Stuck in the Middle: The Challenges of Implementing the New York State Science Learning Standards in Middle Schools

A Dissertation Presented

by

Robert J. Wankmuller

to

The Graduate School

In Partial Fulfillment of the

Requirements

for the Degree of

Doctor of Philosophy

in

Science Education

Stony Brook University

May 2019
Stony Brook University
The Graduate School

Robert J. Wankmuller

We, the dissertation committee for the above candidate for the Doctor of Philosophy degree, hereby recommend acceptance of this dissertation.

Keith Sheppard, Ed.D.
Associate Professor, Department of Biochemistry & Cell Biology

Angela M. Kelly, Ph.D.
Associate Professor, Department of Physics & Astronomy

Craig Markson, Ed.D.
Program Director, Educational Leadership
Assistant Dean, School of Professional Development

Kenneth Lindblom, Ph.D.
Associate Professor, Department of English

This dissertation is accepted by the Graduate School

Richard Gerrig
Interim Dean of the Graduate School
Abstract of the Dissertation

Stuck in the Middle: The Challenges of Implementing the New York State Science Learning Standards in Middle Schools

by

Robert J. Wankmuller

Doctor of Philosophy

in

Science Education

Stony Brook University

2019

The purpose of this study was to investigate how school districts dealt with the challenges of implementing new science learning standards in their middle schools. Six Long Island school districts of varying size and levels of need, with different curricula models, and distinct building grade-level configurations were purposefully selected as case studies for this qualitative study. Interviews were conducted with science teachers, science supervisors, and assistant superintendents of curriculum and instruction at each of the districts. The interview data were transcribed and open coded to determine a series of themes. Data analysis followed a three-cycle process: individual interview analysis, intra-school district analysis, and finally inter-school comparisons. The first research question focused on the factors that impact the implementation of the New York State Science Learning Standards (NYSSLS) for the middle school. The second research question focused on the roles and responsibilities of the science supervisor and how the position fit within the district’s organizational structure. The third research question investigated the logistics of how curricular changes were developed and implemented.

The findings indicate some of the issues that school districts face when implementing new science standards. These issues included a lack of alignment between; teacher science certifications, the middle school building grade configurations, the school district’s policy on student curricular acceleration, and the demands of new learning standards. The determination of what was to be taught in each grade, in the absence of any state mandate, was particularly problematic for the school districts and often resulted in non-ideal idiosyncratic compromises being made. Those districts that had a K-12 district-wide science supervisor seemed able to navigate issues of the horizontal and vertical articulation most effectively and led to a more singular, common vision in which their middle schools were less ‘stuck in the middle.’ The utilization of the secondary science teachers in the decision-making process varied widely across districts, and teachers in some of the districts were uninvolved in the process.

The study outlined some of the implications of the findings for various constituents, especially for the state, school district administrators, and standards’ writers. Several recommendations for the State Education Department included aligning secondary teacher certification with the core curriculum and specifying in the published curriculum the content for each grade. Districts should have a K-12 district-wide science supervisor to open lines of communication and prepare staff for the changes required by NYSSLS.
Dedication

This dissertation is dedicated to my two middle-school learners, Sophia Lorraine and Emily Ann Wankmuller.
# Table of Contents

List of Figures .................................................................................................................. x
List of Tables ..................................................................................................................... xi
Acknowledgements ........................................................................................................... xii

Chapter 1: Introduction and Context .............................................................................. 1
  1.1 Introduction ............................................................................................................... 1
  1.2 Development of the Middle School ........................................................................ 2
      Middle school education in New York State ......................................................... 2
      Long Island schools ............................................................................................. 2
  1.3 Development of the New York State Science Learning Standards ....................... 3
  1.4 New York State Science Teacher Certification ..................................................... 4
  1.5 School District Building Configurations ............................................................... 5
  1.6 Science Supervision ............................................................................................. 6
  1.7 Science Curriculum ............................................................................................... 6
      Accelerated science .............................................................................................. 6
  1.8 Creating a Long Island Middle School Science Scope and Sequence .................... 7
  1.9 Purpose of Research ............................................................................................ 7
  1.10 Conceptual Framework ....................................................................................... 8
  1.11 Research Questions ........................................................................................... 9
  1.12 Thesis Summary ............................................................................................... 9

Chapter 2: Review of the Literature .................................................................................. 11
  2.1 Introduction .......................................................................................................... 11
  2.2 Standards Movement ........................................................................................... 11
  2.3 A Framework for K-12 Science Education ........................................................... 13
      Physical sciences ................................................................................................. 14
      Life sciences ....................................................................................................... 14
      Earth and space sciences ............................................................................... 14
      Engineering, technology, and applications of science ........................................ 15
  2.4 Next Generation Science Standards (NGSS) ....................................................... 15
  2.5 New York State P-12 Science Learning Standards ............................................. 17
  2.6 Standards Implementation in Other States ........................................................ 19
  2.7 Research Related to Reform ............................................................................... 21
      Middle-level years ............................................................................................ 21
      Eighth-grade acceleration .................................................................................. 22
  2.8 The Project 2061 Middle School Curriculum Review ........................................ 22
  2.9 Investigating and Questioning our World Through Science and Technology ......... 23
  2.10 Critique of NGSS .............................................................................................. 25
  2.11 Barriers to NGSS Implementation ................................................................. 26
      Opt-out movement ............................................................................................ 26
      Building grade-level configuration ................................................................. 26
      Science certification ......................................................................................... 27
### 2.12 Science Curriculum……………………………………………… 27
Alignment between curriculum, pedagogy, and assessment……………………………… 28

### 2.13 Assessments…………………………………………………… 28

### 2.14 Decision-Making……………………………………………… 29

### 2.15 Transient Students…………………………………………… 29

### 2.16 Teacher Readiness…………………………………………… 30

### 2.17 Roles and Responsibilities of the Science Supervisor……. 31

### Chapter 3: Methodology……………………………………………. 33

#### 3.1 Introduction…………………………………………………… 33
Development, adoption and implementation of the New York State P-12 Science Learning Standards…… 33

#### 3.2 The Setting…………………………………………………… 34
Accelerated science models……………………………………………………………… 35
Building grade-level configurations…………………………………………………… 35
Curriculum models……………………………………………………………………… 35
Teacher certification……………………………………………………………………… 36

#### 3.3 The Research Design…………………………………………… 37
Institutional review board approval………………………………………………………………………… 37
Letter to participants of the BOCES middle school science scope and sequence workshops………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessments</td>
<td>56</td>
</tr>
<tr>
<td>Professional development</td>
<td>58</td>
</tr>
<tr>
<td>Collaboration</td>
<td>60</td>
</tr>
<tr>
<td>Parent/community influence</td>
<td>61</td>
</tr>
<tr>
<td>Summary</td>
<td>62</td>
</tr>
<tr>
<td>4.2 Case Study of That’s Why We Have Directors School District</td>
<td>63</td>
</tr>
<tr>
<td>Role of the director of science</td>
<td>63</td>
</tr>
<tr>
<td>Hierarchical organization</td>
<td>64</td>
</tr>
<tr>
<td>Building grade-level configuration</td>
<td>65</td>
</tr>
<tr>
<td>Curriculum</td>
<td>66</td>
</tr>
<tr>
<td>Standards</td>
<td>71</td>
</tr>
<tr>
<td>Teacher certification</td>
<td>74</td>
</tr>
<tr>
<td>Assessments</td>
<td>75</td>
</tr>
<tr>
<td>Professional development</td>
<td>76</td>
</tr>
<tr>
<td>Collaboration</td>
<td>77</td>
</tr>
<tr>
<td>Parent/community influence</td>
<td>79</td>
</tr>
<tr>
<td>Summary</td>
<td>81</td>
</tr>
<tr>
<td>4.3 Case Study of Wait and See School District</td>
<td>81</td>
</tr>
<tr>
<td>The role of the science chairperson</td>
<td>81</td>
</tr>
<tr>
<td>Hierarchical organization</td>
<td>83</td>
</tr>
<tr>
<td>Building grade-level configuration</td>
<td>84</td>
</tr>
<tr>
<td>Curriculum</td>
<td>85</td>
</tr>
<tr>
<td>Standards</td>
<td>89</td>
</tr>
<tr>
<td>Teacher certification</td>
<td>90</td>
</tr>
<tr>
<td>Assessments</td>
<td>92</td>
</tr>
<tr>
<td>Professional development</td>
<td>94</td>
</tr>
<tr>
<td>Collaboration</td>
<td>95</td>
</tr>
<tr>
<td>Parent/community influence</td>
<td>97</td>
</tr>
<tr>
<td>Summary</td>
<td>99</td>
</tr>
<tr>
<td>4.4 Case Study of Using Teachers as Educational Consultants School District</td>
<td>99</td>
</tr>
<tr>
<td>Role of the science chairperson</td>
<td>99</td>
</tr>
<tr>
<td>Hierarchical organization</td>
<td>100</td>
</tr>
<tr>
<td>Building grade-level configuration</td>
<td>102</td>
</tr>
<tr>
<td>Curriculum</td>
<td>104</td>
</tr>
<tr>
<td>Standards</td>
<td>108</td>
</tr>
<tr>
<td>Teacher certification</td>
<td>109</td>
</tr>
<tr>
<td>Assessments</td>
<td>110</td>
</tr>
<tr>
<td>Professional development</td>
<td>112</td>
</tr>
<tr>
<td>Collaboration</td>
<td>113</td>
</tr>
<tr>
<td>Parent/community influence</td>
<td>115</td>
</tr>
<tr>
<td>Summary</td>
<td>116</td>
</tr>
<tr>
<td>4.5 Case Study of If It Ain’t Broke School District</td>
<td>116</td>
</tr>
<tr>
<td>Role of the science coordinator</td>
<td>117</td>
</tr>
<tr>
<td>Hierarchical organization</td>
<td>118</td>
</tr>
</tbody>
</table>
Building grade-level configuration ........................................ 119
Curriculum ........................................................................... 119
Standards ............................................................................. 124
Teacher certification ............................................................. 126
Assessments ......................................................................... 128
Professional development ..................................................... 129
Collaboration ....................................................................... 130
Parent/community influence .................................................. 132
Summary ................................................................................ 133

4.6 Case Study of One Unit at a Time School District .......... 133
Role of the science supervisor .............................................. 134
Hierarchical organization ..................................................... 135
Building grade-level configuration ....................................... 136
Curriculum ........................................................................... 137
Standards ............................................................................. 140
Teacher certification ............................................................. 142
Assessments ......................................................................... 143
Professional development ..................................................... 145
Collaboration ....................................................................... 147
Parent/community influence .................................................. 149
Summary ................................................................................ 150

4.7 Common Themes from the Case Study Districts .......... 151
Roles and responsibilities of the science supervisor .......... 151
Hierarchical structure ........................................................... 152
Stakeholders in the decision-making process ....................... 152
Impact of teacher certification .............................................. 153
Building grade-level configurations .................................... 153
Assessments and the opt-out movement ............................... 154
Parental influence and the acceleration models ................. 155

Chapter 5: Discussion and Conclusions ........................................ 156
5.1 Introduction ..................................................................... 156
5.2 Roles and Responsibilities of the Science Supervisor ...... 156
5.3 Hierarchical Organization ................................................. 157
5.4 Accelerated Science Models............................................. 158
5.5 Parental Influence ............................................................. 160
5.6 Intermediate-Level Science Exam and the Opt-Out Movement ......................................................... 160
5.7 Teacher Certification .......................................................... 162
5.8 Building Grade-Level Configuration ............................... 163
5.9 Decision-making Process .................................................... 164
5.10 Recommendations .......................................................... 165
Grade-specific standards for grades 6-8 ......................... 165
Creation of K-12 district-wide science supervisors .............. 166
Secondary certification might be changed to grades 6-12 .... 166
De-coupling of state assessments and teacher evaluation .... 167
5.11 Further Research .............................................................. 167
References ........................................................................................................................................... 169
Appendix A: Institutional Review Board Approval........................................................................... 175
Appendix B: Letter Introducing the Study......................................................................................... 176
Appendix C: Questions for Interviews......................................................................................... 177
List of Figures

Figure 1. Development, adoption and implementation timeline for NYSSLS........ 4
Figure 2. Some actual grade-level configurations of different buildings within school districts.......................................................... 5
Figure 3. Conceptual framework: “Trying to Fit a Square Peg into a Round Hole”.. 8
Figure 4. Conceptual progressions model from Appendix K of the Next Generation Science Standards.................................................. 16
Figure 5. Middle school science performance expectations from New York State P-12 Science Learning Standards........................................... 18
Figure 6. Table of organization for New Leader School District......................... 47
Figure 7. Topics taught in grades 6-8 at New Leader School District................. 51
Figure 8. Table of organization for That’s Why We Have Directors School District. 64
Figure 9. Topics taught in grades 6-8 at That’s Why We Have Directors School District................................................................. 66
Figure 10. Course progression model from Appendix K of the Next Generation Science Standards........................................................... 71
Figure 11. Table of organization for Wait and See School District....................... 83
Figure 12. Topics taught in grades 6-8 at Wait and See School District.............. 87
Figure 13. Table of organization for Using Teachers as Educational Consultants School District.......................................................... 101
Figure 14. Topics taught in grades 6-8 at Using Teachers at Educational Consultants School District...................................................... 106
Figure 15. Table of organization for If It Ain’t Broke School District ................. 118
Figure 16. Topics taught in grades 6-8 at If It Ain’t Broke School District........... 120
Figure 17. Table of organization for One Unit at a Time School District............ 136
Figure 18. Topics taught in grades 6-8 in One Unit at a Time School District........ 137
List of Tables

Table 1. Performance Expectation from Physical, Life and Earth and Space Science and When They are Taught in Grades 6-8 in Kentucky ........................................ 19
Table 2. Grade-specific Science Sequencing for Grades 6-8 for Several States in the United States ........................................................................................................ 20
Table 3. The Types of Schools and Curricula that were Selected for Participation in this Study .................................................................................................................. 35
Table 4. Science Teacher Certification Required to Teach Middle School Grades 7 and 8 .......................................................................................................................... 36
Table 5. Summary of the Size and Building Grade-level Configurations of the Case Studies ......................................................................................................................... 39
Table 6. Demographics of the 6 Case Study Districts .................................................................................................................. 40
Table 7. Summary of the Curriculum Model, Accelerated Course and Role of the Science Supervisor for the 6 Case Studies ........................................................................ 40
Table 8. Coding Themes for the Case Studies ........................................................................................................................................... 45
Acknowledgments

The process of writing a dissertation is a journey. Along the way I have had guidance from educational experts. I thank the members of my committee, Dr. Sheppard, Dr. Kelly, Dr. Markson and Dr. Lindblom. Your feedback, thoughtful criticism and inquisitive questions forced me to think deeply about my results.

Dr. Lindblom I thank you for your quick wit and wonderful insight. You definitely helped ‘break the ice’ and helped me relax during the defense. I had never heard of ‘scientistic’ before, and thought it was an interesting concept. I particularly enjoyed the conversation about skipping versus acceleration.

Dr. Markson thanks for introducing me to the concept of Zoom. That really changed the way I had meetings with Dr. Sheppard. I really enjoyed discussing the opt-out movement and look forward to reading your article comparing the opt-outs in Nassau and Suffolk Counties.

Dr. Kelly, ever since the first class I took with you, you have always given me such wonderfully detailed feedback. I feel that under your guidance, I have grown as a writer and certainly have become more aware of the formatting process of a dissertation. Thanks for always providing direction and other avenues I should pursue with my research.

Dr. Sheppard, words cannot express the gratitude I have for all of the guidance you provided from the onset of this dissertation and all my previous research ideas that never came to fruition. Your dedication and willingness to help at all hours of the day was truly remarkable. The qualitative research class I took with you sparked my interest in doing case study research. I always thought I would do quantitative research but found the case study to be a great way to really get to the root of the problems in ways that numbers could not replicate. You were a wonderful advisor and I will always cherish your honest feedback about my PowerPoint slides putting you to sleep. I appreciate your brutal honesty, which helped me to only get better.

Finally, I want to thank the other wonderful professors I had along the way and the other students that were supportive and helpful. Last but not least I want to thank my daughters and my wife, Gabriela, for allowing me to work on this research. It took a lot of time away from family life, but you always believed in me and encouraged me to see it through. I did it!
Chapter 1

Introduction and Context

1.1 Introduction

It is an exciting time for science education. Many states have either adopted new grade K-12 science standards known as the Next Generation Science Standards (NGSS Lead States, 2013) or adapted them to make their own version of state science standards. The goal is to prepare all students to be scientifically literate citizens who can vote on complex scientific and technological issues. These students will be more competitive in the global economy as there will be an increased need for more STEM-related careers in the future. Within New York State, additional standards were created specifically for students in pre-kindergarten. These standards, known as the New York State P-12 Science Learning Standards (NYSSLS) were formally adopted in December 2016, with implementation beginning during the 2017-2018 school year. The realization was made that science education is important and needs to start at the earliest age possible. Additional standards were also created by the New York State Education Department [NYSED] for some concepts that were not in NGSS (NYSED, 2016).

Although New York State should be commended for realizing the importance of creating pre-kindergarten science standards, there was a missed opportunity in the development of standards for a level of student that is consistently problematic, the middle-school learner (grades 6-8). While there are grade-specific standards for each grade from pre-kindergarten through fifth grade; for grades 6-8 what students should know in each grade is not specified. New York State left the decision to individual districts to decide the scope and sequence for what is taught in science in each of the middle-school grades. Similarly, for grades 9-12, within New York State there are 4 science courses that culminate in a statewide Regents examination, which determines what is to be taught in each grade. In curricular terms, the middle-school learners have been ‘stuck in the middle’.

Adding to the curricular issue, teacher certification considerations in New York State similarly leave middle schools ‘stuck in the middle’. Teachers hold certification for either elementary schools (grades K-6), or for secondary schools (grades 7-12). This does not match NYSSLS which has a middle school grade band of grades 6-8 that cuts across both certification areas.

Further issues are raised by the various ways that grades are distributed across the school buildings within a school district (see Sheppard & Kelly, 2011). The breakdown of grades often separates the elementary students from the high school students but it is the middle-school grades that are placed either split between the elementary grades and the high school, or they exist on their own in a separate middle school building.

There is a mismatch between the science curriculum, teacher certification, and building grade-level configurations. This study specifically investigates the challenges that school districts face in implementing NYSSLS in the middle-school grades.
1.2 Development of the Middle School

Middle-school grades are generally considered to be grades 6-8, is a time of transition, for students as they move from elementary school to high school. Entering as ‘tweens, and leaving as teenagers, the middle-level is a time of great change. Middle schools tend to start at sixth grade with most students being eleven-years-old, and end at eighth grade when most students are thirteen-years-old. Besides the developmental changes that are occurring as students go through puberty, there are also physiological changes happening within the brain.

In most schools, students have a single classroom teacher from kindergarten through grade 5. The classroom teacher is responsible for teaching all subjects, including math, reading, writing, social studies, and science. When students start middle school, typically in sixth grade, they often have multiple teachers for the first time in their academic careers. Students follow a bell schedule, have a locker to store their books, and have to travel to different classrooms for each subject.

Historically, middle school is a more recent innovation. During the nineteenth century schools traditionally followed an 8-4 pattern which consisted of 8 years of elementary school and 4 years of high school. When it was recognized that the needs of young adolescents were not being met, the junior high school was created spanning grades 7 to 9, with the first junior high schools being established in Columbus, Ohio in 1909 (Manning, 2000). This newer model consisted of 6 years of elementary school, 3 years of junior high school, and 3 years of high school.

The junior high school model for grades 7 through 9 resembled a high school in many ways and its purpose was to prepare students for high school. Middle schools were created to better meet the social, personal, and academic needs of young adolescents that were not being addressed by the junior high school model. The first established middle school was in the Bay City Michigan School District in 1950 (Manning, 2000). When the middle school became the new model, students from grade 6, which is considered elementary school in many states, were now placed with seventh and eighth-graders.

The middle school model usually has teachers of different academic subjects working on a team as they teach the same group of students. This practice allows teachers to plan interdisciplinary lessons around a theme and discuss strategies that work with certain students, and address disciplinary issues together. It allows for an easier transition from the elementary school and has a more personal approach since students have a common set of teachers.

As this study will focus on middle schools in New York State, specifically on Long Island, some of the demographics of the state and how new science standards have evolved over the past two decades are detailed below.

Middle school education in New York State. There are 3.1 million students enrolled in grades K through 12 within New York State schools. According to the New York Education Reform Commission’s Final Action Plan, “Putting Students First”, this number represents 694 public school districts, 233 charter schools, and 1,800 private elementary and secondary schools (NY Educational Reform Commission, 2014). As of June 30, 2017, there were 591,725 public school students enrolled in grades 6-8 (New York State Education Department [NYSED], 2017).

Long Island schools. Geographically, Long Island consists of the four counties (Queens, Kings, Nassau, and Suffolk). Queens and Kings counties are part of New York City school
district and are not included in this study, which focuses exclusively on Nassau and Suffolk counties. New York State Education refers, somewhat confusingly, to Nassau and Suffolk Counties as the “Long Island Region.” Nassau has 56 public school districts and Suffolk has 69 public school districts, for a total of 125 school districts. The size of the school districts on Long Island vary considerably, from a small district such as Sagaponack, with a student body of 9 students, to a large district, such as Brentwood, which educates 18,903 students (NYSED, 2017).

The districts have a range of configurations in terms of grades they include. Some districts are comprised exclusively of elementary schools, while others consist solely of secondary schools. Most are K-12 districts, but there are large differences in how these grades are configured in different buildings. It is often middle schools that are split into either elementary or high school-level buildings. In some districts sixth grade is housed in an elementary building, while in other districts it is part of the middle school. For example, some districts have grade K-6 elementary schools and junior high schools that house grades 7 through 9. In other districts, the sixth grade is housed in a middle-school building alongside grades 7 and 8.

1.3 Development of the New York State Science Learning Standards

New York State was one of 26 lead states that helped develop NGSS. Representatives said that they would give serious consideration to adopting them upon their completion. New York modified NGSS to create their own version of science standards, the New York State P-12 Science Learning Standards (NYSSLS). These adapted standards contain all of the performance expectations from NGSS, but also contain additional performance expectations not included in NGSS that were added by the New York State Education Department (NYSED, 2017). The issue of grade-specific standards was not rectified by NYSSLS, but instead New York State allowed each individual district to choose the scope and sequence of science in their middle-school curriculum.

Presently, there are state exams given in grades 4 and 8, and the 4 high school science Regents exams. The fourth-grade exam is called the Elementary-level Science (ELS) Exam and it is based on the 1996 Science Learning Standards. This exam covers the science students should have learned in grades K-4. This exam will be offered for the last time in June of 2020, as there will be a new exam aligned with NYSSLS that will be given for the first time in June 2022 to fifth grade students.

The current exam given to eighth grade students, the Intermediate-level Science (ILS) Exam is based on what students should have learned in grades 5-8. It too is based on the 1996 Science Learning Standards (National Research Council, 1996). This exam also will be changed to align with NYSSLS and will be offered for the first time in June 2022.

Figure 1 shows the implementation timeline for the NYSSLS-aligned assessments.
In January 2019 the state determined which performance expectations would be associated with the 4 new Regents-level courses for grades 9-12: Biology, Earth and Space Science, Chemistry, and Physics. Yet, the state did not dictate which specific performance expectations were to be taught in grades 6, 7, and 8. It did specify that instruction aligned with NYSSLS begin in September 2019 for pre-K-grade 3 and grade 6, September 2020 for grades 4 and 7, and September 2021 for grades 5 and 8.

Unlike the previous science state standards, the 1996 Learning Standards for Science, where there was a grade-band for grades K-4, with NYSSLS, pre-kindergarten through fifth-grade now has grade-specific standards. Despite letters from professional science organizations asking the state to provide grade-specific standards for grades 6-8, as had been done for pre-kindergarten through grade five, this was never done. Instead, the state left the standards for grades 6-8 in a grade-band. While providing more autonomy for a school district it does however create problems regarding consistency from one district to another and requires districts to come up with their own 6-8 course of studies.

1.4 New York State Science Teacher Certification

To teach within New York State Public Schools, a person must possess a bachelor’s degree, have passed content exams, and have completed a teacher certification program. New York elementary teachers are licensed to teach grades kindergarten through sixth grade, while secondary school teachers are licensed for grades 7-12. Sixth-grade teachers can be asked to teach any subject in the middle school curriculum, regardless of their educational background. So, if sixth-grade teachers are in a middle school setting, they may be asked to teach a subject for
which they do not have specific certification, e.g. if their district chooses to put physical science into the sixth grade then an elementary teacher will have to teach the subject.

There are 4 areas of secondary science teacher certification within New York State, in biology, chemistry, Earth science, and physics. In addition, there are certification extensions that allow secondary certified science teachers to teach grades 5 and 6. Teachers are also able to obtain a ‘general science’ license for grades 7 through 12 if they have 18 semester hours in science courses beyond the 30 semester hours for their base certification, (i.e. biology, chemistry, Earth science, or physics) (NYSED, 2017). This general science certification is required to teach middle school science. Although the state has created a grade 5-9 science certification, this does not align with NYSSLS. Having a separate grade 5-9 certification and grade 7-12 certification does not fit with the way the new standards are designed.

1.5 School District Building Configurations

The 125 school districts on Long Island are not all arranged in the same manner. There are differences in how school districts’ grade-levels are configured throughout their buildings. As shown in Figure 2 some districts are comprised of elementary schools that feed into separate secondary school districts.

![Figure 2. Some Actual Grade-level Configurations of Different Buildings Within School Districts.](image)

Some K-12 districts have K-5 elementary buildings, 6-8 middle schools and 9-12 high schools. Other districts still follow a junior high school model with K-6 elementary buildings, 7-
9 junior high schools, and 10-12 high schools. Some school districts have a distinct primary building, K-2, and a separate intermediate building, 3-5, for elementary school. In addition, there are some districts that have a separate building just for ninth-graders.

1.6 Science Supervision

The organizational structure of the Long Island school districts varies. There are also differences in how science programs are supervised and whether there are subject supervisors and the grades that they oversee. In some school districts there are chair people that teach classes and are responsible for supervising the teachers within a building. Some school districts have K-12 science directors or coordinators that do not formally teach any classes, but oversee all science instruction within the district. Some districts do not have administrative subject-specific supervisors, but instead have teachers on special assignment that are in the same bargaining unit as the teachers, and therefore cannot perform classroom observations. In those cases, it is the building principal that is responsible for evaluating teachers. The amount of experience a building principal has with the new science standards can vary. This variation in the science expertise of supervisors may impact how science is taught and how much science is being taught in different buildings throughout a school district. The role and responsibilities of the science supervisors vary as do their positions within the organizational structure of the districts.

1.7 Science Curriculum

Accelerated science. Virtually all Long Island school districts offer an opportunity for students to take a high school Regents-level science course while they are still in the eighth-grade (known as acceleration). In 1984 the New York State Board of Regents mandated that schools offer accelerated mathematics to middle school students, and one other area (NYSED, 2015). Besides accelerating students in math, many districts also allow students to accelerate in science. Districts tend to offer either Regents-level Earth science or Regents-level living environment (Biology), and some districts offer both courses in the eighth-grade. A few districts have even started allowing students to take science Regents exams as early as seventh-grade, so they will have completed two Regents-level science courses before entering high school. This process of taking more advanced science courses starting as early as seventh grade is referred to as ‘double acceleration’. This double acceleration is practiced in a growing number of school districts on Long Island. However, the state only allows students to earn high school credit starting in the eighth-grade. These acceleration models impact the course offerings in school districts at the middle school-level, i.e. in schools offering eighth-grade accelerated science many complete their sixth through eighth grade course of studies in just two years (sixth and seventh grades).

The criteria to take these accelerated science courses varies between school districts. Some school districts require that students have a certain grade-point average in seventh-grade science in order to take a Regents-level course. Other districts have a ‘self-select’ policy where students can choose to take a class despite how low their grades may be, regardless if they have a teacher recommendation.

In some school districts, there is a practice of ‘universal acceleration’, where all eighth-grade students take a high school Regents-level science course. Since this practice is not followed by
all schools, this also leads to vast differences in how science topics in middle schools are sequenced in Long Island schools.

With NYSSLS, the grade K-4 elementary core curriculum has been replaced with grade-level standards for pre-K-5. This places fifth-grade back in the elementary school so the grade is no longer affiliated with middle school-level science curricula. However, sixth-grade is part of the grade 6-8 middle school science performance expectations. The problem is that sixth-grade teachers in New York State have elementary, common branch certification, not secondary science certification. There is a clear mismatch between teacher certification and the curriculum.

1.8 Creating a Long Island Middle School Science Scope and Sequence

Unlike other parts of the country where each county has its own school district, Long Island is unusual in that there are 125 school districts within the two counties of Nassau and Suffolk. Each district has its own Board of Education and its own course of studies. When students move from one district to another, they may repeat the same topics, or have gaps in their instruction.

To mitigate this problem, science teachers and administrators from Nassau and Suffolk counties met for a series of 3 workshops held at a local Board of Cooperating Educational Services (BOCES) during March and April of the 2016-2017 school year, with the goal of developing a uniform curriculum that districts would be able to follow. In total, teachers and administrators from 42 school districts came together to develop a Long Island science scope and sequence for grades 6-8.

Although the intent of the group originally was to create a single scope and sequence that could work for all participating school districts, the realization was quickly made that this would not be possible mainly because school districts accelerate students into different high school Regents-level courses. Another difference was that some school districts wanted to use a domain-specific model, where a specific science discipline is taught each year, whereas others preferred an integrated model, where a little bit of the different science disciplines are taught over the course of the year.

Ultimately, three different models were created. One model was an integrated model. There were two domain-specific models, one for when students were accelerated into Regents-level living environment and one for when students were accelerated into Regents-level Earth science. This present study derived from these meetings and sought to investigate how different districts enacted the new NYSSLS standards given the constraints imposed upon them. The present study addressed several issues; the scope and sequences that districts chose; who was part of the decision-making process and how teacher certification, building grade-level configurations and teacher certification impacted the curricular decisions that were made.

1.9 Purpose of Research

The purpose of the research was to investigate the issues and challenges faced by school districts in implementing new standards such as NYSSLS specifically at the middle-school level. This study utilized a qualitative approach involving detailed case studies of six districts that were purposefully sampled based on certain characteristics. In implementing NYSSLS standards, districts had to choose between implementing an integrated or domain-specific curriculum. The teachers’ certification areas and the buildings’ grade level configuration could not be changed, even though they might impact their curricular decisions. The districts acceleration model and
course chosen to accelerate students also may have influenced their scope and sequence for grades 6 and 7.

Districts with different building grade-level configurations, with different sized populations, serving student bodies of varying socioeconomic status were purposefully chosen to illustrate the differences and challenges of implementing NYSSLS specifically at the middle-school level. Low-need, average-need and high-need districts were chosen for the study. Of the 6 districts, 2 had a junior high school model, 2 had a middle school model and 2 had secondary school buildings. Districts also had either K-12 district-wide science supervisors, building-level chair people or teachers on special assignment. Interviews were conducted with teachers, science supervisors and assistant superintendents of curriculum and instruction in each district. The following research questions were investigated. The first research question focuses on the implementation of NYSSLS at the middle-school level. The second research question focuses on the role and responsibilities of the science supervisor and how the position is organized within the district’s hierarchical structure. The third question investigates how curricular decisions were made within the district.

1.10 Conceptual Framework

The conceptual framework for the study is based on the work of Tyack and Tobin (1994). Schools are naturally resistant to change. Reform movements have come and gone, yet the ‘grammar’ of schooling remains the same. The adage, “trying to fit a square peg into a round hole” epitomizes the dilemma for the middle school science teacher. As illustrated in Figure 3 there is a mismatch between the curriculum, the science teacher certification areas, and the school districts’ building grade-level configuration within New York State.

![Conceptual Framework: “Trying to Fit a Square Peg into a Round Hole.”](image)

*Figure 3. Conceptual framework: “Trying to Fit a Square Peg into a Round Hole.”*

There is a mismatch between science teacher certification (blue person), the science curriculum (orange square peg) and building grade-level configurations (green hole).
As noted by Cuban (1990), teachers are isolated in their classrooms and have the autonomy to teach what is in the best interest of their students despite the regulations coming down from the state. Despite numerous reform efforts, implementing actual change in the classroom is difficult.

1.11 Research Questions

For the selected school districts:

RQ 1: To what extent was the implementation of NYSSLS, specifically at the middle-level grades, impacted by
   a. Eighth grade acceleration?
   b. Building grade-level configuration?
   c. Teacher certification?

RQ2: What were the roles and responsibilities of the science supervisor and how did the position fit into the district’s organization?

RQ 3: How were curriculum changes made and who was part of the decision-making process?

These research questions are answered through interviews with science teachers, science supervisors, and assistant superintendents for curriculum and instruction from the school districts. In addition, quantitative data are used from the New York State Basic Educational Data System (BEDS) including the percentage of English Language Learners (ELLs) and economically disadvantaged students. School report card data were also used to determine the passing rates on science Regents exams. It is intended that findings from this study will be used to make policy recommendations to the New York State Education Department regarding teacher certification and its alignment with both NYSSLS and building grade-level configurations. The square peg needs to be rounded, or the hole needs to have more angles added to it in order to successfully implement NYSSLS at the middle-school level.

1.12 Thesis Summary

The next chapter, Chapter 2 includes a review of the pertinent science education research literature. It describes the standards movement of the past two decades, how NGSS is being implemented in other states, and research on the impact of acceleration and the grades in which students transition to a middle school. Research on the roles and responsibilities of science supervisors are also discussed.

Chapter 3 describes the methodology used for the study. It explains how the participating school districts were selected, the interview process, the coding themes that were used, and the Institutional Review Board (IRB) approval process. It also describes the 6 case study districts including the student demographics, curricula offered, and the grade levels associated with the middle-school buildings. The chapter also discusses how validity and reliability were established.

Chapter 4 details the results and findings from the study. It consists of a detailed description of each district, followed by comparisons between the districts including similarities and differences.
Finally, Chapter 5 discusses the findings and provides some recommendations to the New York State Education Department and practitioners in the field. It makes connections to the reviewed literature and answers the study’s research questions. It is the hope that the recommendations will allow for a smoother transition to NYSSLS particularly for the middle-school grades.

The focus of this study is on middle-level grades implementation of NYSSLS because this is the area where the state has provided the least amount of guidance. Leaving the standards as a grade-band for grades 6-8 could be a missed opportunity by the state. Since most districts on Long Island accelerate students into high school-level course work while they are in the eighth-grade, determining how to fit a three-year sequence into two years becomes a challenge. Do districts want to continue with the integrated model for science implementation for the middle-level grades, as was established for grades pre-K-5, or use the domain-specific approach that is used at the high school-level? The middle-school grades seem to be stuck in the middle. Are they going to continue with an integrated approach as had been done in the elementary schools or move to the domain-specific approach that students will see in high school? Does where the sixth grade is housed within a school district impact the type of curriculum adopted? Overall, the purpose of this research is to uncover the challenges faced by school districts, how they have dealt with the issues and how they plan to move forward to prepare their students to be scientifically literate citizens.
Chapter 2

Review of the Literature

2.1 Introduction

This study looks at the enactment of new science standards (NYSSLS) into the middle schools on Long Island in New York State. School districts have many constraints placed upon them as a result of the adoption of various historical practices and also from the legal requirements of New York State educational law. This chapter starts with a brief overview of the structure of both US and New York’s science curricula and then details the pertinent aspects of reform efforts, standards movement and educational research that have led to the adoption of NYSSLS.

Since the 1890s United States high school science has largely been organized into separate years of biology, chemistry, physics and the subjects have been taught in that order (Sheppard & Robbins, 2005). This ‘layer-cake’ approach is unique to the United States. In other countries, students learn these topics over several years, not all of biology, chemistry, or physics in a single year (Crow & Aldridge, 1993). This historical practice places large constraints on what is taught in science, when it is taught and to whom it is taught. While New York State follows this layer-cake approach, it adds to the mix an additional subject, Earth Science. The present-day science requirements for a student to graduate in New York are to complete three years of science which must include Biology (known as Living Environment) and a physical setting science (either Earth Science, Chemistry or Physics). The third year of science can be a year of any other science (electives, AP courses etc.). Presently most students graduate in New York having completed Biology (Living Environment) and Earth Science to fulfill the mandated portion of their science graduation requirements (NYSED, 2015). What is taught in high school science has a major impact about what needs to be taught in middle school science classrooms and is determined by the standards that New York have adopted.

2.2 Standards Movement

Many of the reform movements in science education have been led by crisis-talk approaches (Schultz, 2009). Since the launch of Sputnik, in October, 1957, there have been multiple attempts to make the United States be more competitive in the sciences (Buxton & Provenzo, 2011). For example, there was a movement of scientists and university professors that attempted to ‘rescue’ K-12 science education in the 1950s by developing federally-funded curriculum development projects (Meltzer & Otero, 2015).

In 1983, the report, A Nation at Risk, forewarned of the United States losing its place as a global super power and this caused widespread concern that helped spur the modern standards movement (Schultz, 2009). The initial movement in the late 1980s was the science, technology and society movement, STS, which attempted to link science content taught in schools with its application to benefit humans.

More current reform movements centered around how students from the United States scored on international exams, such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS), compared to other students.
from around the world. The fact that students from other countries were outscoring the U.S. in science helped to initiate the current movement of science reform (Schultz, 2009). New standards movement started with mathematics when the National Committee on Teaching Mathematics (NCTM) created new math standards in the 1980s. After the completion of mathematics standards, a movement was created to reform science standards. These efforts would eventually lead to what are now the Next Generation Science Standards (NGSS) that this study is investigating.

In 1989, the American Association for the Advancement of Science, (AAAS), released *Science for All Americans*. This landmark publication was the precursor to large scale science education reform. No longer was science to be just for the students who aimed to become scientists, science was to be for all. This was a paradigm shift from the post-Sputnik push for science to be more rigorous for the United States to remain globally competitive. *Science for All Americans* was the product of Project 2061, a project by AAAS, named for the year when Halley’s comet would return to the Earth since it had last passed in 1985.

In 1992, the National Science Teachers Association (NSTA) independently started work on a national science reform movement, *Scope, Sequence and Coordination* (SS&C) for Secondary School Science. Spearheaded by Bill Aldridge, the movement’s goal was to teach a more integrated approach to learning science in grades 7-12, moving from a descriptive and phenomenological approach in grades 7 and 8, to an empirical, semi-quantitative approach in grades 9 and 10, and then to the more theoretical and abstract concepts in grades 11 and 12 (Crow & Aldridge, 1993).

Students were to learn topics over many years, and these topics would be spaced out. This movement encouraged moving away from the ‘layer cake’ approach, where a specific science is taught each year, and advocated for a spiral approach, in which topics were spaced out so students could learn ‘concrete’ material first and then move onto more abstract concepts. It advocated for an integrated approach of teaching science. In its purest form students were to study physics, chemistry, biology and Earth science concurrently over multiple years. If this were not possible, the recommendation was that students get a quarter of a year of each of the science disciplines over the course of grades 7-12 so all students would have a foundation in each discipline (National Science Teachers’ Association, 1992). SS&C was essentially attempting to convert the US ‘layer cake’ organization of K-12 science education into a system similar to how sciences are organized and taught in Europe. Other industrialized nations teach distinct science disciplines over multiple years, and not as single years devoted exclusively to biology, chemistry, and physics (Crow & Aldridge, 1993). This ‘layer cake’ model of each year being a separate disciple started in the high schools in the late 1890s and later when junior high schools and middle schools were created, they followed a similar approach as the high school.

The release of *Scope, Sequence and Coordination of Secondary School Science*, in 1992 provided a guide for curriculum designers to develop an integrated curriculum for grades 6 through 8, 9 and 10, and 11 and 12. At each level, the depth of knowledge increased from the concrete and qualitative, to more theoretical, abstract, and quantitative. Although funding ceased past the grades 9 and 10 implementation, many of the elements of SS&C, including the idea of an integrated approach and the importance of phenomena were included in *A Framework for K-12 Science Education*.

The sister publication of *Science for All Americans, Benchmarks for Science Literacy*, detailed what students should know and be able to do by the end of grades 2, 5, 8, and 12. Eventually,
SS&C and the Benchmarks would coalesce to become the foundation for the National Research Council’s *National Science Education Standards (NSES)* which were released in 1996. The *National Science Education Standards* (1996) were arranged in grade-bands for grades K-4, 5-8, and 9-12 and this is the how science curriculum is presently organized. From these national standards, many states developed their own state science standards. For instance, in New York State, the *Learning Standards for Math, Science and Technology (MST)* were developed. From these learning standards, core curricula in New York State were developed for elementary science spanning grades K-4, for intermediate science spanning grades 5-8, and for the different Regents courses at the high school level: Living Environment, Physical Setting/Earth Science, Physical Setting/Chemistry, and Physical Setting/Physics.

Later, when President George W. Bush signed the No Child Left Behind (NCLB) Act in 2002, science education reform gained impetus for further reform (Liu & Fulmer, 2008). This law required that students be tested at the elementary-level, middle school-level, and the high school-level. In New York State, although the Regents exams had existed at the high school-level for over 100 years, this law led to the creation of both the Elementary-level Science Exam and the Intermediate-Level Science Exam. Although the Elementary Science Program Evaluation Test (ESPET) already existed prior to NCLB, that test was used to evaluate science programs, not individual students. The shift to the Elementary-level Science Exam was to assess how well individual students were prepared in science and to provide academic intervention services to students to better prepare them for intermediate-level science. These exams are still in use in New York State, but will now be changing to bring New York into line with the NGSS.

### 2.3 A Framework for K-12 Science Education

The National Research Council used decades of research on how students best learn science to create a framework for K-12 science education from which new standards could be made. This document, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas* (2012) focused on three-dimensional learning, where science skills were intertwined with science content, rather than as separate standards as they were listed in the *National Science Education Standards*.

The use of phenomena to pique students’ interest was a central part of *A Framework for K-12 Science Education*. The National Research Council created this framework which described what students should know and be able to do by the end of grades 2, 5, 8 and 12. The framework consisted of three dimensions: science and engineering practices (SEPs), disciplinary core ideas (DCIs), and crosscutting concepts (CCCs).

The SEPs were the skills that scientists and engineers used. Students were being asked to think like scientists and engineers. There were 8 SEPs:

1. Asking questions (for science) and defining problems (for engineering).
2. Developing and using models.
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
The SEPs were similar to the inquiry-based standards from the *National Science Education Standards*, but they were to be taught alongside the DCIs. The DCIs consisted of the science content that students needed to understand. The DCIs existed in four different domains: Physical Sciences, Life Sciences, Earth and Space Sciences, and Engineering, Technology and Applications of Science. These domains were further broken down into sub-domains. For each of the DCIs there were grade-band endpoints that specified what students should know and be able to do by the end of grades 2, 5, 8, and 12.

**Physical sciences.** The physical sciences combined topics associated with chemistry and physics. Krajcik (2013) claimed how an understanding of elements and how they engaged in chemical reactions laid the foundation for understanding concepts in life and Earth and space sciences. For instance, understanding chemical reactions was a precursor to photosynthesis and cellular respiration. Likewise, understanding about energy was important for understanding plate tectonics and photosynthesis. Furthermore, an understanding of the force of gravity was required to understand how the Earth revolves around the sun.

There were 4 core ideas that constituted the physical sciences:

Core Idea 1: Matter and its Interactions  
Core Idea 2: Motion and Stability  
Core Idea 3: Energy  
Core Idea 4: Waves and Their Applications in Technologies for Information Transfer  

**Life sciences.** The 4 core ideas that comprised the life science standards were consistent with *NSES, Benchmarks for Science Literacy*, and the *Science College Board Standards for College Success* (Bybee, 2013). Bybee also reinforced the idea that there was a learning progression from kindergarten through grade 12, meaning that students developed a foundation at the elementary-level that was built upon at the middle school and high school levels. There were 4 core ideas associated with the life sciences. They were:

Core Idea 1: From molecules to organisms: Structure and processes  
Core Idea 2: Ecosystems: Interactions, energy and dynamics  
Core Idea 3: Heredity: Inheritance, and variation of traits  
Core Idea 4: Biological evolution: Unity and diversity  

**Earth and space sciences.** Wysession (2013) argued for Earth and space science to be a capstone course for both the middle school and high school levels. He contended that a knowledge of biology, chemistry, and physics was required for understanding concepts from Earth and space science. He blamed the Committee of Ten for regulating physical geography to the middle school and placing biology, chemistry and physics at the high school level. He felt vindicated that the *Next Generation Science Standards* rightfully placed a full-year of Earth and space science at both the middle school and high school level, although it could also be taught in an integrated approach.

The Earth and space sciences consisted of 3 core ideas:

Core Idea One: Earth’ Place in the Universe
Core Idea Two: Earth’s Systems
Core Idea Three: Earth and Human Activity

**Engineering, technology, and applications of science.** The Engineering, Technology and Applications of Science were new to science standards. The engineering design process was added to science standards in grade spans for grades K-2, 3-5, 6-8 and 9-12 growing in complexity. These standards were reminiscent of the Science, Technology Society movement. There were 2 core ideas:

Core Idea One: Engineering Design
Core Idea Two: Links Among Engineering, Technology, Science and Society

The final piece of the three-dimensional architecture of *A Framework for K-12 Science Education* was the crosscutting concepts (CCCs). These concepts were ideas that cut through all of the science disciplines and served as a lens to view the different science concepts.

There were seven CCCs that cut across all of the sciences. They were:

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles and conservation
6. Structure and function
7. Stability and Change

### 2.4 Next Generation Science Standards (NGSS)

From *A Framework for K-12 Science Education*, the nonprofit group, Achieve, developed the *Next Generation Science Standards*, (NGSS Lead States, 2013). These standards consisted of performance expectations, which described what students would be able to do in order to demonstrate that they could apply the information. Performance expectations stated what students could do to demonstrate their understanding by the end of the unit.

Appendix K of NGSS showed three different models that districts could consider for implementing the performance expectations for middle and high schools since they both were not grade-specific, but instead had a grade-band. The first model was a conceptual progressions model for the 6-8 and 9-12 grade-bands. This progression arranged the core ideas in an order where foundational concepts were taught in the first course, then concepts that required that prerequisite knowledge were taught in the second course. Finally, concepts that build upon the concepts taught in the second course were taught in the third course.
Figure 4. Conceptual Progressions Model from Appendix K of the Next Generation Science Standards (NGSS Lead States, 2013).

For instance, in the conceptual progression model represented in Appendix K, shown in Figure 4, physical science concepts regarding the structure and properties of matter were taught in the first course so students could learn about the properties of living organisms in the second-year course. The example model provided showed a majority of physical science core concepts in the first course, except for Earth & Space Sciences (ESS): Earth’s Place in the Universe. In the second-year course the majority of the core ideas were life science concepts except for Physical Sciences (PS): Waves and their Application in Technology for Information Transfer. In the third-year course, the majority of the core ideas were from Earth and space science except for Life Sciences (LS): Biological Evolution: Unity and Diversity. This placement of evolution in eighth-grade made sense since evolution involved such long timescales, it was an abstract concept that sixth and seventh-graders would have a difficult time comprehending.

Another factor mentioned in Appendix K was the math that was required for certain performance expectations. There was a separate connections box at the bottom of NGSS that showed how the performance expectations were related to the math and English Language Arts Common Core Learning Standards. In Appendix K it was suggested that since the performance expectations were for the end of the grade-band, curriculum developers may want to consider teaching about kinetic energy in earlier grades by holding off with the analysis of graphs representing square relationships until eighth grade. This concept of square relationships was part of the eighth-grade Common Core Math Standards. It was suggested that the eighth-grade math teacher use kinetic energy examples when teaching about square relationships (NGSS Lead States, 2013).

Appendix K showed how the California Integrated Learning Progression Model was configured and also provided an example of the thought process of teachers within a particular middle school as they moved performance indicators from one course to another. This example showed how there were many possible configurations with the integrated progression model.

In the science domains model, the performance indicators were grouped by the different content areas: physical science, life science, and Earth and Space science for grades 6-8 and 9-
Since there was a lack of conclusive research as to the particular order to teach the content areas, they were configured in the same order as they were listed in *A Framework for K-12 Science Education* (NGSS Lead States, 2013).

The third model was a modified domains model for grade 9-12. This model took the domains of life science and places them all into a biology course. The physical science disciplinary core ideas and performance expectations were divided between chemistry and physics. The Earth and space science disciplinary core ideas and performance expectations were split between these three courses because most states did not require 4 years of science at the high school level. Wysession (2013) had issues with the modified domains model because he did not think it was realistic to split the Earth and space science within the other three courses.

NGSS called for a shift from students being receivers of science to doers of science (Miller et al., 2018). Students could no longer be passive recipients of information, but must construct their knowledge by engaging in scientific practices.

### 2.5 New York State P-12 Science Learning Standards

New York State was one of the lead states that helped in the development of the Next Generation Science Standards. As a lead state, they agreed to give serious consideration to the adoption of these standards. On December 16, 2016, the New York State Board of Regents adopted their own version of standards based on NGSS, the New York State P-12 Science Learning Standards (NYSSLS). These are the standards that the school districts in this study are being required to adopt and which will determine what is taught and eventually tested in all of New York’s public schools.

There were some additional disciplinary core ideas that were added to NYSSLS, as well as additional performance expectations. These additional standards are highlighted in yellow in NYSSLS. For instance, the middle school physical science performance expectations had two additional performance expectations, MS-PS-1-7 “Use evidence to illustrate that density is a property that can be used to identify samples of matter” and MS-PS-1-8 “Plan and conduct an investigation to demonstrate that mixtures are combinations of substances”, that are not part of NGSS (NYSSLS, 2016). Additional disciplinary core ideas are also displayed in the orange-colored foundation boxes preceded with the initials for the New York State Education Department (NYSED) displayed in parentheses. One of the biggest differences between NGSS and NYSSLS is that the NYSSLS has performance expectations for pre-K. The addition of the pre-K standards is probably in response to the call for full-day pre-Kindergarten in the most high-need school districts as recommended in the New NY Education Reform Commission final action plan, *Putting Students First* (NY Education Reform Commission, 2014).
New York State P-12 Science Learning Standards

MS. Structure and Properties of Matter

Students who demonstrate understanding can:

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules include ammonia and methane. Examples of extended structures could include sodium chloride or diamonds. Examples of particulate-level models could include drawings, 3D ball and stick structures, or computer representations showing different substances with different types of atoms.] [Assessment boundary: Assessment does not include valence electrons and bonding energy, discussing the individual cations, or a complete depiction of all individual atoms or extended structure.]

MS-PS1-3. Gather and make sense of information to come from natural resources and impact society. [Clarification statement: Emphasis is on natural resources that underlie a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment boundary: Assessment is limited to the qualitative interpretation of evidence provided.]

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and phase (state) of a substance when thermal energy is added or removed. [Clarification statement: Emphasis is on qualitative particulate-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles and changes the state. Examples of models could include drawings and diagrams. Examples of particles could include ions, molecules, or atoms. Examples of substances could include sodium chloride, water, carbon dioxide, and helium.]

MS-PS1-7. Use evidence to illustrate that density is a property that can be used to identify samples of matter. [Clarification statement: Emphasis should be on students measuring the masses and volumes of regular and irregular shaped objects, calculating their densities, and identifying the samples of matter.]

MS-PS1-8. Plan and conduct an investigation to demonstrate that mixtures are combinations of substances. [Clarification statement: Emphasis should be on analyzing the physical changes that occur as mixtures are formed and/or separated. Examples of common mixtures could include saltwater, oil and vinegar, and air. [Assessment boundary: Assessment is limited to separation by evaporation, filtration, and magnetism.]

Table: Science and Engineering Practices

<table>
<thead>
<tr>
<th>Discipline Core Ideas</th>
<th>Dispersing Core Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing and Using Models</td>
<td>Crosscutting Concepts</td>
</tr>
<tr>
<td>Model in 6-8 builds on K-5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</td>
<td>Patterns: Causal and effect relationships may be used to predict phenomena in natural or designed systems.</td>
</tr>
<tr>
<td>• Develop a model to predict and/or describe individual phenomena (MS-PS1-1); (MS-PS1-4).</td>
<td>( (MS-PS1-1)(MS-PS1-4) )</td>
</tr>
<tr>
<td>Planning and Carrying Out Investigations</td>
<td>( (MS-PS1-1)(MS-PS1-4) )</td>
</tr>
<tr>
<td>Planning and carrying out investigations to answer questions or test problems to solutions in 6-8 builds on K-5's experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.</td>
<td>( (MS-PS1-8) )</td>
</tr>
<tr>
<td>• Plan an investigation individually and collaboratively, and in the design identify independent and dependent variables, controls, and what tools are needed, to do the gathering; how measurements will be recorded, and how many data points are needed to support a claim. (MS-PS1-8)</td>
<td>( (MS-PS1-8) )</td>
</tr>
<tr>
<td>Engaging in Argument from Evidence</td>
<td>Engage in argument from evidence in 6-8 builds from K-5's experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</td>
</tr>
<tr>
<td>Engaging in argument from evidence in 6-8 builds from K-5's experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</td>
<td>Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.</td>
</tr>
<tr>
<td>Obtaining, Evaluating, and Communicating Information</td>
<td>Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.</td>
</tr>
<tr>
<td>Obtaining and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.</td>
<td>Gaining and communicating information from multiple sources and assess the credibility, accuracy, and potential uses of each source, publication, and methods used, and describe how they are supported or not supported by evidence.</td>
</tr>
<tr>
<td>(NYSED) Substances are made of one type of atom or combinations of different types of atoms. Individual atoms are particles and can combine to form larger particles that range in size from two to thousands of atoms. (MS-PS1-1)</td>
<td>(NYSED) Temperature is not a form of energy. Temperature is a measurement of the average kinetic energy of the particles in a sample of matter. (secondary to MS-PS1-7)</td>
</tr>
<tr>
<td>(NYSED) Each substance has characteristic physical and chemical properties (for example, quantity of solids under given conditions) that can be used to identify it. (MS-PS1-3); (MS-PS1-7).</td>
<td>( (MS-PS1-3)(MS-PS1-7) )</td>
</tr>
<tr>
<td>( (MS-PS1-3)(MS-PS1-7) )</td>
<td>( (MS-PS1-3)(MS-PS1-7) )</td>
</tr>
<tr>
<td>In a solid, the particles are closely spaced and vibrate in position but do not change their relative locations. In a liquid, the particles are closely spaced but are able to change their relative locations. In a gas, the particles are widely spaced except when they happen to collide and constantly change their relative locations. (MS-PS1-4)</td>
<td>( (MS-PS1-4) )</td>
</tr>
<tr>
<td>Solids may be formed by molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)</td>
<td>( (MS-PS1-8) )</td>
</tr>
<tr>
<td>(NYSED) The changes of state that occur with temperature and pressure can be described and predicted using these models of matter. ( (MS-PS1-4) )</td>
<td>( (MS-PS1-8) )</td>
</tr>
<tr>
<td>(NYSED) Mixtures are physical combinations of one or more samples of matter and can be separated by physical means. (MS-PS1-8)</td>
<td>( (MS-PS1-8) )</td>
</tr>
<tr>
<td>( (NYSED) ) Substances react in characteristic ways. In a chemical process, the atoms that make up the original substances are rearranged into different particles, and these new substances have different properties from those of the reactants. (MS-PS1-8).</td>
<td>( (NYSED) ) Substances react in characteristic ways. In a chemical process, the atoms that make up the original substances are rearranged into different particles, and these new substances have different properties from those of the reactants. (MS-PS1-8).</td>
</tr>
<tr>
<td>( (NYSED) ) This Disciplinary Core Idea is also addressed by MS-PS2-3 and MS-PS3-1.</td>
<td>( (NYSED) ) This Disciplinary Core Idea is also addressed by MS-PS2-3 and MS-PS3-1.</td>
</tr>
<tr>
<td>( (NYSED) ) The term &quot;heat&quot; as used in everyday language refers to both thermal energy (the motion of particles within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-7)</td>
<td>( (NYSED) ) The term &quot;heat&quot; as used in everyday language refers to both thermal energy (the motion of particles within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-7)</td>
</tr>
<tr>
<td>( (NYSED) ) Temperature is not a form of energy. Temperature is a measurement of the average kinetic energy of the particles in a sample of matter. (secondary to MS-PS1-7)</td>
<td>( (NYSED) ) Temperature is not a form of energy. Temperature is a measurement of the average kinetic energy of the particles in a sample of matter. (secondary to MS-PS1-7)</td>
</tr>
</tbody>
</table>

Figure 5. Middle school science performance expectations from New York State P-12 Science Learning Standards (NYSED, 2016).

Similar to NGSS, NYSSLS has grade specific standards for grades K-5, and grade-bands for grades 6-8 and 9-12. Since there are high school courses that culminate in a Regents exam, there is consistency between high schools within the state with the offering of biology, which the state calls Living Environment, a name which originated in *Science for All Americans*, chemistry, Earth science and physics. However, at the middle school level, grades 6-8, there is no consistency between the school districts.
2.6 Standards Implementation in Other States

Although New York City is within New York State, it is one large district with its own education department. In 2008, the New York City Department of Education released a scope and sequence for grades K-8. It consisted of a spiral curriculum where topics from physical science, life science, and Earth and space science were taught each year. This ‘scope and sequence’ was enhanced in 2015 to be aligned with the NYSSLS science and engineering practices and crosscutting concepts, but the content still contained the material from the 1996 Science Learning Standards. Starting in 2018, teachers were to use an updated scope and sequence for awareness of the practices and cross-cutting concepts, yet use the enhanced 2015 version for teaching content (New York City Department of Education, 2018).

Unlike New York, other states had created grade-specific standards for grades 6 - 8. For instance, as shown in Table 1, in Kentucky there was a spiraled sequence of topics. Kentucky took the opportunity to take the grade-band from NGSS and created grade-specific standards for each grade, 6- 8.

Table 1. Performance Expectations from Physical, Life and Earth and Space Science and When They are Taught in Grades 6 - 8 in Kentucky (Kentucky Academic Standards, 2015).

<table>
<thead>
<tr>
<th>Grade 6</th>
<th>Grade 7</th>
<th>Grade 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Science (Core ideas 1 and 2)</td>
<td>Physical Science (Core Ideas 1, 3 and 4)</td>
<td>Physical Science (Core Idea 3)</td>
</tr>
<tr>
<td>Life Science (Core idea 2)</td>
<td>Life Science (Core Idea 1)</td>
<td>Life Science (Core ideas 1,2,3, and 4)</td>
</tr>
<tr>
<td>Earth Science (Core ideas 1 and 2)</td>
<td></td>
<td>Earth Science (Core ideas 1 and 3)</td>
</tr>
</tbody>
</table>

The sixth-grade sequence included topics in physical, life, and Earth and space science. In seventh-grade, students studied topics from physical and life science. These topics started at the more concrete level and become more abstract as students progressed from grades 6 - 8. For instance, in sixth-grade students learned about the structure and properties of matter. Building upon this foundation, students learned about chemical reactions in seventh-grade, and how matter and energy were used by living organisms in eighth-grade. In eighth-grade students learned the most sophisticated topics in physical, life and Earth and space science. Concepts such as evolution, the history of the Earth, and the relationship between velocity and kinetic energy were taught to students whose minds were more developed than sixth-graders.

There were also connections to the Common Core Learning Standards in English Language Arts and Mathematics. The middle school physical science performance expectation 3-1 states, “Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object” (NGSS, 2013). Since the math associated with this topic was aligned with the Common Core Math Standard for grade 8, this was the only
physical science topic that was taught in eighth-grade in Kentucky when students concurrently learned the necessary mathematics to understand square relationships.

Other states such as New Jersey, Massachusetts, and California had a similar integrated sequence of topics. Massachusetts followed the 2016 Massachusetts Science and Technology/Engineering Curriculum Framework. It consisted of a spiraled sequence of science topics, with a theme that tied the different concepts together. For instance, the theme for sixth grade was structure and function. For seventh grade, the theme was systems and cycles, and the theme for eighth grade was cause and effect. This curriculum exposed students to physical, life, and Earth and space science in each grade of middle school (Massachusetts Department of Elementary and Secondary Education, 2016).

Table 2. Grade-specific Science Sequencing for Grades 6-8 for Several States in the United States.

<table>
<thead>
<tr>
<th>State</th>
<th>Grade 6 Topics</th>
<th>Grade 7 Topics</th>
<th>Grade 8 Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky</td>
<td>Earth &amp; Space Science</td>
<td>Physical Science</td>
<td>Life Science</td>
</tr>
<tr>
<td></td>
<td>Life Science</td>
<td>Life science</td>
<td>Physical Science</td>
</tr>
<tr>
<td></td>
<td>Physical Science</td>
<td>Integration of Life, Physical and</td>
<td>Earth &amp; Space science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Earth &amp; Space science</td>
<td></td>
</tr>
<tr>
<td>Massachusetts</td>
<td>Theme: Structure and Function</td>
<td>Theme: Systems and Cycles</td>
<td>Theme: Cause and Effect</td>
</tr>
<tr>
<td></td>
<td>Integration of Life, Physical and</td>
<td>Integration of Life, Physical and</td>
<td>Integration of Life, Physical and</td>
</tr>
<tr>
<td></td>
<td>Earth &amp; Space science</td>
<td>Earth &amp; Space science</td>
<td>Earth &amp; Space science</td>
</tr>
<tr>
<td>New Jersey</td>
<td>Integration of Life, Physical and</td>
<td>Integration of Life, Physical and</td>
<td>Integration of Life, Physical and</td>
</tr>
<tr>
<td></td>
<td>Earth &amp; Space science</td>
<td>Earth &amp; Space science</td>
<td>Earth &amp; Space science</td>
</tr>
<tr>
<td>California:</td>
<td>Integration of Life, Physical and</td>
<td>Integration of Life, Physical and</td>
<td>Integration of Life, Physical and</td>
</tr>
<tr>
<td>Preferred model</td>
<td>Earth &amp; Space science</td>
<td>Earth &amp; Space science</td>
<td>Earth &amp; Space science</td>
</tr>
<tr>
<td>California:</td>
<td></td>
<td>Life Science</td>
<td>Physical Science</td>
</tr>
<tr>
<td>Domain-specific</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>model</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Massachusetts had additional performance expectations that were not included in NGSS. Massachusetts had a greater number of engineering performance expectations that were grade specific for grades 6-8. There was a greater emphasis on engineering than in the original NGSS. However, they also specified certain performance expectations from NGSS that were not included in their standards.

In New Jersey, there were 7 to 8 units per grade for grades 6-8. Each grade had units from life science, physical science, and Earth and space science (State of New Jersey, Department of Education, 2016).
Although these states all had an integrated model of science topics, there were differences between the states. For instance, in Kentucky, sixth-graders were introduced to the structure and properties of matter, however, this unit was not taught until the seventh-grade in New Jersey.

In California, there are actually two state-approved curricula. In November, 2013, the State Board of Education adopted an integrated learning progression model. This integrated learning progression model was referred to as the ‘preferred model’.

In sixth-grade, students learned about cells and organisms, weather and climate, energy, and engineering performance expectations. In seventh-grade students learned about ecosystems, natural resources, the structure and properties of matter, and engineering performance expectations. In eighth-grade students learned about natural selection, history of the Earth, waves and electromagnetic radiation, energy, forces and interactions, and engineering performance expectations.

However, at the same California Board meeting, the science expert panel was asked to develop a domain-specific model as an alternative model. Using Appendix K from NGSS as a resource, California also had a domain- specific model where Earth and space science was taught in sixth-grade, life science was taught in seventh- grade, and physical science was taught in eighth -grade. The performance expectations from engineering, technology and application of science were taught in all grades, 6-8 (California Department of Education, 2013).

The next sections of the chapter relate to the science education research that surrounds curricular reforms and the implementation of reforms. Apple (2018) questioned if schools could change society. He advocated for acting relationally, acknowledging that we are all connected to the inequities that exist in society. He also called for repositioning, preventing the continuation of oppressive conditions. Cuban (1990) pointedly asked, “Why do reforms return again and again” (p.3). In attempting to answer his own question he suggested that more in-depth and long-term data on specific reforms are needed within classrooms and from school districts. In the absence of such data, reform efforts have become “acts of mindless speculation” (p.12). Since teachers are decoupled from policymaking, they have the autonomy in their own classroom to teach what they view is in the best interest of their students. Teacher contracts dictate how and how often teachers are to be observed by their supervisors. Tyack and Tobin (1994) note that the ‘Grammar of Schooling’, i.e. the structures and rules that organize and govern classroom instruction, are remarkably stable over time and remain resistant to change. They further warn, in their widely cited article, that “reformers believe that their innovations will change schools, but it is important to recognize that schools change reforms” (p.478). Ultimately the success of reforms rests upon teachers and how they adapt by either selectively implementing or altering reforms.

2.7 Research Related to Reform

Middle-level years. The middle-level years of schooling have a greater impact on students’ career aspirations. A study by Tai et al (2006) found that out of 3,359 eighth-grade students who anticipated that they would pursue a career in science by the time they were 30 years-old, only approximately half of the students went on to achieve their career aspirations. The authors argued for early exposure to science, particularly for the middle-level grades and elementary school. Rivet and Krajcik (2008) explored contextualized instruction, where students used their prior knowledge and real-world experiences to help them with project-based science learning. Working with two middle school classrooms, they found a strong positive correlation between
students’ scores and the contextualized learning. This method of teaching was a reform they contended could increase student science learning.

**Eighth-grade acceleration.** In 1984, to promote increased science and mathematics enrollments, the New York State Education Department mandated that all middle-level school districts should offer an accelerated mathematics course to their eighth-grade students. The decision as to how students would be selected for this accelerated course was left to the districts. Burris, Heubert and Levin (2006) studied the impact of universal acceleration on the performance of students in mathematics in a school district on Long Island. The authors compared the results of three cohorts starting high school from 1995 through 1997 before universal acceleration into Regents-level Sequential I mathematics in eighth grade to three cohorts from 1998 through 2000 after universal acceleration was implemented. The study looked at the impact on high, middle and low achievers in mathematics. In addition, race and eligibility for free or reduced lunch were also studied. They found that all groups increased passing percentage on the Sequential 1 Regents exam, more students took advanced mathematics courses in high school, and a greater percentage of students took Advanced Placement Calculus. However, these results were not replicated in larger districts.

Clotfelter, Ladd and Vigdor (2015) studied two large North Carolina school districts and found that only high achieving students benefitted from universal acceleration, with detrimental effects on lower-achieving students, particularly in the following geometry course. Yet, a distinct difference between their study and the Burris et al (2006) study was that the curriculum was not “backwards mapped” in the previous years’ leading up to the Algebra course. This preparation for the accelerated Algebra class may be a vital precursor to offering a universal accelerated math course. Therefore, the curriculum in the years’ prior to eighth-grade are vital to the success of an accelerated program.

Some NY schools started to offer accelerated courses in science classes. However, unlike accelerated Algebra, there has not been any research studies focusing solely on accelerated science coursework. Maltese and Tai (2011) did conclude that the middle grade students are not aware of STEM careers and that it is interest that drives student enrollment. They found that by eighth grade, students that had an interest in STEM careers had a higher percentage chance of graduating from college with a degree in a STEM area. They also identified that more research was needed with this population of students.

**2.8 The Project 2061 Middle School Curriculum Review**

The AAAS led a middle school curriculum evaluation study through Project 2061. A procedure was developed for analyzing content alignment with key ideas from *Benchmarks for Science Literacy* and the *National Science Education Standards*, the quality of instructional support, and assessment.

Kesidou & Roseman (2002) described the procedure used by Project 2061 to evaluate 9 different middle school science programs. There were 22 criteria grouped into 7 categories:

1: Identifying and Maintaining a Sense of Purpose
2: Taking Account of Student Ideas
3: Engaging Students with Relevant Phenomena
4: Developing and Using Scientific Ideas
The Project 2061 Curriculum Review focused on a specific topic in each life science, Earth science and physical science. For life science, the chosen topic was the flow of matter and energy in ecosystems. In Earth science, the selected topic was processes that shape the Earth. The topic used for physical science was the kinetic molecular theory.

Key ideas from these topics were selected from the *Benchmarks of Science Literacy* and the *National Science Education Standards*. There were 2-member teams that consisted of a middle school science teacher and a science education university faculty member. Each topic was examined by two separate 2-member teams working independently of one another. A key idea was considered to be aligned with a learning goal if it met the substance of the learning goal rather than just the general topic.

None of the nine middle school programs that were evaluated were found to lead to student understanding of the key ideas. The programs’ instructional design was not found to support the understanding of the key ideas. Listed misconceptions appeared to be add-ons, rather than deep-rooted beliefs that confound student learning. The programs’ support to teachers was also found to be lacking.

The recommendations from the Project 2061 Curriculum Review was for the development of new middle school science programs that better support teachers. They also called for stronger relationships between researchers and curriculum developers in order to allow access to high quality curriculum materials.

In the life sciences, Stern and Roseman (2004) used the Project 2061 procedure to look specifically at the flow of matter and energy in ecosystems. They analyzed 9 middle school curriculum materials and found that 8 out of the 9 included the content that followed the key ideas from *Benchmarks for Science Literacy* and from the *National Science Education Standards*. However, the curriculum materials were lacking instructional analysis.

Stern and Roseman looked at how much students’ prior knowledge was taken into account, the inclusion of relevant phenomena, and the use of helpful representations. All 9 of the middle school curriculum materials were found to be lacking in all three areas. The authors encouraged the creation of curricula that offered a greater diversity of phenomena to allow the learner to see the different ways science exists in nature.

### 2.9 Investigating and Questioning our World through Science and Technology

The *National Science Education Standards* of 1996 led to many reform efforts and the development of new curricula. One of these reform curricula was the Investigating and Questioning our World through Science and Technology (IQWST). The IQWST was a middle school curriculum for students in grades 6-8 that covered each of the four science disciplines: physics, chemistry, biology and Earth science. Students developed conceptual understanding over time as they built upon their previous knowledge as they learned new material.

Shwartz et al., (2008) described how the IQWST curriculum focused on coherence. They explained how science programs should integrate content and practices. They identified three aspects of coherence: learning goals coherence, intra-unit coherence, and inter-unit coherence.

Learning goals coherence had to do with the order in which ideas were sequenced to build a deep and interconnected understanding of concepts. The learning goals needed to be linked
together in order to develop coherence. In other words, units were not independent topics that could be taught in any order. There was a specific sequence that students had to follow in order to build from the previous unit and link the information to the new unit.

Intra-unit coherence meant that within the unit students were constructing deep understanding of the science content and practices while using contextualized inquiry. The IQWST curriculum utilized a driving question to engage students.

Inter-unit coherence meant that there was a connection between a discipline learned over multiple grades and also between different disciplines. For instance, the concept of energy was taught in biology in the transfer of energy in ecosystems via food webs, in chemistry for endothermic and exothermic reactions, and in physics in energy transformations.

Fortus, Adams, Krajcik, and Reiser (2015) performed exploratory and confirmatory factor analyses to determine if inter-level coherence existed in the IQWST curriculum for the cross-cutting concept of energy. Dozens of teachers from urban, suburban, and rural areas, and thousands of students participated in national field tests of IQWST. Students took two tests that consisted of 20 multiple-choice questions on 2 different units. They found that students applied the energy concepts learned from previous units to the new unit that they were learning. They recommended that middle school teachers become aware of all the units that students would learn, even the ones they were not responsible for teaching. This practice allowed teachers to make connections not only to what students have previously learned, but also to what they would learn in the future.

Students were exposed to the idea of conservation of energy and how energy could change matter from many different contexts in biology, chemistry, physics and Earth science. By developing a deeper understanding, over a broader range of examples, students performed better on national field tests, and were better able to apply concepts.

Krajcik, McNeill, and Reiser (2008) explained how they created learning performances that described the cognitive tasks students needed to complete by combining the content standard and the science practice. They emphasized the importance of using phenomena to show students that science is all around them and part of their everyday experiences. Two teachers implemented a unit on Stuff, specifically how new stuff comes from old stuff, in two different urban areas with a total of 119 seventh-grade students.

They received input from Project 2061, the reform movement from AAAS. The authors of the paper made revisions to the curriculum based upon the feedback that was received from AAAS. For instance, Project 2061 recommended that the particle nature of matter be taught earlier in the unit to allow for multiple different contexts throughout the unit.

Project 2061 made recommendations for improving the design in 5 different areas. One of the suggestions was to better explain the rationale behind the learning performances and to better align them with the National Science Education Standards. For instance, it was recommended to include in the curriculum materials how the content standards were combined with a practice to produce the learning standard.

A second recommendation had to do with a need to ‘unpack’ or further define the science practices. Although this had been done for the science content, the feedback was that it also needed to be done for the science practices. For instance, when it said “to explain” there was a recommendation to delineate what was required of an explanation.

A third recommendation was to align key science concepts in multiple contexts. One example cited was to introduce the particle nature of matter earlier in the unit so students would be exposed to this concept in multiple contexts throughout the unit. This was done in the revised
curriculum with a tie-in of various phenomena to help support the students’ conceptual understanding of the particle nature of matter.

Another criticism was that students were overgeneralizing concepts from exemplars provided in the curriculum. For instance, students confused the dissolving of lemonade powder as an example of a chemical reaction. The authors realized that instead of solely focusing on what a chemical reaction was, they also needed to include what was not a chemical reaction.

The fifth concern that Project 2016 had was with the alignment of the assessments with the learning goals. The authors conceded that some of the assessment items were not evaluating the intended learning goals, so they discarded more than half of the items on the pre- and posttests.

After making changes based upon Project 2061’s feedback the authors tested the units on the classrooms of 9 teachers, 2 from the previous urban areas and a third location, a large town. With the changes recommended by Project 2061, the authors noticed greater changes in student learning. They identified 3 necessary characteristics of the learning-goals driven-design model: unpacking the standards from the perspective of the learner, the use of learning performances to explain how the learner would apply the knowledge, and the iterative process of aligning learning goals with tasks and assessments.

Buxton and Provenzo (2011) argued that elementary and middle school teachers need to infuse the history and philosophy of science back into their teaching. They argued for the use of natural phenomena be used to teach science. Students could make observations and use simple experimentation to understand the natural world. They explained how this was originally known as natural philosophy.

McComas and Wang (1998) have advocated for a blended approach based on philosophical, psychological, pedagogical, and pragmatic justifications. The philosophical justification is that in nature the sciences are interrelated, and that the boundaries between disciplines only exist in schools. They contend that integrated approaches allow students to make connections between the sciences and are more motivating to students because they are able to make more real-world connections. They also claimed that teachers should find it professionally rewarding to work collegially with other science teachers to learn the sciences in which they were not formally trained. McComas and Wang explained how blended science allows for greater student engagement and greater real-world application.

2.10 Critiques of NGSS

Fick (2018) described using the CCCs to frame classroom activities and dialogue. By coding statements made by middle-level grades students, she saw how the CCCs were used as a lens to have students participate in a discussion regarding phenomena. In addition, students included components of the CCCs into their conceptual models.

However, Osbourne et al. (2018) were critical of the idea of CCCs. Rather than focusing on the similarities between the sciences, they saw the value in replacing the CCCs with six styles of scientific reasoning. Their argument was that the differences between how we gain knowledge in the different science disciplines should be celebrated rather than trying to find similarities between all of the sciences. The diversity of the sciences was more important than trying to find superficial commonalities between them. The six styles of reasoning that they identified were:

1. Mathematical Deduction
2. Experimental Exploration
3. Hypothetical Modeling
4. Categorization and Classification
5. Probabilistic Reasoning
6. Historical-based Evolutionary Reasoning

2.11 Barriers to NGSS Implementation

Opt-out movement. The ‘opt-out’ movement referred to parents declining to have their students take state assessments. The number of students opt-outing out of state assessments has increased over the past decade, most notably in New York (Wang, 2017). New York was the state with the highest opt-out rates in the country (Wang, 2017). Students that initially opted-out of the Common Core English Language Art and Mathematics Exams also opted-out of the fourth grade Elementary-level science exam and eighth grade Intermediate-level Science Exam.

According to Goch (2017) who analyzed opt-outs from Nassau County, a county on Long Island that borders the New York City borough of Queens, opt-outs were more likely to be affluent and Caucasian. ELLs were less likely to opt-out of the state assessments.

Building grade-level configuration. There has been a substantial amount of research as to whether moving students to a middle school or junior high school instead of staying in a grade K-8 configuration impacted their grades. Rockoff and Lockwood (2010) looked at students in grades 3-8 enrolled in New York City schools from the years 1998-1999 through 2007-2008. In their sample 61.7% of the grade 3 students were enrolled in a K-5 school, with 24.4% in a K-6 school and 7.4% in a K-8 school. They found that academic achievement dropped significantly in math and English Language Arts (ELA), about 0.15 standard deviations in both subjects, for students that move to a middle school, compared to students that did not move. They also found a greater decline for students who moved to middle school in the sixth-grade compared to those that moved in the seventh-grade.

Schwerdt and West (2013) performed a similar study using data from the state of Florida. The results of their study with this population of students from a different state confirmed the results of Rockoff and Lockwood. They also found that students entering middle school in grade 6 dropped 0.124 standard deviations in math and 0.06 standard deviations in reading. Unlike Rockoff and Lockwood, they found that students transitioning to middle school in seventh grade performed even worse, with declines of 0.221 standard deviations for math and 0.148 standard deviations for reading.

They attributed students’ success in a K-8 building-environment to students taking on leadership roles when they are much older than the other students. They also felt that the classroom environment in middle schools were not as conducive to learning due to the large cohort size of each grade (West & Schwerdt, 2012).

Similarly using results of state-wide testing in the state of Texas, Clark, Slate, Combs and Moore (2013) found that students enrolled in K-8 schools had better passing rates on the Texas Assessment of Knowledge and Skills (TAKS) assessments than did students enrolled in middle schools. Texas and Florida were amongst the most populated states in the country, and New York City was the largest city public school district, so these results were impressive since they consisted of such large sample sizes.
Dhuey (2013) performed a similar study in British Columbia, Canada and found that students who attended middle school or junior high school in grades 6 or 7 scored 0.158 standard deviations lower than students that attended K-8 schools. She encouraged Canadian schools to consider creating K-8 schools as American cities such as New York and Philadelphia had been doing recently.

Does grade configuration affect student performance in science? The new configuration of NGSS with a 6-8 grade span coincides with a middle school configuration as opposed to the 5-8 or 7-9 grade configurations that some districts followed.

Carolan (2013) looked at math, reading, and science scores for students from grades 3-5 comparing students that transitioned to a new building for grade 5 to students that stayed within the same building. Although he found no significant difference in math and reading scores, he did find an increase in science scores, 0.89 points higher, for students that transitioned to a new building for fifth grade compared to students that did not transition. He attributed this difference to the curriculum and instruction taking place in a building where teachers taught a subject-specific course.

At the end of the 2016-2017 school year the commissioner of the New York State Department of Education, Mary Ellen Elia, needed to intercede to allow rising sixth graders from the Massapequa school district, a school district in Nassau County, to move to the middle school. This decision had originally been made by the Board of Education, but when a newly elected Board of Education took over, they attempted to reverse the previous Board’s decision. There was plenty of debate as to whether sixth graders were better served in an elementary school or in a middle school.

**Science certification.** Within New York State, science teachers need to have general science certification in order to be highly qualified to teach science at the middle-school level. The one exception is that teachers of life science are considered highly qualified even without the general science certification as long as they have 7-12 Biology certification (NYSED, 2011). According to the Report of the 2018 National Survey of Science and Mathematics Education (NSSME+), middle school life science teachers were more likely to have a degree in their discipline (40 percent) than Earth Science (5 percent) and physical science (7 percent) teachers. Furthermore, many Earth science and physical science teachers at the middle school level have had either no coursework in the field or only an introductory course. Only 49% of middle school science teachers have taken at least one college-level course in chemistry, Earth science, life science and physics (Banilower et al., 2018).

### 2.12 Science Curriculum

Since NGSS had a 6-8 grade band for middle schools, individual states across the country are allowed to determine which topics would be taught in specific grades. In New York this decision was passed by the state onto the school district. In schools where sixth grade was taught within the middle school, 45% of schools taught an only integrated science curriculum, 35% offered domain-specific courses, and 19% offered both types of courses (Banilower et al., 2018). The Report of the 2018 NSSME+ included data regarding the percentage of students taking Algebra 1 and Geometry prior to ninth grade, with 13% of middle schools having between 21% - 30% of their students taking Algebra 1 prior to ninth grade (Banilower et al., 2018). However, there were no data regarding students taking high school-level science courses while still in
middle school, a common practice on Long Island.

Alignment between curriculum, pedagogy, and assessment. Fulmer, Tannis and Weiss (2018) made the case for the need for alignment between the curriculum, pedagogy, and the assessment, or else they considered that NGSS was destined to fail since teachers would see no reason to change. They discussed how the Educators Evaluating the Quality of Instructional Products (EQuIP) Rubric by Achieve was used to rate lessons and units of study to determine if they were aligned to the three-dimensional nature required by NGSS. Although they recommended more guidance for educators to differentiate between extensive evidence and adequate evidence, this was a good starting point to help lead to stronger alignment. In addition, for large-scale curriculum analysis for district adoption, there was the Primary Evaluation of Essential Criteria (PEEC), which introduced five innovations that curricula must contain in order to be aligned with NGSS. These five criteria were:

1. Making Sense of Phenomena and Designing Solutions to Problems
2. Three-Dimensional Learning
3. Building K-12 Progressions
4. Alignment with English language arts and Mathematics
5. All Standards, All Students

There was debate as to where to start planning units, at the level of the DCIs, (Krajcik et al., 2014) or the SEPs (Bulgren & Ellis, 2015). Furthermore, there was still need for more research on the use of learning progressions, how student build information from previously learned information, and how that could lead to greater curriculum coherence. More research was needed for how teachers interpret and implement the standards (Fulmer, Tannis, & Weiss, 2018).

Herrmann-Abell and DeBoer (2018) studied the learning progression of the concept of energy, a central topic from NGSS. They described learning progressions as the order at which content should be presented to be most effectively learned. The test population consisted of over 20,000 students from grades 4-12 that answered 359 multiple-choice questions. Using Rasch analysis to determine the item test difficulty, Herrmann-Abell and DeBoer determined that the elementary students’ performance met expectations, while middle school and high school students’ performance did not meet expectations.

Rosemann, Stern, and Koppal (2010) described the importance of curriculum coherence. They defined coherence as the interrelationship between ideas. Students needed to link new ideas to their prior knowledge. In essence, students were developing a storyline. Middle school students that were exposed to a Toward High School Biology unit regarding chemical reactions and the rearrangement of atoms to conserve mass performed better on post-assessments compared to students that did not receive the unit (Herrmann-Abell, Koppal, & Roseman, 2016). This study showed how an understanding of physical science concepts were necessary to understand some life science processes.

2.13 Assessments

Liu and Fulmer (2008) analyzed the New York State Regents exams in chemistry and physics to the standards in the core curricular, which included performance indicators and major
understandings. They used the Porter alignment model which looked at curriculum, instruction, and assessment. It was a two-dimensional model that looks at content and cognitive demand. They found that the Physics Regents Exam was better aligned to the core curriculum than the Chemistry Regents Exam. They found that both had questions mostly at the Understand and the Apply level. They saw the need for more questions at the Analyze, Evaluate and Create levels, which are at higher cognitive levels.

Stern and Ahlgren (2002) looked at 9 different textbook series assessments for middle school science, specifically focusing on the concept of kinetic molecular theory. They found that all but one, were of poor quality and received low scores for the three criteria they evaluated: alignment, understanding, and informing instruction.

As states ponder the use of online assessments for the Next Generation assessments, DeBoer et al. (2014) worked with 1,836 middle school students from 12 states using three different online modalities on ecosystems: static, active and interactive. They found that the most complex tasks could be asked using the interactive features as opposed to just active or static modalities. However, they noted that students need more time for the interactive tests and gave caution to measuring student’s science content knowledge as opposed to their familiarity of using computer technology.

2.14 Decision-Making

In the Report of the 2018 NSSME+ teachers were surveyed regarding their control over curricular and instructional decisions. The authors of the reports combined the items to which teachers responded into two composite variables: Curriculum Control and Pedagogy Control. Teachers responded to having strong control over pedagogical decisions, such as the amount of homework to be assigned (73% of middle school science teachers), and to having no control for curricular decisions such as selecting content, topics and skills to be taught (24% of middle school science teachers). These differences were also correlated to the prior achievement levels of the students. For instance, for mostly high prior achievers, control of curriculum and pedagogy had mean scores of 65 and 90, respectively, whereas these scores plummeted with factors such as the percent of historically underrepresented students, the percent of students eligible for free and reduced lunch, school size, community type, and region.

For example, teachers of science classes composed mostly of low prior achievers report having less control over both curriculum and pedagogy than teachers of classes containing mostly high prior achievers. A similar pattern exists in terms of race/ethnicity composition—teachers of classes serving a high proportion of students from race/ethnicity groups historically underrepresented in STEM report lower instructional control than teachers of classes with relatively few students from these groups. Teachers of classes in high-poverty school and in large schools tend to report less control than their counterparts in low-poverty and small schools (Banilower et al., 2018, p. 105).

2.15 Transient Students

Transient students often suffer from low academic achievement. The United States has one of the highest mobility rates amongst developed countries, with approximately 20% of Americans moving annually (Sanderson, 2004). Disruptions due to this movement are not limited to the
individual students that are moving, but can have greater ramifications on the classroom and on the basic operations of the school.

The increase in transient students is not limited to urban areas, but the inner suburban ring is having an increase in English Language Learners (ELLs), students that live in poverty, and more minorities and immigrants (Hodgkinson, 2001). Nassau County is part of the inner suburban ring as it borders the New York City borough of Queens. However, it was predicted that there would also be growth in transient students in the second suburban ring, where there is another suburb between the city. Suffolk County, the other county on Long Island, is a second suburban ring, as Nassau County lies between Suffolk County and New York City.

Wells et al. (2009) reported how Long Island had some of the most racially segregated school districts. This qualitative study will highlight some of the difference in the percentage of student population receiving free or reduced lunch and the correlation to the percentage of ELLs. But with new standards, students are only part of the equation. The other big component is the readiness of the teaching staff.

2.16 Teacher Readiness

Haag and Megowan (2015) surveyed 710 teachers on a NGSS national readiness assessment regarding their readiness to implement the science and engineering practices. They found that high school teachers were more motivated and felt better prepared to implement the science and engineering practices than middle school teachers.

They also coded open-ended responses and found that teachers identified inadequate training, limited instructional time, and lack of resources as barriers to implementation of the science and engineering practices. Both high school and middle school teachers also identified a need for more preparation in engineering.

In a study on technology implementation, Zhao, Pugh, Sheldon and Beyers (2002) found that a transition to change was more effective when the change was not too far removed from the current practice. Although this study was on the implementation of computers, not new science standards, the same idea was applicable. If the innovation (project), in this case NYSSLS, was too far removed from the innovator’s (the teacher’s) current practice, implementation was more difficult.

In New York State some of the elements of NYSSLS are already in place. Earth Science has already been taught at the high school level, unlike in other parts of the country which solely focused on biology, chemistry and physics (Contino & Anderson, 2013). In addition, the former standards, the Learning Standards for MST of 1996, already had crosscutting concepts and many of the same science and engineering practices, albeit with different names. However, the difference with the new standards is that now all three dimensions are to be interwoven in lessons so that students are using the science practices to make sense of phenomena and engineering practices to solve problems. Now they are to use the crosscutting concepts as the different lenses to develop questions. The biggest shift is on the learner, and making the students active participants as they construct their knowledge (Pruitt, 2014).

America’s Lab Report, Investigations in High School Science (NRC, 2006) focused specifically on lab investigations at the high school level, and called for the integration of process and content through integrated instructional units. A follow-up to the original report, Science and Engineering for Grades 6-12: Investigation and Design at the Center (Moulding, Songer & Brenner, 2019) described the importance of incorporating science and engineering.
addition, unlike *America’s Lab Report*, this report included the middle-level learner, acknowledging these grades as an important time for the learning of science and engineering. Since it was released after a *Framework for K-12 Science Education* and the release of NGSS, it focused on students engaging in science investigation and engineering design. It discussed the inequities posed to schools with large percentages of underrepresented minorities in STEM, the need for professional development of the teaching staff, and the necessity of alignment between standards and summative assessments. Many of these issues will be further investigated in this qualitative study on how NYSSLS are being implemented specifically in the middle-level grades.

2.17 Role and Responsibilities of the Science Supervisor

Perrine (1984) surveyed 29 science supervisors and 470 K-8 self-contained classroom elementary teacher from New Jersey. The survey included 32 questions to be answered on a 5 point-Likert scale comparing how the science supervisor performed certain tasks to how they should be performed. A large discrepancy existed between the teachers’ and supervisors’ view of an ideal supervisor. The major needs identified were assistance with technical expertise and humanistic interactions with teachers. Perrine concluded that the role of the science supervisor needed to be more clearly defined.

Madrazo and Hounshell (1987) surveyed different individuals from 23 local education agencies (LEA) in North Carolina. The group included the superintendents, 5 assistant superintendents, the K-12 science supervisors, 100 principals, 208 elementary teachers, 208 secondary science teachers, and 25 college professors. These people completed the Science Coordinator’s Role Expectations Questionnaire which consisted of 48 items based on 5 subscales: resource in science teaching, resource for implementing the science program, resource for in-service programs, leader in science teaching, and supervisor of science. It was found that the science supervisor’s role in the organization was perceived differently by different groups or individuals. Part of the confusion was the variety of titles used by the LEAs for the science supervisor. The authors recommended that the role be constantly evaluated and that the job responsibilities be classified.

In performing a qualitative study of how new software was implemented for use by Earth science teachers, Lee et al. (2014) discovered how the role of the science coordinator varied across five districts. Although common job responsibilities included implementation of standards, professional development of teachers and the purchasing of curriculum materials, they also found distinct idiosyncrasies that were unique to each individual district that made the jobs different. They also discovered that the science coordinator’s relationships with the teachers was what ultimately resulted in whether or not the teachers utilized the computer software.

Whitworth and Chiu (2015) argued for more research in the role of science coordinators in providing professional development for their teachers. Teacher change is accomplished through professional development and it is the subject-specific administrator that played a crucial role in providing this domain-specific professional development for his/her teachers.

Whitworth, Bell, Maeng, and Gonczi (2017) investigated the impact of professional development of 47 science coordinators from 42 school districts from throughout Virginia. Although the participants experienced an increase in understanding about pedagogy and job responsibilities, they only changed some of their practices as a result of the professional development.
Whitworth, Maeng and Bell (2018) performed a qualitative case study that involved 3 science coordinators, teachers and principals from a mid-Atlantic state. The 3 coordinators attended a professional development specifically for coordinators in the first 5 years in the role, the Science Coordinators’ Academy. The 3 districts varied in size: small, mid-sized and large. They found that the coordinator in the mid-sized district was able to provide the most one-on-one help with the teachers because the coordinator in the small district was given additional responsibilities such as being the testing coordinator.

The background of the coordinators also made a difference. Two of the coordinators had secondary science teaching experience, and they had no issues with the elementary science curriculum. The authors recommended districts having an elementary science supervisor and a separate secondary science supervisor.

The major findings from their study was that the most important practices for coordinators to be effective was when they established a coaching relationship with their teachers, encouraged collaboration between the teachers, enacted effective professional development, and encouraged reflection through modeling and feedback.

Whitworth, Maeng, Wheeler and Chiu (2017) surveyed 122 science coordinators that were members of the National Science Education Leadership Association and had a follow-up interview with 16 of the participants. They found that science coordinator had many responsibilities with 93.4% of the participants identifying aligning curriculum with standards. Thirty-six percent of the coordinators that completed the survey were from large suburbs. Seventy-nine percent of those surveyed had a degree in science and 50.8% only had content-area responsibilities in science. Almost 92% of the respondents desired more professional development and time to collaborate with other science coordinators. They also described having a lack of power in their district. The authors recommended that future research focus on the roles and responsibilities of the science coordinators through ethnography or case study methodology.

Spillane and Callaghan (2000) argued that the successful implementation on new standards ultimately rested on the teachers. Policy makers often made changes with which they were familiar, using broad hooks, such as ‘hands on’, without have a deep understanding of the paradigm shifts required by new standards, such as constructivist learning. The authors recommend that policy makers become familiar with ideas that should have more emphasis compared to those that should receive less emphasis.

In this study science supervisors, science teachers and assistant superintendents shared their challenges of implementing NYSSLS during the 2017-2018 and 2018-2019 school years. Through interviews, participants shared how the new standards are being implemented, the roadblocks they encountered and the solutions they have uncovered to help with the transition.
Chapter 3

Methodology

3.1 Introduction

This chapter describes the methodologies used in the study. Starting with an introduction to the implementation of the New York State P-12 Science Learning Standards, the chapter identifies how the research study developed, explains the themes that the research questions investigated, and details the Institutional Review Board (IRB) approval process and the pilot interviews which helped frame the interview questions. The transcription of the interviews, determination of the coding themes, and reliability of the coding process are also discussed.

Development, adoption, and implementation of the New York State P-12 Science Learning Standards. The researcher attended a three-day series of workshops through a local Board of Educational Cooperating Services (BOCES) on creating a uniform scope and sequence for the middle-level grades. Forty-two school districts participated in this series of workshops in the Spring of 2017. Witnessing how districts had different curricula, accelerated students into different courses, and had different acceleration models helped pique the interest of the researcher and was the impetus for the study to focus on the implementation of NYSSLS at the middle-school level.

Unlike other parts of the country where school districts encompass an entire county, Long Island is unusual in that there are 125 school districts within Nassau and Suffolk Counties. These districts are very different from one another in terms of student demographics, socioeconomics, and size. Yet, each district has its own district office administration, science supervisors and teaching staff with their own distinct unions, bargaining units, and contracts. To get a sense of the diversity of districts, a purposefully selected sample of districts that varied in terms of need, socioeconomic status, and building grade-level configuration was chosen. After interviews with personnel from 11 school districts, ultimately 6 were selected to be part of the case studies. Two of the districts had a middle school configuration, grades 6-8, 2 had a junior high school configuration, grades 7-9, and 2 had a secondary school configuration, grades 7-12. Interviews were conducted between the spring of 2018 and the winter of 2019 with teachers, science supervisors, assistant superintendents of curriculum and instruction, and for 1 of the districts the superintendent of schools.

The focus of this study was on the implementation of the New York State P-12 Science Learning Standards [NYSSLS] (NYSED, 2016). These standards are an adaptation of the Next Generation Science Standards (NGSS Lead States, 2013). Since New York State was one of the 26 lead states that participated in the development of NGSS, the state had agreed to consider adopting the standards once they were complete. Although the final version of NGSS was released in 2013, New York State did not adopt the standards as is. Draft standards were open to public comment and the final standards were released and ultimately adopted by the New York State Board of Regents in December 2016. Implementation began July 1, 2017 for the 2017-2018 school year.
While the implementation was supposed to begin during the 2017-2018 school year, new examinations reflective of these new standards have yet to be devised. This first phase of a three-phase implementation plan is called “Raise Awareness and Build Capacity” as district leadership is to make all stakeholders aware of the new standards and build capacity. The fourth-grade assessment is planned to move to fifth grade and there will be a new eighth grade assessment aligned with NYSSLS in 2022. The new Life Sciences: Biology Regents Exam and Earth and Space Sciences Regents Exam are to be implemented in 2023. The new Physical Sciences: Chemistry Regents Exam and Physical Sciences: Physics Regents Exam are to be offered in 2024 (NYSED, 2019). Since districts are still in the Raise Capacity and Build Awareness phase until 2020 when Phase 2, “Transition and Implementation” begins, districts are in various stages of planning about how this implementation will look.

Since the pre-K-5 standards are grade specific, districts do not have many decisions to make as far as curriculum is concerned as students will learn a bit of life science, physical science and Earth and space science each year. New York State is unusual compared to other states because there are statewide high school Regents exams that are given on a year’s worth of curriculum. The state has released the specific standards that are to be associated with the 4 distinct high school Regents-level courses: Life Science: Biology, Earth and Space Science, Physical Science: Chemistry, and Physical Science: Physics (NYSED, 2019). For pre-K through grade 5, and the high school Regents-level courses, what is to be included in each grade is specified.

However, at the middle school-level, the state has offered no guidance as to how the standards are to be taught in grades 6, 7, or 8. Moreover, what further complicates matters is that many school districts accelerate some or all of their eighth-grade students into a Regents-level science course. This practice can lead to two different problems. First, the students that are taking Regents-level science course in the eighth grade are missing whatever content is taught to the non-accelerated students. Secondly, if there is universal acceleration, then potentially the 3 years of standards are being forced into only 2 grades worth of science instruction in grades 6 and 7. Because of these reasons, it was decided that the decisions regarding the implementation of NYSLSS for the middle-level learners, grades 6-8, would require the greatest amount of decisions and therefore would offer the most compelling data for this study.

3.2 The Setting

Long Island (Nassau and Suffolk Counties) was chosen due to the large and diverse number of districts (n=125). Although the counties of Queens and Kings are geographically part of the island, they are boroughs of New York City and are therefore considered for educational purposes to be part of the New York City School District. In this qualitative study, six school districts from Nassau and Suffolk were purposefully selected for investigation. The school districts were chosen to include a range of building grade-level configurations, school types, curriculum models and student acceleration models (see Table 3).
Table 3. The Types of Schools and Curricula that were Selected for Participation in this Study.

<table>
<thead>
<tr>
<th>Building grade-level configuration</th>
<th>School Type</th>
<th>Curriculum Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades 6-8</td>
<td>Middle School</td>
<td>Integrated</td>
</tr>
<tr>
<td>Grades 6-8</td>
<td>Middle School</td>
<td>Domain-specific</td>
</tr>
<tr>
<td>Grades 7-9</td>
<td>Junior High School</td>
<td>Integrated</td>
</tr>
<tr>
<td>Grades 7-9</td>
<td>Junior High School</td>
<td>Domain-specific</td>
</tr>
<tr>
<td>Grades 7-12</td>
<td>Secondary School</td>
<td>Integrated</td>
</tr>
<tr>
<td>Grades 7-12</td>
<td>Secondary School</td>
<td>Domain-specific</td>
</tr>
</tbody>
</table>

Accelerated science models: Many Long Island school districts accelerate students into a Regents-level science course in eighth grade. Students enrolled in a Regents-level science course in eighth grade take the Regents exam instead of the Intermediate Level Science (ILS) exam. In schools that practice universal acceleration, where all eighth graders take a Regents-level course, there are no students who take the ILS exam.

Another reason why Long Island is an interesting area to study is because there is a large ‘opt-out’ movement where students, with permission from their parents, are able to decline to participate in the grade 3-8 state testing. The 3-8 testing opt-outs focused on yearly state exams based on the Common Core English Language Arts and Common Core Math Standards. It was determined that 50% of a teachers’ Annual Professional Performance Review (APPR) score would be based on students’ performance on these exams (NYSED, 2018b). The fourth and eighth grade science exams which had already been in place long before the Common Core, have been lumped together by the public with the math and English language arts state exams and have also received widespread numbers of students opting out.

Building grade-level configurations: Districts on Long Island have many different building grade-level configurations. Some districts have middle schools that house the middle-level grades, 6-8, in their own separate building. Other districts have a more traditional junior high school, a building which houses grades 7-9, while sixth grade is housed in the elementary school buildings. Another unique configuration, present in a smaller number of districts, are elementary buildings for grades K-6, and separate secondary buildings for grades 7-12. Districts that had differing building grade-level configurations for the middle-level grades were selected.

Curriculum models: Textbook publishers are seizing upon the opportunity to design new textbooks aligned with NGSS. However, making textbooks for the middle-level learner becomes a challenge because some districts use a domain-specific approach where a distinct science domain, either life, physical or Earth and space science is taught in each year. In other districts, an integrated approach is used where a little bit of each science domain is taught each year in grades 6-8. Because of this textbook companies offer textbooks that have either a domain-specific approach or an integrated-approach. Middle schools have to resolve the dilemma of what to teach in each grade. Should they continue with the integrated approach that was used in the elementary grades, pre-K-5, or prepare students for high school by implementing a domain-specific approach? There is a tug-of-war between the two different models and the middle-level learners are stuck in the middle, being pulled in opposite directions.
Districts with either a domain-specific or integrated science curricula were purposefully sampled as described later in this chapter.

**Teacher certification:** Teacher certification for most teachers is either common-branch elementary education for grades K-6, or secondary science education in one of 4 areas, biology, Earth science, chemistry, or physics for grades 7-12. There is a mismatch between the science certification areas and NYSSLS, especially at the middle-school grade level. Grade 6 is considered part of elementary school, while grades 7 and 8 are part of the secondary school. Although secondary science teachers can obtain a grade 5/6 extension that would allow them to be ‘highly qualified’ to teach either fifth or sixth grade, it is not a commonly held certification. A grade 5-9 certification also exists, but it is also not commonly held by teachers. Moreover, in a memorandum shared with New York State superintendents sent in October 2011, (see Table 4), the state also requires that middle-school teachers have a general science extension, unless it is a biology certified teacher teaching life science.

Table 4. *Science Teacher Certification Required to Teach Middle School Grades 7 and 8* (NYSED, 2011).

![Table 4](image-url)
This chart shows how middle school is considered grades 7 and 8 according to New York State. Since Earth/Space is presently characterized as a physical science by the state it is unclear how Earth Science 5-9 or 7-12 certification is not deemed as the appropriate certification to teach this course.

3.3 The Research Design

This was a qualitative study that utilized a case study design. A case study approach was chosen because the researcher wanted to investigate a phenomenon that was uniquely of importance at the time, the implementation of new science standards by school districts within New York State. The cases were 6 individual school districts that were studied. By going into the districts and interviewing teachers, science supervisors, and assistant superintendents, allowed for a rich, diverse set of data to be obtained and made triangulation possible. Since the researcher was a director of science, he had access to other science supervisors throughout Long Island. Although Creswell (2013) recommended the use of 4 to 5 cases, in order to have a pair of cases for each of the 3 different types of building grade-level configurations, ultimately a total of 6 case study districts were chosen.

A semi-structured interview process was selected to investigate the choices with their underlying rationale that the districts made in implementing their new standards. Questions were established prior to the interview, but follow-up probing questions were asked depending upon the responses provided by the interviewees. The interview protocols were piloted as per the recommendations of Patton (1990). After appropriate modifications were made, the interviews were conducted at three different levels within each school district. Cross-case synthesis as described by Yin (2009) was used to compare the school districts and uncover how they had implemented NYSSLS and the challenges they needed to overcome.

The research involved qualitative evaluation as described by Patton (1990). Data collection was done systematically with teachers providing information about the topics taught in grades 6-8 and the assistant superintendents drawing the district’s table of organization. From this information, evaluations of the science supervisors’ position in the organization and the scope and sequence of topics were analyzed in comparison to the other case study districts.

Since this was case study research it was not generalizable. The districts were selected using maximum variation sampling to included districts of differing need, percentage of students on free and reduced lunch, with different building grade-level configurations and acceleration models. Districts with different roles and responsibilities for their science supervisors were also purposefully selected.

Institutional review board approval. Before initiating the study, Institutional Review Board (IRB) of the University approval was obtained. The researcher had to demonstrate how subjects would not experience any harm, would not be compensated, could withdraw at any time, and would have their identities protected. The IRB approval was granted on August 28, 2017. The IRB approval form is included in Appendix A. The next step was finding districts that represented the variety of curricula, accelerated models, and building grade-level configurations.

Letter to participants of the BOCES middle school science scope and sequence workshops. The researcher provided a letter introducing the study to an administrator at the local BOCES which hosted the Long Island middle school science scope and sequence series of workshops. The administrator shared the letter, included in Appendix B, as an email attachment.
to all of the participants. Within the letter was a link to a Google Form, an online survey that the participants were asked to complete. This survey was used to ascertain how NYSSLS was being implemented and to determine if the schools were following one of the 3 models that were developed during the workshops, an integrated approach, or a domain-specific approach with eighth grade students accelerated into either Regents-level living environment or Regents-level Earth science. The researcher used the results of the Google Form to identify school districts that could be part of the study. To expand to additional school districts beyond those that participated in the workshops, the researcher also contacted members in a science professional organization to which he belonged.

A purposeful sampling strategy was utilized (Creswell, 2013). Districts were selected for the interviews using maximum variation sampling. This procedure consisted of districts with different building grade-level configurations for the middle-level grades, grades 6 through 8, including middle schools (6-8), junior high schools (7-9), and secondary schools (7-12), to illustrate the great deal of variety of how grades are housed in different buildings within school districts and their impact on science instruction.

Another variation that was selected for was whether school districts were using a domain-specific curriculum or an integrated curriculum.

**Pilot interviews.** Before interviewing any of the participants, 3 pilot interviews were conducted with a science teacher, a science supervisor, and an assistant superintendent for curriculum and instruction from 3 different school districts. These pilot interviews were recorded with a Sony digital audio recorder. These files were transferred to a computer and transcribed using Sound Organizer software. The researcher worked with an expert in science education research to review the transcripts and determine initial coding themes, which were largely descriptive (Saldana, 2016). The initial codes were then used to generate additional codes, which were then used for transcript analysis. Disagreements between coders were addressed and consensus eventually reached. After a back and forth exchange to establish the coding themes through numerous meetings, intra and inter-rater reliability was set at 90% agreement (see James et al., 1993).

**Interviews.** The initial interviews were with science supervisors. Using a snowball approach described by Creswell (2013), names of additional individuals whom it would be useful to interview were gathered from the science supervisors. In order to corroborate the statements made by the science supervisors, interviews were also conducted with science teachers and assistant superintendents for curriculum and instruction in each district. In 1 district, the assistant superintendent was not able to participate in the study, so the interview was conducted with the superintendent of schools. Triangulation was used to report discrepancies and when answers were corroborated by a third-party. Follow-up interviews were conducted as necessary to clarify statements.

**Details of the selected case study districts.** Out of the 6 school districts that were part of the case studies, 4 were considered low-need districts as per the schools’ needs to resource capacity. One district was considered an average-need district and one was considered a high-need district. The population of English Language Learners (ELL) also varied tremendously. In the high need district 20% of the students were ELLs. This percentage also correlated with the percentage of students on free and reduced lunch. In the high need school district, 79% of the
students were on free and reduced lunch. Three districts with a low percentage of students on free and reduced lunch also had a low percentage of ELLs. One of the low-need districts had a higher percentage of ELLs and a higher percentage of students on free and reduced lunch when compared to the 3 other low-need districts.

The role and responsibilities of the science supervisor was also explored. Some school districts had science directors/coordinators that oversaw science district-wide, K through 12. These individuals may have had other departments to supervise such as health or technology education in addition to the science department. Other districts had science chair people who also had a teaching component to their position and were considered building-level administrators. Some districts had teachers on special assignment supervise science.

The questions asked of the science supervisors included how their buildings were configured, the types of teaching certifications held by their middle-level grades teaching staff, and why an integrated or domain-specific curriculum was chosen. A complete list of questions to be asked during the interviews are found in Appendix C. An example of one of the questions was: Do you accelerate students into a Regents-level science course in 8th grade?

a) Which course(s) is (are) offered?
b) How are students selected?
c) How does this impact their science instruction in grades 6 and 7?

The interviews lasted approximately 30 minutes in duration and took place in the office or classroom of the interviewee. The interviews were audiotaped via a Sony digital recorder. The researcher transcribed the audio recordings verbatim using Sound Organizer software.

Pseudonyms were given to the districts to preserve their anonymity. The districts were given names that characterized the types of responses that were elicited from the interviewees: New Leader, That’s Why We Have Directors, Using Teachers as Educational Consultants, Wait and See, If It Ain’t Broke, and One Unit at a Time.

Table 5 summarizes the 6 case study districts investigated in the study. It depicts the building-grade level configurations of the middle-level buildings, the size of the district and the number of middle-level buildings in the district. One Unit at a Time was half the size of New Leader, Wait and See and If It Ain’t Broke.

Table 5. Summary of the Size and Building Grade-level Configurations of the Case Studies.

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Size (approximate number of students)</th>
<th>Number of middle-level grade buildings</th>
<th>Grade span of middle-level buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Leader</td>
<td>Medium (3,000)</td>
<td>1</td>
<td>6-8</td>
</tr>
<tr>
<td>That’s Why We Have Directors</td>
<td>Large (8,000)</td>
<td>2</td>
<td>6-8</td>
</tr>
<tr>
<td>Wait and See</td>
<td>Medium (3,000)</td>
<td>1</td>
<td>7-9</td>
</tr>
<tr>
<td>Using Teachers as Educational Consultants</td>
<td>Large (6,000)</td>
<td>2</td>
<td>7-9</td>
</tr>
<tr>
<td>If It Ain’t Broke</td>
<td>Medium (3,000)</td>
<td>1</td>
<td>7-12</td>
</tr>
<tr>
<td>One Unit at a Time</td>
<td>Small (1,500)</td>
<td>1</td>
<td>7-12</td>
</tr>
</tbody>
</table>
The needs of the schools varied. In most instances, the percentage of ELLs correlated with the percentage of disadvantaged students. As seen in Table 6, at *One Unit at a Time* almost one-quarter of its students were eligible for free and reduced lunch, yet it was considered a low-needs district.

Table 6. *Demographics of the 6 Case Study Districts.*

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Needs to Resource Capacity</th>
<th>% of ELLs</th>
<th>% Free and Reduced Lunch</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>New Leader</em></td>
<td>Average</td>
<td>6</td>
<td>29</td>
</tr>
<tr>
<td><em>That’s Why We Have Directors</em></td>
<td>Low</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td><em>Wait and See</em></td>
<td>High</td>
<td>22</td>
<td>77</td>
</tr>
<tr>
<td><em>Using Teachers as Educational Consultants</em></td>
<td>Low</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td><em>If It Ain’t Broke</em></td>
<td>Low</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td><em>One Unit at a Time</em></td>
<td>Low</td>
<td>8</td>
<td>23</td>
</tr>
</tbody>
</table>

The 6 case study districts also varied in whether students were universally accelerated, or if it was just a certain percentage of students that were accelerated. Also, the title and responsibilities of the science supervisor varied tremendously. Building-level chair people taught for 0.6 of their full-time equivalency (FTE). District-wide supervisors did not have a teaching component. As shown in Table 7, the same curriculum at *One Unit as a Time* was described by one interviewee as integrated, yet described by another interviewee as being domain-specific. Some districts had both models because eighth grade students took a Regents-level course which was domain-specific.

Table 7. *Summary of the Curriculum Model, Accelerated Course and Role of the Science Supervisor for the 6 Case Studies.*

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Curriculum</th>
<th>Accelerated course</th>
<th>Science Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>New Leader</em></td>
<td>Both</td>
<td>Earth Science</td>
<td>K-12 Science coordinator</td>
</tr>
<tr>
<td><em>That’s Why We Have Directors</em></td>
<td>Domain-specific</td>
<td>Earth Science</td>
<td>K-12 Science Director</td>
</tr>
<tr>
<td><em>Wait and See</em></td>
<td>Both</td>
<td>Living Environment (Universal accel.)</td>
<td>Science Chairperson (taught classes)</td>
</tr>
<tr>
<td><em>Using Teachers as Educational Consultants</em></td>
<td>Integrated</td>
<td>Earth Science</td>
<td>Science Chairperson (taught classes)</td>
</tr>
<tr>
<td><em>If It Ain’t Broke</em></td>
<td>Domain-specific</td>
<td>Living Environment (Universal accel.)</td>
<td>K-12 Science Coordinator</td>
</tr>
<tr>
<td><em>One Unit as a Time</em></td>
<td>Integrated/ Domain-specific</td>
<td>Earth Science</td>
<td>K-12 Science Supervisor</td>
</tr>
</tbody>
</table>
Open coding of the transcribed interviews was used to determine common answers given by the interviewees. Once these common answers were identified, they were categorized by theme. From these themes, the factors that influenced how curricula were implemented were identified. The challenges in implementing NYSSLS and the resolutions to ensure successful implementation were also identified.

3.4 Coding Themes

Ten coding themes were identified based upon the answers provided by the interviewees. These themes were shared with the science education expert and transcripts from several interviews were separately coded by the researcher and the expert. Once both individuals assigned the same codes to the same excerpts from the interviews, inter-rater reliability was achieved. These ten themes were: role of the science supervisor, hierarchical organization, building grade-level configuration, curriculum, standards, teacher certification, assessments, professional development, collaboration, and parent/community influence. An explanation of the concepts that fit under the themes follows.

Roles of the science supervisor. The role of the supervisor referred to the responsibilities of the science supervisor. Answers pertaining to the teachers that were supervised and the departments that were overseen fit into this code. In addition, any teaching responsibilities were part of this code.

Hierarchical organization. The hierarchical organization referred to the table of organization for the district. Responses that related how the science supervisor fits into the organization were coded with this theme. Responses that included who directly supervised the science supervisor were also coded with this theme.

Building grade-level configuration. The building grade-level configuration theme was used to code responses regarding the arrangement of specific grades in school buildings within the district. Although the specific number of elementary or high school buildings were redacted to protect the identity of the school district, the number of buildings that housed the middle-level grades were identified.

Curriculum. The curriculum code was used when interviewees discussed specific science topics that were taught. The scope and sequence of science topics were also included, as well as the accelerated science course offered to students. Whether an integrated or domain-specific approach was used was also coded under this theme.

Standards. The standards code was used specifically when interviewees discussed NYSSLS, NGSS and the current Math, Science, Technology Learning Standards of 1996. Pedagogical teaching shifts aligned with the three-dimensional nature of the standards, including science and engineering practices, disciplinary core ideas, and crosscutting concepts were also grouped under this code.
**Teacher certification.** The teacher certification theme was used to group responses that discussed teacher certification areas. These responses included common branch certification, the different secondary science certification areas, as well as the general science certification and the grade 5/6 science extension.

**Assessments.** Responses that included discussions of assessing student learning, including both formative and summative assessments, were part of this theme. State exams such as the Intermediate Level Science Exam and the science Regents exams were also included as part of this theme in addition to mid-term examinations and other local assessments.

**Professional development.** The theme of professional development centered around the training of the teaching staff to raise awareness of NYSSLS. This included departmental meetings, in-house training with guest speakers, and off-site trainings such as at the local BOCES or workshops on Superintendent’s Conference Day.

**Collaboration.** The collaboration theme was used for responses that described how teachers worked together and how teachers and administrators worked with one another. Responses in this theme included how teachers of the same grade and/or science discipline worked together and with their administrators. Responses also included how teachers from different buildings did or did not work together.

**Parent/community influence.** The parent/community influence theme was used to identify responses that discussed how parents were influential in decisions that are made in the district. The Board of Education, who are elected members of the community, and sometimes parents of students attending the schools, were included in this theme.

Each coding theme was assigned a different color, and the transcript was color-coded. An excerpt from the interview with the science director from That’s Why We Have Directors with the color-coded themes is shown.

**Teacher certification**  **Curriculum**

[**Interviewer**]: And how did teacher certifications held by the middle school teachers, how did that impact the decision to, you know, maybe go spiral versus a domain-specific approach?

[**Science Director**]: Yeah, so sixth grade, we have all elementary teachers teaching sixth grade. We don’t have any secondary with the extensions, so there are no 7 to 12 secondary science teachers with the 5/6 extension. Everything at sixth grade is an elementary piece, and there’s nothing we can do about that. So, from a certification standpoint that was no impact whatsoever because we have who we have. But as it flows, our seventh grade, typically, not typically, just, by just fact, they’re mostly bio certified teachers. So the life science piece mainly in seventh grade made a lot of sense. And then eighth grade typically we have our eighth-grade teachers their schedule typically consists of teaching two Earth science sections and two science 8 sections. So, they’re teaching two Earth Science and a science 8, is you know connected with topics they’re currently teaching in Earth Science, it just made sense to do it that way. So, I would say that’s kind of how the certification played out. And for sixth
grade what we were attempting to do, was there were some non-negotiables, but at the same time we wanted to provide them with some comfort because they’re not content specialists. Although we have outstanding sixth grade teachers, they’re not, they’re not science certified teachers. So, the ecology piece was big for us. We thought it would be a nice application for energy. So, energy is an abstract concept, so now we’re going to connect it to energy flow and ecosystems. And our teachers our comfortable with that, kids would be comfortable with that, and it just seemed to make sense. It’s something we found that just made sense in there. So, you know, for teacher backgrounds and certifications, I would say that’s how that kind of came into play.

3.5 Reducing Potential Bias

Since the researcher is employed in one of the districts that participated in the Long Island Middle School Science Scope and Sequence series of workshops, this district was not included in the study. A conscious effort was made to remove any of the researcher’s personal biases regarding curriculum since one of the approaches was recently selected and implemented in the district in which he is employed. Data analysis followed a three-cycle process: individual interview analysis, intra-school district analysis, and finally inter-school comparisons.

Since the researcher was a science director, a former science chairperson, and a former seventh-grade science teacher, a concerted effort was made to separate personal beliefs from impacting the analysis of the transcripts. The experiences gained from these roles helped the researcher have a greater empathy for the challenges associated with such positions.

In order to validate the results, defined by Creswell (2013) as the accuracy of the findings, triangulation was used where the interviews at the three different levels for each district were compared for corroborating evidence. Evidence was used from the interviews as well as artifacts. The district’s table of organization was completed by the assistant superintendent of curriculum and instruction. In addition, the teacher from each district was asked to write the topics taught in grades 6-8.

Negative case analysis was used when interviewees provided disconfirming evidence. These instances were specifically stated and supported with quotes from the interviews. Themes were identified via open coding. The researcher confirmed with the interviewees that the interpretation of what was said was correct.

Rich, thick description was provided for each of the 6 case studies including information about the characteristics of the districts, such as its needs to resource capacity, and student demographics such as the percentage of ELLs and students on free and reduced lunch. Curricular approaches, such as the acceleration model and the roles of the science supervisor were also detailed. Quotes from the different levels were provided to describe the district under study.

Reliability as defined by Creswell (2013) refers to the stability of responses from different coders. In order to establish reliability, the researcher worked with a science education expert to independently code the transcripts and compare the results. This process was done first for the three pilot interviews, for a teacher, science supervisor, and assistant superintendent from three different districts and then again for the three different levels all from the same district. Intercoder agreement was established after several meetings.
3.6 Limitations

A limitation with the study was that only some of the districts that participated in the workshops agreed to participate in the study. In order to expand the scope of the study, districts which did not participate in the Long Island Middle School Science Scope and Sequence series of workshops were also invited to participate in this study.

Another limitation was that the researcher assumed that the participants were being open and honest with their answers. Some of the science supervisors interviewed were acquaintances with the researcher, who held a similar role. Professional relationships were developed through involvement in professional science organizations and attendance at science conferences and workshops throughout the years. These professional acquaintances may have been more comfortable divulging information than with the interviewees with whom the researcher did not know.

It is expected that differences in the roll-out plans will be identified and the factors that influenced the decisions will be uncovered. It is the hope that districts in other states in the country may learn to avoid mistakes that were made in New York, and may gain insight into potential solutions so they can effectively implement NGSS, specifically at the middle-level grades. The insight from these interviews will help to inform practitioners in the field and will lead to recommendations to the New York State Department of Education regarding teacher certification areas in science.
Chapter 4

Results and Findings

4.1 Introduction

Although there were interviews that took place in 11 school districts, ultimately 6 were chosen as case studies: 2 with a middle school, 2 with a junior high school, and 2 with a secondary school. Interviews were conducted at three different levels at each district: with a science teacher, with a science supervisor and with the assistant superintendent. In one district the superintendent was interviewed instead of the assistant superintendent.

The interviews were audio recorded and transcribed. They were coded using the 10 coding themes depicted in Table 8, with a description of each code.

Table 8. Coding Themes for the Case Studies.

<table>
<thead>
<tr>
<th>Coding Theme</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of the Science Supervisor</td>
<td>Departments and teachers supervised; classes taught</td>
</tr>
<tr>
<td>Hierarchical Organization</td>
<td>How the science supervisor fits into the district’s hierarchical organization</td>
</tr>
<tr>
<td>Building grade-level configuration</td>
<td>The grade span for each building</td>
</tr>
<tr>
<td>Curriculum</td>
<td>Integrated or domain-specific approach</td>
</tr>
<tr>
<td>Standards</td>
<td>How NYSSLS is being implemented</td>
</tr>
<tr>
<td>Teaching Certifications</td>
<td>The certification areas of the teachers</td>
</tr>
<tr>
<td>Assessments</td>
<td>How local and state assessments are used</td>
</tr>
<tr>
<td>Professional Development</td>
<td>How teachers are being trained on NYSSLS</td>
</tr>
<tr>
<td>Collaboration</td>
<td>How teachers work together</td>
</tr>
<tr>
<td>Parent/Community Influence</td>
<td>The impact of parents and the community</td>
</tr>
</tbody>
</table>

The following research questions were answered through the interviews with teachers, science supervisors and assistant superintendents for curriculum and instruction.

RQ 1: To what extent was the implementation of NYSSLS, specifically at the middle-level grades, impacted by
   a. Eighth grade acceleration?
   b. Building grade-level configuration?
   c. Teacher certification?

RQ2: What were the roles and responsibilities of the science supervisor and how did this position fit within a district’s organizational structure?

RQ 3: How were curriculum changes made and who was part of the decision-making process?
Each case study is individually described in detail. Then, cross-comparisons between the case studies are made. Finally, major findings are discussed.

4.2 Case Study of New Leader School District

*New Leader* was a medium-sized, K through 12 school district that had an enrollment of less than 3,000 students. Twenty-nine percent of the students were eligible for free and reduced lunch (NYSED, 2016). The district had an average needs-to-resource capacity as determined by comparing the percentage of students in poverty to its ratio of combined wealth (NYSED, 2011). Five percent of the students were ELLs and 32% were economically disadvantaged (NYSED, 2018a).

The district had a school building structure of grades K-1 building(s), multiple grade 2-5 buildings, a grade 6-8 middle school, and (a) grade 9-12 high school(s). The grades 2-5 school buildings had very different student bodies. One school was culturally diverse, where 57% of the students were Caucasian, while the other school was not nearly as heterogenous, where 73% of the students were Caucasian (NYSED, 2017). All students came together in one district-wide middle school.

There was a K-12 science coordinator that supervised science instruction. This position was part of the teachers’ unit and the coordinator received an additional stipend for this role. He was considered a Teacher on Special Assignment, (TOSA). In addition to supervising science, this person also supervised the business and technology departments. The science coordinator intended to leave the district, something which was mentioned numerous times by all of the participants in the interviews. He was taking a position in a similar role in a better paying district. There appeared to be some concern about how things would be once the new science supervisor began.

The middle school had universal acceleration for Regents-level algebra for all eighth-grade students. Approximately 43% of eighth-grade students took Regents-level Earth science (NYSED, 2018). It was reported by the science coordinator that there was about a 70% opt-out rate from the Intermediate Level Science (ILS) Exam which was normally taken by eighth graders not enrolled in Regents-level Earth science.

Interviews in the district were conducted with the science coordinator, an eighth-grade science teacher, and the assistant superintendent for curriculum and instruction. The coding terms used to identify the major themes during transcription were used to organize the evidence.

The role of the science supervisor. The science supervisor formally observed all teachers in grades 6-12 in the areas of science, including the special education teachers that taught science in an integrated co-teaching (ICT) model. He served as a “consultant” for the teachers in grades K-5 with regard to the new science standards. He had recently started supervising science instruction in grade 6. Prior to that change, he had only supervised science instruction in grades 7-12.

Since the district was so small, the science coordinator also supervised teachers from the business and technology departments in addition to the science teachers. The following exchange is from the interview with the science coordinator:

**Science Coordinator [SC]:** I supervise directly everything from 6 to 12. And then, K-5, I have a consultant almost relationship with the teachers. Still drive the curriculum,
but if they have any questions about the new science program, I am the point person to help them with the transition to the new standards…That also includes the ICT [integrated co-teaching] teachers, so any of the ICT teachers that are linked to any of the science courses, I do their observations as well.

Interviewer [I]: That’s like the co-teachers?

[SC]: Correct. So, any of the special-ed teachers that are predominately just science, and we have four of them in district, I do their observations as well, their formals. And then at the secondary level, all of the principals or APs [assistant principals] do their informal observations, so I’m the one responsible for the pre-observation, and post-observations for all three of those departments.

The assistant superintendent for curriculum and instruction corroborated that the science coordinator would be leaving the district. She explained how he was responsible for the content. Being that the district was not that large, the science coordinator had the additional responsibilities of supervising the technology and business departments. As of last year, he started to formally evaluate the sixth -grade science teaches.

Hierarchical organization. The science coordinator and the assistant superintendent for curriculum and instruction both mentioned how the science coordinator was part of the teachers’ bargaining unit, so he was under the teachers’ contract, and when it was time to negotiate salary, the coordinators were with the teachers as opposed to being with the administrators. This practice applied to the curriculum coordinators in the core academic areas of math, science, social studies, foreign language, and English language arts. The other areas such as athletics, music, art and technology had directors which were part of the administrators’ unit. By not being part of the administrators’ unit, the curriculum coordinators were considered teachers on special assignment, which essentially allowed them to be paid a lower salary than administrators in the administrators’ bargaining unit. The assistant superintendent drew the district’s table of organization shown below in Figure 6.

![Organizational Table for District](image)

*Figure 6. Table of organization for New Leader School District.*
As displayed in Figure 6., the directors and the K-12 curriculum coordinators reported to the assistant superintendent, despite the fact that they were in different bargaining units. The assistant superintendent drew a circle to indicate that the director of technology was also the director of music and performing arts. This person had two roles in the district.

The assistant superintendent explained the difference between the directors and the curriculum coordinators.

[I]: And what’s the difference between a director and a curriculum coordinator?

Assistant Superintendent [AS]: One, they’re in different units…The curriculum coordinators here are part of the teachers’ unit. The Director of Technology, it’s an administrative position.

[I]: Okay. So, they would be with, like, the principals?

[AS]: Correct. They’re in that unit.

By having the K-12 curriculum coordinators in a different bargaining unit than the directors created a pay disparity as TOSAs received a stipend on the teacher’s salary schedule, while directors were part of the administrators’ contract. Also, the K-12 curriculum coordinators were the lowest ones written under the supervision of the assistant superintendent.

Building grade-level configuration. The participants in the interview discussed how the district was arranged. A commonality in their responses was how one of the grades 2-5 buildings was much more diverse than the other grade 2-5 building. This difference was due to the proximity to the water, as one school was literally on the ‘other side of the tracks’, in this case Long Island Railroad tracks, where property values were not as high as the homes located closer to the water. The students all came together for middle school and high school. This disparity showed that even buildings within a district can have populations of students from different socioeconomic status.

[I]: How are grades organized within buildings within this district?

[AS]: We have a school, the wing, primary center. It houses grades K and 1. Then we have two schools that house grades 2-5. One of those schools is a North school, north in the district and the other is a South school in the district. The fifth grade in both of those schools is departmentalized. Next year will be the first year of departmentalization for one of those schools. The schools are very different. One is much bigger than the other in terms of population. They’re also very different in terms of diversity. One has a very diverse population with a free and reduced lunch percentage, 35%. …The other is less diverse, with much smaller free and reduced lunch population of about 28%...The small school only has 317 students.

[I]: And that’s in three grades, 3, 4, and 5?

[AS]: That’s 2,3,4,5. Four grades. There is a middle school that’s district-wide. A single one for the district.

The science coordinator also spoke about this difference. Since the sixth-grade teachers were in the middle school, just last year he started to formally observe the sixth-grade teachers.

[I]: What is the building grade-level configuration of your district?
So, we currently have [number] buildings in district, (a) K-1 building which all the students go to, [number] community intermediate schools, grades 2-5, one is South of [street name], the other is North of [street name], so there is a tremendous difference in socioeconomic status and ethnicity in relation to where they are in that one dividing line. Then they all come back together for a common middle school, sixth, seventh, and eighth. And then we have (a) nine through twelve high school(s). So, [number] total buildings. Most of the time they’re heterogeneously mixed, except for that weird intermediate transition period between grades 2 and 5.

The middle school teacher spoke about how the sixth-grade teachers worked alongside the science coordinator because their grades would be used to determine their placement into seventh grade honors. She believed it helped that sixth grade was in the same building.

So, are they chosen after sixth grade or after seventh grade?

Well, they get placed into seventh grade honors from sixth grade, so they’re really scrutinizing the sixth-grade scores, and I think that’s also why our department chair was working with the sixth grade in terms of developing their curriculum so they can elevate the level of materials so that it kind of weeds students out so they can really see who belongs and where. Since the sixth graders are in the same building as the seventh and eighth grade teachers it appears that the seventh and eighth grade teachers can serve as a resource for the sixth-grade teachers.

By having sixth-grade in the middle school, the process of determining which students would go into the accelerated Earth science course in eighth grade started after sixth grade. The students selected for honors science were tracked to take Regents-level Earth science in eighth grade.

Curriculum. The curriculum at New Leader school district had gone through some changes to adapt to NYSSLS. In grades K-5, units had been assigned to be aligned with the K-5 NYSSLS performance expectations. It was more difficult at the middle school level because there was a grade band for grades 6-8. The middle school had changed to a spiral curriculum in grades 6 and 8 where students learned performance expectations from the life science and Earth & space science domains. In seventh grade, the curriculum was domain-specific focusing on the physical science performance expectations. As the science coordinator explained, the reason for splitting life science and Earth & space science between grades 6 and 8 was to potentially universally accelerate all students into Regents-level living environment in eighth grade. If the current sixth grade students were to take Regents-level living environment by the time they were in eighth grade at least they would have had some exposure to middle-level Earth science.

Is an integrated or domain-specific approach being used?

We are doing both. The domain specific is primarily in seventh grade. And now we’re doing an integrated, spiral approach in grades 6 and 8 and that’s due to our acceleration model. Right now, we’re currently in Earth science due to our certification areas. We have a lot of well-certified and master teachers in eighth
grade they are in Earth Science. But again, going forward we don’t know how that’s going to work out so we definitely wanted to remain flexible with how we’re going to implement, so that’s kind of why we did an integrated approach so they had a little bit of a taste in sixth grade of either Earth and life, and depending on the way the district decides to go, there’s been murmurs about universal acceleration, possibly in life. I don’t know how that would work in terms of certifications, but that’s the next person’s responsibility. But at least with that preemptive, you know, sixth grade curriculum, the kids will have some sort of preliminary understanding of what life and Earth is all about.

Regardless if the accelerated course was in living environment or Earth science, the students would be missing either the life science or the Earth & space science concepts that would be taught to the non-accelerated students in Science 8. To avoid this situation, the science coordinator thought it would be best to expose all sixth-grade students to some concepts in life and Earth & space science.

The science coordinator discussed how the new leader that would be taking his place might try to change the scope and sequence at the middle school-level. Although he assured his teachers that this would not be the case, he could not guarantee that changes would not take place after he left.

[I]: And how does the current science scope and sequence compare to the one to be implemented next year? Are there any changes going on?

[SC]: In terms of DCIs [disciplinary core ideas] no. We’ve realigned the content. That’s part of the angst right now of me leaving the position is that they’re going to have to move everything around now with the new leader. I assured them that that won’t happen. So hopefully it doesn’t...But I don’t see any changes with the science content that’s being delivered, but I do foresee a change in how it’s being delivered.

In the interview with the teacher, she also hinted at the possibility of a curriculum change to Regents-level living environment. In the selected exchange, she explained how new topics were added to the eighth-grade curriculum, which used to be domain-specific in life science.

[I]: So, eighth-grade had always been life science, but now it had some…Earth science topics put in there?

[T]: Right. Like we were always supposed to talk about the phase of the moon, the reason for the seasons, and that’s there. It’s still there. I feel they took anatomy away so we could spend more time on space, which is interesting. We’re supposed to do a scale model of the solar system and spend more time on that which is new.

The teacher wrote the major topics that were taught in grades 6-8, depicted in Figure 7.
The teacher went on to explain that just because something was in the curriculum did not mean it was necessarily taught. In this case, the intended curriculum differed from the actual curriculum.

[T]: Well, I didn’t get to space this year. How convenient for me. Because that’s going to be a really big stretch because that’s not my background. So, I need to plan. I have to first learn the material, like a sixth-grade teacher, I have to learn it. Have somebody teach it to me, I have to learn it. Become comfortable in that and figure out how I’m going to teach it. … So, at first, I was paranoid about it, but then I spoke with lots of other teachers in different districts and they said their whole schools a mess also. And that’s just the way it’s going to be for a little while and that’s okay. So, I went with that. So, I didn’t get to climate change or space this year. And I also taught things I shouldn’t have taught because I couldn’t help but teach them because I knew that they weren’t taught in sixth grade. So, each year, I guess when the seventh graders come to me, the following year in eighth grade, I will have a better understanding of what they already know and keep pulling material, I guess, from what I have.

Since many of her students did not take the ILS exam, the eighth-grade teacher was able to cut a topic from the curriculum without being concerned of students not doing well on a high stakes assessment like a Regents exam. Middle school teachers had more flexibility than high school teachers because there was not a Regents exam at the end of the year that was used for their Annual Professional Performance Review (APPR).
When the assistant superintendent for curriculum and instruction was asked about decisions making the middle school curriculum, she did not answer the question. Although changes had been made and implemented according to the science coordinator and the teacher, she did not speak about these changes. However, she acknowledged that the middle school scope and sequence needed more attention.

[I]: Great. And do you have this type of information at all, specifically for the middle school-level, grades 6-8?

[AS]: [Shaking head, no].

[I]: No, okay. Could you discuss what the plan is for grades 6-8?

[AS]: [Sigh] I wish I had a better plan 6-8. This was my focus right now … My next focus after this, I had to replace my biology, or living environment texts and, and program. We are running a pilot on that…The training for that was just last week…Very exciting. All brand-new stuff, and that’s through Pearson. They had a full-day of training. So, the middle school, my focus was I had to do K-5, and then I must do living environment. We just finished physics last year…re-doing that. So, the next piece on my plate is for 6-8.

[I]: Alright, so when you said living environment and physics, that’s at the high school level?

[AS]: At the high school level. So middle school really didn’t get my full attention…and next year needs my full attention. We need a plan for 6-8.

The science coordinator had talked at length about changes that were taking place at the middle school level. It appeared that the assistant superintendent was unaware of these changes. She knew what was happening at the elementary-level and in ninth grade living environment, but as she indicated, “the next piece on my plate is for 6-8” reinforced the idea of middle school being neglected.

The teacher explained how she was not happy with the curriculum changes that were made and wished that her input was taken into consideration. She did not want to make additional changes because she felt bad for the sixth-grade teachers that had already made the most changes to their curriculum. The teacher also expressed uncertainty with whether the new changes would remain in effect once the new leader began.

[I]: And this, this … science scope and sequence, that you laid out for me, is that the same that’s going to be, what’s anticipated to be, in the next couple of years?

[T]: I would believe so. We did ask [science coordinator] although he was leaving, are things going to be changing again, although I would now myself be in favor of having some input, like can we shift things around because of x, y and z? … I don’t know if I’d want to do that to my sixth-grade colleagues who have just spent an entire year and so much energy on learning the new standards and content and either taking it from them or giving them something else, so I believe it is most likely going to stay this way moving forward, but we’ll see.

There was uncertainty with what the future would hold with a new leader coming to the science department. The idea that curricula could change specifically at the middle school-level seemed like a legitimate possibility. The district was considering moving to universal
acceleration into Regents-level living environment, and with a new, untenured science coordinator coming in, the timing could be ripe to make the change.

**Standards.** From the interviews, both the teachers and administrators were familiar with the practices associated with NGSS. They realized that it was more of a shift in the approach than in the content itself. The assistant superintendent focused her responses on changes taking place at the elementary level. This may be due to the fact that she had teacher certification in reading and special education for kindergarten and grades 1-6, so she was possibly most comfortable focusing on this level first.

[I]: That’s great. How are the New York State Science Learning Standards being implemented?

[AS]: [Science coordinator] really took the lead on that. He met with grade levels…and teachers individually and worked with them. And really did a side-by-side comparison of what they had been teaching and what they would be teaching. The big changes for the teachers was not so much in content, but really in approach…The new learning standards have an engineering component. They’re much more hands-on. They’re lab-based. We have some online work that the teachers have to do. Those were sea changes for them. They don’t have engineering backgrounds or when they heard engineering, people were really very put off by that. So, they had to, he had to show them what really was meant so that it was an approachable curriculum for them. When you tell someone, well you’re going to have to teach engineering to an elementary school teacher, they don’t know what you’re talking about. But when he showed what is really meant by that, the innovation, the creativity end of it, they did that all the time. And once they wrapped their heads around it, it became easier for them to jump into the curriculum. So, they like the hands-on actually now, and that, but they’re taking a very long time to learn this, I have to tell you. [Science Coordinator] and I were hoping that they were going to cover 2 or 3 units this year, … at the lower grades they were able to cover a single unit of study. It floored us both. We were surprised. So, the pacing is very slow.

The biggest surprise was how long it took to implement the new units. There were tremendous changes required to align teaching pedagogy to NYSSLS. The assistant superintendent saw that implementing 3 new units in a single year was not feasible. Making change required a great deal of time.

The science coordinator was very proactive in familiarizing the staff with the new standards. He had focused on storylines, phenomena, and questioning techniques. He also explained how curriculum writing would be the vehicle to incorporate the storylines and phenomena.

[I]: Great. So how are the New York State Science Learning Standards being implemented, specifically at the middle school level?

[SC]: So, specifically at the middle school, what we have really focused on is making sure we’re piloting on the practices. Unfortunately, this is what I think you’d probably hear from a lot of other curriculum leaders. We don’t really know what to do with the crosscutting concepts yet. I’ve introduced them as common language that we
should be using in our questions… Introduced the STEM learning tools. They have a wonderful document there that has a bunch of crosscutting concepts question stems, so, they could start building their labs and start building some of their assessment questions around those stems. So, we’re starting to bring in the crosscutting concepts, but we really focused on the science and engineering practices. Besides the curriculum realignment that I focused and talked about before, …that’s where we really tried to beef it up. There’s a lot more station work that’s going on. A lot more embedded literacy as well to try to get them used to looking at graphs, looking at, even just recounts, you know, this is what a particular student said about the results. So, try to bring that DOK [Depth of Knowledge] level up so that eventually when we do see these new assessments hopefully the students will be prepared at the high school so they’re ready for these, what we perceive to be more difficult NGSS-styled assessments. So that’s really where we focused. And like I said, next year it’s just going to be more curriculum writing to try to get more of the storylines and more of the phenomena.

Although the new fifth grade and eighth grade assessments were not going to be administered until 2022, the middle-level students could take the new Regents exams aligned with NYSSLS when life science: biology and Earth & space science were offered in 2023, and physical science: chemistry and physical science: physics were administered in 2024. The science coordinator was being proactive in trying to get students ready for these new state assessments that they could potentially take during their junior and senior years of high school. He had planned for the future assessments the students would have to take by introducing storylines and phenomena.

The teacher also discussed how the new standards were being implemented, specifically at the middle school-level. She also mentioned how curriculum writing occurred over the summer to allow the teachers to develop a unit.

[I]: And how are these New York State Science Learning Standards being implemented this year?
[T]: …Good question, so… what our department chair did, he took all the standards and chunked them. So, this year was the first year that we received, I guess, our chunk that we’ll be using for the next few years of standards…And then we had curriculum writing opportunities over the summer. So, we were able to, another teacher and I, develop a whole unit… in alignment with the new standards. I know that our department chair was working closely with the sixth-grade teachers to help them through the new standards and the new curriculum. And then trying to, I guess, NGSS-ify the old stuff that we do and kind of do little by little as we go along.

The common theme was that implementation was going to take longer than originally anticipated. The slow and steady approach seemed to be an effective implementation plan for New Leader District. There appeared to be a thoughtful approach, and this message was evident throughout all of the interviews. However, the message was not consistent amongst the different levels. Although the teacher and the science coordinator knew of the changes at the middle-level grades, the assistant superintendent was unaware of the changes that had already taken place.
Teacher certification. The interviews revealed that all the sixth-grade science teachers had elementary certification. None of the sixth-grade science teachers were science certified with the 5/6 extension, meaning they were elementary certified teachers as opposed to secondary science certified teachers. However, why Earth science was chosen as the course to accelerate eighth grade students into was attributed to teacher certification by the science coordinator and the assistant superintendent, but not by the teacher.

[I]: And do you know why Earth science was chosen as the course to accelerate them into rather than Living Environment?

[AS]: I do, unfortunately. It was not, again, I like to do things with intention. It was because we had more teachers who were certified in that and I could accommodate the numbers. I don’t have, you know, I don’t know why science is like this, where you have certification for each thing. I don’t think this is a smart thing for my science. You know I’m begging people, get certified in everything, please so you can, we can mix and match. But, if I didn’t do it that way, there would be a lot of movement between my, my middle school and high school. It’s a waste of time. I, I need to be efficient here.

With four different science subject areas in which a teacher can be certified, the idea of asking teachers to “get certified in everything” seemed unrealistic. Dual certification was rather common and often preferred in job listings, but to expect teachers to be “certified in everything” was more difficult than it sounds. A middle school teacher was required to have general science certification, unless he or she was teaching life science in which case secondary certification in biology for grades 7-12 allowed the individual to be considered highly qualified. With general science certification a teacher could teach any of the middle-level science courses. When the science coordinator was asked the same question, he gave a similar response.

[I]: And do you know the history as to why Earth science was the course chosen to accelerate students into?

[SC]: Certifications. The teachers that were down there were primarily Earth science certified at the time, ...and we were reconfigured in the early 2000s when the new standards came out, the current standards, so everybody in ninth grade, when they came to the high school, was taking Living Environment.

The science teacher, however, gave quite a different response when she was posed with the same question.

[I]: And as far as Earth science, because I know a lot of districts now are moving toward doing the living environment in eighth grade, do you know the history of why Earth science was chosen as the course to accelerate students into?

[T]: The history, no. It’s been done that way since as long as I’ve been here. I know there’s been some talk about moving …living environment down to the middle school, but then there was money and it was cost and I think that, and I wasn’t in favor of it, so, not that that mattered, but it just never happened here. I don’t know why, it’s always been Earth science.
The teacher hinted at the possibility of living environment being the course taught to accelerated students and attributed the decision to monetary concerns. She did not mention certifications as an issue with any of the decisions, even when asked directly.

[I]: Okay. Do you think the teaching level, the teaching certifications held by the middle-school teachers, did that impact where certain courses go?

[T]: I want to say no, because the other seventh grade teacher, it’s a small building, the other seventh grade teacher, he’s my husband, he’s… biology certified like I am. And he’s teaching and he always has taught physical science…And sometimes I do that as well, when they need me to. But, no, I don’t think so. I don’t think that plays a part.

[I]: And like the sixth-grade teachers being elementary certified, … was there any thought about, you know, concern about them being able to teach material that would be too difficult for either them or their students?

[T]: Honestly no. I have a tremendous respect for the amount of work the sixth-grade teachers put in. And they’ve always done a really great job.

The exchange with the teacher explained how teachers at the middle-level can be asked to teach any of the sciences because of the general science certification. Although the eighth grade had always been life science, now she taught life science and Earth & space science topics. Likewise, she mentioned how her husband was also biology certified, yet he taught physical science. Sometimes teachers are not aware of the certification areas of their colleagues. People may have assumed that the physical science teacher had physics or chemistry certification, but since this was her spouse, she knew that he had biology certification. Although curricular decisions should be made based upon what is best for children, sometimes districts have to work with the teachers they have and need to make decisions based upon teacher certification in order to ensure that highly qualified teachers are in the classrooms.

Assessments. In all three interviews, the lack of clarity about the new assessments aligned with NYSSLS were mentioned and were a cause of concern. The interviewees also mentioned how the school had a high opt-out rate for the ILS exam, normally taken by eighth-grade students. According to the science coordinator, the teachers were able to be more creative since they had so few students taking the exam and therefore could focus more on NGSS.

[SC]: … I’ve already told the eighth-grade team, we have a 70% opt out rate. Don’t worry about the eighth-grade intermediate test, you know most of the kids taking it are ENL [English as a New Language] students, so regardless of how we do things, their scores are not going to be indicative of what you did in the classroom because they have other restrictions that are preventing them from excelling at the level that they should. So, after I told them don’t worry about reviewing three to four weeks, reviewing for an assessment that nobody takes, it really allowed that creative juice to flow.

In the interview with the eighth-grade teacher, the same sentiment was echoed regarding students not taking the ILS exam.

[T]: We used to, when the students took the state assessment, the seventh-grade
honors students would be taught life science and physical science at, throughout the year, so, they would just be going at a greater pace so that we could prepare them and they would take the exam. But now they don’t take it.

Another area where there was a common language used was regarding choosing students for the Regents-level Earth science course. The I-Ready assessment was used to measure students’ level of reading comprehension. All three interviewees also mentioned the need for a teacher recommendation and a specific grade point average on the report card, however the order that they described these requirements varied based upon who was being interviewed.

[I]: How are students selected for that Regents-level Earth science course in eighth grade?

[AS]: So, one of the criteria that I did insist on is a particular reading level. We give something called an I-Ready assessment, three times a year. At the end of that assessment, or actually it’s the winter assessment we have to use for planning purposes, children have to be reading on at least grade-level to be considered for honors courses. If they’re not reading, because science has become really literacy-dependent, as have all our courses. And if our students can’t read and write on grade-level, they’re not going to really be successful in science. So, I do have that as a baseline criterion now and students can’t be considered. Once that’s laid out, they have to be recommended by their teacher and they have to have a grade point number on their report card of 90 and then they’ll be considered.

The science coordinator indicated how new criteria were just recently put into place and he had a similar response.

[I]: And how are students selected for that course [Regents-level Earth Science]?

[SC]: … But the first one is still the teacher recommendation. The second is a cut-score on the midterm, the third is a minimum first semester grade, I don’t remember those off the top of my head, but it’s based off of percentages. And the fourth was I-Ready scores. We use I-Ready for our diagnostics for ELA and math. So, we wanted to make sure that at least students were reading at a seventh-grade level before they get into a high school course, or seeing that we had about 15 to 20% of our kids in honors that were reading at a fifth and sixth grade-level. So obviously they would probably be ones that are more struggling when they get to those high school-level assessment questions. So, we self-select, hook them out, if they met three of the four criteria they’re allowed to stay in. If they didn’t, they were asked not to enroll in Earth science. And we are kind of dealing with the fallout right now, since this is the first year.

Although they both mentioned the same criteria, it was interesting how they were stated in a different order, suggesting the order revealed the level of importance they placed on the criteria. The assistant superintendent started by talking about the I-Ready assessment and the importance of reading on grade-level. By contrast, the science coordinator started by first discussing the importance of the teacher recommendation. The I-Ready scores were the last of the four criteria
he mentioned, while it was the first one mentioned by the assistant superintendent, who happened to be certified in reading.

When the teacher was interviewed, she also identified the same criteria.

[I]: And how are students selected for that course [Regents-level Earth Science]?
[T]: That’s also something that they’re working on this past year. They take their scores from sixth grade, … sixth grade final exams, sixth grade mid-terms. I believe they take their I-ready scores for reading, their math scores play a part, I think teacher recommendation takes a part, …so they’re really trying to refine that process…this past year.

All three also mentioned how this was a new process that was just implemented during the past school-year. In the past all students that wanted to take Regents-level Earth science were automatically rolled into the course. This was the first year that students had to meet specific criteria in order to be allowed into the Regents-level Earth science course. Requiring certain criteria was a way of ensuring that students were ready for a high school-level course in eighth grade and could pass the Regents exam. If students were reading below grade-level they would struggle in the course.

Professional development. Professional development was identified as an important piece for implementing NGSS. The teacher participated in monthly department meetings which were used by the science coordinator to provide professional development on NGSS-aligned practices. Throughout the interviews, professional development was discussed in terms of its value and how it was provided to teachers.

[I]: How did he communicate that information?
[T]: Good question. Through emails, suggested videos, …links, articles. He talked about it during department meetings. He did a really great job during department meetings. He would have things set-up around the room that we could walk around and kind of experience the types of activities that we should be doing and the way we should phrase our questions and things like that.

The science coordinator modeled for the teachers what they should be doing with their students. By having the teachers first experience activities aligned with NYSSLS, they could then try similar activities with their own students.

The science coordinator also discussed the importance of professional development. Finding the time to meet with teachers was an issue for him.

[I]: What are the biggest challenges in implementing NYSSLS?
[SC]: The middle school is fine. Elementary I think is providing them enough time to delve into the new program, offer that PD that they may need. Offer that one-to-one or one-to-group support that they may need. The time thing there is a factor because there I don’t have the monthly department meeting to help with that process. It’s more school business days. Contractually they only have one required meeting, one common planning time. And we can’t dictate that. So, it’s only if the team asks us to come in as curriculum leaders to help them with the program do they do that. Some grade levels have asked me numerous times to
come. Some buildings and grades have never asked me to come. So, I think that piece right there is the only limiting factor for K-5. I think the program is great. It’s just getting the teachers up to speed with that.

Since the science coordinator did not have monthly department meetings with the elementary teachers, finding the time during the workday to provide professional development opportunities became a challenge. Similar to the secondary science teachers, having time to work with the science coordinator would help the elementary teachers in making some of the shifts required by NGSS.

The other issue was that since it was not a contractual obligation, only some teachers chose to take advantage of these opportunities. The elementary teachers had faculty meetings, but they did not have contractually required department meetings with the curriculum coordinators, so only some of the teachers met with the coordinators, while others chose not to do so. Making mandatory meetings with the science coordinator would be a way to get more professional development for the elementary teachers.

Similarly, the assistant superintendent specifically identified professional development as the biggest challenge in implementing NYSSLS. Since elementary teachers only had a single preparatory period and lunch period, she felt that giving them release time or making use of Superintendent’s Conference Day would be the best way to ‘train’ that group of teachers. The assistant superintendent discussed the significance of professional development and identified the lack of trainers, time, and money as hurdles that needed to be overcome in the following exchange.

[I]: And what are the biggest challenges in implementing the New York State Science Learning Standards?

[AS]: Training. The professional development. Just like I said, when we explained that engineering was a key component, teachers were put off quite a bit. They need help and I need trainers who, who are good and knowledgeable. It’s almost as if, if you pick good, then they’re not knowledgeable because they’re good at instruction. But if they’re knowledgeable, you know, they’re not, it’s, it’s hard to get a whole package. I think New York State has really missed the boat in getting trainers ready…We don’t know where to get them from. We’re trying to get them through the program, Amplify. They’re really expensive and I have to pay travel costs. There’s not a lot of local folks.

[I]: And when teachers are trained is that usually through department meetings or release time or how is the training kind of delivered to the teachers?

[AS]: It has to be either release time or a Superintendent’s Conference Day because after school they’re shot. They’re tired. They taught for 6 hours. Our elementary folks, they get one prep. You know they don’t get a hall duty. They get one prep and a lunch. And they’re very tired at the end of the day. To train people is unfair. So, release time is expensive. And, I don’t know if you know this, there’s a crisis of subs on Long Island. Nobody, because of health care issues, and other issues, there are just no substitute teachers. I can’t get them even if I have the money for them. That’s another thing, you have to pay them. Every time I call a sub, it’s a hundred dollars, a hundred twenty-five dollars. It’s a lot of money.
Although the assistant superintendent mentioned the need for more trainers, the science coordinator could be better utilized to provide professional development for the K-5 teachers as he had done for the grade 6-12 teachers. The importance of professional development was identified in all three interviews. The assistant superintendent viewed training as something that was done to teachers, instead of focusing on the learning that took place. There seemed to be more concern about the logistics of paying substitute teachers. She claimed that training teachers after school was unfair to the teachers. Neglecting teacher training could negatively impact the elementary students in the district. At the elementary level, the K-2 curricula provided the foundation for the grade 3-5 curricula. Without proper scaffolding, students may not be adequately prepared for the middle school and high school grade bands of NYSSLS.

**Collaboration.** When it came to collaboration regarding curricular decisions, different accounts were given depending on who was being interviewed. According to the science coordinator, deciding the new scope and sequence at the middle school level was a collaborative process that involved the teachers. This change included both Earth & space science with life science topics in grades 6 and 8.

[I]: And who is involved in the decision-making process to make these changes, curricular changes?

[SC]: It was a good two to three of our department meetings, last year. I’m forgetting when we made these…it was last year because I wanted to get the sixth grade involved as well. So, it was a collaborative approach. Teacher input was definitely listened to.

When the teacher was interviewed, she portrayed it very differently. She stated that the teachers were not involved in the process, something which she now regretted.

[I]: Any input from the teachers really?

[T]: No, I was. As now I go through them even more and I’m even more familiar with them, there are some things that don’t make sense to me… And things I don’t like, but no, there was no input. It was kind of just given to us.

Whereas the science coordinator said “teacher input was definitely listened to”, by contrast the teacher claimed, “…but no, there was no input. It was kind of just given to us.” The assistant superintendent’s response supported the collaborative approach that the science coordinator described. However, according to the teacher, the decision as to which topics were to be taught, and when they were to be taught, came directly from the science coordinator without input from the teachers.

[I]: … How are the New York State Science Learning Standards being implemented?

[AS]: [Science coordinator] really took the lead on that. He met with grade-levels…and teachers individually and worked with them. And really did a side-by-side comparison of what they had been teaching and what they would be teaching. The big changes for the teachers was not so much in content, but really in approach…

The teachers are only going to buy-in to change when there is a consistent message that is coming from district leadership. With NYSSLS there were major changes to some content that was historically taught in a certain grade that was being moved to a new grade. There would be
greater buy-in on the part of the teachers if they had a hand in some of the decision-making. Although NYSSLS dictated what was to be taught in pre-K-grade 5, there were more decisions that needed to be made locally for the middle-level grades.

Although teachers at the middle-level grades were required to have general science certification, they all had primary certification in one of the four areas: biology, Earth science, chemistry or physics. Teachers tend to be most comfortable with their primary certification area. With the integrated model being implemented in grades 6 and 8 for the first time, the middle school teacher described how the teachers with different science backgrounds worked together to support one another. As a biology certified teacher, she felt uncomfortable with the Earth science content that she was given to teach.

[T]: So, I need to plan. I have to first learn the material, like a sixth-grade teacher, I have to learn it. Have somebody teach it to me, I have to learn it. Become comfortable in that and figure out how I’m going to teach it. …So, the person that I designed curriculum with last summer, he’s an Earth science teacher, so that can be like an easy kind of way of learning it…but there are things that I didn’t get to this year because of the shift, you know, let’s spend a little more time on this, remove things.

The teacher described collaboration between teachers during curriculum writing. While working with the Earth science teacher, he was able to help her understand the Earth science topics that were being incorporated into the life science curriculum.

**Parent/community influence.** The influence of parents and the community was a theme that was mentioned in all 3 interviews. According to the science coordinator, the change in how students were selected for the accelerated Earth science course had been an issue. In the past, student could simply self-select into the course, or a parent could make a phone call and have his or her child placed into the course. With new criteria to be selected for the course, the community had started to “rumble.” Parents seemed to be used to their children following along a set path, moving from class to class with other students from seventh grade honors science. Now, it appeared that some students were not guaranteed to go into Regents-level Earth science if they did not meet specific criteria.

By instituting specific criteria, parents were not able to get their child into a course by simply placing a phone call. The science teacher was aware of the criteria, but unsure about a parent’s ability to request that his or her child be placed in the Earth science course since she taught the Science 8 course taken by students not selected for Earth science.

[I]: And if a student is not recommended for the accelerated Earth science, is there any way that they’re able to get in?
[T]: I believe in the past, yes. But now and in the future, I’m not so sure.
[I]: Is there a process? Or is it more someone just picking up the phone and saying?
[T]: It might be. It might be that. Like I said it’s not anything that I ever had to do. If I had, the rare occasion I taught a seventh-grade class, it was an honors class and the students just moved on to and that was many years ago.
The assistant superintendent reiterated some of what was said by the teacher and the science coordinator. She explained how the parents could get their way.

[I]: And if a parent wants to self-select their child in?

[AS]: We, we have them come in and we conference because it’s not a flat no…I’m not hard and fast. If I have a student who has missed this criteria, but has a passion for science, we’ll let them in. We’ll let them in…You know, we’re not in the business of saying no for no’s sake. It’s for a child to be successful. If you have a passionate science student, we want them in. We have a science academy at the high school, a STEM academy. And so, we’re trying to let our students find what they like to do. What’s their affinity? If that’s their affinity, who am I to say no to that.

Although the teacher and science coordinator discussed criteria, according to the assistant superintendent, if the student really wanted to get into a course, it appeared that she could have gotten in. Although there were criteria, it appeared that students could still get in without meeting all of the criteria if they truly had a passion for science. If the district was going to have criteria for what students must have in order to be placed in the accelerated Regents-level course, the teacher, science coordinator, and the assistant superintendent need to have the same message. The criteria are set to determine which students would be successful in the course, so parents should be made aware of these criteria and should leave the decision-making to the school professionals.

Summary. New Leader District utilized a collaborative approach by having the sixth-grade teachers work directly with the seventh and eighth grade teachers and was able to capitalize on the sixth, seventh, and eighth grade teachers all being in the same building.

Professional development was orchestrated by the K through 12 science coordinator through department meetings and Superintendent’s Conference day. He also arranged for summer curriculum writing projects by the teachers. Since the science coordinator did not have any teaching responsibilities, he was able to focus his attention on changing the curriculum, and on the professional development and evaluation of his teachers.

Changes to the middle school science curriculum were determined solely by the science coordinator. He was a proponent of using a systems model for Earth science and life science in sixth grade. A domain-specific model was used in seventh grade which focused on physical science. Life science and Earth science topics were re-visited in eighth grade. Part of this decision was influenced by the possibility of moving toward universal acceleration in living environment in eighth grade.

Unlike the directors, the curriculum coordinators were part of the teachers’ bargaining unit and were considered teachers on special assignment. Since the district was not large, the science coordinator also supervised the business and technology departments. He was leaving the district for a similar role in a better paying district.

The student population in the grades 2 to 5 buildings were very different from one another in terms of socioeconomic status and diversity. Even within a school district, there was tremendous differences in the diversity of the students within its own buildings.

Since the district was not large, all of the elementary buildings fed into one middle school. The assistant superintendent confirmed that from her end more attention had been placed on the
elementary school and high school grades. She explained that the middle school science program would be her focus for the upcoming school year.

4.2 Case Study of That’s Why We Have Directors School District

That’s Why We Have Directors was a large, suburban district located on Long Island, New York, with an enrollment of over 8,000 students. It was a low-need school district as identified by its needs to resource capacity (NYSED, 2012). It had 16% of its students qualify for free and reduced lunch (NYSED, 2016). Three percent of its students were ELLs and 21% were economically disadvantaged (NYSED, 2018a).

That’s Why We Have Directors had district-wide K-12 directors that did not have a teaching component to their job. The district had 2 middle schools. There were numerous elementary schools that fed into these middle schools. There were also multiple high schools.

The science director had a NGSS sub-committee composed of teachers that helped learn about the pedagogical shifts required. This committee was a sound board for ideas that were generated by the teachers.

Interviews were conducted with a sixth-grade science teacher, 2 eighth-grade science teachers interviewed together, the science director, and the assistant superintendent for secondary education.

Role of the director of science. A consistent message from the interviews at That’s Why We Have Directors, was that the directors had the autonomy to make decisions for their departments. The science director was responsible for providing professional development, overseeing curriculum writing, and developing the implementation plan for NYSSLS. In addition to supervising the science teachers, the director also supervised the middle school technology teacher and observed 7 elementary teachers.

When the sixth-grade teacher was asked how the decision was made to move from an integrated model to a domain-specific model she stated that although there was a committee comprised solely of teachers that explored the new standards, it was ultimately the director’s decision as to how they were to be implemented.

Interviewer[I]: Did this committee ultimately make the recommendation as to the direction the district was going to go in?

Sixth-grade Teacher [ST]: I would say when we attended that workshop through BOCES [Board of Cooperating Educational Services], [science director], in talking with a lot of different people, was convinced that we should un-spiral. It was ultimately his decision. We did not vote at all. He didn’t you know…He asked for our input. Or did he? Cause I was on the committee. I think he just said, “Nope, this is what we’re doing.” We were asked as part of the committee to get feelers out. When I put my feelers out the eighth-grade teachers were like, ‘No, we would love to have it separate.’ And I don’t know how he really decided that life would go in sixth. I mean why it would go in seventh and not sixth. That more schools do that I’m not really sure.

The director of science echoed the same idea when he was asked about the curricular making process.
[I]: And who’s involved in the curricular making process?

Science Director [SD]: Me. [laughs] Really that’s it. I mean for better or for worse. I’m in this office, so the expectation is that I’m putting forward a plan. And I keep people informed. I keep [assistant superintendent for secondary education] informed, I keep our assistant sup for elementary education informed as well. Obviously, our teachers are informed. But in the end, it really comes from me. I mean, you know, there’s nobody telling me from above that you need to do a domain-specific or you need to do an integrated model. It’s, you know, we have the autonomy to make that decision on our own. And the expectation is that we are doing that stuff on our own. So, for better or for worse.

The assistant superintendent for secondary education corroborated that the responsibility ultimately fell on the science director.

[I]: Great. How are the New York State Science Learning Standards being implemented?

Assistant Superintendent [AS]: So, we have...my understanding is, again with the directors. Typically, that stuff, any, whether it’s the new art standards, everything is kind of with them.

This approach appeared to be successful because teachers were able to participate in a NGSS sub-committee that allowed them to voice concerns about discipline-specific issues. The directors had the autonomy to make the ultimate decision and that was why their positions existed.

Hierarchical organization. That’s Why We Have Directors had two curriculum support administrators, an assistant superintendent for elementary education and an assistant superintendent for secondary education. The district had directors for the academic subject areas, 1 for elementary and 1 for secondary English language arts, and assistant principals at the secondary buildings that were associated with a certain subject area to act as ‘go-to’ people at the building level.

The assistant superintendent for secondary education drew the table of organization for the district in Figure 8.
Figure 8. Table of Organization for That’s Why We Have Directors School District.

According to Figure 8 the department directors, such as science, reported directly to the assistant superintendent for secondary education. However, the directors had the autonomy to make decisions that directly affected their departments.

The assistant superintendent explained how there was an assistant superintendent for elementary education and one for secondary education.

[AS]: [Assistant superintendent for elementary education] does K-6. So, we have [number] elementary buildings. And [assistant superintendent for elementary education] is the assistant superintendent for elementary education. Her direct reports are the [number] principals, there are, any of the K to 12 directors reports to the two of us, and then there are some coordinators that are just mine, and some that are just hers. ELA [English Language Arts] is split. We have ELA and reading coordinator for elementary and ELA and reading for secondary. So, there’s that. Then there’s myself, for secondary. We have an assistant sup for, we call it district-wide admin, but it’s really just HR [human resources] …Then we have an assistant sup for finance and facilities. From there I’ll give you what’s under me. So, from there we have building principals and departments. And I do guidance, and we have guidance directors that are not administrators, they’re teachers. They report directly to me. And I do, I do tech, I do data, [laughs], so technically the tech is the assistant superintendent for elementary and myself.

By having directors for all of the different academic areas, there was equity. The guidance directors were not administrators, they were teachers, but at least the science director and the other departmental directors were administrators.

Building grade-level configuration. That’s Why We Have Directors consisted of numerous K-5 elementary buildings, 2 grades 6-8 middle schools, and a number of grades 9-12 high schools.

The pair of eighth-grade teachers explained how elementary schools fed into the middle school and then all of the students in the middle school continued into the same high school.

[I]: And so, like for this middle school, are there multiple elementary schools that feed into it or just one elementary that feeds into this middle school?

Eighth-grade Teacher 1 [ET1]: There’s multiple.

Eighth-grade Teacher 2 [ET2]: Multiple. Umm hmm.

[ET1]: We have 2 middle schools, [name] and [name]. And then there are a number of elementary schools that feed into our building. I want to say that there are at least 2 elementary schools that feed into [name]. [Name] is a little smaller population compared to our building. And then there’s [number] high schools.

[I]: And so, do all of the kids from this middle school all go to the same high school?

[ET1]: Umm hmm.

[ET2]: Yes. Yeah.

Since all of the middle school students went into the same high school, it created a smaller feel, despite being such a large district.
Curriculum. From the interviews, 1 of the themes that emerged was the importance of aligning the eighth-grade curriculum taught to the mainstream students with the curriculum taught to the accelerated students to allow students to move from one class to another. This theme consistently came across in all of the interviews.

[I]: Do you know why the decision was made to switch to a discipline or domain-specific model?

[ST]: I was for the spiral. I like the variety. However, when someone spoke with me, an eighth-grade teacher said, “We do Earth science in eighth grade. So, if a child is in Earth science Regents and they drop out, now they’re in a class where it’s not matching.” It does not match at all because eighth grade was a spiral. They’re doing a little bit of life, you know, it builds up each year. The feeling was that that would work out better for someone that didn’t, that had to get bumped down from Earth science. I think that was the biggest rationale.

This theme was also identified by the pair of eighth-grade teachers. The teachers wrote the topics taught in grades 6, 7 and 8, noting the topics that were to be removed with a minus symbol (-), and the topics to be added with a plus symbol (+) in Figure 9.

![Diagram](image)

**Figure 9.** Topics taught in grades 6-8 at That's Why We Have Directors School District. Current topics shown in the left column and changes noted in the right column. Negative symbol (-) indicated topics removed and positive symbol (+) indicated topics added.

The teacher explained how the curriculum changes would start with the sixth grade.
When is it changing?

They’re going to start implementing some changes in sixth grade next year. So right now, sixth grade was heavy on the life sciences, DNA and things of that nature. It was more life science. Where the emphasis for seventh grade was more physical, and the emphasis in eighth, even though it was a little bit spiral, the emphasis was this is life, this was physical and this was Earth. So now it’s, they still want to keep us primarily Earth, because you’re going into Earth science. But some of this is going to change.

The teachers also explained that since the mainstream students study Earth science in the eighth grade, they were better prepared to take Regents-level Earth science in the ninth grade.

And when you say Earth, you’re talking about Earth science for the middle school students, not Regents-level?

This is Science 8. Not Regents-level. So, we do astronomy, we do plate tectonics, we do weathering and erosion, it’s like, you know, surface processes.

It’s geology-based topics. Astronomy and meteorology are like the 3 main components.

We do meteorology in eighth grade. We do it up here, but it’s above the level of them. Surface processes, that’s weathering and erosion. We do mapping, so it’s all, it’s baby Earth science is what it is.

It’s really a foundation for what they’re going to take next year which is Regents Earth science.

They take Regents Earth science as ninth graders?

Well, the students that are in Science 8 do. The kids that aren’t in honors. And they take, I don’t know if you’re familiar, yeah, you’re familiar, the ILS exam. So, we’re prepping them for the ILS exam, also trying to give them a foundation for next year, so they’re better prepared for when they are taking Earth science.

The teachers affectionately referred to the eighth-grade mainstream Earth science as ‘baby Earth science.’ In addition to preparing students for Regents-level Earth science for when they enter high school, they also need to prepare students for the Intermediate Level Science Exam (ILS) a state exam still based on the 1996 Science Learning Standards.

The science director reinforced the idea of allowing for movement between Science 8 and Regents-level Earth Science. He explained that he would not want to cram three years of science curricula into grades 6 and 7 for students taking accelerated Earth science in eighth grade. These students would essentially be learning the middle school-level and high school-level Earth science curricula in the same year.

And how does this, you know, offering this Earth science course in the eighth grade, how does this impact instruction in grades 6 and 7?

So, what we tried to do, for better or for worse, and again we are still wrestling with this a little bit, my concern was, at least initially, let’s say a student is in Honors Earth Science, in seventh grade they are going to miss, since the way we are doing it, they are not going to have a whole lot of Earth science before they are in the
Earth science course, they’re not going to get the middle school Earth science standards. That’s just the nature of the beast. We’re not going to fit all of our...We’re not doing a situation where we’re trying to get all the middle school performance expectations in grades 6 and 7. We’re just not going to do that. So, I guess just getting back to the point, my concern was a student that is struggling let’s say in the Honors Earth Science, we need, if they need to downshift into a Science 8 course it would be nice to be able to downshift into a course that is also going to be teaching Earth science material at a middle school-level. So, if we were just teaching, you know, biology, now a student would be, or life science, a student would be in an eighth grade Honors Earth science course and would now be dropping into a course that is completely different, you know maybe after 8 weeks. And that was a concern that we had. So, we wanted that to mesh with what we are doing in regards to what do we accelerate, and what’s our regular science eight course. We wanted that to be similar. There were a couple of other arguments for doing that as well. For example, our students in Science 8, they’ll have a year of Earth science in eighth grade, the following year they’ll be taking Earth science so that material will be fresh in their minds. Serve as a support. So, in essence, maybe they’ll have two years of Earth science and have more successful outcome on a state assessment in that regard. One of the concerns that I have is how are those students going to fare in an Honors Earth science course without those middle school Earth science standards. I don’t know. We’ve been doing it with the old standards for a while, but we will have to wait and see how that impacts it. We were not comfortable, like I said, trying to get all of the performance expectations from the new standards, middle school standards in to sixth and seventh grade. We haven’t really discussed here acceleration for all. It has not really come up and it is not something that I have been pushing.

The science director was not an advocate for universal acceleration, although less decision-making is required when all students are learning the same material in eighth grade. The new model was essentially providing 2 consecutive years of instruction in Earth science, in grades 8 and 9, to better prepare students for success on the Earth Science Regents Exam.

The assistant superintendent also reiterated the message that was conveyed by the teachers and the science director. By aligning the Science 8 curriculum with the accelerated Earth science allowed for an easier flux of students into or out of either class.

[I]: How is science taught at the middle school level specifically?
[AS]: So obviously, you know, certified teachers, secondary certified teachers, I believe all of them right now, I haven’t been in that world, and dug deep enough, but I believe they all have their general science certification as well...Once you get past the certification area so, we tend to, we, so the curriculum, the program we are using now, and I don’t want to say program, like we buy into a program, but the way it has been set-up traditionally has been a spiral. So, each year students will be doing a little bit of Earth, little bit of physical, a little bit of life. We have, over the last probably three years, we have veered away from, over by doing curriculum writing, using, we do a lot of discovery, we use a lot of online resources and getting away from our hard-textbook resources. We’ve actually not completely moved away from spiraling, but we are moving in that direction. Mainly because of Earth science and Science 8. And we tend to bulk a lot of Earth science in there so, because we have a
lot of movement. We, we recommend a lot of kids into Earth science. We do have for all of September, most of October, we have students that are moving. So, we try to, wherever possible, we mirror those two courses so we can facilitate moving up or down.

The assistant superintendent attributed the movement away from the spiraled curriculum to the accelerated Earth science and Grade 8 science course. This idea of the movement into or out of the accelerated class was also mentioned as part of the answer to another question.

[I]: And how does that impact instruction in grades 6 and 7?
[AS]: …It doesn’t. …Other than like I said before the last 3 or 4 years, we tried to push some of the Earth science material into eighth grade…not because kids weren’t capable in grades 6 and 7, but to better facilitate the flux, the movement of kids from one level to the other. So, you don’t want to have a situation where…there’s a kid that was not recommended for Earth science but wants to challenge the course, you know, enrolls in it, finds out in the second week of October that it’s not for them, and then they’re going to a class where they’re learning about, you know, life science. You know, so, we try really hard to avoid that…But we don’t segregate students in sixth grade or seventh grade based on what we think they’ll be doing in eighth grade. Literally at the end of seventh grade, at about this time…the process starts earlier, but this is kind of the final decision time for who would make recommendations. That’s done by a seventh-grade teacher.

By not having an honors seventh grade science course, students were not tracked for accelerated Earth science as early as sixth grade. Students had the opportunity to adjust to the middle school in sixth grade, and then after seventh grade it was determined who should be accelerated in eighth grade.

The consistent message was that since students were able to challenge themselves to take the most rigorous courses, there was going to be movement into and out of the accelerated Earth science course. By teaching similar topics and science content in Science 8 and Regents-level Earth science allowed the least amount of disruption to students that moved either up or down from one course to another.

The science director talked about the changes that were happening specifically at the middle school-level. He described how there were topics added to each of the grades, but a main focus science for each year.

[I]: So, you talked a little bit about the middle school piece. So, how, can you describe that scope and sequence specifically at the middle school.
[SD]: …So, our sixth grade is mostly going to be physical science, with a little bit, let me see, I’m trying to remember, we did recently make a change. It’s mostly physical science, oh yeah, with a touch of life science, more with the ecosystem relationships, food chains, food webs. We thought that was user friendly for sixth-grade teachers, teaching energy in sixth grade as part of physical science, and with energy flow we just thought that would be a nice fit. Our seventh-grade sequence is going to be mostly life science with a little bit of Earth science with human impact as kind of the capstone piece. And with the new standards that’s actually part of the Earth & space science that human impact piece. So, seventh grade will be mostly life science with a
little bit of the human impact at the end, and then in the eighth grade it’s going to be mostly Earth science with a little bit of physical. We’re going to hold off like waves and things like that. We’re going to keep that in eighth grade as part of the physical science component for eighth grade. And the other piece was, I want to say electricity and magnetism. We kind of want to hold that to eighth grade as well. So, it’s probably less integrated, more discipline-specific for sixth, seventh, and eighth grade, but there’s a couple of places where we made some decisions to make it a little more integrated.

In addition, certain topics that were not domain-specific would be added to each course because they appeared to be more age-appropriate. For instance, the science director described that since energy was a major topic taught during physical science, including the topics of food chains and food webs would allow students to see how energy flows. The sixth-grade teacher being interviewed was under the impression that food webs were being taken away, but this was actually a life science topic that would remain in the sixth-grade curriculum.

[I]: What is the plan for next year as far as implementation?
[ST]: I actually might have it right here. Sixth grade is changing. We are changing to physical science. This is the original version, but we’re changing and then next year it will be seventh. Okay, so 2018 we’re starting a new curriculum where I’m losing all my life science. Actually, that’s it. There are some changes here. I think we lost food webs and we picked up something else.

To the teacher’s delight, sixth-grade kept food webs to tie in with energy conversions. The changes being made allowed the teachers to make connections with age-appropriate concepts that students should be able to comprehend. However, the teacher was upset about losing the songs she had created, which revealed her elementary background.

[ST]: Cause, I know some people in the other school were upset, the sixth-grade teachers. The life science, we do a really good job at it. I mean I have my songs for life science. Like, I’m going to have to come up with new songs.

The more abstract physical science concepts of waves, and electricity & magnetism were to be taught in eighth-grade Earth and space science. The director felt that students would have an easier time grasping these topics in eighth grade than in sixth grade.

With these changes at the middle school, the director indicated that the curriculum was being changed from an integrated curriculum to a domain-specific curriculum with some integrated units. He referred to the table in Appendix K from NGSS as an important resource that was used to guide the decision-making. Figure 10 shows the course progression model.
Figure 10. Course Progression Model (NGSS Lead States, 2013).

Figure 10 showed how the primary focus for course 1 was physical science. Course 2 was primarily life science, and course 3 was primarily Earth & space science. Similar to what the science director described, certain elements from other science domains were infused where appropriate to support the topics that students were currently learning and to serve as a foundation for what they would be learning the following year.

Standards. The teachers in That’s Why We Have Directors were aware of NYSSLS. The director of science had communicated these standards through department meetings, workshops on Superintendent’s Conference Days and by attending professional development workshops with the staff. The district was slowly implementing some of the elements of NYSSLS by developing curriculum at the elementary schools. There were big curricula changes occurring at the middle school grades.

[I]:  Great. How, how are the New York State Science Learning Standards being implemented this year?

[SD]: Good question. Depending on the level, where we are, I would say at the secondary level collectively, I, we’re integrating elements of new standards into curriculum. I wouldn’t say that by any stretch of the imagination that we are, you know, implementing full-scale by any stretch. We are probably a little slower in implementing the new standards themselves. Our plan is for next year, implement fully in sixth grade, following year adding seventh grade to the mix, and the following year add eighth grade to the mix….at the middle school-level. At the high school-level, I think there’s some reluctance considering that the assessments haven’t really changed to completely shift. So, what we’ve been trying to do is…is to integrate elements. If we, you know, so, claim, evidence, reasoning [CER]
framework that’s a CER framework has been a big part of the high school. It doesn’t matter if you’re doing a lab that’s based on content, that students are going to get on a particular Regents, but we can implement CER. So, we’re trying to implement elements of the practices into our high school curriculum. At the elementary level we, we’ve done a lot. Kindergarten, we’ve developed we’re aligned to the new standards and partially in first grade as well. We’ll integrate. We’ll probably finish first grade over the summer. And then sporadically there are several other units in third, fourth, and fifth grade that have been adapted to reflect new standards. So, …. the goal is within the next few years at the elementary level to be really aligned, and then sequentially at the middle school over the next few years too, to be aligned for sixth, seventh, and eighth grade. We probably will be, you know (laughs) delayed most in the courses that end with Regents exams at this point.

The science director summarized the different changes that were taking place at each level. The high school was the slowest to make changes due to the fact that the end-of-the-year Regents exams were still based on the 1996 Math, Science and Technology Learning Standards. The plan was to roll-out the standards in the elementary and the middle school levels over several years.

The eighth-grade teachers reiterated that implementing the new standards was a slow and staggered process.

[I]: For this year specifically, how were, how were the standards implemented?
[ET1]: Well, do you want to go?
[ET2]: Well, I was just going to say, they haven’t rolled out yet for the eighth-grade Earth Science course that we teach. ...So, like what you said before, we’re just trying to be proactive, trying to understand what the new standards are going to be.
[ET1]: Right.
[ET2]: It’s more of an inquiry-based approach, so, we’ve tried to, you know, when you look at your lesson, not every single lesson or topic would, like it’s not appropriate to do an inquiry-based lesson for every little thing, so we kind of decided to pick and choose what topic we thought would be a good fit to try to do something more inquiry-based. And…you know, we just tried, ...different lessons really.
[ET1]: You know, one of the things with the standard is, are you familiar with it?
[I]: Yes.
[ET1]: Okay. So, one of the things I wanted to do, I said, okay, I was getting observed. And I’m like, let me force an NGSS lesson and see if I can do it this way. And one of the easy ways to think about it is, what is my phenomenon going to be, with this particular, with this particular lesson? That’s really important, and I really like that aspect.

The assistant superintendent described the process by which new standards were brought to his attention and then passed onto staff.

[I]: …How are the New York State Science Learning Standards being implemented?
[AS]: So, we have…my understanding is, again with the directors. Typically, that stuff,
any, whether it’s the new art standards, everything is kind of with them. They’re the people that are going out, getting the information and then it comes back to us. And then we either do it in kind of one-to-one meetings or group meetings. But my understanding is that we’re kind of in that, kind of phase one, where we’re, you know, the schools are trying to build capacity, get people aware of it, make sure teachers know that it’s coming, and actually have people looking at them, and reviewing them and seeing what we can pull into our existing courses. But one of the things I’m sure [science director] shared with you, so, we’re looking at different middle school science programs. I think the thing for us is the middle school is kind of where we can do the most work. Once you’re in high school, as you know, a lot of those courses and the curriculum documents are pretty much created for you and then you are taking a set of standards and operating from there. So, we tend to do less, … I’d say less professional development for high school teachers for a new set of standards, cause they are very much, kind of, content experts at this point. They have been doing it for years. We kind of, we talk about the standards, you know, have those conversations and dialogue, get them in groups, to actually collaborate themselves. But we don’t typically tell our teachers, so in response to Standard X, you know, students must be able to do this, this is the lesson we want to see. That almost always comes, kind of, from a group of teachers. And then we have shared folders, and things like that, where we populate it with new materials, and share it with anybody teaching that particular course.

The assistant superintendent validated the importance of having directors. They were an integral part of the process. He also explained how the middle school was “kind of where we can do the most work.” Because there were not Regents exams for the middle-level grades, teachers had more flexibility as to what they would teach. The middle-level grades were where the most decisions had to be made regarding curriculum.

The sixth-grade teacher explained the steps she had taken to align with NGSS. She was employing many of the pedagogical shifts required of NGSS.

[I]: And what would you do differently to make it aligned with this NGSS format?

[ST]: Definitely have a phenomenon. Today we were doing physics and they were playing with marbles, so they don’t know, literally they come in, and this is my spiel, “What path will the marble take?” We just started physics two days ago. So, I’m not exactly saying you’re learning this today. My goal was, what was the path, what things affect motion? Or something like that. So, it’s not just me giving out the information, fill-out a note sheet. I try not to do the cookie-cutter, fill-in the blank labs. Some kids don’t learn if it’s too open ended so I do struggle with that. I do a little bit. So, this is really open-ended and then they had to do three labs, well they had to do two out of three labs to reinforce the concept of inertia. So that’s kind of, I think, an NGSS format.

*That’s Why We Have Directors* had a plan for the implementation of NGSS that had started at the level of the teacher, instead of being a top-down approach. The teachers were aware of the standards and had started to infuse elements of NGSS into their lessons.
**Teacher certification.** The sixth-grade science teachers in That’s Why We Have Directors, all held elementary certification. None of them had secondary certification with a 5/6 science extension. The teacher certification impacted eligibility for curriculum writing. According to the assistant superintendent for secondary education only teachers that held certification in a specific course were allowed to participate in curriculum writing for a particular course.

[I]: How has teaching certification impacted how science curricula are to be implemented?

[AS]: So, the biggest issue we have now, is, so we have in our science department, the only people that can do curriculum writing, actual, the act of curriculum writing, are people that are certified to teach the course they are writing for.

Teacher certification also impacted the decision to create a domain-specific model. In the eighth grade, the teachers that taught Regents-level Earth science also taught 2 sections of Science 8. These Science 8 courses would eventually become middle school Earth & space science courses that would allow for easier movement between the two courses. This need for movement between the 2 courses was mentioned in all of the interviews at That’s Why We Have Directors.

[SD]: Our new scope and sequence has been really adapted to fit the needs of our teachers where they are in terms of their certification and their comfort level and it needs to make sense in terms of their flow.

The science director also explained how teacher certification played a large role in determining which topics were taught in specific grades.

[I]: And what about the decision to do, why do the life science in seventh grade and physical science in sixth, and not the other way around?

[SD]: Okay. …Two. I’m not saying they’re the most educationally sound reasons, but the rationale for that was most of our seventh -grade teachers are biology certified teachers, so it made sense to do life science, secondly…we’re mostly doing that now. So, in seventh grade we have most life science things taken place currently. So, it kind of just made sense. So, what we ended up doing was …sixth grade had genetics for years. We actually took the genetics out of sixth grade and put it in seventh grade. It just made more sense. So that was something our sixth-grade teachers loved to teach so, they were disappointed about that. Getting back to the two reasons, they were doing mostly life science in seventh grade to begin with, although it was an integrated piece, they were mostly doing life science.

By contrast, the sixth-grade teacher did not see teaching certification as being an issue.

[I]: The decision to go to a domain-specific curriculum, was that influenced by teacher certification? Did that fit into the puzzle at all?

[ST]: I don’t think so. Cause they all have general science so any of the teachers could teach any of the domains. Yeah, [science director] spoke to a few people and this is what they were doing or what they thought would work best.
The changes were made because of the certification areas of the teachers and because what was currently being done. It was easier to make changes that were not too different from what was currently being practiced.

The science director summed it up best by indicating that in terms of teacher certification areas, he was stuck with what he had.

[I]: And how did teacher certifications held by the middle school teachers how did that impact the decision to you know maybe go spiral versus a domain-specific approach?

[SD]: Yeah, so sixth grade, we have all elementary teachers teaching sixth grade. We don’t have any secondary with the extensions, so there are no 7 to 12 secondary science teachers with the 5/6 extension. Everything at sixth grade is an elementary piece, and there’s nothing we can do about that. So, from a certification standpoint that was no impact whatsoever because we have who we have.

Assessments. The general sentiment towards assessment was the importance of students performing well on state-wide assessments. The science director was concerned about how well the assessments would actually assess the performance expectations from NYSSLS. Getting students to do well on the Earth Science Regents exam in ninth grade by essentially having two years of Earth & space science instruction was viewed as another benefit of moving this domain-specific model to eighth grade.

[SD]: So, in essence maybe they’ll have 2 years of Earth science and have more successful outcome on a state assessment in that regard.

The rationale for offering a Regents-level Earth science course in eighth grade was so students could take many of the AP offerings that the district had to offer.

[I]: And what’s the rationale for accelerating students into a Regents-level course in the eighth grade?

[AS]: Less now than there was. But the rationale for us is, we have 23 AP courses, soon to be 24 AP courses. We offer every AP science course that exists. And we have every computer science, every AP Computer Science course that exists. So, we want kids to have the opportunity. One, we have seen historically that they can do the work. We know there is a significant part of the population that has no issue doing the work. Our kids that are in Earth science in eighth grade, they do well, they get credit for it. They get great grades. It’s a non-issue. Our passing and mastery rates in eighth grade are through the roof. So, we’ve seen that they can do it. It allows them to take an additional course, whatever it might be when they are in high school.

The eight-grade science teachers were concerned about the time it took to teach lessons aligned with NGSS and were upset that certain misconceptions students had would have to be un-learned.

[I]: So, with all this, these shifts that you are making, how are you going to assess if this
program is working?

Eighth-grade Teacher 1 [ET1]: Isn’t that what I just said?

Eighth-grade Teacher 2 [ET2]: Yeah. That’s the big question.

[ET1]: That is my issue with this. I don’t know how you do that because based on student feedback, I would say it’s not working. Do you know what I mean? Cause I don’t get this kind of blow back when I do it the standard way. I don’t have my top kids melting down saying, “[Teacher] please don’t ever do that to me again.” I literally had a kid say, “You’re making me potentially come up with the wrong answer.” They said it to me. That, if I make it up, I believe it and now I’m going to have to unlearn it, when you could have prevented me from doing that? I literally had one of my top students say that to me and you can’t, I can’t argue with that. The one thing I wanted to do, is she did a mapping lesson this year, NGSS-style and I did it standard style. And I had wanted, I wanted us to be like, well let’s give a quiz and see how the grades would come out, but again, it’s like, you can’t judge on that either, you know? It’s like different students, different. I don’t know how you assess this. You know, because either way, the kids are going to come up with what you want them to know. You know what I mean, cause even when I did the seasons the way I did it, I had to stop and show them and have them go back and re-work their models and so on…So, I think ultimately, you’re getting to the same place, it’s just this one takes a lot longer, and the kids didn’t seem to like it as much. I’m just being honest.

[ET2]: One of the negatives is the amount of time it takes, and kids walking away with misconceptions. Those are 2 of the big things.

It seemed that the top students were the most resistant to the teaching approach required by NGSS. Students that had been successful with traditional teaching did not like the change in teaching pedagogy required by NGSS. Since the state assessments had not changed yet, the teachers did not seem to see the point of changing their teaching-style to something that took a lot longer to teach and their top students did not enjoy.

Professional development. All 5 interviewees stressed the importance of professional development. Professional development was coordinated through the science director primarily through department meetings, workshops he led on Superintendent’s Conference Days, and participation in out-of-district workshops through BOCES or professional organizations.

When asked about the coordination of professional development of the staff the assistant superintendent for secondary education summed up the sentiment for having district-wide directors.

[I]: And how is professional development on the new science standards coordinated for the teachers?

[AS]: [Science Director], he, when you have a director where his sole purpose is science and technology, he, and not like instructional technology, like technology, like shop-type technology, and he does our makerspaces as well, it’s his sole focus. So, we pay him specifically to be the person that looks at program, comes up with the decisions, recommendations, looks at how things are actually being implemented, …and makes those changes from year to year. It would be rare for me to make a recommendation without a recommendation from the directors to do something…I,
I can’t even think of an example off the top of my head. But, yeah, that’s what we have them for.

The assistant superintendent explained that the directors had not only the autonomy, but the expectation to make curricular decisions. That was why they had directors. The existence of the NGSS sub-committee served to educate the greater teacher community through the development of model lessons. The sixth-grade teacher described how their colleagues walked them through a model lesson:

[ST]: At the last faculty meeting the eighth-grade teachers did a sample lesson. It was phenomenon based. She showed them two pictures and the students had to guess which one was the season. And one looked like snow, so you would say winter, and one looked like summer, and so the kids had to do the whole, it was an Earth science Regents class.

Collaboration. The importance of teacher collaboration was discussed at length. The NGSS sub-committee was viewed as an effective way to discuss ideas and also to communicate the standards and their associated pedagogical shifts with the staff members that were not part of the sub-committee. According to the director of science, the subcommittee had been invaluable:

[SD]: It’s been a nice sounding board to bring up ideas to a small group before bringing it to the department at large. It’s also fostered some really good conversations for us to think about. And then collectively develop lessons and materials that I think align nicely with the new standards. And then you build that buy-in with that group, and that group is now doing that in the classroom. And that teacher that was maybe resistant who was two halls down now sees some cool stuff going on, now they hop on board. So, the committee has actually grown in size from last year to this year. We plan on doing that again next year.

The teachers were instrumental in getting real exemplars from their classroom. This practice allowed teachers to learn from their colleagues, instead of having the information presented to them from a top-down approach.

The science director had created an environment where the teachers were able to learn from one another. Since high school physics teachers were content-experts, the director was utilizing this resource to have them teach physics concepts to the sixth-grade teachers.

[I]: Okay. And then, I’ve mapped out what you said, how in sixth grade you’re doing physical science, life science in seventh and then eighth grade regular Earth or the Regents-level Earth. I was just curious. The teaching certification of the sixth-grade teachers being elementary certified, do you have any concern about them being able to teach the physical science?

[SD]: Yeah. Yes. And they’ve expressed some of those concerns. In particular when it comes to things like forces and motion, and energy, we do a little forces and motion currently in sixth grade, but not to as much depth as the new standards are calling for. And energy is a pretty abstract concept. So, some of the things that we’re
putting in place is, I’m actually organizing this currently as we speak, is I’m having some physics teachers conduct a couple of workshops at the end of the year so we’re going to have high school physics teachers work with our sixth-grade teachers to teach concepts specific to energy, specific to forces and motion. So, to make them feel a little more comfortable with, with the content. That was one of the initial concerns that we did have. Which is why we tried to keep it, for the most part, user friendly. We removed the electricity and magnetism part. We’re going to put that in eighth grade…Some of the performance expectations that are more sophisticated, that relates to energy and things related to waves and electromagnetic radiation, we’ve moved into eighth grade as well. So, we were pretty selective as to what concepts would be most appropriate for sixth-grade students, but also for our sixth-grade elementary teachers. So, we were really thoughtful about that. At the same time we wanted to make it a little user friendly so, we thought since energy is a big concept, to bring ecosystems into sixth grade and to be an illustration of transfer of energy. We thought that would be a nice capstone to, to end the year. Sixth grade is going to be mostly physical science, but not all physical science, with some of it, you know, held off until eighth grade. And then we have a nice, very user friendly sixth grade ecosystem, transfer of energy scenario there. So, that was kind of our thought process. Absolutely a pretty big concern with our sixth-grade teachers when we were going through this.

The science director attributed teacher buy-in to teachers learning from one another instead of using a top down approach.

[I]: Great. What are the biggest challenges with implementing NYSSLS?
[SD]: So that’s why I thought the sub-committee was good. I’ve had sub-committee members share out the work that they have done in their classroom. Instead of me basically telling them what they should be doing and me sharing out exemplars, the teachers themselves have been sharing out their exemplars. I think that’s kind of how you build buy-in over time.

The sixth-grade teacher indicated that she had been on the committee. Everyone spoke highly about the committee and how it was used to bring about change in the department. The pair of eighth-grade teachers expressed happiness that they felt that their voices were heard and that their opinions were valued by the science director.

[I]: Is this due to the committee work that this was decided?
[ET1]: This is predominately, I think, our science director, ultimately. And there was some summer work where they were talking about this.
[ET2]: Summer work. We had that committee for two years, and [science director] is really good too in involving us in conversations and discussions. One thing that I love is that he values our opinions. And he’ll, he’ll ask and take into consideration what feedback we, we give him. I think that came from the committee. He also spends a lot of time during our department meetings talking about all of this. And that has been going on for years.
Teacher buy-in was achieved by having ideas generated from teachers and teachers learning from one another. This approach was successful because it was not a top-down approach.

**Parental/community influence.** There were different impressions of the influence of the parents expressed by the 5 people interviewed. The sixth-grade teacher specifically described the district as a place where the parents get what they wanted. After saying this, she asked for reassurance that the identity of the district be protected. She specifically changed her wording from “parental input” to “parental demand.”

[I]: So, is it based on teacher recommendation?
[ST]: Teacher recommendation.
[I]: That they would normally get in?
[ST]: Yes. It’s definitely teacher recommendation. And they don’t recommend… they have to have over a 90 average, it might actually be a 93 now, I don’t know. But in this district, all you have to do is say; “I want my child in Earth science.”
[I]: I see.
[ST]: And it happens. I don’t know if I’m allowed to say that. You won’t mention [school district]?
[I]: No, not at all.
[ST]: Our parental, parental input is definitely considered.
[I]: Great.
[ST]: Demand. I should say demand.

The science director explained how there was an override sign-off sheet that parents needed to complete for their child to take a course for which they were not recommended. The director indicated that he approved virtually all of the override forms. He said, “Pretty much I almost always sign the form.”

[I]: And is there a policy for students who if they wanted to get in if they didn’t meet the teacher recommendation?
[SD]: Yes, so we have an override procedure so basically what happens if a student isn’t necessarily recommended for a course, … they can, they can engage in the override process. They get a form from the guidance counselor, … it’s signed off by the parent, there are specific stipulations indicated what they fully understand… It typically reaches my desk… If it’s close, I just typically sign the form. If there’s something that I have specifically a concern with in terms of the performance of the currently seen that would indicate significant struggles in the course that they are being recommended for that they want, I give them a call. We have a conversation. Pretty much I almost always sign the form. But, it’s more of a just letting families know, you know, the situation that you signed up for a course that you weren’t recommended for. It’s going to be more challenging, more rigorous, need to keep on top of your child, make sure the kid is going to extra help. You know, just some of those sort of things. Most of the times I sign it for them. So, we do have an override process.
The assistant superintendent for secondary education explained how the process was not “open-enrollment” due to the fact that teachers made recommendations. Yet, students were able to try the most rigorous courses they wanted.

[I]: So, students are recommended for the Earth science course?
[AS]: So, we do, yep, so we have modified open enrollment. It’s definitely not open enrollment where...we don’t recommend, and kids just choose. We have, at the high school we have several courses that are like that. But we don’t do that for Earth science at the middle school...What we do is have a recommendation process. I think we’re at 90 or better, he would know, it might be 93. I don’t know if we moved up in science or not. There’s a minimum grade requirement. Students that are above it get recommended. If there are students below it but teacher feels like they’re below, but whatever, they’re capable, they can recommend them as well. Those students get put on the request list automatically, unless a parent contacts us and lets us know they don’t want to be in it. And then we do allow for kids that were not recommended to...to go in, we have a kind of override process where it’s basically just acknowledging that you weren’t recommended for it, that historically students that weren’t recommended for courses, you know, that they have a lower success rate, it’s not impossible. If you’d like to do it, sign here, parents sign off on it, and we put kids in. So, we operate at about, we have 2 middle schools, we’re somewhere between 50 and 60% at the middle schools for kids that are going into Earth science in eighth grade. But again, we don’t do anything different in seventh grade for those kids. Everybody gets the same science instruction in sixth and seventh and then we recommend for eighth.

However, according to the sixth-grade teacher, it was very easy for parents to get what they wanted. According to the teacher, all a parent had to do was ask.

[I]: How are students selected for that course?
[ST]: I believe they have to have a 90 or 93 average. But off the record a parent just has to say, “I want my kid in Earth Science” and they’re in. And he does keep track of that, how these kids actually do. Some of them are okay. Some of them have to hire tutors.

When the pair of eighth-grade teachers were asked the same question, they gave a similar response.

[I]: Now for the eighth-grade, this Regents-level course, how are students selected for that course?
[ET1]: Okay. I’m going to let you answer that one. [laughs]
[ET2]: It’s based on grade. It should be based on grades.
[ET1]: Teacher recommendation and grades.
[ET2]: I think it’s supposed to be 90%. A 90% average in seventh grade and their teacher gives them that recommendation. Those students will go on into the honors course. However, there’s students who have averages below that, that do get into the course. Anyway.
[ET1]: So, basically if you want to get into the course, you can.
[ET2]: You can take, if you’re not recommended, you or your parents want to try it and
challenge yourself and do it, you can, you can join in.

Clearly, the parents had a lot of power in the district. Ultimately, the parents got what they wanted.

Summary. Although the That’s Why We Have Directors was a large district, students stayed together from elementary school, through middle school and high school. Having a director, K-12, added to that consistency and allowed there to be a single vision for science education district-wide.

Having accelerated Earth science in eighth grade helped in making the decision to offer ‘baby’ Earth science in Science 8 so students could easily move up or down since similar topics were being taught. The other advantage of teaching Earth science in Science 8 was to prepare the non-accelerated students for Regents-level Earth science in ninth grade.

Students were able to self-select into courses and the director did not recall not signing-off on one of these requests. If the parents wanted their child in accelerated science, they tended to get what they wanted.

The teachers were an integral part of the decision-making process. The use of the NGSS subcommittee served as a sounding board for teachers to give their opinions and helped with teacher buy-in for teachers that did not serve on the committee.

4.3 Case Study of Wait and See School District

Wait and See School District was a medium-sized, high-need school district based on its needs to resources capacity (NYSED, 2012). There were approximately 3,000 students enrolled in grades K-12. Twenty-two percent of the students were ELLs and 80% of the students were economically disadvantaged (NYSED, 2018). Seventy-seven percent of the students were on free and reduced lunch (NYSED, 2016) The district followed the Princeton Model where all students in the same grade attended the same building. There was (were) a pre-K and kindergarten building(s), grades 1- 3 building(s), grades 4- 6 building(s), a 7-9 junior high school and grades 10-12 high school(s).

The science chairs were part of the teachers’ bargaining unit. They were responsible for teaching 3 classes. There was a science chair at the middle school and at the high school(s).

The district universally accelerated all eighth grades into living environment and algebra. Forty-six percent of students in the junior high school passed the Living Environment Regents Exam and 49% of students passed the Algebra Regents Exam (New York State Report Card, 2018).

Interviews were conducted with a seventh-grade science teacher, the junior high school science chairperson, and the assistant superintendent for curriculum and instruction.

The role of the science chairperson. The seventh-grade science teacher explained that the science chair did not formally observe her because the science chair was part of the same bargaining unit, the teachers’ bargaining unit. The science chair observed her classes and offered feedback, but she did not receive written evaluations from her.

Interviewer [I]: And the science chairperson, does that person observe you?
Teacher [T]: Informally, she can stop in at any time.
[I]: But not formal observations?
[T]: No formal.
[I]: Okay.
[T]: But she really doesn’t stop in much.

This practice of not being able to write formal evaluations of the teaching staff was confirmed by the science chairperson.

[I]: Which teachers do you formally observe?
Science Chair [SC]: Before here?
[I]: No, here.
[SC]: The same teachers. Well observe or evaluate?
[I]: So, what do you see as the difference between observe and evaluate?
[SC]: Cause right now I’m just observing teachers, giving them feedback if they would like it, on their pedagogy, on what went wrong. I’m observing the new teacher.
[I]: Okay.
[SC]: New science teacher. You know, helping her out as we go along. Evaluating is, is like Danielson, APPR.
[I]: Oh, okay. So, you don’t do the Danielson?
[SC]: No.
[I]: I see.
[SC]: Not now. No.
[I]: And is that because you are in the same building as the teachers, why is that, that you aren’t able to evaluate?
[SC]: Because we’re still here considered, I’m in the teachers’ union.

The assistant superintendent for curriculum and instruction mentioned how the science chairs supervised their science teachers. She also explained how they taught three classes and were in the teachers bargaining unit.

[I]: Who supervises science instruction at the different grade levels?
Assistant Superintendent [AS]: So, the principals at the elementary buildings, technically supervise. Then there’s a science chair at the middle school that teaches three classes in the teachers’ bargaining unit. And at the high school as well there’s a science chair, who’s also in the teachers bargaining unit and teaches three classes.
[I]: I see. …So, these are building-level science positions then? Correct?
[AS]: In the two buildings.
[I]: In the junior high school/middle school and the high school?
[AS]: Right. Right.

The science chairperson confirmed how she was split between administration and teaching, with a total of 3 classes that she taught.

[I]: And then, …, how much of your…, of your position is teaching?
[SC]: I teach three classes...A STEAM class, …Earth science class, and then the
Essentials, one period of Essentials every day.

[I]: So, are you like a 0.5? What, how much are you?

[SC]: A 6 and a 0.4.

[I]: 0.6 is teaching and 0.4 is administrative?

[SC]: No 0.4 is teaching, and 6 is administrative.

[I]: Okay. Because the Essentials is every other day?

[SC]: No Essentials is, Essentials is one period, every day. STEAM is every other day. And then Earth science is one, one day, two the next. One, one day, two the next.

A majority of the responsibilities of the chair involved teaching the 3 classes. Not being able to formally evaluate the teachers meant that the teachers in the junior high school were formally observed by administrators that did not have a science background.

Hierarchical organization. The assistant superintendent explained how there were academic chairs at the junior school and the high school, however there were directors for athletics, physical education and health, English as a new language, and fine arts. She drew the Table of Organization for the district, which is shown in Figure 11. Because chairs were part of the teachers’ union, they were not included in the organizational table.

Figure 11. Table for organization for Wait and See School District.

[I]: And then can you just draw who you supervise directly?

[AS]: So, it’s the principals, its [School],[School], [School] Middle school and High school and the directors. So, there’s 3 directors. It’s ENL [English as a New Language], athletic director, and PE [physical education] and health, and fine arts.

[I]: Now the directors, are they in the administrative unit or are they in the teachers’ unit
as well?

[AS]: Admin.
[I]: Admin, okay.
[AS]: They’re in admin as well.
[I]: And you directly supervise the directors as well?
[AS]: Hmm. Yeah, there’s no other administrator, oh yeah, there’s one. We have an administrator, that’s his title, Administrator for PPS [Pupil Personnel Services. And he supervises his assistant. And they answer directly to the superintendent. Here.

The science teacher explained that since there needed to be an outside observer, one that is not within the same building, she has been observed by the director of fine arts.

[I]: Great. Who formally observes you?
[T]: The principal will formally observe me, any of the assistant principals will formally observe you. I’ve also been observed by another administrator in the district, who happened to be the administrator of… I think fine arts. She came in because they have, they had to have people other than the principal and the assistant principal in that school so, they took administrators from the, outside the immediate school.

[I]: Great. Do any of these people have a science background at all?
[T]: I wish. Last year, the assistant principal had a science background. This year none of them have science backgrounds.

The idea that no one with a science background was doing the formal evaluations of the science teachers was an issue if they were not aware of NYSSLS.

The fact that there were directors for some areas such as ENL (English as a New Language), but science chairs for the academic disciplines created an inequity. The directors were part of the administrative unit, but the chairs were part of the teacher union.

**Building grade-level configuration.** The teacher described how the junior high school went to a grade 7-9 configuration because the high school was too crowded.

[T]: This school is only sixth, …seventh through ninth.
[I]: 7-9… And do you know why they configured it that way, in having 7 to 9 junior high school?
[T]: The high school was too crowded. I started out at the high school. It was ninth through twelfth, and there were just too many kids, so they had to move them down here which is a big school since it’s three stories. So, they moved them down here, but they had to move the sixth graders back down.

The science chairperson confirmed that the school was configured this way because the high school was overcrowded. Construction was being done to make the high school larger, and when completed the ninth graders would return to the high school and the sixth-grade students would return to the middle school.

[I]: What is the building grade-level configuration of the district?
[SC]: Right now, the grade level, is seventh, eighth and ninth grade. Eventually, in about two years when construction is finished, the sixth grade will come up to the middle
school to be sixth, seventh and eighth, and the ninth graders will go to the high school.

Since the junior high school had formally been a middle school, the terms were used interchangeably during the interviews although it currently had a 7-9 configuration.

The science chairperson also explained how it was challenging teaching the middle-level curriculum in grades 6 and 7 since the 2 grades were in different buildings.

[I]: So, being that the middle school standards are now 6-8, with NGSS, not having the sixth-grade teachers in this building, do you see that as something that makes it more challenging?

[SC]: A whole lot. I mean it’s, it’s worlds apart. So, if we had the sixth grades and seventh graders in this building, you know it lends to some of the psychology of the kids because they, the sixth graders think that they are still elementary school students. When I speak to the seventh-grade students here, “Guys you are second – grade middle school students and they’re like, “What, we just came here.” It makes a big difference on that part.

It also seemed to be challenging to the students since they were still in an “elementary school” mindset since the sixth grade was housed in an elementary school. They were transitioning in seventh grade to a new building instead of in sixth grade like their middle school counterparts.

The assistant superintendent discussed how the new configuration with a grade 6-8 middle school and 9-12 high school would make the most sense.

[I]: Great…Then I had done some other interviews and there was talk about possibly re-configuring the grades. Is that something that’s being discussed?

[AS]: There was a bond passed about two years ago and they’re breaking ground now, and the ninth grade in two years will be moving to the high school. The sixth grade will be moving to the middle school. And the kindergarten, pre-K building will become a complete pre-K building. Right now, it’s a half-day pre-K. We’re going to go to full-day pre-K. Yeah, that’s the plan.

[I]: And what’s the rationale for changing the building configuration?

[AS]: We ran out of space. And we really feel that the ninth grade belongs in the high school. That’s where they’re earning credits. And they really belong in the high school as freshmen.

Everyone was in agreement that it would be better to have the sixth graders in the junior high school building to make it into a middle school once again. Placing the ninth-grade students back in the high school would happen once the construction at the high school building was completed. The assistant superintendent explained how a new science wing was being constructed at the high school.

Curriculum. The curriculum in the middle-level grades was recently re-aligned to better prepare students for living environment in the eighth grade. According to the teacher, prior to the move to universal acceleration the curriculum has been domain-specific, with physical science taught in seventh grade and life science taught in eighth grade. Now with all eighth-
grade students taking Regents-level living environment, the seventh-grade course had become an integrated science course.

[I]: What topics do you teach in seventh grade science?
[T]: Okay, seventh, it used to be, seventh grade would be life science, I’m sorry seventh grade would be physical science. Eighth grade would be life science. That was when we used to do the eighth grade New York State test. And then ninth grade would be living environment. And then when they accelerated the living environment to the eighth grade, they had us do…seventh grade do half year physical science and then once the second half of the year hits, we jump into the cell. So as a seventh grade teacher, I’m still teaching matter, …some geology, astronomy, things like that, maybe physics, some Newton’s stuff, but it depends on how much time we have. And then I jump into the cell and we go the cell and we do like mitosis, …evolution, all stuff in living environment they want us to touch on. So that’s the second half of the year.

As a middle-level grades teacher, the teacher had the flexibility to do certain topics based upon time constraints. There was not a Regents exam to worry about and since there was universal acceleration, she did not need to worry about the ILS exam either since no one took that exam.

In Figure 12, the teacher wrote the topics taught in grades 7 and 8. She was not aware of what was taught in grade 6, so she intentionally left it blank.
<table>
<thead>
<tr>
<th>Grade 6</th>
<th></th>
</tr>
</thead>
</table>

| Grade 7 | Lab Safety
Scientific Methods/Science Words
Lab Equipment
Atomic, Matter, Periodic Table
Geology, Astronomy, Physics,
Cell, Mitosis, Meiosis, Photosynthesis,
Cellular Respiration, Genetics
Evolution |
|---|---|

<table>
<thead>
<tr>
<th>Grade 8</th>
<th>Living Environment</th>
</tr>
</thead>
</table>

Figure 12. Topics taught in grades 6-8 at Wait and See School District. The topics taught in grade 6 were unknown.

The teacher did not feel comfortable writing anything specifically for sixth grade, but she assumed that they learned geology since they seemed to know a lot about that topic.

[I]: Do you know what topics they do in sixth grade?
[T]: I know that they do geology in sixth grade because they come in here knowing a lot about the rocks...I’m not sure what else they do really in sixth grade...Some astronomy possibly, but I’m not sure. I could not give you the sixth grade information.

In essence, the second half of the year of seventh grade was used to prepare students for the Regents-level living environment course they would be taking the following year.

[I]: Okay. And do you know what the rationale would be for doing a half-year of those life science topics if they’re going to be taking Living Environment in eighth grade?
[T]: The rationale is because they don’t want them coming into eighth grade living environment not even knowing what a cell is. So, that is why we have to introduce this stuff. It gives them, again, a jumpstart, which is what eighth grade used to do. But now they broke it up. So, since they don’t have eighth grade, if we taught all physical science in seventh grade, then they wouldn’t, they would go into eighth grade, like the first year that they did the acceleration, those kids went in not even knowing what a cell is. So, that was a big disadvantage.

The science chairperson also was unaware of the topics that were taught in the sixth grade because she did not supervise those teachers because they taught in a different building. Similar to what the teacher had said, she assumed that they taught about rocks and minerals because students seemed familiar with those topics.

[I]: Do you know what they teach in sixth-grade science?
[SC]: No….We are assuming that they teach rocks and minerals because they come up here knowing a lot about rocks and minerals. They don’t know anything about density, but that’s a difficult subject to teach and for it to stick. It would take a special person for them to memorize or remember a lot of what about density…and there’s really little. Someone just walked in here that can talk more about it. She’s actually teaching the seventh graders and she actually, she said that they know nothing. They know nothing. So, when we went to the meeting, they talked a good talk and I was encouraging them to speak to us regarding what they were teaching, you know does it mirror what we’re doing up here with the seventh graders to meet eighth and ninth grade needs. But, as I said, you know, that’s …

The science chairperson referred to a curriculum committee meeting that had taken place the previous year in which an attempt was made for there to be articulation between sixth and seventh grade science since they were in different buildings. She talked about removing topics from the seventh grade that would be taught in eighth and ninth grade, and instead focusing on foundational concepts with which students struggled, such as density. She intended to broach this subject with the curriculum committee, if it were to meet.

[I]: Okay so I was asking about … at the middle school level, whether an integrated approach was going to be used, where it’s a little bit of each science each year, or a domain, domain-specific approach, where it would be a specific science for each year, in the grades, you know, the middle-school level grades?
[SC]: So, you know, there was talk about what the approach is going to be. They were thinking that the sixth and seventh grade curriculum should follow what would be the eighth-grade state test curriculum. So, the curriculum should be finished between sixth and seventh grade we’re going to split the curriculum, take out some of the topics that are going to be stressed in Living Environment in eighth grade, or stressed in …Earth science in the ninth grade, go basic on rocks and minerals, or basic on reproduction or genetics and teach the other topics that they need to know, …like density. I keep coming back to density because that’s a big problem. And so that was talk when we were planning out the curriculum. But it hasn’t, again, that curriculum committee has not been set-up for this year. So, keeping it to the back of my mind cause that’s going to be the first thing that comes up when the
committee does meet.

However, from the interview with the assistant superintendent, she seemed to believe that this change had already taken place because she did not realize that seventh-grade was teaching half a year of life science topics.

[I]: So, you said how eighth grade, they do living environment. Having everyone go into living environment in eighth grade, how does that impact science instruction in grades 6 and 7?

[AS]: It didn’t really impact sixth grade very much. Seventh grade revamped their curriculum and they moved some of the physical science into seventh grade and took out almost all of the life science. And that obviously went to eighth grade because they’re doing living environment.

The assistant superintendent was under the impression that almost all of the life science was removed from the seventh-grade curriculum, but according to the teacher, the second-half of the year was all life science to prepare students for living environment the following year.

However, the one thing that was confirmed by both the teacher and the science chairperson was that they really did not know what the sixth-grade curriculum entailed.

**Standards.** In the interview with the teacher, she revealed that she did not receive a lot of professional development on the new standards, nor was it clear how and when the new standards would be rolled-out for the middle-level grades. Since the students did not take the ILS exam, it was more of a concern for the Regents-level science teachers in grades 8 and 9, than it was for the seventh-grade teachers. Her answers reinforced the wait and see approach.

[I]: How are the New York State Science Learning Standards being implemented this year?

[T]: …They want when we make up our exams, they want the science standards put down. As far as the NGSS standards, they don’t say they have to be NGSS, so we’re not really implementing them formally, it’s just informally. Some of us use lessons from NGSS, …but some don’t. It’s not really formally, we’re not formally immersed in it right now.

[I]: …Do you know if there’s a plan for next year as far as

[T]: I believe [science chairperson] wants to, I believe [science chairperson] wants to be more into the NGSS next year because I think in a couple of years, two or three years, our Regents exams are going to be NGSS. So, we’re going to start to gear that way. So, she’s going to start moving us in that direction, probably by next year.

The science chairperson further described the teachers’ resistance to moving to the new standards. She described how it was very hard to get people to change.

[I]: How are the New York State Science Learning Standards being implemented this year?

[SC]: Very slowly, so the teachers are kind of stuck with the old scope and sequence. We’re teaching the seventh graders for half the year living environment and half the
year for Earth science or physical science. Then in eighth grade they’re accelerated living environment and in ninth grade they’re accelerated for Earth science. So, the Earth science teachers and living environment teachers are very tied to the old scope and sequence and the old curriculum and what they had to do. So, this year we had the opportunity to write curriculum. It has been a daunting task to make that switch. They’re willing, but everything that comes back from them, is “So, well, this is what we taught.” So, it’s hard for them to make that switch in their mind, so I, we decided we were going to do the first unit for every, for Earth science and living environment, the first unit to fruition, in its totality. To teach it to the way NGSS would like it to be taught, and then come back to the table and discuss what went wrong, what didn’t go wrong, what worked for us, or just it’s not working, you know, because we’re so stuck. So, I did identify the fact that we are stuck in that hole, the old routine. So, we have to make that, it’s hard to make that switch in their mind, until they actually do it and start using the standards…from NGSS and then switch over to the curriculum.

All of the changes that the science chairperson described were for the Regents-level living environment and Earth science courses taught in grades eight and nine respectively. Once again, the middle-level grades were not even on the radar. Seventh grade was the only grade under her supervision devoted to the middle-level grade band of standards, yet the focus was on the Regents-level course because students did not take the ILS exam.

The assistant superintendent confirmed that science has been on the backburner for quite a while, where most of the time had been focused on math and English language arts. She reiterated the wait and see approach.

[I]: And the plan is to keep it with the same approach moving forward with the new standards?
[AS]: We’re going to wait and see what happens. Yeah, I, I don’t know.
[I]: And what is the approach to teaching science, within say [school district] schools? Like are there any, any, I guess, anything aligned with the new New York State Standards that are being infused into the classes yet?
[AS]: We’re looking to do that for living environment, somewhat., but not really. No, the general, run of the mill classroom teacher that isn’t on the science committee is still doing whatever science they’ve had in place. Hasn’t been a focus here for a long time. So, it’s whatever’s in place.
[I]: Okay.
[AS]: We’ve spent a lot more time in ELA [English Language Arts] and math recently.
And we’ve now turned our focus on science and social studies. We’ve done, we now have kind of turned to science and we’re looking to see what we’re going to be doing.

Science had been neglected. Although the focus was going to be moving to science, the focus was going to be on the Regents-level courses first since students did not take the ILS exam. It was as it the middle-level science program did not exist.

**Teacher certification.** Since all of the teachers in the junior high school had 7-12 certification, the topic of teacher certification was not a major theme for this district. It was
mentioned more when discussing the sixth-grade teachers. The teacher indicated that more of the teachers at the junior high school had biology certification than Earth science certification.

[I]: What about teaching certifications held by the teaching staff here? Did that maybe impact why living environment was chosen as the eighth-grade course?
[T]: It could have. It may have been. To tell you the truth, I don’t think so because they usually don’t think of the teachers around here. You know, I don’t think that’s the reason, but it’s possible. I’m thinking because eighth grade was life science, they figured the most logical thing might be to go into living environment. But I don’t think that the teaching certifications had to do with it, but it’s possible because not a lot of people have Earth science certification.
[I]: What is your certification?
[T]: Mine is living environment.

The science chairperson described how teacher certification impacted curricular decisions at the junior high school. Having more teaching staff with biology certification helped to make living environment the accelerated course for eighth grade students.

[I]: …What about teaching certifications held by the middle school teachers, did that impact …kind of like which courses would be taught in which grade levels?
[SC]: Definitely. So, a lot of Earth science, there weren’t a lot of certified teachers in this building for Earth science, but … but the ninth graders were moved down here and it was dubbed that the ninth graders would do Earth science. A lot of teachers didn’t have certification for Earth science so, but what was kept here was the eighth-grade living environment. So, a lot of teachers have living environment certification, so I guess that was probably a reason. Maybe that apple came before, the chicken came before the egg, or the egg came before the chicken. I don’t know which way it was. But …the certification did lead to somewhat, somewhat of a switch in that curriculum.

However, when the assistant superintendent was asked about the impact of teacher certification on curricular decisions, she gave the opposite response.

[I]: Gotcha… Did teacher certification impact the decision about how curricula were to be… implemented at the middle school level?
[AS]: No.

She mentioned how the science teachers were science experts while the sixth-grade teachers were not.

[I]: And then seventh grade and eighth, the seventh-grade program, there hasn’t been a decision yet as far as what program may get to be adopted or something like that?
[AS]: They’re regular science teachers in a lab. So, I don’t think we would adopt a program. It would be more like writing a curriculum and then as we purchase supplies and materials to fit the curriculum. Not necessarily a program. I can’t see buying kits for seventh and eighth grade. I mean I’ve never done that for seventh
and eighth grade. The elementary, yeah, because they’re not science experts.

[I]: Right.
[AS]: So, try to get them stuff that’s all packaged and ready to go.

She recognized that elementary teachers did not typically have a strong science background and were more likely to teach science if the teaching materials were readily available for them.

Assessments. Since there was universal acceleration, the district did not have any of the eighth-grade students take the ILS exam. Instead all eighth-grade students took the Living Environment Regents Exam.

The teacher explained how students took the Living Environment Regents Exam, but less than 50% of students passed the exam.

[T]: No, I mean when I was here I taught all physical science to seventh grade. And then they taught eighth grade life science and then they took the eighth grade New York State Exam. And they had a practical with it and everything. And now, so we don’t even do that anymore.

[I]: So, since the students take the Living Environment Regents they don’t take the Intermediate Level Science Exam?

[T]: Right.
[I]: I see. Do you know what the passing rate has been here for the eighth grade?
[T]: Living environment passing rate is less than 50%. In the 40s, 43, 45. Something like that.

The teacher explained that students were universally accelerated in both math and science to increase the likelihood that students would graduate from high school.

[I]: And do you know what the rationale was for moving all eighth graders into living environment?

[T]: Yeah, the rationale was because [school district] does not have a high graduation rate, so, they figured if they could get as much to pass the requirements for graduation, they accelerate for Algebra also, so if they can have by eighth grade, by the time they get into high school, they can have a math requirement and a science requirement, for graduation, so if they end up dropping out, alright, they’ll be less likely to drop out because they’ll have the requirements.

When the science chairperson was asked the same question, she provided a different rationale. Although she mentioned the possibility of taking Advanced Placement (AP) courses, she was hired after the decision had already been made and was not in favor of it.

[I]: And what was the rationale for accelerating all students into living environment?

[SC]: What I’m hearing...living environment is easier and to get them to pass living environment. So, it’s, it’s, it was a high school, middle school through high school initiative. Meaning that if they passed in the middle school, living environment, or Earth science, they would move on to another science to get their Regents diploma, and then they would be able to do AP courses for college credits. So that was the rationale that I heard. I don’t necessarily agree with that model…
The assistant superintendent essentially combined the two answers that were given by the teacher and the science chairperson, and confirmed what they had said.

[I]: Okay. What about the way that the science curriculum is set-up at the middle school level. So, I understand students accelerate into Living Environment in eighth grade. That there is universal acceleration.

[AS]: Yep.

[I]: What was the rationale for moving in that direction?

[AS]: It was two-fold. One was they’re taking a state test, the eighth-grade science performance test. It might as well be a test that counts for something. And it gives students an opportunity to earn a high school credit in eighth grade. And moves them into ninth grade with possibly two credits because we also do the same in math. So, it would give them a living environment and a math credit. And I don’t know if you want to say this, but on the eighth grade state assessment in math, we had maybe two kids that were proficient. It is a very low-performing district. But we had 50% of the kids pass the Algebra Regents so, why not give 50% of the kids credit? Whereas only two or three of the kids were proficient with 3s or 4s. It seemed like a total waste of time. So that was the rationale behind moving to universal acceleration. And on the other end, to give students the opportunity to take higher level math and science courses. And we have open enrollment in AP and in our dual-enrollment college courses. And we’ve seen significant improvement in our enrollment. The grades have actually gone up. The scores on the AP exams have gone up.

The assistant superintendent was also asked why living environment was the course chosen to accelerate the eighth-grade students into instead of Earth science. The Living Environment Regents Exam was viewed as an easier exam for students to pass, so that is why that course was chosen.

[I]: Okay... And do you know why Living Environment was chose, chosen say versus Earth Science?

[AS]: Yeah, easier exam. Sure. That was easy. It’s a much easier exam to pass. More relevant to students. We have a lot of English Language Learners. So, the vocabulary is possibly more familiar than let’s say in Earth science. So, it was chosen for a lot of those reasons.

While the assistant superintendent thought that living environment was easier for students, it was the teacher’s opinion that living environment was actually more difficult than Earth science.

[I]: And do you know why…living environment was chosen as the course for all students to go into rather than, say, Earth Science?

[T]: …I want to say maybe because they think it’s easier. I personally don’t agree but.

The science chairperson was not as supportive of universal acceleration. In her opinion, the ELLs and the special education students could benefit from taking the ILS exam in eighth grade.
[SC]: I don’t necessarily agree with that model…because some of our special ed kids, some of our ESL [English as a Second Language] kids, ENL [English as a New Language] kids, one, are, is not being taught. They’re being taught the same way the regular kids are being taught. And so, they’re not passing. And it’s not until it’s the kids’ initiative to start learning, so unless they take that initiative, they’re not going to pass, the beginners especially. And we have a lot of beginners or emerg, not emerging, a lot of special ed kids, a lot of ENL kids who are just beginners that I don’t think are being serviced to take the Regents. I think they can do a lot more with the eighth-grade state test with those kids. But, not my call.

The district was trying different things, such as creating a bilingual class to help more students pass the Living Environment Regents Exam. There was also an Essentials class for students that failed the Living Environment Regents exam, that prepared students to re-take the exam in January. Since the school did not offer the ILS, all of the energy was put into trying to get as many students to pass the Living Environment Regents Exam as possible, especially since students only needed to pass one science Regents exam to earn a Regents diploma.

**Professional development.** There were discrepancies when the participants were asked about professional development. According to the teacher there had been very little professional development on NYSSLS.

[I]: Okay. How were staff informed of the New York State Science Learning Standards?
[T]: We weren’t. You mean NGSS?
[I]: Yes.
[T]: We were not really informed. The staff was not informed about it, except when we did a …a professional development at a park in [location]…where they did some NGSS stuff. That’s where I first like learned about it and through publications and stuff. But we were never really formally introduced to it in this district. Our science coordinator, she talked about it a little bit, but nothing formally introduced.

The science chairperson described professional development opportunities that she provided. She also described trying to have professional development for the science teachers during Superintendent’s Conference Day and how this was ultimately denied by the Board of Education.

[SC]: …We had a PD [professional development] set-up to, on Superintendent’s Conference Day, with. We did a PD last year to introduce the high school and the middle school, something that I had set-up…to introduce the middle school and the high school to the NGSS standards. So, this year I figured, nobody is doing NGSS except for me, so …why not follow it up. So, I asked him to do NGSS to curriculum, curriculum to lesson planning. That was the PD. And in the last Board meeting they turned it down. So, we were denied. So, we have to stay here.

The assistant superintendent explained how professional development was mostly through workshops that teachers attended through the Board of Cooperating Educational Services, (BOCES) and how they then became turnkey trainers for other teachers in the district. This
explanation was different from the professional development that was described by the teacher and the science chairperson.

[I]: …How is professional development on the new standards coordinated for teachers?
[AS]: So right now, the professional development is we attend workshops through [county] BOCES. And then we come back and turnkey. So, that’s what we’ve done right now. We haven’t done, I haven’t seen any kind of crosswalks between the old standards and the new standards. But, typically what we do is, develop expertise within certain people in the district and then they do internal professional development. We do, we do a lot of that.

[I]: So, teachers are teaching the other teachers you’re saying?
[AS]: Mm hmm. Mm hmm.

Collaboration. Collaboration was a topic that had a diverse range of responses. Committees where teachers collaborated with one another were mentioned. However, there seemed to be a lack of communication between the junior high school and the elementary school. The teacher described this disconnect between the elementary school and the junior high school during her interview.

[I]: And now the middle school grade band has a 6-8 grade band…So not having the sixth-grade teachers in the building, so how is the communication between the seventh and eighth-grade teachers in this building with the sixth-grade teachers?
[T]: We don’t communicate at all. I’ve been teaching seventh grade for 10 years here. I’ve had no discussion with any of them at all. Okay, maybe the department chairperson has, at the time when we had one. When we had a chairperson, now we have a coordinator. You know, but we’ve never, we’ve never really talked about it.

The teacher referred to the science supervisor as a coordinator, but according to the assistant superintendent and the science chairperson, she was, in fact, a chairperson, not a coordinator. The teacher also expressed how the opinions of the teachers did not matter. She felt that decisions were made using a top-down approach. This approach did not lead into teacher buy-in.

[I]: Okay. And who’s involved in this curricular decision making-process?
[T]: I believe the superintendent. It’s at the superintendent’s level. The superintendent, the assistant superintendent of curriculum…you know, those people up there. The administration up there.
[I]: Okay. So, do you feel like the teachers have had any say?
[T]: Oh, we’ve had no say whatsoever. We’ve had no say. I think the principal might be involved as well and the assistant principal, who was a science person last year. But I’m not positive. But I know it came from curriculum.

The science chairperson also mentioned how there was a lack of communication between the junior high school and the sixth grade. However, she described collaboration between the science teachers that worked together at the junior high school.

[I]: Gotcha. And then how is having this universal acceleration in eighth grade, how is
that impacting science instruction in grades 6 and 7 currently?

[SC]: Because the seventh-grade teachers are here, we can communicate directly to the sixth and seventh grade. So, when they get to the eighth grade and starting to do certain units, and we see the majority of kids are lacking in …certain topics or certain content areas, we, we have a meeting or, you know, informally talk to the seventh-grade teachers …did you do this? How did you do it? Ba, ba, ba blah. It’s not really in the curriculum that we were supposed to do it. And we either revamp the seventh-grade curriculum, or just add to the eighth-grade curriculum that there should be more…in depth.

[I]: But, now, you said sixth and seventh. Did you just mean seventh?
[SC]: Just mean seventh.
[I]: Okay.
[SC]: The sixth graders, we don’t have any communication with them.
[I]: And is there someone that supervises science at the elementary-level?
[SC]: Just the AP [Assistant Principal] that’s there.
[I]: Okay.
[SC]: So, at one point, not last year, but the year before when we were going to have articulation with the sixth-grade coach at the time, who’s now the assistant principal, and at the end of the 2016-2017 year, and … the meeting was cancelled, and the AP here said don’t worry about it.

The assistant superintendent gave more positive responses discussing how teachers collaborate with administrators through the various committees and sub-committees. The curriculum advisory council (CAC) had representatives from the teachers’ union, and the administrators’ union, and they made decisions about new courses after research was done by a sub-committee. The assistant superintendent described how this process worked.

[I]: How are curricular changes made within the district?
[AS]: So, there’s a process where, if it’s a new course, like a new course proposed at the high school or the middle school, it goes to what we call a curriculum advisory council. And that council says, “Yes, we want to set-up a sub-committee to explore it”, and then we would set-up a sub-committee. Let’s say it’s a forensics, or whatever the course might be, that group does some research on what’s forensics, is it a half-year course or a full-year course, is it every other day, semester, whatever, and then they make a recommendation to the CAC. And on the CAC, it’s the administrators sit on that, as well as … representatives of the teachers’ associations, the [letter] TA, the [school district] teachers’ association. So, they get to nominate who they want and the administrators are the ones that we want. So that’s who sits on that committee. And then they vote yes or no if they want to move it forward to the superintendent.

[I]: So, the sub-committee though is the teachers?
[AS]: We nominate people to be on the sub-committee so, for example, there’s no science people on the CAC. They wouldn’t do the research. So, we would reach out and say, “Hey are they any science people that want to do the research?” And they should say, “Yeah, because it’s my course. Yeah, there’s two or three of us that want to do the research on that, we’ll present it.” Most of the time they already have a lot of that done because they know they want to present it. If there are things that are coming
about because of the state, so, for example, the Next Gen Science Standards, ELA, you know, we wait for the state to come out, obviously with a timeline, would be nice.

Although the assistant superintendent described how the process worked, according to the science chairperson and the teacher, the science committee did not have any meetings planned for this year.

**Parent/community influence.** Many of the decisions made in the district were in response to the needs of the community. This theme was apparent in all of the interviews. The teacher explained how the Essentials class was created to meet the needs of students that were not successful passing the Regents exam in June. It provided remediation to help the students re-take the exam in January. She described it as being an every-other- day course, whereas the science chairperson, who actually taught the course, explained how it was an everyday course.

[I]: So, if students don’t do well in eighth grade would they take that Regents, would they take that class over again in ninth grade or they just go to Earth Science?
[T]: Okay. What they’re doing, what they’re doing is if they’re failing the entire class and the Regents, they take it again in ninth grade. Okay, if they failed the Regents, but passed the class, they’re put in what’s called a Living Environment Essentials class, which is, you know, they focus on, you know, no labs, the labs are done already, they focus on the different units, and like practice all year long.
[I]: Oh, I see.
[T]: And they try it in January and if they pass it in January, then they move on. But they also at the same time, they take Earth science. So, they haven’t passed living environment, they put them in Earth science and they put them in the Essentials class as well.
[I]: So, they’re in both classes simultaneously?
[T]: Only if it’s the Essentials.
[I]: I see. So that’s for the kids who passed the course, but failed the Regents.
[T]: Right.
[I]: They re-take the Regents again?
[T]: First in January. And that’s an every-other day class.
[I]: Oh, I see.
[T]: So, they’re taking their science, their Earth science with the lab and then probably with the opposite days of the lab they are taking the Living Environment Essentials.

The assistant superintendent also described many of the programs that were brought into the district in response to community need.

[I]: So, if there were, let’s say, new textbooks adopted, aligned with the Next Generation Science Standards
[AS]: Okay. Alright. So, it depends on like what your definition of program is. That’s why I’m asking for an example. Well, we are doing that right now. Our living environment teachers are looking at textbooks. But that goes through the CAC [Curriculum Advisory Council]. So, the teachers say, “Hey, we need a new textbook.” CAC says, “Okay.” We put a committee together of our living
environment teachers, and we’re looking at textbooks. They make a recommendation to the CAC. I actually have to do a presentation on textbooks, really for any kind of program, there’s a presentation made to the Board of Education and they have to adopt it.

[I]: I see.

[AS]: So, you know, it like, … it depends on your definition of program. Like AEGIS is a character education program that’s adopted by the Board of Education…Too Good For Drugs is another one. Like we do a fifth/sixth grade puberty program. Those are programs, right. And they’re adopted by the Board. But it comes directly from a need that the teachers or the community sees. Cursive writing is another program that we brought in.

[I]: Okay. But is there a committee, like a sub-committee like there was for the new course?

[AS]: Always a sub, yes. Always a sub-committee for that particular program or proposal really. Before it’s a program, it’s a proposal. So cursive writing for example, …the community really wanted to see a cursive writing program, so the committee was started, it was mostly second, mostly third grade teachers, some second, some fourth, and they did research on all the different types of programs that are out there and the pros and cons of bringing the cursive writing program in. They presented to our curriculum advisory council, and the council made a decision to move forward with the program. But then there was a Board presentation where the Board adopted that.

She also discussed how the kindergarten building would be changed into a full day pre-K and kindergarten building once construction was completed. These were changes that were asked for by the community, so the district followed suit.

[AS]: And the community would really like to have full-time pre-K. And right now it’s just two and a half hours. So, we’re not accommodating the needs of the community.

The assistant superintendent attributed the low passing rate on the Living Environment Regents Exam to the school’s large ELL and special education populations. She also described a new bilingual Living Environment course which had just been created.

[I]: So, you already discussed the rationale, accelerating all the students. And how has that been working accelerating the students into living environment?

[AS]: Right now, we have about a 50% pass rate and the students who are not passing tend to be our English Language Learners and our special education students, our self-contained special class, special ed students… So, we’re providing intensive… remediation right now, first semester so they can take the Regents in January. And we’re looking at our instruction, our mode of instruction, and what to do for students who might not be ready for that first year. Not like we’re going to break it up, like a part one, part two. That doesn’t work. We’ve all tried those. Like pre-living environment. Doesn’t work. So, we’re just trying to decide, do we wait a year for those students and then they take it in ninth grade? Do we change our mode of instruction? It’s already hands-on. That’s what science is. We’ve …this year started
bilingual living environment class, so we don’t have results of that yet.

These changes were a step in the right direction. The science chairperson complained that the ELL students were being taught the same way. The bilingual program may be able to meet some of the students’ needs.

**Summary.** *Wait and See* was trying to meet the needs of its students by universally accelerating all eighth-grade students into Regent-level living environment. They have not had good results, so the school started a Living Environment Essentials course to prepare students to re-take the Living Environment Regents Exam in January. The middle-level program does not get much attention since no students take the ILS exam. Also, since the sixth grade and seventh grade are in different buildings, there is not much communication between the teachers in these grades.

The second half of the seventh-grade science course really was meant to prepare students for the living environment course they would be taking the following year. Although there was a science committee for grades K-7, nothing had been scheduled for this year.

The district had started a new bilingual living environment course since there was such a large influx of ELL students. Since the middle school standards were only being taught during the seventh grade, the focus in the junior high school is on the Living Environment and Earth Science Regents Exams. It was as if a middle-level grades science program barely existed.

**4.4 Case Study of Using Teachers as Educational Consultants School District**

*Using Teachers as Educational Consultants* was a pre-K-12 school district with a large student body of over 6,000 students. It was considered a low-need district based on its needs to resource capacity (NYSED, 2012). It had a low free and reduced lunch population of only 8% (NYSED, 2016). One percent of the students were ELLs and 10% were economically disadvantaged (NYSED, 2018a). The district had numerous pre-kindergarten-grade 6 elementary buildings, 2 grade 7-9 junior high schools and (a) high school(s) that housed grades 10-12.

The district had science chairs in each of their secondary buildings which included a teaching responsibility. This practice allowed them to teach alongside the teachers whom they supervised. This experience gave additional credence to the messages they communicated to their teaching staff. However, having the sixth grade housed in elementary buildings and taught by teachers responsible for teaching all academic areas presented a challenge when the new science standards consisted of a 6-8 middle-level grade band.

Interviews were conducted with a science chairperson from one of the junior high schools, with a junior high school science teacher that worked in the same building, and with the assistant superintendent for educational services.

**Role of the science chairperson.** The science chairperson explained that a greater percentage of his time was spent being a teacher than being an administrator. This year he also acted as a consultant, where he went to the elementary schools and assisted the teachers in planning laboratory investigations and activities.

**Science Chairperson [SC]:** I teach Earth science, I teach a farm-to-school class and I’m an elementary consultant for science in one of the [number] elementary
buildings.

**Interviewer [I]:** Great…So how much of your position is teaching?

**[SC]:** My teaching is 0.6. It’s 0.4, 0.2 consult but that’s both considered …a 0.6 and 0.4 administrative learner.

**[I]:** Okay. So, 0.4 is teaching and 0.2 is the consultant.

**[SC]:** Consultant, yeah. Which is just this year, a TOSA [Teacher on Special Assignment]-based position. A chair is traditionally a 0.6 instruction, but they moved that to a Teacher on Special Assignment, a TOSA, for this year to help develop labs and activities at the elementary level.

**[I]:** Okay. And then it was, then it was 0.4 administration.

**[SC]:** Yeah, 0.4 admin.

The science chairperson described how he had many responsibilities and explained some of the challenges of being a consultant to the elementary teachers. His role at the elementary schools could be filled by someone on a more permanent basis.

**[SC]:** I’m doing that in my chair role. So, I’m having a lot of different hats this year, and my time that I’m free, might not work with the team when they’re free, even though I’m looking at a schedule and am trying to plan it. Or it means my students here don’t have their teacher for extra help like they would have. So, that’s something that I’m taking this experience with, as well as the other consults and trying to make that position so someone’s there longer in the day, can be more used throughout the entire day, maybe expand that piece.

The teacher explained how the science chairperson was the only person who observed her that had a science background, other than the occasional observation from the science chairperson from the high school(s).

**[I]:** Okay. Great. …Who formally observes you?

**Teacher [T]:** We do two different observations. So, we have one formal, or announced, unannounced and the department chair does one and it’s a randomly selected administrator from the district that does a second one.

**[I]:** And of those people, who has a science background?

**[T]:** …The department chair would be the one that has a science background. And then sometimes it’s hit or miss with the other ones. Sometimes it’s the department chair up at the high school science, so they have a science background. Like the last couple of years, mine has not been a science background.

The science chairperson explained that in his capacity as educational consultant, he was not able to observe the elementary teachers. They were observed by the building principal.

**Hierarchical organization.** The assistant superintendent explained how the science chairperson was a building-level position. The principals oversaw science at the elementary schools. The chairs reported to the building principal.

**[I]:** And who supervises science instruction?

**Assistant Superintendent [AS]:** We have chair people in each of our secondary buildings,
and then there are the building principals oversee the science components in the elementary level, but we have consulting science teachers that come from the secondary-level to work with the teachers individually.

[I]: And the science supervision at the secondary-level, is that district-wide or a building-level position?

[AS]: It’s a building-level position and then those chairs report to their principal and then ultimately to me.

The assistant superintendent described who he was responsible for supervising. The chair people were mentioned the lowest on the list.

[I]: So, who do you directly supervise?

[AS]: I directly supervise all [number] principals, the executive director for secondary education and human resources, the director of elementary curriculum, the director of music, the director of social studies, the director of art. I’m trying to figure if there’s anyone else on that list (laughs). And subsequent to that, assistant principals and chairs below them.

The assistant superintendent shared the table of organization shown in Figure 13.

![Table of Organization](image)

Figure 13. Table of organization for *Using Teachers as Educational Consultants* School District.

The chairs were listed under the assistant principals, who then reported to the principals. The chairs were on the lowest rung in the hierarchical structure of the district.
There were K-12 directors for some academic areas, such as global languages and social studies, yet chair people for other academic areas such as science, math, and English language arts. The assistant superintendent explained the rationale for this structure.

[I]: …So, you mentioned how there’s like, I see a director of global languages. And I know you mentioned like, a social studies director. Is there a reason why there is a director, let’s say, for, like, social studies, but not for some of the other academic areas, such as science?

[AS]: Yes, the English, and the math and the science are associated with state assessments. So, we want to see a person in each individual building to oversee that because the assessments are how scores are determined for APPR [Annual Professional Performance Review] purposes for the teachers. So, for the departments that don’t have that component, are more centralized with the social studies, the foreign language, so we need the individual attention in those buildings with those individual chairs.

The state assessments were the reason for the chairs in some academic areas, compared to K-12 directors in other academic areas. However, many students opted-out of these state assessments, so this seemed like an inequity between the academic subject areas.

The science chairperson explained how there was no direct content administrator at the elementary schools, so the teacher as consultant model was adopted to fill this void. He was also acting as a consultant to the elementary teachers.

[SC]: There’s not a direct supervisor in their discipline area either. So, they don’t have a science chairperson. So, what we’ve done, and this is very nice as a district, we’ve generated, created a consultant role that goes to the elementary buildings. And then is able to meet with staff, and discuss things. The obstacles with that is the ability to meet when everyone’s free and to plan and to have the person there at those times. I’m experiencing that myself.

The difficulties of having so many responsibilities was expressed by the science chairperson. The planning of common meeting times with the elementary teachers was a major issue. He felt that spending the time at the elementary school was taking time away from providing extra help from the Earth science students that he taught.

**Building grade-level configuration.** The science chairperson explained how it was difficult to implement the middle-level grade band of performance expectations when the sixth grade was housed in separate buildings from grades 7 and 8. He explained some of the challenges with having sixth grade housed in the elementary buildings. He expressed how the elementary teachers taught what was assessed.

[I]: Now having the sixth grade in a separate building, what kind of challenges are there?
[SC]: Oh, it’s a big challenge. There’s communication liabilities. There’s the ability of staff to cover the content of an area that’s not being assessed. They’re assessed in math and English every year, and that’s traditionally what’s been taught to the greatest extent.
The science chairperson explained how the sixth-grade teachers teaching middle-level science in the elementary building was comparable to teachers teaching high school-level coursework in the middle-level grades. He described the sixth-grade teachers as being stuck in the middle.

[SC]: It’s an obstacle for them too because they are. It’s sort of like being a high school-level teacher in a middle school. They’re a, they’re a middle school teacher in an elementary school. It’s something I’ve always faced, I feel as an Earth science teacher in a…in a junior high school, like kind of has a foot in the high school and the middle school, but we have a heart of a high school. We are kind of pushing kids at that higher level. So.

The teacher thought that the district would change the configuration as enrollment in the district continued to decline.

[I]: ...And being that the sixth grade is in a separate building, cause, you know, the new standards is for 6-8, what challenges does that, does that present being that that sixth grade is not located with the seventh and eighth grade teachers?

[T]: Right. We feel that that does make a reasonable impact and we had. That was also part of the meetings to discuss what was going to happen and actually even if there is going to be, the decision was made that right now we can’t switch because we can’t accommodate the ninth grade at the high school yet, because the high school can’t accommodate that many people. So, our numbers are dropping, so with an eye down the road, they’re thinking that potentially when the numbers drop far enough, we will move the ninth grade up and move the sixth grade up here. But until then, we’re kind of stuck with the, you know, situation that we’re in. So, they decided that they, and that has not been finished, decided yet, about how to handle the sixth grade for next year, whether they’re gonna have teachers specialize, kind of, for science and go back to the old school where they change so that they’re getting consistent through the [number] buildings, you know, delivery of information… But that presents problems with the number of sections. So, there’s things that I don’t understand about elementary school, …and the way their day is set-up that, that is making that a little bit problematic, but that is one of the things that’s on the table that we’re still trying to figure out.

Having only some teachers teach science as a way of departmentalizing the sixth grade was mentioned, but there were issues trying to do this because the elementary schools varied in the number of sections they would require because some elementary schools were larger than others.

When the assistant superintendent was asked specifically about this issue of re-configuring the district, he supplied clarification. He explained how the community did not want to change the building grade-level configuration.

[I]: And being that the sixth grade is in separate buildings, yet it’s part of that 6 through 8 band, has there been any discussion of moving the sixth grade to the junior highs to make them into middle schools?

[AS]: That topic keeps coming up every year in [school district]. The frank conversation is there is not space for us for sixth grade to be placed in the junior high school-level.
And there’s not space because the ninth grade is in the junior high school-level. And that’s an even bigger issue because our ninth grade would not fit in our high school. So, we can, we don’t have enough, it’s not physically large enough. Perhaps as enrollment declines in the next few years, that might be reconsidered by the Board of Education, but it’s not going to happen in the next 5 to 10 years that I can see. So, there’s a lot of studies that show that keeping the sixth graders at the elementary level is actually better for the child than it is to have them advance to a secondary model. So, given the success of this district, it’s working. So, it’s one of those, you don’t mess with it if it’s working [laughs]. So, but we’ll work around that component. It is terribly frustrating when you’re dealing with vendors, and with curriculum such as this coming out, that are only geared that way. So, it makes it difficult to work with those teachers too. You know their expectations are going to be different than their other elementary colleagues. So, but thankfully we have a very good group of teachers, we have a team that is working on this curriculum right now. They’re doing remarkable work with it. And they’re making it work for the structure of our population. So, this is, we actually may consider a shared model where almost as if the students would be passing to other classes, we may appoint one teacher in each of the sixth-grade levels that would be the sole science person for all the teachers in that. The difficulty with that is some of our schools have three sections in sixth grade and some have five. So, in order for it to work, it has to look the same in each of those locations. So, the number of sections throws that off a little bit for us. So, we’re treading very lightly. We’re becoming scheduling gurus at this point.

It was apparent that the building grade-level configuration was not going to change because the Board of Education and the community wanted to keep the junior high school model with the sixth grade in the elementary schools and the ninth grade in the junior high school. Although this configuration may have had advantages for the sixth grades students at the social-emotional level, it certainly posed greater difficulties in implementing the 6-8 science grade-band.

Since there were state assessments in math, science and English language arts, the district was configured to have a point-person in each of these subject areas at the building-level, the chairperson. The chair people were able to model what they wanted their teachers to do. The fact that they were still in the classroom with the other teachers in the department gave their messages more credence with their staff. The district was also using the science chairperson as an education consultant.

On the other side, the K-12 science instruction does not seem to have a singular vision because they were multiple science chair people. The chair people did not have as much power to yield, as the teachers had more say in the ultimate direction of the district.

**Curriculum.** The science chairperson explained how the committee ultimately chose to implement an integrated curriculum for grades 6-8.

[I]: So, are you using an integrated approach where each of the sciences, the life, the Earth & space and the physical are taught each year, or domain-specific where it’s just one science each year?

[SC]: It’s, it’s, we call it spiral, but it’s an integrated approach where each grade… and you know at the elementary, at the elementary’s kind of band it that way as well.
We’re doing that with sixth, seventh and eighth. …So, they’ll be a little bit of each of the three disciplines in each year.

The science chairperson was in favor of the integrated approach because he believed it allowed students to make connections between the different science disciplines.

[I]: And this, this spiraled approach, I forget if we mentioned this, why was it chosen to go with this spiraled approach, like, what was the rationale?
[SC]: The rationale was that we’re teaching various subject areas and we are touching upon them as kids are advancing. That was the thought. To make connections between the subject areas.

The science chairperson also acknowledged that teachers who were not as comfortable with teaching a certain area had to cope with this issue for a shorter period of time with an integrated curriculum. This limited amount of discomfort made it advantageous. Middle school also had much more flexibility because they did not need to worry about a Regents exam.

[I]: Right. But, at the middle school-level where you don’t have the confines of the assessment
[SC]: Yes. You have far more flexibility. Far more flexibility and more enjoyable teaching in many ways. I think I’m going to become a seventh-grade teacher (laughs). Actually, I like it now because I’ve been such a wonky Earth science teacher and geology background that that’s been a liability for me. I’ll acknowledge that. It opens the doorway now with our spiral model where anyone can teach anyone of those grades and not feel, you know, you’re weak throughout the whole topic based on background knowledge.

[I]: Because it’s a spiral, because you’re doing a little bit of Earth?
[SC]: Yeah, because, hey you’ve got your comfort zone, but hey, we’re all learning and your kids are learning too. That’s less inhibiting for someone to embrace.
The teacher wrote the topics taught in grades 6-8 as depicted in Figure 14.

![Figure 14: Topics taught in grades 6-8 at Using Teachers as Educational Consultants School District.](image)

She described why specific topics were specifically chosen to be taught in particular grades.

[I]: So, then there’s some type of correlation with these topics, like from weather and climate and then get into forces and motion? Is that what you’re saying?

[T]: Right. Because if you’re talking about photosynthesis and respiration you’re talking about chemical reactions, right? So those two things will link together, right? And we’re talking about getting energy to the Earth, which will bring you to the sun, which then you can talk about gravity and the planets. And then with ecosystems you can think of a way to kind of blend it together. More than sticking in waves and electromag, well not that. That’s a poor example of light. But, you know what I mean. So, that it just looked to us that there would be a phenomena that we would be able to find that would support all of those in an easier manner than just trying to strictly talk about life science and then okay we’re talking about photosynthesis and energy, but we’re not going to talk about what energy is, forget about that, that’s going to be next year. You know, don’t worry about chemical reactions in there, you know, you’re not going to worry about that until you do chem. You know it didn’t make sense.
She thought it made more sense for students to revisit certain topics, such as atoms, than to see them in sixth grade, and then not talk about them again until high school chemistry.

The assistant superintendent explained how the middle-level grades would be moving to an integrated approach so that students taking a Regents-level course in the eighth grade would not miss an entire domain that would be taught in the mainstream eighth-grade science class.

[I]: Great…How is science taught at the middle school level?
[AS]: So, what we’re looking at for the sixth, seventh, and eighth grade model for the middle-level model is a spiraling really of, of the curriculum. The sixth-grade teachers because they’re not science experts will lay the foundation as an introductory program. And then the seventh and eighth-grade will layer it even further. So, it’s, the model seems the way to go at this point in time, given the way the nature of the curriculum is structured. And also knowing our population of where our eighth-grade may wind up if they’re in the honors level courses. So, that’s why it’s sort of being structured in that manner.

The assistant superintendent explained how the new model of spiraling the curriculum in grades 6, 7, and 8 would cause the accelerated students enrolled in a Regents-level course in eighth grade to miss the regular eighth-grade curriculum. However, he thought it was better for them to be exposed to part of each domain in grades 6 and 7, than to miss a single, entire domain in grade 8. No matter which option, students would be missing something by taking accelerated science in eighth grade. The choice was which would have the least impact on their future studies.

[I]: Right. How does that impact science instruction in grades 6 and 7?
[AS]: …Again that spiraling component that starts in grade 6 and the next tier is seventh, unfortunately, that last component is missed for those eighth-grade students if they’re in the honors level. However, the vast majority of those students in our experience looking at their success in school, it’s one of those, they can handle that component, that piece. And what they don’t know, those Earth science teachers and the living environment teachers subsequent to that have that understanding. They’re in the honors track. This is what they missed going through, and this is what we need to do. Already the curriculums are set-up that way. So, they’re already prepared for that implementation as they’re coming through. So, it will be a bit of a change, but one that I don’t think our secondary science teachers can’t handle.

The assistant superintendent was confident that the teachers were aware of what the students would be missing and would be able to fill in the gaps. He also felt that since the students were performing at such a high level, they would easily be able to catch-up.

The science chairperson noted how NYSSLS did not account for acceleration as it was written. Having an acceleration science course in eighth grade created numerous curricular issues, but since it was so prevalent on Long Island, he conceded that it was not going to be taken away.

[SC]: How it’s written, you should have no acceleration. But we teach on Long Island and our kids are very special, and I think, I think we’re going to continue our acceleration.
One of the issues the science chairperson mentioned was whether students were learning material from the middle school band for the first time while in the accelerated science course. This deficiency would require the teacher to teach both the middle school standards and the high school standards in the same year, making the curriculum larger, when it was supposed to have less content so students could learn the science and engineering practices and crosscutting concepts alongside the disciplinary core ideas. This predicament went against the whole spirit of NGSS.

[SC]: We’re a little concerned with the best way to do that because as Long Islanders, I think most districts offer acceleration, and so thus you’re going to be putting kids into a curriculum where they haven’t learned the stages beforehand, either the appropriate length of time, or not at all. And so that’s kind of like, it’s gonna hit the fan at some point when those assessments roll-out. And that’s the piece I’m interested in.

Standards. The science chairperson explained how the pedagogy aligned with NYSSLS was being implemented in all grades despite the fact that the new curriculum was not being introduced in the seventh grade until the following year.

[I]: And are teachers, even though they haven’t made the shifts in grades 7 and 8 yet,
[SC]: They’re implementing the pedagogical changes. Claim, evidence, reasoning activities. We’re adding other components into the labs. At the high school I’m asking the staff to do the lab earlier than generally you would have. That’s great. You get stronger interest. You get stronger buy-in.

The teacher also described changes that she was making to her teaching pedagogy to align with NYSSLS. She had doubts about the shifts being made in sixth grade, other than teaching the new topics they were assigned to teach. The educational consultants were there to help the sixth-grade teachers change their pedagogy.

[I]: And are there shifts that you’re making to your pedagogy right now… aligned with NYSSLS?
[T]: Yeah, so, right. We’re bringing in, you know, where we can, based on the fact that we still have the final exam that we have at the end of the year, needs to be what it is. So, we’ve been bringing in, you know, phenomena, doing more claim, evidence, reasoning stuff, in, you know, bits and pieces of it throughout the year where we can fit it in just as a trial run, figure out how, how that’s going to work, what it’s going to look like, how the kids are going to respond, you know, it’s a totally different way for them. Come up now, already in seventh grade, and never really have seen that. You know, it’s a totally radical change for them and how they’re going to embrace that or struggle with it.
[I]: Right, right. And in sixth grade right now, they’re doing that this year then?
[T]: Yes. So, I mean, they’re supposed to be doing it. I think they’re doing the topics they’re supposed to be doing. But, I think it’s not so much phenomena, claim, evidence, reasoning, as it is, you know, kind of old school.
The assistant superintendent explained how the new standards were to be rolled-out. The plans were aligned to when the new assessments would be rolled-out.

[I]: How are the New York State Science Learning Standards being implemented?  
[AS]: The sixth grade being in the middle level, although in our district they’re in the elementary-level, has been also working on their project this year because they’re going to roll out their first year this year with K-2. The following year when 3-5 rolls out, 7 and 8 will roll out their project.

It seemed that the district had a plan in place for rolling-out the new standards. The standards will roll-out with the students as they move to grades 3-5 at the elementary-level and grades 7 and 8 at the secondary-level.

**Teacher certification.** The science chairperson explained how the sixth-grade teachers in the district had elementary certification. He explained how this impacted the decision as far as what would be given to the sixth-grade teachers.

[I]: Great. Did the teaching certifications held by the middle school teachers, did that impact any decisions as far as what would be taught in sixth grade as opposed to what would be taught in seventh or eighth grade?  
[SC]: Well, sixth is a tricky thing for our district because we have sixth in the elementary. And we only have two secondary staff members with the sixth-grade extension. So, we have not brought anyone to the elementary. The elementary also had had a departmentalization policy up until these new standards. So, one person was the science guy or gal for their building. And they rotated, someone else was social, someone else was math. They pulled that back. And that was pulled back so that everyone should be teaching the sciences, everyone should be teaching the social studies in their own rooms to try to have uniformity amongst the different buildings in the district.

The teacher did not feel that the teacher certification played a big role in determining which topics where taught in which grade.

[I]: Did teacher certification play into determining which classes would go where at all?  
[T]: Not for 6, 7, 8. …Cause we’re all certified in whatever we’re certified in with our middle school extensions. In theory everybody in the building can teach 7 and 8.  
[I]: Cause the general science certification?  
[T]: In terms of the general science certification, right.  
[I]: Gotcha.  
[T]: So, we talked about it a little bit about the people currently teaching eighth grade and the people currently teaching seventh grade. The subjects that are in there and what we would like to do. And see what fit in, but when it came right on down to it, that’s kind of hard to do.
When the assistant superintendent was asked about teacher certification, he explained how teachers not having science certification was the impetus to using secondary science teachers as teaching consultants for the elementary teachers.

[I]: How has teacher certification impacted the decision as to how science curricular are to be implemented?

[AS]: In the, in the … there is no requirement for a science certified teacher at the elementary - level in the state of New York. Although the new standards have necessitated looking at that differently, hence why we went to the science consulting level. The average elementary teacher in this district would not, …does not have a science certification background. But the complexity of some of the standards, not that it necessitates them having that depth of knowledge, but it does help. So even if it was just a version of having a person there, that has done labs, has understood the curriculum, has been, is a science certified teacher in a particular science area, having them present, sort of has alleviated the anxiety that teachers have been building-up over the changes that are potentially coming. And the new methodology has also been very important. It’s been changing the way a lot of our teachers do teach. You know, putting the experiment first is not the typical process that most of the elementary teachers have experienced. So that’s been significant, putting that into place that has helped a great deal. [School district] is lucky to have many teachers in the district with multiple certifications in science. And we’re also lucky to have the support of the Board of Education to be able to maneuver staffing to assist with that. So, right, for this coming school year we have a 1.0 FTE devoted to moving into our [number] elementary schools.

By devoting a 1.0 full-time equivalency [FTE] for secondary science teachers to serve as consultants to the elementary teachers, the district was investing in the expertise of their own teachers. The assistant superintendent expressed a similar concern with the sixth-grade science teachers having common branch certification rather than holding a science certification.

[AS]: …Again going back to the standards, it doesn’t necessitate having someone with a science certification, but honestly, it really would help. And especially for the sake of the students, when they start asking questions, and you have no clue what they’re talking about. So, that’s why we have the consulting teachers right now working with them.

Assessments. The science chairperson discussed how many students were opting-out from taking the state assessments. The science exam was being grouped with the Common Core English language arts and mathematics exams.

[SC]: In the last few years, we had very few students take the assessment. It wound up that after opting out for English, those that didn’t opt-out, opt-out for English, opted out for Math. And then those that didn’t opt-out for Math, they opted-out for science (laughs). So, I wound up with I think 16 kids out of 100 and something actually take the science assessment last year.

He also was concerned about the mismatch between instruction and the current state assessments. He felt that the instruction was changing, but the assessments may continue to
focus on content, which ultimately would result in teachers reverting back to the traditional way they had always taught.

[SC]: And there’s some frustration, sometimes angst among certain individuals that the State isn’t doing their piece. And I’m always wondering, are we doing one faster than the other? There’s who’s leading who? It’s kind of like the paradigm I think we’re at. And if it’s not done well, I think we’ll wind up with the same type of assessments. And the same type of teaching that we’ve had. [Professor] hates when I say this. (laughs) If she heard that she would be. But, that’s, that’s how I’m feeling with it right now. And I don’t know how that’s going to change because we currently have inquiry in lab components. We have inquiry. We have inquiry. It’s there. It’s in our curriculum. We teach inquiry. But, we don’t assess on it. So, that’s where I’m uncertain how the state will move with this final adaption of the assessment component.

The science chairperson was concerned about the alignment between the standards, the instruction, and the assessments. If the three were misaligned, NGSS was bound to fail.

The science teacher discussed how a new seventh grade final exam would be developed. This exam would include questions that tested students at higher levels along Bloom’s taxonomy and Webb’s Depth of Knowledge (DOK).

[I]: I see …And once you make these changes to this new curriculum, next year in seventh grade, how would you assess if the program is working?

[T]: Right. I mean, I guess one of the best assessments, because we are also going to rewrite the entire seventh grade final to reflect the new curriculum, so on that final, I just went to a three- day training class with people from [school] , you know, on how to design assessments that reflect in the NGSS. …So, we’re going to be doing that, and seeing how they respond to that. Whether it is actually making an improvement in the way that they think and in the different manner in which they think. Like, can they, do they understand what it means to make a claim, and use evidence and then back it up with the science. You know. And they’re able to do that and think kind of differently and do less you know DOK 1, DOK 2- type questions, you know, bring in more of that. You know, go higher on Bloom’s. See if we can get them into that different level of competency, than something there’re going to forget when they walk out the door in fifteen minutes and go to the next level and be like, “What, you never told me anything about density,” or whatever.

When the assistant superintendent was asked about assessment, he insisted that it should not be based on state assessments, but instead internal assessments that the district had in place.

[I]: How will curricular changes be evaluated for their effectiveness?

[AS]: That’s an interesting point. So, the idea of evaluation should not be based on state assessments. That’s the first thing. So, we should be more critical of ourselves than that. Years ago, the state assessments were a test of minimal standards. Standards now are far greater than that. But we have our own assessment tools that we use.

The science chairperson explained how getting feedback from both the teachers and the students would help him to assess how the new program was working once it was fully
implemented. He discussed using more qualitative data rather than focusing solely on quantitative data.

[I]: And what are you planning to do to assess if the program is working? Now you’re fully aligned with NYSSLS, you have the new curriculum rolled-out, how would you assess if it’s working?

[SC]: I would look toward student success in classrooms. Student success on state assessments. …General feedback from classroom teachers as well, …in terms of how it is proceeding. We’ll have staff members who will have taught the current curriculum. We’re not turning anyone over till, you know, a few years after that point. So, we’re gonna have my current staff will be teaching when we are fully implemented. So, we’ll actually have staff who are aware of that experience then. Kind of, live through the changes of it. How it’s affecting their students. How it’s affecting their classroom. How it’s affecting their instruction and how they feel as a science teacher.

That qualitative data gives information that cannot be determined from state assessment scores alone. Getting feedback from the teachers and students will be important information as the implementation really takes places.

**Professional development.** The science teacher explained how the monthly department meeting was the primary way that staff was informed of NYSSLS. She also mentioned workshops that she attended outside of the district.

[I]: How were staff informed of the new New York State Science Learning Standards?

[T]: I think it probably started two or three years ago when the conversation first came up. In the last couple of years, it’s been in a bunch of our department meetings. We’ve had professional development prior to the start of school addressing some of the new standards. We’ve had joint department meetings with both …junior highs about it. You know, and then just going to workshops and people doing that kind of stuff.

The assistant superintendent explained that there was summer curriculum writing projects for kindergarten through grade 2. There was also a curriculum writing project for grade 6, since it had been decided that there would be a spiraled, integrated curriculum for grades 6-8.

The assistant superintendent corroborated how the chair people provided professional development through their monthly department meetings.

[I]: And what about on the secondary -level? How is professional development?

[AS]: Secondary-level uses the conference days as well, but they also have departmental meetings every month. So that’s where a lot of our, they’ll do the nuts and bolts part of the meeting and then there’s a component and because there’s multiple certifications involved, it’s where your general area specialty is, what you’re generally teaching, you’ll be grouped together to work with those teachers.

Having the department meetings each month gave the teachers additional time to work together with the other science teachers teaching the same content area. The science chairperson
added how he thought it would be beneficial to have departmentalization begin in sixth grade so a teacher could specialize in science and attend departmental meetings at the junior high schools.

[SC]: Or look at a departmentalization where there is a specialty person who could then attend science meetings or something at a secondary-level. It’s an obstacle. There’s no doubt about it.

Collaboration. The science chairperson explained how the science chairs, principals, teachers from grades 6-8, and the assistant superintendent met to determine the best scope and sequence.

[I]: So, the decision-making process, who was part of that decision-making process to go toward this integrated or spiral approach?
[SC]: That would be the chairpersons of the three secondary schools, the assistant superintendent, principals were on hand from the three secondary buildings.
[I]: And teachers?
[SC]: Teachers, oh, yeah, teachers were involved also. Teacher representatives, I think there were a teacher from seventh, eighth, and a high school class from each building in each of the two junior high schools.
[I]: And do you know how teachers were selected to be on that committee?
[SC]: That were asked to be on. Specific people were chosen and selected to be asked. And everyone that was asked agreed.

The teacher provided a similar answer as the science chairperson. The decision-making process involved teachers and administrators working together.

[I]: How did it come about deciding which topics would go in which grade levels?
[T]: We had a series of meetings last year with the superintendent, people from sixth grade, seventh grade, and eighth grade. After a lot of deliberation, trying to figure that out…we let the sixth grade obviously because they have so much else to do, we decided we were going to do 20%, 40%, 40% and then how to divvy that up, instead of giving them one full topic, we decided to give them the easiest, you know, the topics to do. So, they were kind of doing entry level stuff and then we would build on it from there so that they didn’t feel like without their science certification that they were being overburdened. So, that’s how we did it. And then…just kind of, what sort of fit together if we were gonna do phenomena, so looking at what made sense, that one topic would lead into the other, instead of trying to do all life science. It made more sense, if you were going to do it, we thought, that if you were going to do a big phenomena, that you would take the pieces that make natural sense in the world that would go together and try to put those sections together. One for seventh grade and one for eighth grade evenly split.
[I]: And you were part of that committee?
[T]: I was part of that committee.
[I]: And how were teachers selected to be on that committee?
[T]: I have absolutely no idea. (laughs) But it was one person from this building, one person from [other junior high school], and then one at each of the sixth grade.
The assistant superintendent also explained how it had been a collaborative process between the elementary teachers, the secondary science teachers, and the administration.

[AS]: This was a design created by teachers, teachers with science certification and elementary teachers working together at the table with their administrators saying what would work best. And they went out and they explored what was being done in other places and then brought it back and said this seems to be the model going forward. There are states using the national science standards right now and they’re full blown implementation. So, New York’s a little back because they want to put the New York spin on it. So, we want to make sure that we’re following that…that process for those teachers similarly to what those other states. Letting them run out and get hit first and then we learn from their mistakes and then now we’re looking at it saying, this is what the literature is saying that this is the way it would work better. So, nothing is perfect, but it’s better so. (laughs) And hopefully the test will be once we hit the ground in a week and a half, seeing how are teachers operate with the curriculum, and their degree of comfortability with it, that will be telling right from there.

The assistant superintendent also explained how teachers and administrators met on a regular basis as part of the curriculum development council (CDC). The CDC reviewed curricula on a five-year rotating basis, and determined when new curriculum writing projects should be proposed. There was also a program review at the elementary and secondary-levels.

[I]: Great. How are curricular changes made?

[AS]: There is two ways. There is a curriculum development council, that is comprised of teachers and administrators from all grade levels and all departments, and then there’s a program review that exists. The program review is an overarching committee and then two sub-committees, one for elementary, one for secondary. The program review committee meets three times a year. Once in the beginning of the year, once around January, then once around May. ...And in between those times, the elementary and the secondary committees meet separately in-between the meetings. So, then there’s two in the fall and two in the spring. And the curriculum development council meets about four times a year. Any changes to our current curriculum, whether its driven by the state changes, if there’s a standards change, or if there is something internally where we have, we have a Board requirement to review all curriculum programs every five years on a rotational basis. If it comes up from that, teachers and administrators propose curriculum projects, and those projects then go forward to have curriculum written that was usually done over the summer, but can last sometimes throughout the school year. New courses are proposed typically for the fall meeting for the CDC and they go to, have to be approved by the Board of Education by November so they can be placed in the course catalogs so the students come January, when they start signing up for courses, they’re available.

The common theme in all of the interviews was that the input from the teachers was valued and respected. Instead of a top-down approach, the input from the teachers was being used to drive the decision-making process. Ultimately it was the teacher’s idea to go with the integrated approach that was supported.
Parent/community influence. The science chairperson explained how parents were able to request that students be placed in certain courses despite the recommendations that had been made by their teachers.

[I]: And how are students selected for the Earth science in eighth grade?
[SC]: It would be based on the recommendation of the kids who are enrolled in the seventh-grade honors would enroll into Earth science. There are some students who do not, if they do not perform higher than mastery. Generally, 90% is a requirement, however, kids above 85 often get in. ... And kids who do well in the Regents class also opt into that track.

[I]: What grade would they need, like what’s the?
[SC]: 95. We ask for 95.
[I]: And if a student doesn’t have that 95, and they still
[SC]: And the parents want them to, there’s a sign-off waiver we ask the parents to sign off on. That it’s not our professional recommendation and they’re going against the recommendation of the professionals in the district. We have a lot of those letters though.

The teacher made it clear how the parents in Using Teachers as Educational Consultants District got what they wanted. All they needed to do was sign a piece of paper.

[I]: I see…Now what course do you accelerate students into eighth grade here?
[T]: Honors kids go into honors Earth science in eighth grade and take the Regents exam.
[I]: How are they selected for that course?
[T]: I mean they’re selected supposedly in elementary school. You know we probably have something like 60% plus of our kids are in honors at the moment, and some of those are self-selectors, overrides, parents put them in. Even though, you know, they’re on the track in seventh grade, and then we have criteria they’re supposed to meet, maintain, but again that can be overridden.

[I]: Okay.
[T]: With a signature on a piece of paper.

The interview with the assistant superintendent revealed that the district had a self-select policy, but efforts were made to inform parents and then allow them to make the decision regarding what was best for their child.

[I]: And then how are students selected for Regents-level courses?
[AS]: It’s self-, we have criteria to recommend levels for students. But for, essentially if a student wants to go into a level, unless they’re failing science in particular, it’s, it’s really an encouragement, okay, go ahead. The one thing though we have clearly identified though, is we’ve tried to inform parents. Give parents and students the knowledge that they would understand. Particularly when you hit physics and chemistry. While we’d like to think the experience in living environment and Earth science is indicative of performance in those levels, what we’ve tended to see is that it’s not really based on those science results. It’s really the math results. Because they’re so heavily-laden with mathematical concepts in chemistry and physics. So, what we’ve advised parents is don’t just look at your living environment grade.
Also look at how you did in mathematics. And that preparation. If they struggled in math, they’re going to struggle in chemistry and physics. We’ve done the correlation study already, so, we know what it looks like. So that has helped a lot of parents make informed decisions, like okay, you’re going to try this then I think I’m going to have to get you a tutor or you’re going to be going to extra help every week for chemistry and physics.

Informing parents about the correlation between students’ math performance and how they would do in chemistry and physics helped parents make better decisions. Ultimately the decisions rested with the parents.

**Summary.** Due to the myriad of challenges of housing a sixth grade in an elementary school, it was decided that it would be best to shift to an integrated model. The sixth-grade teachers would teach introductory-level concepts in life, physical and Earth & space science.

Although the science chairperson was responsible for grades 7-9, he was being asked to serve as an educational consultant to one of the elementary schools. In addition, he had a teaching component that was part of his roles and responsibilities. This teaching responsibility took time away from his handling of administrative issues and providing extra help for his Earth science students.

Select science teachers from the junior high schools served as educational consultants to the elementary teachers. This practice allowed the common branch certified sixth-grade teachers to learn from science experts.

**Using Teachers as Educational Consultants** had a roll-out plan for the new standards, and have phased them in with the current sixth grade students, and then would continue to grades 7 and 8 as they entered the junior high schools. The plan was for students to be ready for the new NYSSLS-aligned state assessments when they rolled-out in their respective grades.

### 4.5 Case Study of *If It Ain’t Broke* School District

The *If It Ain’t Broke* School District was a medium-sized school district that educated over 3,000 students K through 12. It was considered a low-need school district based on its needs to resource capacity (NYSED, 2012). Only 6% of the students qualified for free and reduced lunch (NYSED, 2016). The student population consisted of 1% ELLs and 5% economically disadvantaged students (NYSED, 2018a). It was comprised of kindergarten through grade 6 elementary schools and a grades 7-12 secondary building.

The district universally accelerated all eighth-grade students into Regents-level living environment and had 97% of the students pass the Regents exam during the 2017-2018 school year (NYSED, 2018a). It also double accelerated a select number of students into Regents-level Earth science in seventh grade. These students took a combined living environment/AP Environmental Science course as eighth graders.

There was a district-wide K-12 science coordinator that did not have any teaching responsibilities. He also supervised the technology and health teachers and science specialists at the elementary schools.

Interviews took place with a seventh-grade science teacher, the science coordinator and the assistant superintendent for curriculum and instruction.
Role of the science coordinator. The seventh-grade science teacher explained that instead of having a single announced and a single unannounced observation, he was observed up to eight times over the course of the year by the science coordinator, using mini-visits because the district used the Marshall Plan for its APPR (Annual Professional Performance Review).

Interviewer [I]: Great. …Who formally observes you?
Teacher [T]: That would be our coordinator. So, in this case its [science coordinator]. But, the … observations here are done with the Marshall Plan here, which is mini-visits. Instead of two full visits, maybe one announced and one unannounced, so here the visits are all unannounced. And they take maybe, depending on the length of the mini-visit, somewhere around ten minutes. And they may be done once a month for up to seven or eight visits a year. So, initially I think we were even looking at ten visits a year, but I think they’ve cut it back a little bit, but that’s the way it’s done here, so.

The science coordinator confirmed that he supervised the science teachers, as well as the technology education teachers. Since the district was not large, he had this additional department.

[I]: Great. Which teachers do you supervise?
Science Coordinator [SC]: I supervise all of the science teachers at the secondary level, as well as all of the technology teachers at the secondary level, and the science specialists at the elementary levels.

The science teacher explained how the science coordinator played a vital role in linking the grades that were in different buildings, such as linking the sixth grade with the seventh and eighth. He described it as being ideal.

[I]: And … your coordinator, does he observe sixth grade teachers? Is he in charge of sixth grade teachers?
[T]: Yes. Absolutely. So, he’s in charge of that. I mean our coordinators are K-12.
[I]: Oh. Okay.
[T]: So, our coordinators would even see kindergarten through twelfth, but right now it’s ideal, because you have one person, a coordinator, who’s able to bridge the sixth grade to the seventh and the eighth. Yeah.

The science coordinator explained how he was primarily responsible for informing the science staff about the new science standards.

[I]: And how were staff informed of the New York State Science Learning Standards?
[SC]: Mainly be me.

Assistant Superintendent for curriculum and instruction explained how the teaching responsibility from the science coordinator’s position was removed because the job was too big.

[I]: And who supervises science instruction?
Assistant Superintendent [AS]: We have a coordinator, K-12 that oversees the content area for science, technology, health.
[I]: And is that district-wide or a building-level position?

[AS]: It’s a district position.

[I]: So, is there any teaching responsibility that goes along with that?

[AS]: No.

[I]: Okay.

[AS]: There used to be. But it became too big of a responsibility, so we took it away.

When it was realized how many responsibilities the science coordinator had, the teaching component was removed from the position. This change allowed the coordinator to focus solely on administrative matters.

**Hierarchical organization.** The assistant superintendent described the organizational table shown in Figure 15. He explained how he supervised the coordinators, while the superintendent of schools directly supervised the directors. He also explained how directors were in charge of the entire program, whereas coordinators chiefly supervised the teachers.

![Organizational Chart](image)

*Figure 15. Table of Organization for If It Ain’t Broke School District.*

The assistant superintendent provided some additional information about the organizational table.

[I]: I see. And I know you shared with me last time the...organizational table.

[AS]: Yes, that’s actually in flux. There are some changes coming this summer. One of them is actually, so I gave you some erroneous information. Because the organizational table we did establish last year, the superintendent was new last year.
He wanted to work with the directors directly last year, and gave me the coordinators, only the coordinators, math, science, social studies. So, I think we should go with what technically happened last year. So, take the directors out of there.

[I]: Okay.
[AS]: For me, for me. Cause the superintendent did the directors.
[I]: What would you say is the difference between a director and a coordinator?
[AS]: A coordinator, the director ...overssees more than just the teachers in a program. There’s a lot of ... state and federal regulations. They oversee the entire program, all the logistics, the legal stuff, the entire subject area of the program in addition to supervising the teachers. Where coordinators mostly just deal with the teachers directly, I do the other stuff for their subject areas.

[I]: I see.
[AS]: The grant, the grants and state grants, Title 1 and Title 2. Things like that.

There were directors for some areas, such as instructional technology and libraries, yet district coordinators for the academic areas. The district coordinators for the academic areas were at the lowest rung in the organizational table.

**Building grade-level configuration.** The issue of having the sixth grade in a separate building from the seventh and eighth grade was mentioned numerous times throughout the interviews. The science coordinator was making a concerted effort to include sixth grade in the 6-8 grade band.

The teacher explained how the sixth grade was part of the 6-8 band despite being housed in the elementary buildings. The middle-level curriculum needed to be covered over 3 years, instead of only over 2.

[I]: Great. So, how, if this school is 7 to 12, how’s the layout of the other buildings, do you know, like what grades?
[T]: The other buildings go from kindergarten to sixth grade. And there are [number] elementary schools in this district. So those [number] districts culminate with a sixth grade that we are looking at more closely over the last few years to integrate into a middle level science. So, we can kind of coordinate sixth grade with seventh and then eighth. And particularly going forward, that would mean we could then split-up the responsibilities of the course load into a 6, 7, 8, rather than overloaded in just the 7, 8 up here in the middle school.

The assistant superintendent confirmed that the 7-12 secondary school was a unique configuration.

[I]: How are grades organized within your buildings?
[AS]: Elementary is 1 through 6 buildings, 1 through 6, and then one secondary building, 7 through 12. Which is a little unusual in this day...on Long Island. A little unusual. There’s a few districts that have it like that.

**Curriculum.** Since all eighth-grade students were universally accelerated into Regents-level living environment, planning had to be done to decide which topics were to be taught in grades 6
and 7 to expose students to the middle-level band of NYSSLS at the same time preparing students for the living environment course.

The teacher identified the topics taught in grades 6-8 in Figure 16.

![Topics Taught At Each Grade Table]

Figure 16. Topics taught in grades 6-8 at If It Ain’t Broke School District.

The teacher explained how it was determined which topics would be taught at each grade level.

[I]: Would you be able to fill this out for me to the best of your ability? It’s just what topics are done.

[T]: Yeah, I don’t mind doing that. In fact, we had done a scope and sequence ourselves, and so, I kind of have that, a little bit here. Like in sixth grade, what we’re looking at is to start off with some introduction to science. And actually, I would say also, we do that in seventh grade as, we call it a first quarter science skills. And so, the introduction to science in the sixth grade would include some scientific method work, some graphing. They have it, we have it for maybe about one month sixth grade. And that would include the scientific method, and graphing, and I would even start this one, safety. Cause that’s covered. And that, and that safety is covered throughout. So, we have safety in sixth grade, safety issues in seventh grade, and don’t forget our classrooms appear a little bit different than the elementary school, so. And then in eighth grade too they would have safety. The nice thing about eighth grade is, one of the advantages to eighth grade is that it is the living environment course with the Regents at the end. So, we can cover all of the life science requirements of NGSS in the eighth grade. Which leaves us sixth grade and seventh grade to cover the Earth
science requirements and the physical science. So, I’m going to put here for grade eight, that’s a life science Regents course. And actually I think that’s enough there. That’s a full course, a Regents course. And in a way NGSS has their requirements that are more than covered in that course. So, that’s not a problem for them. In the seventh grade, what we do with the seventh grade is after the first quarter of science skills, we go to what I would call an introductory physics course. And that’s covered in NGSS in part of the physical science piece. And then an introductory chemistry. So that would be second quarter. I’m just putting this down to sort of give you an idea, where it falls. This would be the third quarter. And then in a nice way, in the fourth quarter, we have a little bit of a transition, a nice liaison of life science. So, I’ll put life science. So, this way, we do a little bit of work on the cell, a little bit of work on the microscope. Some of the things then that obviously are covered typically pretty early in the Regents course in eighth grade. So then in a way they have the microscope at the end of the year in seventh grade, and they lead that right into the microscope in pretty much the first quarter of eighth grade. So that this would be your first quarter, second, third, and this would be fourth. All of this can be incorporated into NGSS very easily. It’s a question of how we do it and how, how much is involved with that. And as, at this point, we’re still in an early phase of kind of looking at that. Going back to sixth grade, the introductory to science, scientific method, graphing, safety. I’m just looking here. They have some here, Earth science that we don’t cover, if you notice, in the seventh grade. So that would be the piece that we would anticipate sixth grade covering that. And then, the question then becomes, how much of this will be the meteorology, or geology. I mean that to be determined but, my sense is, we’re pretty full right here with these three quarters. So, we can’t in seventh grade, cover too much with Earth science. We would depend on the sixth grade to do that. We’ve got all the life science handled here.

He explained how the sixth-grade teachers needed to teach the Earth science material since the seventh-grade teachers were teaching physical science and a quarter of life science to prepare students for living environment the following year as eighth graders.

This idea of needing to get the sixth-grade teachers to be part of the 6-8 grade-band was confirmed by the science coordinator. He also mentioned the freedom that the middle school teachers had because they did not have the pressure of the Regents exam.

[I]: Great. So, specifically the middle school-level, the 6-8, how are they being implemented in those grades?

[SC]: You mean in terms of how I’m distributing the content? Which standards are going with which grades kind of thing?

[I]: Exactly. Because how they left it, it’s not grade-specific, like it is for K-5. So, you have more control for 6-8 so, I’m just curious how it’s being

[SC]: That’s one of the reasons why I’m starting there because you do have some freedom there. You don’t have to worry about Regents exams and anything like that. But I actually do have to worry about the Regents exams because we universally accelerate in eighth grade. So, it actually presents an interesting problem for me because in the 6-8 band, sixth grade is in the elementary school, the seventh grade is here and they do sort of a general science class. And then the eighth grade all take living
environment. So, the really only way I can see to implement was to put all of the life science standards in eighth grade because we’re already preparing for the living environment. So, they’ll cover all of those. And then split up everything else between the sixth and seventh grade. And the way that’s sort of starting to fall out is probably Earth science concepts, Earth & space science will go into sixth grade and seventh grade will cover physical science. And then the eighth grade will still cover the life science. And that’s kind of how it would be divvied up among my middle school band.

The science coordinator explained how the universal acceleration of living environment in eighth grade forced his hand to offering a domain-specific approach in grades 6 and 7. He chose Earth science for sixth grade because the teachers had already been teaching those topics and it was easier to leave the Earth science lab materials at the elementary schools.

[I]: And so are you going with an integrated approach or more of a discipline, or domain-specific approach?

[SC]: As far as the implementation of the standards?

[I]: Yes.

[SC]: I’m doing more of the domain. Because I’m kind of forced to, because the eighth grade is devoted to the life science. So, I’m not going to get anything done in the eighth-grade other than the life science standards. Which means now I could go integrated and do a little bit of both in sixth grade and a little bit of both in seventh grade, but since they are in two different buildings and I worry about equipment use, I worry about lab use, and lab materials. I figured it was better to really just divvy it up and do physical science in one, Earth science in the other and that way I can put, like I can bring all of the stuff I need for the Earth science to the elementary schools and I can just leave it there.

[I]: Gotcha.

[SC]: So, a lot of that is materials-driven more than anything else, and lab-driven. Plus, it’s easier to do, I think, the Earth science labs in an elementary school than it would be, like, physics and chemistry.

[I]: So, the factors that impacted this decision were the materials, anything else besides that?

[SC]: Lab space and use. Equipment. I mean I could move a lot of it. And then also the comfort level of the teachers. You know, I think they’re going to be a little more comfortable with the Earth science. If you look at the curriculum that I inherited, that I’m changing, they do a lot of Earth science already. That it’s kind of a natural for them to just expand it. They used to already do a lot of Earth science and then they’d have a little bit of physical science, but not much. So, it made sense instead of making a huge change, cause I kinda could have gone either way with it, to just keep on let them do what they’ve been doing already and just expand it and then, and then, just make it very specific by grade.

The science coordinator explained how it was easier to make small changes to what was already being done, than to make drastic changes. Since the sixth-grade teachers had mostly been teaching Earth science, it was easier to keep that subject in that grade.
The assistant superintendent confirmed how the middle school band was covered in grades 6 and 7, but he did not mention how Earth science was no longer part of the seventh-grade curriculum and now was being taught in sixth grade.

[I]: And how is having Living Environment in eighth grade, how does that impact what’s done in grades 6 and 7?

[AS]: In 7 we revamped that course to cover a little bit of all the sciences, a little physics, a little chemistry, Earth science, … We took some of the living environment material out that was originally in seventh grade. So, they get a taste of all that before they go into living environment in the eighth grade. So, it’s changed in that way...It has, we’ve implemented … some skills and work habits, let me just turn this off. Skills and work habits they’re going to need for the more rigorous work in eighth grade, we’ve embedded them there into seventh grade and into sixth grade.

He also described a more rigorous pathway for the most advanced science students that had students start with Regents-level Earth science in seventh grade and then take a combined living environment/ AP Environmental Science course in eighth grade. By starting with Regents-level course work in seventh grade, the middle school science program essentially did not exist for these students.

[AS]: So, then there’s this other pathway that’s even more rigorous than the one we were discussing. And that’s for just a handful of students, typically one class worth. Sometimes, some years two. Where they actually take Earth Science Honors with the Earth Science Regents in the seventh. Then they take living environment …and AP Environmental Science, together, they take the Regents and the AP exam in eighth grade. Then they take the AP Biology in ninth grade. Then they take AP Chemistry in tenth grade. Then they take AP Physics 1 in eleventh grade. Then they have other choices in twelfth. They can take AP Physics 2, they can take AP Physics 3 …in twelfth grade.

The assistant superintendent also described how a program called Project Lead the Way was brought in to meet the engineering standards that were part of NGSS. It was started at the elementary grades and in the high school. It would eventually get to the middle school as it followed the students each year as they progressed to the following grade. He described the middle school grade curriculum as still being a work in progress.

[I]: How is science taught in grades 6 through 8 specifically?
[AS]: …What do you mean by how?
[I]: As far as which topics would be taught in which grades?
[AS]: Well, we’re still in that process. We haven’t, we haven’t decided yet. As I said, we’re only, we’re up to grade 3 in Project Lead the Way right now, along with our own curriculum, so we’re only meeting to discuss it with the science coordinator now.

Project Lead the Way was available at the high school and up to grade 3 in the elementary school, but had not made it to the middle-level grades yet. The middle-level grades were left for last yet again.
**Standards.** The new standards were gradually being implemented, one unit at a time at the middle-school level, with a greater implementation starting at the second-grade.

[I]: Great...How are, how is NYSSLS being implemented this year?

[SC]: This year we are implementing it completely at the second grade. My science specialist did curriculum writing over the summer with second grade teachers, so they started this year in second grade. The idea at the elementary level is for them to start in the second grade. The first year that I’ve heard for implementation is 2021 at the earliest I think, or 2022, I forgot. I think it’s 2021. But it coincides with that. So the grade that I started with, which is second grade, they will hit fifth grade in the year that they said is the first year that we may be giving the new tests, so that was the plan for why we started in second grade. At the secondary level we’re just kinda doing it on a unit basis. So, my seventh grade and my eighth grade have been, tried out, each tried out a unit. You know really more like a lesson than a unit, a mini, a mini unit...following the standards.

[I]: Great. And what is the plan for next year?

[SC]: So next year we’re going to do the same thing we did in second grade, but in third grade. So, we’ll add them in, we’ll write curriculum...and introduce a whole new sequence, you know, a whole new curriculum in third grade. And then sixth and seventh grade will expand their use, maybe do a full unit, ...or maybe several different lessons. And then in sixth grade we’ll also start implementing a little bit cause I want that 6, 7, 8 band nailed down. And probably not much more than some dabbling, maybe a lesson beyond that at the other high school classes yet.

The teacher confirmed what the science coordinator had indicated, about starting with the elementary grades and then gradually working up to the middle-level grades.

[I]: So, how are the New York State Science Learning Standards being implemented this year?

[T]: I think right now, we’re at a point … where we have tried for example, over the last, say, one lab activity, last year, we kind of have, have folded it in slowly that way. Partly I think because we’re not exactly sure where this is finalized. And so, without that finalization, we’re, we’re just folding in some of the lab activities for practice if you will. Yeah.

[I]: And what’s the plan for next year?

[T]: The plan is for elementary school they’re moving more swiftly than the upper grade levels. So, we’re going to kind of fold that in. By the time, I think it’s 2022, where it’s going to more impact … the higher levels here. But the elementary school has been more a focus, and they’re going to be moving on that more soon.

[I]: So, specifically implementation at the middle-level grades, 6-8, is there a plan in place for how these new standards are going to be

[T]: The plan right now is more focused on a division of curriculum, but with that, and I’m just sharing some of the standards I’ve taken notes on, so, for example, if you have something here where it says for example “Analyze and interpret data on the properties of a substance before and after it interacts to determine if a chemical reaction has occurred.” Well, that’s the standard, and then we would look, we’re slowly looking at

124
the science and engineering practices, the disciplinary core ideas, and the cross-cutting concepts. I think at this point, we’re all getting more familiar with the focus on it. I think the key is we’re all doing this right now, which is a good thing. We all have in place a curriculum that covers the standards. The key for [school district] is to now just sort of meet NGSS and do it in a way that the teachers are comfortable with it, so they can communicate that to the students. And I’ll just share this with you, in speaking to other teachers and even for myself, it’s important going forward that, that whatever we end up with, is clarified enough so that teachers feel very comfortable with the activities, and how we want to approach this, so the students get the best out of it. Otherwise, because if teachers are confused by it, or in some way it looks too complicated for them, it’s going to break down.

As explained by the teacher, the buy-in on the part of the teachers was the most important element for successful implementation of the new standards. The teachers had to feel comfortable with the new standards, or else they were destined to fail.

The science coordinator also expanded on the biggest challenges of implementing NYSSLS. He explained how teaching more in depth required more time, and was unsure of how the new Regents exams would look. He was concerned with the time requirement to teach more in depth when not much content was removed.

[I]: And what are the biggest challenges in implementing NYSSLS?
[SC]: The biggest challenges in implementing it is, well first you’re teaching more in depth, the style of teaching is more time consuming, so if you really do it the way they designed it, you have to use more time to do it. And when you really look at what we have, they haven’t taken a whole lot out. So, you know, if you’re going to teach it deeper, you teach less. But they don’t really give us less. They really have given us, it seems it’s a little less, but it’s not that much less. I really feel that that’s one place where they really tripped up. I really feel this was an opportunity to change the way we were going to do it, and if you’re going to go more in depth and have students do discovery learning, and engineering and build things, then that’s great, but let’s not teach a whole bunch of stuff so that we can spend time on the stuff we do want to teach. And instead they kind of tried to serve both masters by doing both. Well, we don’t want to lose content, but we want to teach it in more depth, and teach it, you know, much more inquiry-based, it’s not going to…I think it’s going to be a big problem. Once we really get into, I mean I haven’t gotten into the heavy -duty implementation yet, so I haven’t really hit any of these problems yet, but that’s what I anticipate. And then, and then meshing it with the Regents, I think is going to be a huge challenge. I’m still not sure how they’re going to do that. But again, those aren’t things we’ve had to cross yet, we haven’t had to cross those bridges yet, but I see it coming as a problem.

The alignment between the standards, instruction and the assessments was an area of concern. The science coordinator was concerned with how the new standards would be assessed on the Regents exams because the students did not take the ILS exam. The middle-level grades were not an area of concern because the students did not take an assessment at that level.
The assistant superintendent described how the implementation of the new standards depended on the teachers and getting them to change. He confirmed that teacher buy-in was the biggest obstacle, a sentiment echoed by the teacher that was interviewed.

[I]: Great. And what are the biggest challenges in implementing the New York State Science Learning Standards?

[AS]: Probably the shift required, the teacher shift. Having them to have a conceptual and pedagogical understanding of the shift. And then internalizing it. And enacting it, actually, implementing it is the biggest challenge. Change. Change is always the biggest challenge. And then, cause then whenever the state changes things, it always takes time and a process and really skilled leadership to try to get people to come around and some reason or rationale for doing it. But everyone comes to that understanding at different rates, times. So, trying to get a whole department or a whole school district in one discipline to make the shift, it’s challenging. So, I think the teacher shift is the most challenging part. You can do all the paperwork, you can give out curriculum, you can share the standards, you can bring people in, you can send people out, but until the lesson plans actually change, or the department or the district provides those lesson plans or unit plans, and then even if they do, getting the teachers to change is always the most challenging part. I remember that as a teacher myself, I taught for twenty something years, getting me to change was not easy. (laughs) I remember, I remember that. Every teacher thinks that what they do is, not every teacher, but many teachers think that what they do is really superior, maybe a lot of it is, but you hold on to it for that reason. Plus, you’re really familiar with it. You do it to an expert level. It’s kind of, you think you do it to an expert level, or you do, whatever, but, it’s hard to change.

Teacher certification. The teacher explained how teacher certification had not been much of an issue at the 7-12 building because most of the teachers had the general science certification. This certification allowed them to teach any of the “middle-level” science courses. He actually preferred that general science teachers taught physical science as opposed to chemistry or physics certified teachers.

[I]: …Did the teaching certifications held by the middle school science teachers … did that impact what, what topics would be taught in grades 6 and 7?

[T]: Not really because, you know, you have general science as a certification that we all have, and then the biology certification, … is covered in the eighth grade. So that worked out very nicely. …Could you argue, would you rather, for example, have a certified chemistry teacher come in and do the chemistry portion of seventh grade, or a physics certified person come in? I’ve thought about that a little bit actually. And I like the idea of middle-level people who have that priority and that focus teaching those kids. Because, you know what, you’re really teaching kids. You’re teaching them. The curriculum becomes an avenue, if you will, for reaching children. And I’d much rather have a general science teacher who knows middle-level teaching the chemistry portion and the physics portion than necessarily a certified physics teacher or chemistry teacher. But we don’t need that. It’s not a requirement, so, so because we’re all general science, we can meet the criteria for, for Earth science in sixth grade, and then
seventh and eighth.

The science coordinator explained how the sixth-grade teachers were certified to teach science due to their elementary certification, which allowed them to teach all of the subjects. He was unsure if any of them had a 5/6 extension, but then clarified that they were elementary-certified teachers that “just happened to do the science.”

[I]: And what about, like, teacher certification? Does that become an issue at all for making that choice?

[SC]: Not really. That’s one of the advantages of the mid, of the secondary school, 7-12. Everybody’s in one building. You know, so I have, all of my living environment teachers are here, but if I wanted to do something different, I could have, cause all of my other teachers are still here...so it wouldn’t really have been much of a problem. You know, the sixth graders doing the, the sixth-grade teachers doing the Earth science standards, they’re not going to be certified in Earth science but at the sixth-grade level they are certified for general science in that, in that realm. They’re not ending in a Regents exam, so it still covers it.

[I]: Do the sixth-grade teachers here, do they have the elementary certification or are they secondary teachers with the 5/6 extension?

[SC]: They vary. I’d have to look at every single one of mine to see which ones they are. Cause we have four. We have four different teachers that do it between the [number] buildings, that specialize in the science. I know they have the 5/6 one, but I don’t think they have anything beyond that.

[I]: Okay. So, they’re elementary teachers?

[SC]: They’re elementary teachers who just happen to do the science.

The science coordinator explained how the sixth-grade teachers either taught English language arts and social studies or science and math. It was mini-departmentalized.

[I]: I see. So those teachers only do science?

[SC]: Those are the only two that do science, but they also do other things.

[I]: Oh, okay.

[SC]: So, there are some that do science, but they also do math. Like one of mine, one of those four actually also does the advanced math classes as well as the science.

The assistant superintendent also described the elementary science teachers as being elementary-certified teachers. He explained how these teachers had received extensive professional development in science.

[I]: And...at the sixth-grade level, ...who teaches science ...at that grade level?

[AS]: Elementary-certified teachers, not science specialists.

[I]: Okay.

[AS]: Except our elementary school, some schools around here have it, but not everyone has it, is a, we also have an elementary-certified teacher who has been trained to work in science only for ... many, many years. You know attended a lot of professional development in science, and that’s their specialty so to speak even though they’re not certified in science specialty. They’re just an elementary-certified teacher. Shouldn’t
say just, but you know. They’re not a content specialist.

Assessments. Since all eighth-grade students took the Living Environment Regents Exam, students did not take the ILS exam. The science teacher explained that the school had local assessments such as common mid-term and final exams that were used to assess how well students were learning the material.

[I]: How you’re evaluating if they’re getting what they needed at the middle, at the middle-level?

[T]: Well, we, well we have coordinated mid-terms. So, we’re all giving the same mid-term and the same final. I mean, so that piece is in place. And you know what, and it’s covering the curriculum thoroughly, cause first of all, I, I taught the eighth-grade intermediate science. I mean, I’m here that long. So, I know we are covering what that test covered. But, we do it differently. But, we do it consistently. Yeah. I, I have no doubt that no matter what teacher they have in seventh grade, they have covered the … chemistry portion, the physical science portion of the ILS … and also the living environment portion of it. Yeah.

The science coordinator explained how he wanted to see a seventh-grade final exam that covered material from both grade 6 and grade 7 before students took living environment as eighth graders. This practice was not in place yet, but something he wanted to implement.

[I]: And with that changes you are making to the middle school, going like domain-specific for sixth and seventh grade, how are you going to plan to assess if that program is working?

[SC]: We do, well the sixth grade I haven’t really even thought about yet. I’m not sure I want to introduce a new exam there to assess it. Seventh grade we do give a final exam in our middle school class. So that would be the assessment there. I guess once we really get into full implementation, we would probably make that final exam almost a two-year exam, where it would cover some of the things they learned in sixth and some of the things they covered, learned in seventh grade. I haven’t really fleshed that all out yet. And remember I really don’t think I’m going to be held to an eighth-grade assessment. So, I’m not overly concerned about that. You know in terms of having to have kids pass the eighth-grade assessment, they’ll probably just be taking the Living Environment Regents.

By not having to worry about students taking the ILS exam, the middle-level teachers had more freedom and flexibility.

The science coordinator elaborated on how well students had been doing taking the Living Environment Regents Exam in the eighth grade.

[I]: With this decision to do universal acceleration, how has it been working out?

[SC]: That’s been fine. That was made really prior to the new standards. It really wasn’t made in conjunction with the new standards. It’s my understanding, you know, I wasn’t the one that did it, but the year I got here was the first year that it was implemented, so I didn’t really design it. But it’s been working out really well. The
living environment kids, the first couple of years I did a comparison of living environment kids from the high school with the middle school. Cause it also flipped our sequence. We used to accelerate eighth graders into Earth science, but it wasn’t universal acceleration, so some of the kids were accelerated into Earth Science in eighth grade and then those kids were perpetually a year ahead of everybody else and there was really no way to get there unless you skipped a class or took something over the summer. It did away with that problem entirely. Now everybody is really on the same path and everybody in the same year is taking the same classes which is great. That first year, I had double living environment cause of the flip in the sequence you had eighth graders plus all of the ninth graders and tenth graders were all taking it simultaneously. I had literally over 500 kids taking living environment, where in a normal year it would be a little over 200. The results when you looked at them were completely comparable. The eighth graders did just as well if not better than the ninth and tenth graders did. And we maintain that level. So, there’s been no drop-off in student performance, which has been really good.

The benefit of universal acceleration was that all students were taking the same course work in eighth grade. There were less decisions to be made regarding what accelerated students would be missing that students in Science 8 were learning. All students were learning the same material.

The assistant superintendent corroborated how the Regents exams were the high-stakes assessments that really mattered for the district. He did not see changes happening to the high school curricula until the assessments changed.

[AS]: The state has recently told us, they have not given us an answer on whether the Regents exams are changing or not. They don’t know, because if they keep them the way they are, then they still will have to be taught discretely, you know, physics, chemistry, living environment, etcetera. The state itself has not changed the assessments. The schools are not going to change until the assessments change, at least not completely. You can’t change the structure of a living environment course if your end of the year assessment required by the state is still the Living Environment Regents, you know what I mean?

The high school teachers had the least amount of reasons to change what they were doing because they were teaching the old curriculum and having their APPR score derived from assessments based on the 1996 MST Learning Standards. In the secondary building, only the seventh-grade teachers were teaching a course that did not culminate in a Regents exam.

Professional development. There had been a considerable amount of professional development to prepare the teaching staff for NYSSLS. The teacher explained how the staff had been supported.

[I]: Great. How were staff informed of the new, New York State Science Learning Standards?

[T]: We’ve done a few things with that. Our coordinator has shared with us, different seminars that have occurred, actually, all of the seventh-grade teachers attended last
year. There were a number of them given through BOCES. And so, we attended …about one each, each person did that. I’m trying to think if there’s been others. The other things that we’ve done is, is our coordinator has shared with us just some of the documentation that has been coming out from NGSS. And so, we’ve looked at that and we’ve actually begun to divide and separate the categories by grade-level. That he feels, the coordinator, that by the time the children are done with eighth grade, they would have had basically the NGSS curriculum met for Earth science, for physical environment, and then for the living environment.

The science coordinator expanded on the professional development that he had provided to the teaching staff. Much of it had focused on the new science standards.

[I]: And how were staff informed of the New York State Science Learning Standards?
[SC]: … I’ve been working it in for the last couple of years, actually, as we’ve been leading up to it, through department meetings, professional development that we’ve been doing. We’ve been carving out time on Superintendent’s Conference Days, where we have time I’m allowed to designate. So, I’ve been using some of that time to get them accustomed to it as well. You know, first off, I did a whole big introduction on how to read the standards, and what they’re about, and then have them all look them over. And you know, we’ve been building up from there to the point now where we’re starting to get ready to design lessons and actually doing implementation.

The assistant superintendent confirmed that the professional development lied primarily with the science coordinator. He generally gave the approval after confirming the justification for the professional development.

[I]: ...What about professional development on the new standards? How is that coordinated for teachers?
[AS]: Well the science coordinator makes recommendations to me. Typically, I just start to probe about the appropriateness of it and what the rationale is for it. And then typically I grant the recommendation for the professional development whether it be sending teachers out, or bringing people in.

The district was supportive of professional development of its teachers at the discretion of the science coordinator.

Collaboration. The It Ain’t Broke School District had a lot of collaboration which was facilitated by having a K-12 science coordinator. According to the teacher, the coordinator helped to keep open lines of communication between sixth, seventh, and eighth grade teachers.

[I]: Is there communication between the sixth-grade teachers with the teachers here?
[T]: Oh, yeah. We’ve had, … we, we have had meetings among the sixth graders and the seventh-grade teachers. For most part that’s, and the eighth grade. Because it works out that many of the eighth-grade teachers also would have a seventh-grade course. So good for them in that they’re not only teaching the Regents course to eighth graders, but they have the experience of the year earlier, some seventh grade. Now those, those teachers in eighth grade, have met with the sixth-grade teachers. Have we met enough?
I could see us meeting a little bit more as we all get a little bit closer to the enactment of NGSS.

The teacher also spoke about how the teachers collaborated with one another and also with the science coordinator.

[I]: …And then so how does this current scope and sequence that you drew out for me, how is that different from what it may look like next year or even the year after that?
[T]: I don’t think, I don’t think it will be that much different. I think that the district is quite content with the eighth-grade program in, in, you know, life science, the Regents, the living environment. I think in seventh grade, it, it, there’s some flexibility there. We’re constantly discussing that with the coordinator level, with each other and saying, you know, is this really the direction we want to continue in? And the same with sixth grade. I think it’s a little bit more fluid in that way, but we’re, we’re quite content, I think, going forward with, with the direction we’re going in. I think the key for NGSS is how do we incorporate the … philosophy of it, if you will, into what we’re doing? Now we’re not a lecture-based program in the least. So, we don’t have a problem with that aspect, but as far as going forward and, and … utilizing self-discovery maybe a little more, integrating engineering a little bit more, that’s going to be a work in progress.

This idea of collaboration between the teachers was confirmed by the science coordinator. To facilitate this collaboration, he purposefully scheduled the seventh grades teachers to also teach the Regents-level living environment course to the eighth graders.

[I]: And being that this building here is a 7-12 building, are there teachers who only teach seventh and eighth grade and then other teachers who just teach at the high school level? Or there are some teachers who, let’s say, teach Regents-level courses and then also teach seventh and eighth grade classes?
[SC]: In different years we’ve had it in different ways. You know this year, it just so happens, the way I organized it, and it is intentional, I’ve organized it that my eighth grade living environment teachers are also the same teachers teaching the seventh grade. So, they do tend to be purely middle school teachers…In the past it hasn’t quite been that way. We’ve brought down some people, maybe, you know, maybe a chemistry teacher, or an Earth science teacher to teach some of the seventh-grade classes as well. But this year the seventh-grade classes are all being taught by teachers that teach the living environment classes.

The collaboration between the sixth, seventh and eighth grade teachers was corroborated by the assistant superintendent. He described the teachers meeting together as a team.

[AS]: We’ve asked the sixth, seventh, and eighth grade teachers to meet as a team so they can kind of sequence as best they can, what content goes where and recommended to the coordinator and then to me. And so, we’re in the midst. We made some of those tweaks last year and we’re going to make some this summer, for the following year. So, we’re in that process.
The teacher explained how the teachers were part of the decisions-making to universally accelerate all eighth-grade students into Living Environment. He explained how the Board of Education was involved with the decision, as were all of the different levels of the organization.

[I]: So, one last question is what was the rationale for having universal acceleration in eighth grade?
[T]: That is a very good question. And, I would say, this goes back probably now, 6 years. Could be 6 ... I think there was a thought that, for a number of reasons. The ILS exam was, as good as it was curriculum wise, the nature of it wasn’t really that effective. We didn’t find it to be necessarily in the best interest of [school district] moving forward. And the Board of Ed was involved in this. Probably started at the coordinator and principal level, but it moved up there and they conferred with us. And I think that was one of the reasons. They decided with the ILS course not being that effective...

In essence, by not having any students take the ILS, there really is not much of a middle-level program. The focus tends to be on preparing the students for the Regents exams.

Parent/community influence. The teacher explained that although there was an honors-level living environment course and a non-honors Regents-level course, parents were not able to override the seventh-grade teachers’ recommendation. Since all students were going into living environment, it was not an issue. By having universal acceleration, the idea of parents pressuring for their children to be in certain courses was eliminated.

[I]: And then if a student was not recommended for the honors living environment?
[T]: Then they go in the Regents living environment.
[I]: Is there a way for them to self-select, you know to have
[T]: No.
[I]: To have the parents want the kid in honors?
[T]: Not here. In [school district], what we’ve been able to do here, there is a certain amount of override we would call for high school students. But seventh into eighth grade, is a recommendation from the teacher based on your grades. So, no, there’s, we keep that, in a way, because it’s already accelerated for all, into the eighth grade, we want to be sure that it’s a good fit. And, you know, you don’t want to have children that could struggle quite mightily at the age of thirteen in eighth grade being in that honors living environment. So, we, we give enough choice there. They’re both living environment, just one’s honors, and one's Regents.

The assistant superintendent described a double acceleration program for select students that allowed them to take Regents-level Earth science in the seventh grade and then a combined living environment/Advanced Placement (AP) Environmental Science course in the eighth grade. The students had to meet extensive criteria, as read by the assistant superintendent.

[AS] … “As you are aware a very small number of sixth-grade students will be identified for possible participation in the AP intensive science pathway starting in seventh grade. This is an extremely rigorous pathway that will launch students immersed in highly challenging high school-level course work in grade 7. And then moving on to the college-level AP work in grade 8 and beyond. This course sequence will require
the highest level of analytical and mathematical skills, outstanding cognitive reasoning abilities, as well as an exceptional work ethic to keep up with the expectations and the quantity of work assigned.” So that just gives you an idea of what we’re talking about. I’m trying to find the specific criteria they ask for. They ask the students and parents to “provide their whole assessment record from fourth, fifth and sixth grade, ask for the science related experiences, …in school and out of school, a personal statement indicating the reasons for wanting to be in this pathway. There needs to be a faculty recommendation from the current science teacher and the current math teacher in sixth grade,” … “there is an interview.” Then, “they’ll be notified of their status in July.” And then, “the science teacher recommendation assesses certain, certain things on a rubric: laboratory skills, scientific reasoning, ability to draw a conclusion, scientific understanding, attention to detail,” blah, blah, blah.

Parents could not self-select their children into this most rigorous pathway. They had to be chosen.

[I]: If a parent wanted to self-select their child into that course, is that something that could happen?
[AS]: Which one?
[I]: The seventh grade Earth science Regents course.
[AS]: No.
[I]: Okay. So, they have to be chosen? They have to be selected?
[AS]: Yeah. Yeah.

By having universal acceleration, *If It Ain’t Broke* did not have an issue with parents demanding that students be placed into an accelerated course during the middle-level grades.

Summary. *If It Ain’t Broke* had already moved to a universal acceleration model for all eighth-grade students into living environment prior to the release of NGSS. There were changes occurring at the elementary level, starting with second grade, to prepare students for the fifth-grade elementary science test that would be in place by 2022. The middle-level grades had a domain-specific approach due to universal acceleration. Sixth grade would teach Earth & space science concepts, allowing seventh grade to teach physical science and a quarter of life science to prepare students for Living Environment the following year. Since no one took the ILS exam, the last quarter of seventh grade was preparing students for the Regents-level courses they would take in eighth grade. By having a select group of students start Regents-level science courses in seventh grade, a middle school science program was virtually non-existent for those students.

Although the sixth grade was housed in the elementary buildings, this issue was overcome by the role of the science coordinator. He was able to provide articulation between the grades despite the fact that sixth grade was not part of the secondary building. Although this position had a teaching responsibility in the past, it was removed since it was apparent that the job was too big.

4.6 Case Study of One Unit at a Time School District
One Unit at a Time was a small district that educated approximately 1,500 students. It was a K-12 school district with K-3 building(s), 4-6 building(s) and a 7-12 secondary school. It was considered a low need district based on its needs to resource capacity ratio (NYSED, 2012). Eight percent of the student population were ELLs and 24% were economically disadvantaged (NYSED, 2018a). Twenty-three percent of the students were on free and reduced lunch (NYSED, 2016). Despite being considered a low-needs district, the district had almost a quarter of its population on free and reduced lunch. Perhaps the disparity between the wealthy and the impoverished was so great that overall the district was considered low-needs.

Interviews were conducted with a sixth-grade science teacher, a seventh-grade science teacher, the K-12 science supervisor, and the superintendent for schools.

**Role of the science supervisor:** The science supervisor played an important role in this small school district. She observed teachers in grades K-12 and was instrumental in getting teachers to write curriculum over the summer. In addition, she had been the driving force for infusing NYSSLS into the standards. In addition to observing the secondary science and technology teachers, the science supervisor also observed the elementary teachers.

**Interviewer [I]:** Which teachers do you supervise?

**Science Supervisor [SS]:** I supervise the 7 through twelfth grade science teachers, the technology teachers, the computer science teachers. I supervise the science specialists, and the technology specialists in the buildings, and then I’m involved in supervision of and sometimes serve as lead evaluator of different primary grade levels on an alternating basis.

[I]: So which teachers do you formerly observe?

[SS]: K-12 we’re responsible for different years observing different teachers. This year, for example, I’m the lead evaluator for kindergarten. I perform unannounced observations for first grade. And I intentionally vary from year to year who I supervise at the elementary level. But I always directly supervise and am the lead evaluator for my 7 to 12 teachers, the technology teachers, and the science specialists.

The sixth-grade science teacher explained how the science coordinator helped to ensure that the new standards were being implemented.

**6th grade science teacher [6ST]:** Our supervisor also coordinates meetings during the year, within a school day, to discuss curriculum changes and what’s being met and not met and changes that need to occur.

The seventh-grade science teacher also explained how the science supervisor utilized the departmental meeting time to instruct the staff how to design assessments that included the cross-cutting concepts.

**7th grade science teacher [7ST]:** So, that’s during our department meeting. She usually has some sort of activity set-up and we go over what they are. So last, our last meeting we had a lab where there were 9 or 10 different stations and different labs and there were underlined portions of questions. And we had to go figure out this underlined portion of questions referring to which cross-cutting concept so,
we could get a better idea of how to test those sorts of ideas, and then, I guess, implement them in labs.

By experiencing this activity during the department meeting, the teachers could then implement assessments that included crosscutting concepts with their students.

The sixth-grade science teacher also stated how the decision to make curriculum changes ultimately rested with the science coordinator.

[I]: And who’s involved in curricular-decision making processes?
[T]: The science department chair. I mean she takes feedback from her teachers, but ultimately, it’s her decision.

The superintendent corroborated the importance of the K-12 science supervisor in leading articulation between the different buildings. She described the role as being vital to the district.

[I]: And being that the configuration of the secondary school is unique in that it’s 7 through 12, science at the middle school level, how is it with having sixth grade, which is considered part of the middle school, as part of the elementary, and then having 7 and 8 as part of the secondary school?

Superintendent [S]: Well … our supervisor works hard to make sure there’s articulation, the [elementary school(s)] to the high school.

Hierarchical organization. The superintendent drew the table of organization for the district. She explained how there were K-12 supervisors for the academic areas and a director for physical education, health and athletics and a director for special education.

[I]: Then who do you directly supervise?
[S]: I, as superintendent, directly supervise the principals, the assistant superintendents, several secretaries, and the K-12 directors. The directors report to the superintendent. The supervisors report to the assistant superintendent. The directors are of phys. ed, health and athletics and special education.

[I]: Okay. It’s just a different title for the directors?
[S]: The directors are a different title, they put in additional days over the summer, etcetera.

The superintendent drew the table of organization for One Unit at a Time as shown in Figure 17. She drew arrows to represent how some teachers were supervised by K-12 supervisors, while other teachers were supervised by directors.
The idea that there were directors for some areas but supervisors for other areas created inequities. The fact that the directors were supervised by the superintendent, while the K-12 supervisors were supervised by the assistant superintendent made it appear that the directors were higher in the organization.

**Building grade-level configuration.** In the interviews, the fact that the sixth grade was in a different building was mentioned multiple times. This building grade-level configuration had an impact on the communication between the sixth-grade science teacher and the seventh and eighth-grade science teachers. The need to meet more often was described by the sixth-grade science teacher.

[I]: Now the New York Standards, the band, it’s a 6 through 8 band, so do you have opportunities to meet with the other middle school-level science teachers?

[6ST]: Not as often as we’d like to because we’re in different buildings. But I’d say on average probably, probably three times a year.

The seventh-grade science teacher also explained how the sixth-grade teacher did not attend the science department meetings because he was in a separate building.

[7ST]: Yes. We spent a lot of professional development this year talking about the crosscutting concepts, how to better implement those and that’s from 7 to 12. I’m sure they’re talking about it in the sixth-grade meetings too, but our once a month department meetings are the 7 to 12 building, they don’t include the sixth grade teacher as this point.

The science coordinator also expressed the impact that having the middle-level band split between buildings imposed. There was a science specialist that taught science.
The science specialists are at which buildings?

SS: The pre-K to 2, so the [number] elementary buildings each have a science specialist. The pre-K through 2 building(s) is science/technology.

I: Okay. And the 3 to 6 building(s)? Is there a science specialist there?

SS: There is a science specialist there. And a separate technology specialist.

The Superintendent also described the configuration of the district as being ‘unusual’ but she attributed the successful articulation between the buildings to the work of the science supervisor.

I: And being that the configuration of the secondary school is unique in that it’s 7-12, science at the middle school level, how is it with having sixth grade, which is considered part of the middle school, as part of the elementary, and then having 7 and 8 as part of the secondary school?

S: Well … our supervisor works hard to make sure there’s articulation, the [elementary school(s)] to the high school.

Curriculum: At One Unit at a Time the curriculum was changing primarily at the sixth grade. This grade, which used to be an integrated curriculum, now was becoming mostly physical science. Seventh grade was primarily focusing on life science, while eighth grade was primarily focusing on Earth science. The district accelerated some eighth-grade students into Regents-level Earth Science.

The seventh-grade teacher wrote the topics for grades 6-8 shown in Figure 18.

![Figure 18](image.png)

*Figure 18. Topics taught in grades 6-8 in One Unit at a Time School District.*

The science supervisor explained how the topics were chosen for grades 6-8.
[I]:  Great. Are you going with an integrated approach or a domain-specific approach … at the middle school level?

[SS]:  We are mostly domain-specific. I would say there’s a certain amount of integration that happened. When we saw NGSS and started re-writing our seventh-grade curricula, we integrated systems into our units. So, body systems is something that we felt students didn’t understand their bodies and so, for example, simple machines and physics is being taught through the skeletal system. So, those relationships are being made in that curricula. So, we are domain-specific, with a lot of interdisciplinary topics.

[I]:  So, for instance, what domain do you do in grade 6, 7, and 8?

[SS]:  So, sixth is chemistry and some physics, seventh is living environment and ecology, and then the eighth grade is some ecological systems, but mostly Earth science and astronomy.

[I]:  And what factors impacted this decision to go with this more domain-specific type of approach?

[SS]:  Current curricula alignment, specific expertise of current teachers in a very small school district, and prior curriculum in terms of what is building towards it, so, our K-5.

Although the science supervisor described the curriculum as being domain-specific, the seventh-grade science teacher described the curriculum as being an integrated curriculum. It was a similar description, but the practitioner described it from a different lens than the chief architect.

[I]:  And would you describe this as more of an integrated approach where you do a little bit of each of the sciences each year, or more of a domain-specific approach, where it’s just one main science each year?

[7ST]:  It’s definitely more of an integrated approach. It’s not perfectly spirally integrated…. I’ve seen some where every year hits on chemistry, every year living, life sciences and physical sciences, but we kind of have more chunks of the year toward one specific unit. We definitely in seventh and eighth grade, we do come back to chemistry. The eighth-grade teacher also teaches chemistry at the other levels. … So, we do kind of have the integrated approach. Big chunk physical science in 6 and 8 and big chunk life science in grade 7 even though there’s a little bit of those in the other grades.

The seventh-grade science teacher also explained the rationale for moving toward an integrated science curriculum.

[I]:  So what factors impacted this decision to go with more of an integrated approach, rather than say sixth grade is Earth science, seventh grade is life, eighth grade is physical, something like that? But to rather do an integrated approach where you’re hitting each of the sciences each year.

[7ST]:  I think we all agree that it’s best to kind of keep it kind of refreshed in them. So instead of having them examine atoms in sixth grade and then never think about them again until tenth grade chemistry …I think that’s doing them a disservice. So I think it was really just a group decision that they should see at least some chunks
of this every year, even if it’s not the whole unit, but to have them understand a little bit about cells in sixth grade, and then how those cells turn into tissues in seventh grade, and how evolution works to how populations at a macro-level work in ecology in eighth grade. I think they can see that sequence and put it all together a little better.

The science supervisor explained how sixth grade had the greatest amount of change, becoming less integrated and more domain-specific. Sixth grade was focusing on the physical science standards of NGSS.

[I]: So, your current science scope and sequence is there any difference between that, what you’re doing this year and what you’re going to be doing next year as far as curriculum is concerned?

[SS]: Yes … We are fine-tuning and focusing on the chem and physics. Whereas I feel like sixth grade has become less and less interdisciplinary and integrated and more and more subject-specific to chemistry and physics. Those units of chemistry and physics have gotten bigger and broader. And we have selectively moved some of those other units to the seventh and eighth grade. That’s the biggest.

[I]: Those would be like life science and Earth & space science units?

[SS]: Yes. And we’ve elaborated greatly on our life science units. So that’s kind of been it. I would say the sixth grade has changed the most over the past five years. Whereas seventh grade we’ve more integrated what was there. So, we didn’t want to lose the systems, body systems, the teachers did not, even knowing that the Next Gen was coming, and body systems aren’t necessarily related, we found ways to integrate them. So, our You Are What You Eat is the kind of… biochem unit that’s associated with living science, living environment or the sciences at the seventh-grade level. I don’t think we are going to get rid of any of the You Are What You Eat unit. We’re going to keep that unit and add to it. So, … having subject specialists who are efficient teachers also enables us to not just offer the basic core units, but we can integrate and keep some of the other interdisciplinary things that we do. We can have the kids have visitors from Cold Spring Harbor, do the DNA labs and keep some of the systems work that we already developed in an interdisciplinary way. I think without sacrificing the integrity of the NGSS new state aligned standards.

The science supervisor explained how Earth science was taught in eight-grade so students in accelerated Earth science would not have gaps in their science instruction if different content was to be taught in science 8.

[I]: And having Earth science as the course that you accelerate into, how has that impacted science instruction in grades 6 and 7?

[SS]: Well I think a lot of our alignment was also so that no one would lose out on learning the breadth of really valuable science in Earth science and astronomy. So, part of our rationale in aligning the eighth-grade curricula for the general science with Earth science was to make sure no one, even if they moved into honors classes, they wouldn’t have a gap in their exposure to scientific phenomena.
When the superintendent was asked specifically about the curriculum, she admitted that she did not know the fine details and referred to the science supervisor. There was trust that the science supervisor had the autonomy to do what she needed to in the departments she supervised.

[I]: So, do you know how it was decided which topics would be taught in grades 6, 7, and 8, …whether it would be more of a domain-specific approach, that it’s like a year of life science, a year of physical science, or more of an integrated approach, where it’s a little bit of each of the sciences each year?

[S]: I can’t give you the specific of which of the two it is, but I know that it’s always with the input of the teachers, what’s best for students, and under the supervision of the science supervisor. We support a lot of curriculum writing in the summer, a lot of summer curriculum projects. We also network and liaison with other … you know the teachers do with other teachers from other districts, but I can’t give you the specific as to which approach. That would be more in [science supervisor]’s domain, and I’m sure she can answer it easily.

The superintendent explained how the revamping of the curriculum was being done by the science supervisor. She did not know specifics, but described the changes in more general terms.

[I]: Great…How are the new New York State Science Learning Standards being implemented?

[S]: They’re being implemented …with fidelity I would say, largely because of our science supervisor. And so she has really overseen the revamping of our curriculum. First of all making sure at the elementary-level science is taught regularly. Cause I know sometimes it can fall to the backburner especially when it’s not a tested subject. As well as at the …secondary levels with… teacher leaders under her supervision.

The superintendent was comfortable letting the science supervisor oversee the departments as the science expert. She did not need to know all the details, that was the science supervisor’s domain.

Standards. The science supervisor discussed how the standards were slowly being implemented. She described how changes were being made with some elementary grades, and at the middle school-level through summer curriculum mapping projects. She described the difficulty of making changes at the high school-level since the Regents exams were still aligned with the former standards. In her opinion, the AP courses were most aligned with the pedagogy required by NYSSLS.

[I]: Oh, okay. So how are the New York State Science Learning Standards being implemented this year?

[SS]: So, this year, different grade levels have participated in different levels of curriculum writing as of now. So, our most aligned curricula now is our second grade. And followed by K,1 which each did one unit. Our fifth grade and third grade did a unit. The last to adopt at least one unit as a pilot unit with alignment with NGSS is our fourth grade. We were kind of waiting to see where the testing would lye so they’re starting the process and doing two units this summer. At the middle-level I would say that we are most moved towards alignment at the seventh-grade level. We
recently re-wrote curricular in the last few years that’s somewhat aligned with and kind of bridged the old standards and the NGSS standards kind of foreseeing that it was moving in that direction. And so, this summer we’re doing a comprehensive mapping project to clarify exactly what is staying in our curricula, and what’s coming out. But it’s fairly aligned. And then at the high school level, for the past few years we focused on performance-based assessments. We’ve focused on evidence-based claims, and modeling. I would say as like the three areas to bring us closer to alignment, again with the backdrop of the Regents exams, it’s been a little bit hard to depart from the types of unit structures that we had. But some teachers have been very successful at making inquiry-based units. And the AP [Advanced Placement] teachers specifically, I’d say theirs is most aligned with NGSS. There’s always an inquiry, there’s a lot of experimentation, and evidence-based conclusions. And so, the AP courses I feel are most fully aligned right now than any other area as well.

The science supervisor had a K-12 plan for infusing the new standards, in some cases, one unit at a time. Implementation was difficult for the high school classes because the Regents exams were based on the old standards. These teachers could not change the content, but their approach to teaching.

The sixth-grade science teacher described the process of keeping the material that aligned with the new standards and “tabling” the material that no longer aligned.

[I]: And what are you doing to the curriculum specifically right now this summer?
[6ST]: We’re trying to tie and marry things we’ve done in the past, to, to match and correlate with the NGSS standards. And if things don’t correlate and match, we put them to the side, table them. We’re also trying to change the language of what we do, including performance-based assessments, phenomenon-based questions and so on.

The seventh-grade teacher described how he was implementing many of the pedagogical shifts required by NYSSLS and how he was changing his curriculum one unit at a time.

[I]: And are you, say now specifically in seventh grade, are you NGSSing your entire year’s worth of material or are you doing it say a unit at a time? How are you breaking it down?
[7ST]: Well I’m still fairly new here so a lot of my stuff has been made in light of student-centered learning and phenomenon-based instruction. But I’m really going through it unit by unit to align it with NGSS. So, the first unit that was fully, perfectly aligned with phenomenon-based learning was the evolution one. And then the genetics one followed and I’m still working on doing that to the physics unit. So, I have a lot of like, performance-based labs and things like that, but it’s not quite exactly in NGSS language yet.

The superintendent was not able to provide specifics regarding the roll-out plan for the new standards. She spoke in more general terms.

[I]: Great. What are the biggest challenges in implementing the New York State Science Learning Standards?
[S]: I would say at the elementary level it’s the competition with the other core content areas, especially when they’re being tested and when there’s a focus on getting more kids to take the tests, to do better on the tests, so I think that presents a challenge. And then I think for some teachers, who taught more traditionally, teaching from a more experiential, deeper level of understanding...the why behind it, can be a challenge for some of our staff members who are more used to a more traditional approach.

Teacher certification. The sixth grade was taught by a common branch, elementary-certified teacher that had an affinity for science.

[I]: And then certification wise, are you an elementary certified teacher or a science teacher with a 5/6 extension?
[6ST]: Elementary.

The seventh-grade science teacher was not aware of this. He was under the impression that the sixth-grade science teacher was certified in science.

[I]: And the fact that the sixth-grade teacher ...is technically an elementary teacher, ...not necessarily a science certified teacher, did that impact what would be taught in sixth grade?

[7ST]: He is actually a science certified teacher. He, so our sixth-grade class runs only, it’s like block scheduling, so they’ll have like two hours in science and math one day and two hours of, I guess it’s two hours of science and social studies, and then two hours of math and English. I think they alternate them with those. ...But I believe he is also science certified. I believe he’s got a 6-8 extension, or a 5/6 extension. That’s it.

From the sixth-grade science teacher’s perspective he was technically certified to teach any science topic, unlike a high school science teacher, that was certified in a particular discipline.

[I]: Do you think the teaching certifications held by the teachers impacted what courses would be offered and, and, you know, what topics would be taught in particular grades?

[6ST]: No, because, well, I can only speak on sixth grade. Sixth grade certification is really broad, you can teach life, physical, Earth science, physical, you know, whatever comes your way, so to speak. Whereas if you’re Earth science certified as a high school teacher, that’s the area you can, that you’re, you know assigned ...contractually at the high school, you can teach one subject out of your certification, but, that’s rare. That’s rare.

The science supervisor explained how the sixth-grade science was taught by a “specialist”, a teacher that only taught science, but was a common branch certified teacher. The teacher just happened to have an affinity for science.

[I]: What about teacher certification? Did that impact the decision as to which classes to offer or which subject to teach at each grade level?
[SS]: It didn’t, although it’s interesting that sixth grade certification is so different from 7 to 12. So, there is some inconsistency now with the certification, in elementary versus middle-level and subject specification and including the sixth grade in the NGSS. So, I, I think that in the future it might have a bigger impact than now, but for now I have science specialists at from fifth grade through twelfth grade, so, our fifth-grade teachers are math and science teachers, our sixth-grade teachers are science specific, so it’s less of an issue to me in terms of I have a science specialist basically, fifth through twelfth.

[I]: Great. So, these teachers that teach in grades five and six, are they science teachers with a 5/6 extension or are they elementary certified teachers?

[SS]: No. Elementary certified teachers, with affinity for and great education and excitement about science.

[I]: So, they teach math and science?

[SS]: Fifth is math and science. Sixth is just science.

The superintendent explained how the district tried to hire teachers with dual science certification, especially teachers with physics certification in order to teach the engineering courses.

[I]: Teacher certification, how has that impacted the decision to how science curricular are to be implemented?

[S]: Well, we push for more engineering so we definitely wanted someone with experience in engineering, and a certification in physics, which we have. And so, when we do hire teachers in science and in other areas, we try really hard to get dual certification if possible. Especially in science with the restrictions in the different content areas, and also, with the general science license so you can have people teaching electives, etcetera.

Science was unique, similar to foreign language certification, in that teachers were certified in specific discipline areas unlike math, English language arts, and social studies. Having dual certification in science areas was preferred. To teach middle-level science courses, general science certification was required.

Assessments. The science supervisor detailed how the district used performance-based assessments and students were asked to generate their own questions. She identified teacher buy-in as the most important thing for the successful implementation of NYSSLS. She also valued students being able to ask questions.

[I]: …And what are you planning to do to assess if the program is working?

[SS]: …First and foremost the teachers have to believe that it will yield student learning. And so, teacher buy in to me as a supervisor, is probably the most important indicator of a potentially successful program or curricula. The second is the students’ questioning. So, if there is one thing I can do right now to test if a curricula is working, it’s going in and seeing what kinds of questions students are generating. From kindergarten to twelfth grade, when I stand in a class and I listen, are students asking questions? And if they are, what questions are they asking? Both the teachers,
themselves, each other. And so, I think that’s a huge piece of formative assessment for curricula…I love some of what our teachers are experimenting with in a unit, having a model. And it’s very similar to what’s been shown in different trainings that we’ve had on Long Island. So, for example, my physics teacher had plexiglass and charged it by rubbing fur on it and had …Rice Krispies sitting on a table. Kids had to draw what happened as the Rice Krispies became charged and, you know, came up because of the opposite poles attracted. They had to label. They had to diagram. They had to show it and they had to…explain static electrical forces. And so, and induced electrical forces. And so, they, they struggled with that. And so, we had them model at the beginning major, at the middle and at the end. And so, if I can do something like that for every single topic, in every single unit, that’s kind of my desired state. So that would be an ideal assessment where you have a concept that you can somehow develop a model. Now the models might be very different. They might not be two-dimensional. They may be experimental. They may be different, but my ideal world, if we as teachers, supervisors had in our minds that every phenomena, every unit had a beginning, middle, end model that could open-endedly test students’ ability and knowledge and answer it that would be ideal…I don’t foresee that coming from the state. So, I think right now, kids will have to perform on the Regents exams. They’re still taking the eighth-grade exam. They’re still taking the fourth-grade exam…Those are very content-based tests, that year to year have a very narrow focus. And I don’t know that they’re testing those same skills. They’re very open-ended questioning, a great open level of understanding, or a student’s ability to question the world around them.

The science supervisor was concerned about the alignment between the instruction in the classroom and the state assessments. There was a mismatch between the current state assessments and the more open-ended nature she had encouraged her teachers to use.

The sixth-grade science teacher explained that the assessments need to be differentiated to meet the needs of the lower-ability students. He expressed concern about students on a lower-reading level and their ability to perform on the new assessments.

[I]: And how would you assess if the program is working? Now with this new alignment you’re going to have, going into next year, how would you assess, you know, if the kids are getting it?

[6ST]: …We have formative and summative assessments. That’s one way. See how they’re doing on the exams versus how they were doing in years’ past. But I find that most of the class, whether you’re doing a lab on volume or density or endothermic reactions, or double replacement reactions, it’s usually just a feat for the class, a feel for the class, sorry. How many kids kinda have that blank look on their face, like what in the world is he talking about? And sometimes you get that. The kids are a little lost on this topic right now. You know the language we use, they are not quite ready for. They know what a microscope is, but discussing what a macroscopic concept is, is hard for them to get their head around. So, sometimes, when you’re picking and choosing from different resources, that uses some of the vocabulary that’s used in NGSS, the kids have a hard time understanding what’s being asked of them. So, assessing is kind of hard because in my opinion, I re-write the tests to match their reading levels, right, and differentiate, there’s not a lot of differentiation in the standards…So that’s also a challenge…It doesn’t necessarily meet the needs
of your low to low-average readers in the classroom. So, it’s challenging, but …that’s what the different strategies are, that’s why there’s movies, and films and clips, plus hands-on experience. You’re kind of hoping that through one of those modalities your child is going to learn, you know, the standards.

The seventh-grade teacher was most concerned between the mismatch of the curriculum with the current state standardized assessments. He was teaching using performance-based assessments, but the current assessments were focused more on pure content. This mismatch made him uncomfortable.

[I]: And what do you think the biggest challenges are in implementing the new science standards?
[7ST]: The fact that we don’t quite know what it’s going to look like yet. I feel like I love the whole idea of phenomenon-based learning, I love these open-ended inquiries where they get to design their own experiments, things like that. But they’re very difficult to grade so, we have no idea what the test is going to look like. So, I think that’s a little, you know, it makes us all a little unsure. I know in seventh grade I do a lot of project-based assessments, performance-based assessments which shows me that they’re learning but, we’re not quite sure if that translates to doing well on a standardized test of some kind. So, that part’s intimidating. That’s why I count my midterm so heavily when I figure out who’s going into Earth science and who’s not. A lot of our other assessments are performance-based, phenomenon-based.

The superintendent confirmed that student performance on standardized exams was still one of the ways that new curriculum was evaluated. Standardized tests were still the barometer to measure effectiveness.

[I]: Great. And curricular changes, how are they evaluated for their effectiveness?
[S]: Probably mostly from looking at what’s happening in the classroom, observations, formal and informal, and walkthroughs. We have program reviews as far as presentations to the Board of Education, and then also of course looking at student achievement associated with those programmatic changes. Both standardized and non-standardized, looking at unit exams, looking at quarterly exams, and, of course, looking at the state-level exams, and the AP.

Professional development. The sixth-grade teacher described how the district provided ongoing professional development. Some of the professional development opportunities had been provided by administrators, while others had taken place outside of the district.

[I]: How were staff informed of the New York State Science Learning Standards?
[6ST]: …Conferences, workshops, at weekly meetings on Tuesday afternoons that last about an hour.
[I]: And who, who are those meetings with?
[6ST]: Administrators. Yeah. There… again it’s from building to building, and from subject area to subject area may vary from week to week… That’s one way. Conference days, Superintendent’s Conference Days, in-district conferences, out of district
conferences.

The science supervisor corroborated what the sixth-grade science teacher said. There had been trainings that she has facilitated as well as professional development through outside organizations.

[I]: And how did teachers learn about the New York State Science Learning Standards? How have you…

[SS]: The new standards?

[I]: The new standards, yeah.

[SS]: So different representatives have attended different trainings. So, there are three specific people that I sent them to trainings. BER hosted a training. And so, my high school teachers I sent to either BER workshops, or [trainer] ran a few trainings. And then elementary went to Trisha. She did the … why am I blanking on the organization? Well LISTEMELA co-sponsored it, and she had a training. And there were some great leaders that did those trainings. Internally, we’ve had grade-level meetings devoted to it. I’ve done a lot of, … QFT, Question Formulation Technique… I’ve been doing modeling. I’ve also had teachers share. So, each teacher this year was supposed to work on a best practice at the high school level, 7-12, and they shared out a lesson, whether it be modeling, the way they constructed the unit, the questions at the beginning… Our last Superintendent’s Conference, we had someone come from IQWEST. And they did question, different type of questioning boards, and prompts for discourse among students. And a lot of it has been either Superintendent’s Conference Day, … faculty meetings, grade level meetings, and then days of turn-keying by individual members of the department and elementary grade-levels. So, there’s two kind of lead science teachers at every elementary grade. And then at the middle level, there’s so few of us.

[I]: And now you alluded to it before, but with the sixth graders in a different, sixth grade teachers in a different building, how does that affect that continuity of the six to eight middle school curriculum and really getting those standards across in those grades?

[SS]: They were together at our Superintendent’s Conference Day this year. And we are re, we are re-converging, and so we have three days and then we have a curriculum writing project over the summer through which our goal is to completely align. And we’ve been experimenting with Amplify and IQWEST and a few different materials and to finalize a decision about which materials from which of these programs we’re going to adopt. And so that’s happening this summer. And then I got some coverage and I’m pulling them out for half-a-day in June.

The superintendent described how the district was supportive of teachers attending local, regional, and national conferences. She described the importance of teachers learning from other teachers and how much of the professional development was coordinated by the science supervisor.

[I]: … How is professional development on the new standards coordinated for teachers?

[SS]: Largely basically through the same person [science supervisor], under the supervision of the assistant superintendent for curriculum and instruction. Through department meetings, through Superintendent’s Conference Days … We’re very supportive of
teachers attending conferences both local and State and national and regional. So, we really try to have our teachers, and then we also have teacher leaders who come back and present to colleagues and professional learning communities.

The seventh-grade science teacher also discussed how the science supervisor had provided much of the professional development for the science teachers.

[I]: How were staff informed of the New York State Science Learning Standards?  
[T]: NGSS?  
[I]: Yeah, the New York State version of that.  
[T]: So, we have regular department meetings. Once, once a week we have faculty meetings, and then once a month we have individual department meetings. And our and our science meetings usually revolve around the roll-out of NGSS. So, we’ve done that. I also have taken like plus credits in NGSS. And some of the other teachers in the district have done those with me.

The department meeting was the primary way that teacher received information about NYSSLS. Having a K-12 science supervisor helped to bring people together from different buildings.

Collaboration. The teacher described a collaborative process where the sixth and seventh-grade teachers worked together over the summer determining which topics were taught in which grade.

[I]: And, do you know, are they doing something comparable in grades 7 and 8?  
[6ST]: They’re doing the same thing in 7 and 8, yeah. Last year, the seventh-grade teacher was here when I was here. This year, I think we met in early June. We literally, page by page, went through the NGSS standards. We highlighted what I do, what they do. If there’s any repetition to try to avoid that in the future…To fill-in spaces or left gaps. So, that was pretty productive. And the seventh and eighth grade teachers are doing that this summer, as well.

The sixth-grade teacher explained how the summer curriculum writing projects helped lead to articulation with the seventh and eighth grade science teachers.

[I]: I see. And then how is that being that you’re in different buildings to, as far as coordination of content, being that, you know, you’re in a different building than the 7 and 8 middle school teachers?  
[6ST]: Well, it’s funny. This is the second summer in a row we’re doing curriculum writing together. So that can be 9 to 15 hours depending on the approval of the Board of Ed.

Doing the summer curriculum writing with the seventh and eighth grade teachers led to vertical articulation.
Since there was only one teacher at each grade-level for grades 6-8, it was easier to coordinate between the grade-levels. The teacher further explained how the staff had influence in determining which topics would be taught in which grades.

[I]: And then what factors influenced this decision? For instance, how was it chosen that sixth grade was going to do these topics since the state says this is what has to be done by eighth grade.

[6ST]: Some of it was taught by teacher preference. My stronger background is in chemistry and physical sciences. As early as two years ago, I had done physical, chemistry and life sciences. You know, plant biology, animal biology as well. It was determined between the three grade-levels that they would go with the more physical science in six and the life sciences in seventh and eighth. So, it’s determined by teacher’s strength I guess, teacher preference, teacher background. And then in some cases, … just things we agree upon as a staff.

Allowing the teachers to decide what was to be taught in each grade helped with teacher buy-in. The fact that there was only one teacher per grade level allowed consensus to be reached more easily.

The science supervisor explained how curricula decisions were made, and identified the middle-level science teachers as an integral part of the decision-making process.

[I]: And who was involved in this decision-making process?

[SC]: The assistant superintendent, the teachers. I would say that we’ve been talking about these things quite a bit. And then finally I would think the middle-level teachers had the biggest influence on the decision-making. We did not have a committee formalized in that way. We did not ask students or parents what they thought.

This idea of collaboration amongst the teachers and in coordination with the science supervisor was corroborated by the superintendent.

[S]: And there are a couple of key people at [elementary school(s)] that teach science and only science. One of them is on the sixth grade only and the other one teaches and pushes in and pulls out across various levels. … And then we also have a technology teacher there so they are kind of in two departments. They’re kind of part of one school, but they meet and discuss curriculum freely with their counterparts here at the high school.

Later in the interview when asked about whether a domain-specific or integrated curriculum was used in the middle-level grades, the superintendent explained how the teachers learned from one another, even with teachers from other districts.

[S]: … but I know that it’s always with the input of the teachers, what’s best for students, and under the supervision of the science supervisor. We support a lot of curriculum writing in the summer, a lot of summer curriculum projects. We also network and liaison with other … you know, the teachers do with other teachers from other districts.
The seventh-grade science teacher also described the process as being very collaborative between the sixth, seventh, and eighth grade teachers. Due to the fact that there was essentially one teacher per grade level for grades 6-8, this helped facilitate it being a tight knit group.

[I]: Now being that this is a 7 to 12 building, and the middle school standards of NYSSLS are 6-8, how is it with having the sixth grade in a different building from seventh and eighth grade?

[7ST]: I mean we’re lucky in that that building(s) really close. And we’re all in pretty close contact. I wouldn’t say it’s really a problem. We meet with the sixth-grade teacher probably three or four times throughout the year and we constantly come back and see what we’re doing and what’s working and how it’s not. And towards the end of the year every year we have these big kind of science department groups and in those times we do talk about our lessons and the scope of the units.

**Parent/community influence.** Parents did not have any say in decisions regarding the science curriculum. According to the science supervisor:

[SS]: We did not ask students or parents what they thought.

The science supervisor described a “very open-enrollment policy” where students were easily able to move from class to class. She also described an “honors by choice” which allowed students to select to take an honors level course. Allowing this easy movement pleased students and their parents.

[I]: Okay. And Earth science as the course in eighth grade, do you know the history as to why Earth science is chosen?

[SS]: No. I know it was the most common thing that was historically done. Why it was chosen I do not know. I do perceive Earth science to be more challenging developmentally with regard to graphical understanding and awareness and the ability to transfer learning and content between ideas. I think it is, in some ways, cognitively at a higher degree of challenge than the living environment course. So, no I don’t understand the theory or philosophy behind it, … but we have so many opportunities in mobility. We have an honors by choice that enables kids to get honors credit in the tenth-grade program over at science also. So, students that don’t have in eighth grade can revisit it. We allow students to move between sections into honors, AP. And it’s a very open enrollment system. So, I don’t feel like students lose out on opportunities, and I don’t feel a big push for students to either take it or not take it. If they’re ready for it cognitively, they take it. If they don’t, they revisit it. And we do not exclude those students from being able to pass freely into other classes. So, it is not something that has proved problematic.

The superintendent described parents as being part of the curriculum committee, which was different from what had been stated by the science supervisor when she described the process of determining the curriculum for the middle-level grades. However, the superintendent had mentioned how parent involvement varied.
[I]: Is there a formal, like … some type of curriculum committee that’s needed to
[S]: As needed. We don’t have a standing curriculum committee. As needed we do have
curriculum committees look at programs.
[I]: And who would be on those type of committees?
[S]: Teachers, building administrators, and district-level administrators. And we have also,
in some cases, asked for input from …families, parents as well. But definitely teachers
and administrators.

The seventh-grade teacher explained how parents could “push” to have their child placed into
the accelerated Earth Science course even if their child was not recommended. The teacher
indicated that the choice was left “up to the parents.” If parents wanted their child in Earth
science ultimately, they got what they wanted.

[I]: And let’s say a student was not recommended for Science 8, but they or their parent
wants them to be in the Earth science course.

[7ST]: I always tell students … so there’s this weird stigma here about going into Science
8 that we keep trying to work on. Haven’t quite figured out how to crack that one
yet. But the students don’t want to be put into Science 8, they want to be put into
Earth science. So, towards the end of the year we usually get a lot of phone calls.
…At that point we just have a serious conversation with the parent. Some of the
students don’t do so well because it’s a maturity thing. They’re not handing things
in on time so they’re losing points. Some students it’s because their test scores are
not too viable. So, we have a conversation. Some of the students it’s, “Your child
is very capable, we’re just not sure he’s up to the workload.” And then for some of
the students they might just need a little more extra help. We always kind of really
leave it up to the parents though. If they really want, they can push and have their
students put into Earth science.

The seventh-grade science teacher further explained how parents of students that were not
recommended for Regent-level Earth Science first had a conversation with him. They then were
referred to the science supervisor who made the ultimate decision as to whether students advanced
to the accelerated course.

[7ST]: But we, at least we have that conversation. And it goes through a couple of layers. That
conversation starts by talking with me, as a seventh-grade teacher. And after I’ve given
my cents, we move it up to the supervisor, who then ultimately makes the final decision.

Although it was stated that the science supervisor made the ultimate decision, it appeared to be
whatever the parent wanted.

Summary. One Unit at a Time was slowly making the shifts to NYSSLS, literally one unit at
a time. With a single teacher teaching science for grades 6-8, it was easier to bring the 3 teachers
together. By having professional development for teachers, curriculum mapping projects during
the summer, and common meeting time allowed the teachers to buy into NYSSLS which was
crucial for its successful implementation. Despite having sixth grade housed in (an) elementary
building(s), the K-12 science supervisor was able to bridge the gap and keep open lines of communication.

The “honors by choice” where students could get into an honors Earth science class later in high school, helped to get away from tracking. Also, there was a large demand for students to take Regent-level Earth science in eighth grade. Parents had the ultimate say as to what classes their children took. This approach helped alleviate any battle with the parents.

There was still inequity between supervisors and directors as supervisors where supervised by the assistant superintendent, while the latter was supervised by superintendent. Although they were in the same administrative unit, directors worked additional days during the summer and presumably earned a greater salary.

4.7 Common Themes from the Case Study Districts

From these 6 case study districts, there were 7 major findings that cut across the districts, comparable to the way the crosscutting concepts cut across the different science disciplines. The most intriguing finding was the vast differences in the roles and responsibilities of the science supervisor. The biggest distinction was whether the position was a building-level position or a K-12 district-wide position.

Role and responsibilities of the science supervisor. The two districts with junior high schools, Wait and See and Using Teachers as Educational Consultants, both had a building-level science chairperson that spent 0.6 of the full-time equivalency teaching classes (FTE), and only 0.4 FTE being an administrator. At Wait and See the chairperson could not formally evaluate her teachers because she was in the teachers’ union. The impact was that the teachers were formally evaluated by administrators who did not have a science background. The person with the science certification could only give feedback.

Using Teachers as Educational Consultants developed a work-around to the fact that they did not have district-wide science supervisors by having the junior high school science chair and other junior high school science teachers work at the elementary schools as a 0.2 FTE as a teacher on special assignment (TOSA). Therefore, the science chair only taught two classes in the junior high school building for 0.4 FTE, and then was at the elementary school for the remaining 0.2 FTE. However, as the science chair shared in his interview, he felt he was doing his students a disservice by not being in the building as much as he should. What was most surprising was that the district had a district-wide director for social studies, K-12.

According to the assistant superintendent, the rationale for this inequity was that there were no middle-level state assessments for social studies, yet there were for math, English language arts and science, so the chairs were in the buildings to oversee the administration of these exams. However, as the science chair pointed out, only 16 out of over 100 students took the Intermediate Level Science (ILS) exam. Rather than pulling the science chairs to be in multiple buildings while still teaching classes, the district should have district wide supervisors for all of the academic disciplines. Using the junior high school chairs in the elementary schools seemed like a band-aid trying to bring cohesion to different buildings since the sixth grade was housed in the elementary school buildings. A change in the organization structure seemed like a more permanent solution.
In the other case study districts, the science supervisor was a K-12 district-wide position that did not include a teaching component. These supervisors were able to focus solely on teacher evaluation, professional development, and curriculum development.

Hierarchical structure. Another major finding was the disparity in the hierarchy in administrative positions on the districts’ organizational tables. For instance, at Using Teachers as Educational Consultants, the science chairs reported directly to the building-level assistant principals. The chair people were on the lowest rung in the hierarchy, yet they had so many responsibilities including teaching classes, formally evaluating their staff, and providing professional development, it seemed that they should at least be lateral with the assistant principals in reporting to the building principals. By contrast, there was a K-12 social studies director that reported directly to the assistant superintendent. The inequity of department chairs directly reporting to assistant principals was apparent.

In districts that had K-12 district-wide science supervisors, New Leader, That’s Why We Have Directors, If It Ain’t Broke and One Unit at a Time, only one had parity amongst the supervisors, That’s Why We have Directors. At That’s Why We Have Directors all of the directors reported to the assistant superintendent. By contrast, at If It Ain’t Broke and One Unit at a Time, the K-12 science supervisor reported to the assistant superintendent, while the directors for certain areas such as athletics and special education, reported directly to the superintendent. According to the assistant superintendent from If It Ain’t Broke, the directors were in charge of the entire program including state mandates, grants and Title I and II funding, while the coordinators chiefly supervised the teachers in their departments. These differences placed the coordinators lower on the table of organization and presumably they received less compensation than the directors.

At New Leader and Wait and See the science supervisors were considered TOSAs. They were on the teachers’ salary schedule and received an additional stipend for being supervisors. This resulted in the supervisors being paid less than administrators in the administrative bargaining unit. This set-up had several ramifications. At Wait and See, the science chair could not formally evaluate her teachers. At New Leader, the supervisor, who had so much responsibility in the district, was leaving for a similar position where he would receive compensation commiserate with his responsibilities. Rather than changing its hierarchical structure, the district was willing to let good people go.

Stakeholders in the decision-making process. Another major finding was that the involvement of teachers in the decision-making process varied tremendously and led to differences in teacher buy-in. The most successful model was at That’s Why We Have Directors. In this district, the science director created an NGSS sub-committee comprised entirely of teachers which he ran. The teachers were able to make pedagogical shifts aligned with the New York State P-12 Science Learning Standards (NYSSLS) and then share their experiences with colleagues on the committee. The director also had these teachers put out ‘feelers’ with their colleagues not on the committee about shifting from an integrated science curriculum to a domain-specific science curriculum. Teachers not on the committee also saw the shifts their colleagues were implementing in their classrooms and were curious to try them in their own classrooms. This model heavily involved teachers in the decision-making process and resulted in changes occurring at the teacher, grass-roots level.
The opposite was reported at *Wait and See*. In this district the decision to universally accelerate all eighth-graders into Regents-level living environment reportedly was a top-down approach that did not involve teacher input. The interviewed teacher and the science chair did not feel that this was in students’ best interest. The low passing rates, less than 50% of the students passing the Living Environment Regents exam, indicated that it was not working well.

At *Using Teachers as Educational Consultants*, the teachers were heavily involved in the decision-making process. In fact, it was a teacher’s proposal to move toward an integrated approach that was ultimately accepted by a committee comprised of teachers from the middle-level grades, the science chair people, the building-level principals, and the assistant superintendent. The impetus to move toward an integrated approach was that the sixth grade was housed in elementary school buildings and taught by teachers responsible for teaching all of the different content areas. The idea was to introduce students to the basic concepts of life, physical and Earth & space science in sixth grade, and then build upon those concepts in grades 7 and 8. Since this idea came from a teacher, it was truly a ground-up approach.

**Impact of teacher certification.** Another major finding was how teacher certification impacted the decision-making process of the districts. In some districts, such as *New Leader* and *Wait and See*, the reason to accelerate students into Regents-level Earth science or Regents-level living environment was attributed to the certification areas of the teachers. In *New Leader* both the science chair and the assistant superintendent mentioned how many of the teachers at the middle school had Earth science certification. Similarly, at *Wait and See*, the teacher mentioned how many of the teachers had biology certification which enabled them to teach Regents-level living environment. Districts had to take the certification areas of their teachers into account when making decisions.

An unexpected finding was when interviewees mentioned how sixth grade teachers were more qualified to teach any science compared to secondary science certified teachers because of their common branch certification. The sixth-grade teacher at *One Unit at a Time* and the science coordinator from *If It Ain’t Broke* explained how the teachers were qualified to teach any of the science concepts because of their common branch certification. However, the assistant superintendent from *Using Teachers as Educational Consultants* clearly stated how it would be best to have science certified teachers teaching sixth grade. The science chairperson from this district indicated there were only 2 secondary science certified teachers in the district that had the 5/6 extension, yet neither of them were teaching sixth grade science.

**Building grade-level configurations.** The sixth grade was configured in different ways in the districts. In some districts, such as *One Unit at a Time*, sixth grade was housed in the elementary school where there was one teacher that taught science to all of the sixth-grade students. This practice ensured that all students received the same experience. This practice was possible at *One Unit at a Time* because the district was small, with an approximate student population of 1,500 students. By contrast, *Using Teachers as Educational Consultants* consisted of numerous elementary schools where the sixth-grade teachers taught all of the subject areas. It had been much more difficult to standardize the amount of science instruction that students received when there were so many teachers. This disparity in science instruction was part of the reason why the district ultimately decided to move toward an integrated science curriculum.

Although districts had different building-level grade configurations, it did not have as great of an impact on articulation as expected. At *One Unit at a Time*, the sixth-grade teacher, who
taught in a separate building, met with the seventh and eighth grade teachers and they worked on curriculum writing projects over two consecutive summers. Similarly, at *If It Ain’t Broke*, the science teacher explained how they met with the sixth-grade teachers who were science specialists in terms of their teaching of science to all sixth graders, not in terms of possessing science certification. The science supervisor was the person identified as coordinating the meetings between these individuals despite the fact that they taught in different buildings. By contrast, at *Wait and See* the teacher and the science chairperson did not know what content was being taught in the sixth grade because the sixth grade was housed in the elementary school building. However, the reason why there was no articulation was because the science chairperson only supervised the teachers in grades 7-9. Because she did not supervise the sixth-grade teachers, and they were in a different building, there was no communication with those teachers.

At *Using Teachers as Educational Consultants*, the science chairperson knew what the sixth-grade teachers were teaching because he was working with them directly as an educational consultant which accounted for 0.2 of his FTE. In the other case study districts, having K-12 district-wide science supervisors helped provide articulation between the teachers regardless of the district’s building grade-level configuration.

**Assessments and the opt-out movement.** A common theme that was mentioned by teachers and administrators was a concern regarding the alignment between the standards, the curriculum and the assessments. At the high school-level it was very difficult for teachers to implement the content required by NYSSLS when the year-end Regents examination was still based on the 1996 Science Learning Standards. Furthermore, science teachers’ Annual Professional Performance Review (APPR) was determined based upon the performance of their students on this exam. Teachers could implement some of the pedagogy associated with NYSSLS but had to still teach the content that was assessed on the Regents exams.

In districts that had universal acceleration, *Wait and See* and *If It Ain’t Broke*, students did not take the ILS exam, but instead took the Regents exam. Since students were not assessed on the intermediate-level standards, the focus in the middle-level grades was preparing students for the Regents exams as evidenced by life science concepts being taught in seventh grade to prepare students for the Regents-level living environment course they would take in eighth grade.

In districts that did not have universal acceleration, the opt-out movement, where students refused to take state assessments, was frequently mentioned. Although this opt-out movement had originated with the math and English language arts Common Core exams for grades 3-8, it had spread to the fourth grade elementary-level science exam and the eighth-grade intermediate-level science exam. As the science chair from *Using Teachers as Educational Consultants* explained, students who did not opt-out for the English, opted-out for the math, and the students who did not opt-out for the math, opted-out for the science, so only 16 students out of 100 and something students took the ILS exam.

As the teacher from *One Unit at a Time* and the science chair from *Using Teachers as Educational Consultants* explained, there was a misalignment with the new standards and the most recent assessment. They both described teaching using performance-based assessments and inquiry, yet the ILS exam primarily assessed content knowledge. They both expressed concern that if the new assessments that were supposed to be aligned with NYSSLS, did not assess students on the other dimensions, teachers would revert back to the traditional teacher-directed
style rather than the student-centered, discovery-based approach where students figure things out required by NYSSLS. The concern was that this mismatch could lead to the failure of NYSSLS.

**Parental influence and the acceleration models.** Parental influence varied in the districts. In districts with universal acceleration, such as *Wait and See* and *If It Ain’t Broke*, the parents did not demand that their children be placed in an accelerated eighth-grade course because all students were already placed into a Regents-level course in eighth-grade. By contrast, at *New Leader, That’s Why We Have Directors, Using Teachers as Educational Consultants*, and *One Unit at a Time*, parents were described as demanding that their children be placed in the accelerated science course regardless if they had received a teacher recommendation. At *That’s Why We Have Directors* the science director explained how students could override the teacher recommendation by completing a form that he needed to sign allowing them to be placed into the accelerated science course. He could not recollect a time where he did not sign the form. In other words, the parents got what they wanted.

At *New Leader* the science coordinator explained how there were rumblings in the community since criteria had been put in place for recommending students for the accelerated Regents-level Earth science course. Parents were used to having their children get into the course based on their desire to take it. They were not happy that there were criteria that were to be met. However, the assistant superintendent explained how when parents met with her, if she saw that the child was passionate about science, the students would be allowed into the course.

These major findings are further explored in chapter five. In addition, the answers to the research questions as they relate to the findings are considered. Support from the science education literature is also discussed. Finally, recommendations for the New York State Education Department, practitioners in the field, and districts throughout the country implementing NGSS will be provided based upon these major findings.
Chapter 5
Discussion and Conclusions

5.1 Introduction

As described in Chapter 4, the major themes that were found across the 6 Long Island school districts case studies included the roles and responsibilities of the science supervisor, how the position fit into the hierarchical organization of the district, the certification of its teachers and their involvement in curricular decisions, the acceleration model, the assessments taken by the middle-level grade students, and the impact of parental influence on the district. In this chapter, these themes are evaluated in light of the three research questions, and in consideration of the reviewed literature. Finally, recommendations are provided to the New York State Education Department, practitioners in the field, and to school districts throughout the country looking for ways to successfully implement NGSS or their own state adaptation of these standards.

5.2 Roles and Responsibilities of the Science Supervisor

This theme about the role and responsibilities of the science supervisor helped to answer the first portion of the second research question: What are the role and responsibilities of the science supervisor and how does the position fit into the district’s organization?

The roles and responsibilities of the science supervisor varied considerably across the 6 districts. The biggest difference was whether the supervisor was a building-level position or a K-12 district-wide position. The 2 districts with building-level science chair people, Wait and See and Using Teachers as Educational Consultants, had their science supervisor teach for 0.6 of their full-time equivalencies (FTE). These teaching responsibilities were greater than their administrative responsibilities, which were only a 0.4 FTE. The most troubling finding was that the science chairperson at Wait and See was not even included in the organizational table because they were not considered administrators, but rather teachers on special assignment (TOSA). As such, the chairperson was not able to formally evaluate her teachers because they were in the same bargaining unit.

Although New Leader also had their K-12 curriculum coordinators as TOSAs, they were considered as administrators and formally evaluated their teachers. However, at New Leader the science coordinator was leaving his position for a similar role in a higher paying district. If the district valued the role of the curriculum coordinators by making them directors as they did for technology, art and music, better compensation may have enabled them to retain this experienced science coordinator.

A difference amongst the districts was who was supervising science instruction. In some instances, it was a science supervisor, in others it was a building principal, specifically when the sixth grade was housed in an elementary school. Having a district-wide K through 12 science supervisor improved communication between teachers of different grades, regardless if they were located in different buildings. However, having grades in different buildings and not having a district-wide supervisor to bridge communication led to isolated teachers who were
unaware of what was being taught in the previous grade. Having a district-wide science supervisor opened lines of communication and led to greater articulation between the buildings.

Another responsibility of the supervisors other than evaluation of the staff, was providing professional development. The department meeting was the primary means by which professional development was provided to the teachers, with the majority of the time being spent on NYSSLS. Teachers mentioned how the science supervisors modeled how to infuse the crosscutting concepts into assessments, introduce storylines through the use of phenomena, and use claim, evidence and reasoning. The use of Superintendent’s Conference Day as well as off-site training were also mentioned as ways teachers received professional development, with the science supervisor as the one who coordinated these professional development opportunities. At That’s Why We Have Directors, the science director created a NGSS sub-committee of teachers that investigated ways to implement pedagogy aligned with NYSSLS.

At Wait and See, the teacher explained how she had learned little about NYSSLS from the science chairperson. In addition, the Board of Education had denied an opportunity for teachers to attend professional development on NGSS through a local BOCES during Superintendent’s Conference Day. So, although the science chair had good intentions, without the support from the Board of Education and district office administration, it was difficult to provide professional development for the staff. The science chair indicated that although there had been a science committee to examine the middle-level curricula, there were no plans for the committee to reconvene for the current school year. The assistant superintendent, science chairperson and Board of Education were not sending a consistent message to the teaching staff.

As the teacher had commented, the building administrators asked that lessons be aligned with the 1996 Science Learning Standards, as NYSSLS were not being implemented, hence the Wait and See epithet for the district. There was not a plan in place for the implementation of NYSSLS. The building administration that formally evaluated the science teachers were still pushing for the 1996 Science Learning Standards. Since students did not take the ILS exam, the district did not have to worry until the Life Science: Biology and Earth and Space Sciences Regents Exams were to be administered in 2023. As the chairperson indicated, this date was sooner than many of the teachers realized.

5.3 Hierarchical Organization

The second portion of the second research question addressed the hierarchical organization of the district. The science supervisors tended to be on the lowest rung on the district’s table of organization. The only district where there was parity between the science supervisors and the other departmental supervisors was at That’s Why We Have Directors, where all of the supervisors were considered directors and were directly supervised by the assistant superintendent. At other districts, such as If It Ain’t Broke and One Unit at a Time, there were directors for non-academic departments that reported directly to the superintendent, and supervisors or coordinators for the academic departments which reported directly to the assistant superintendent. This difference presumably resulted in differences in compensation, responsibility and levels within the organizations.

The district with the most inconsistent hierarchical organization was Using Teachers as Educational Consultants because unlike If It Ain’t Broke and One Unit at a Time which had disparities between academic and non-academic departments, at this district there was a disparity
between academic departments. The district had a K-12 district-wide director for social studies, but building-level chair people at each of the secondary schools. The assistant superintendent attributed this difference to the need for the building-level chair people to focus on the state assessments in science, math, and English language arts, however since there was such a large opt-out movement within the district, this rationale did not make much sense.

From the findings, the science supervisors played important roles in a school district. From evaluating the science staff, to providing profession development, to providing guidance for curriculum development, there were many responsibilities that fell under the science supervisor. How the position fitted within a district’s hierarchical organization was an indication of how the position was valued by the district. Unfortunately, in many of the districts this position was at the lowest rung of the districts’ organizational table. Since it was such a vital position, it should be higher in most districts’ hierarchical structure.

5.4 Accelerated Science Models

Another major theme that was uncovered was the model of acceleration that the district implemented. Although only two of the districts practiced universal acceleration, Wait and See and If It Ain’t Broke, at two of the districts, New Leader and Using Teachers as Educational Consultants, there was at least some consideration of moving toward a universal acceleration model. One of the districts, One Unit at a Time had universal acceleration for math, but did not have it for science, whereas Wait and See and If It Ain’t Broke had universal acceleration for both math and science. The first research question involved the districts’ acceleration model: To what extent was the implementation of NYSSLS, specifically at the middle-level grades, impacted by

a. eighth grade acceleration?

b. building grade-level configuration?

c. teacher certification?

One issue that seemed to impact the scope and sequence of the curriculum for the middle-level grades was the course that students were accelerated into in the eighth grade. Along with that, whether the entire grade was universally accelerated or only a portion of the eighth-grade students were accelerated into a Regents-level science course had ramifications on the other grades. For instance, at If It Ain’t Broke all students were accelerated into Living Environment in the eighth grade. This practice actually made it easier to decide what topics were to be taught in grades 6 and 7 because all students were taking the same course in the eighth grade. This fact helped the chairperson to essentially work backwards and devote the fourth quarter of the seventh-grade curriculum to life science topics in order to prepare students for the living environment concepts they would be learning the following year.

At Wait and See all students were universally accelerated into Regents-level living environment in the eighth grade. However, at this district the entire second half of seventh grade was devoted to preparing students for the life science concepts they would learn the following year. At this district, the passing rate for the Living Environment Regents Exam was much lower than at If It Ain’t Broke, 46% to 97%, respectively (NYSED, 2018a).
The rationale for having universal acceleration was also very different. At *If It Ain’t Broke*, the decision to universally accelerate the students was based upon the community’s request to offer more rigorous coursework during the latter half of high school. By having the students take living environment in eighth grade, students could take Earth science, chemistry and physics in grades 9, 10, and 11 respectively, and then be able to take an AP science course during senior year.

At *Wait and See*, the decision to universally accelerate all students into living environment was a strategy designed to increase the graduation rate at the high school. The reasoning was that if students could gain a science credit from living environment and a math credit from algebra, then students would enter ninth grade with two credits toward graduation, and thus would be more likely to graduate. However, as previously mentioned, the passing rate at *Wait and See* school district was extremely low. To help prepare students that were unsuccessful passing the Living Environment Regents Exam, the district offered an Essentials course in ninth grade to prepare students to re-take the Regents exam in January. If they failed the Regents exam again in January, they continued with the course in the Spring semester to re-take the Regents exam in June. So, although both *If It Ain’t Broke* and *Wait and See* school districts universally accelerated all students into living environment, they did so for very different reasons and had results on opposite ends of the spectrum.

At the districts that did not universally accelerate, *New Leader*, *That’s Why We Have Directors*, *Using Teachers as Educational Consultants*, and *One Unit at a Time*, finding ways to teach some eighth-grade students a Regents-level science course, while teaching the rest of the students a different curriculum became a challenge. One of the common concerns was the eighth-grade material that the accelerated students would be missing. How would they learn the material they had missed?

At *That’s Why We Have Directors*, the district tried to ameliorate this issue by offering Regents-level Earth science for the accelerated students and a middle school-level Earth science, referred to as ‘baby Earth science’ by the teachers, to the non-accelerated students. This practice relegated most of the Earth science topics to eighth grade, although some of the easier Earth science topics were taught in sixth grade as per a model in Appendix K from NGSS.

A similar concern was expressed at *Using Teachers as Educational Consultants*. Here, unlike at That’s Why We Have Directors, the seventh-grade students were placed into an honors or non-honors course. The students in seventh grade honors were ‘tracked’ to take Regents-level Earth science in eighth grade. The problem was that in the mainstream eighth grade science class, students learning basic physics concepts. There was concern that the students in Regents-level Earth science missed those physics concepts. The impact was that either students did not take Regents-level physics in high school and therefore never received any physics instruction at the secondary level, or when they took Regents-level physics they struggled because they did not have the same foundation as their non-accelerated peers. Either way, this was a problem. The district ultimately decided to move toward an integrated approach to prevent students from missing out on an entire discipline in eighth grade. This decision to switch from a domain-specific approach to an integrated approach transpired during the course of the interviews with the different school personnel. It was first proposed during the 2017-2018 school year and was implemented during the 2018-2019 school year in grades K-3, and in grade 6.
5.5 Parental Influence

Another commonality between schools that offered universal acceleration was it eliminated parents demanding that their child be placed into an accelerated science class. Since all students were accelerated, this issue was completely removed. For instance, the seventh-grade teacher from *If It Ain’t Broke* explained that although there was a Regents-level living environment course and an honors-level living environment course, students had to receive a teacher recommendation in order to be placed into the honors course. Since all students were taking living environment regardless, the teacher recommendations stood and was a non-issue with the parents. Similarly, the assistant superintendent described a double accelerated program where select students took Regents-level Earth science in seventh grade and then were placed in a combined Regents-level living environment/AP Environmental Science course in the eighth grade. Parents could not ‘self-select’ their children into the seventh grade Regents-level Earth science course. There were extensive criteria that determined which students were selected for this program that parents could not override.

By contrast, at *New Leader* the science coordinator described a very different scenario. Specific criteria were used to determine which students could be enrolled in Regents-level Earth science for eighth-grade, including students’ reading scores and their grade-point average. However, there were rumblings in the community about such criteria being used to determine which students could or could not be accelerated in science. The assistant superintendent explained how parents could essentially override the teacher recommendation after meeting with her. She explained how she was not in the ‘no’ business.

A similar situation was described by the sixth-grade teacher and the science director from *That’s Why We Have Directors*. The sixth-grade teacher described the situation as “parent demand”. As she described it, parents “get what they want.” Likewise, the science director explained how there was a self-select form for the accelerated Earth science course, but indicated that he could not recall ever denying one of the requests. Clearly, not having universal acceleration caused more issues with parents because parents sometimes wanted their children in the accelerated course even though they did not receive a teacher recommendation for the course. With universal acceleration, this issue did not exist. Also, with universal acceleration there was less of an issue with what students would be missing because all students studied the same curriculum.

Yet, *Wait and See* was very responsive to its community by enacting programs such as a bilingual living environment class, full-day pre-K, and a cursive writing program. Realizing that their ELL population was very vulnerable, it reinforced the research by Apple (2018) by trying to reposition the ELLs so they could be more successful in school. In addition, the Essentials coursework tried to help students that were unsuccessful passing the Regents exams and provide additional supports throughout the year to help them pass the exam. *Wait and See* listened to the concerns in their community and responded accordingly.

5.6 Intermediate-Level Science Exam and the Opt-Out Movement

Another issue that districts that offered universal acceleration did not have to deal with was the Intermediate Level Science (ILS) exam, the state exam given to students in eighth grade based on the Intermediate-level Science Core Curriculum currently from grades 5-8. Since the accelerated students took a Regents exam at the end of eighth-grade, the state allowed districts to
substitute the Regents exam in lieu of the ILS exam, so none of the students took the ILS exam. In essence, these districts did not need to worry about the middle-level grades as much because there was no state assessment taken by their students on the intermediate-level science standards. Although the new exam for the elementary-level will move from fourth grade to fifth grade, and the intermediate exam will assess the 6-8 grade-band, these districts will continue to not have their students take the new eighth grade science exam because they take a Regents exam instead. For these districts, there will be less of a focus on the middle-level grade-band since there is no state assessment taken by students specifically on these standards.

At the other four districts where universal acceleration did not exist, the eighth-grade teachers needed to prepare students for the ILS exam. At New Leader, the science coordinator explained how the opt-out rate was so high, he had told his eighth-grade teachers not to worry about preparing students for the ILS exam. The findings from New Leader supported the research from Goch (2017) which showed that ELLs were less likely to opt-out of state assessments. That could change in the future if districts where to get penalized financially for not having a high enough percentage of students participate in the state testing. However, for the schools with universal acceleration this would not be an issue because students cannot opt out of Regents exams as it is a high school graduation requirement, so all students would be taking a state assessment in eighth grade.

In response to the first research question, eighth grade acceleration had a large impact on the science scope and sequence. As the science chairperson at Using Teachers as Educational Consultants noted, the standards as written do not account for eighth-grade science acceleration, which is the norm for Long Island school districts. For districts that practiced universal acceleration, it was much easier to plan the scope and sequence for what was taught in grades 6 and 7 because all students were learning the same material in grade 8. There were no gaps in instruction that needed to be addressed. In terms of ease of implementation, universal acceleration was the easiest choice because it led to consistency for the entire cohort of students. As noted by Clotfelter, Ladd and Vigdor (2015) backwards planning for what students learned in grades 6 and 7 was crucial for the success of eighth-grade students in an accelerated course. For the districts where only a portion of the students were accelerated, careful planning was required since students in accelerated science could be missing topics taught to the non-accelerated eighth grade students.

At New Leader, an integrated curriculum was created for grades 6 and 8, focusing on topics from life science and Earth and space science. Part of this planning was strategic because although there currently was no universal acceleration, the science coordinator shared how there was the possibility of moving toward universal acceleration for living environment. Students were currently accelerated into Regents-level Earth science. By offering topics from both domains in grades 6 and 8, the coordinator was preparing for the possibility of universal acceleration into Regents-level living environment. The eighth-grade teacher had shared the difficulties of incorporating those Earth science topics into what had formerly been a life science curriculum. Acceleration had a large impact on what was taught in grades 6 and 7, and where students were not universally accelerated, also in grade 8.
5.7 Teacher Certification

Although it was anticipated that teacher certification would be a major issue mentioned by the interviewees, in reality, it was not of much concern. At the middle school-level, teachers were required to have general science certification in order to be considered highly qualified by New York State. The one exception was that teachers with 7-12 biology certification were considered highly qualified to teach life science even if they did not have general science certification.

When asked about the certification of the sixth-grade teachers responsible for teaching science, this was only voiced as a concern by the assistant superintendent from Using Teachers as Educational Consultants. In fact, the decision to use junior high school teachers as consultants to the elementary teachers was due to the elementary teachers not having science certification. Moreover, the lack of science certification for the sixth-grade teachers was the impetus for moving toward an integrated approach so the most basic concepts from life, physical and Earth & space science would be taught in sixth grade. However, these results should not be surprising because they support the work of Tyack and Tobin (1994) that schools are resistant to change. Although the state created a 5/6 extension to allow secondary certified teachers to teach sixth grade science, all of the sixth grade science classes in the case studies were taught by elementary certified teachers.

However, the attitude in most of the cases was that since the teachers had common-branch certification they were certified to teach any discipline of science. Therefore, a sixth-grade teacher could teach physical science and be considered highly qualified by New York State, yet a teacher with 7-12 certification in physics would not be considered highly qualified to teach sixth-grade physical science without possessing a 5/6 extension, which is somewhat nonsensical.

The one commonality that was mentioned was that there were more teachers with biology certification than the other disciplines at the middle school-level. This was supported by the Report of the 2018 National Survey of Science & Mathematics Education, (NSMME+) (Banilower et al., 2018), which indicated that middle school life science teachers were most likely to have certification in their content area. This response was often used to explain why living environment was the class that was used for universal acceleration. Some interviewees also identified the greater interest on the part of the students to learn life science topics. At Wait and See the teacher explained how the Living Environment Regents Exam was easier to pass. She attributed the decision to accelerate students into Regents-level living environment rather than Regents-level Earth science being based on the ease of passing the exam, rather than anything to do with student learning.

Only in New Leader did the assistant superintendent and science coordinator both identify a large percentage of middle school teachers possessing Earth science certification as the reason why Regents-level Earth science was the course that students were accelerated into in the eighth grade. However, the possibility of having universal acceleration into Regents-level living environment would only be possible if teachers possessed biology certification.

When asked if any teachers teaching sixth grade science were secondary science teachers with the 5/6 extension, the science chairperson from Using Teachers as Educational Consultants identified two such teachers, yet neither one was teaching sixth-grade science. The sixth-grade science teachers were often described as having an affinity or an aptitude for teaching science despite not having secondary science certification. At If It Ain’t Broke, the assistant superintendent described the sixth-grade science teachers as having attended extensive professional development training. However, he conceded that although they taught science,
they were not science specialists, meaning that they did not have specific certification in a science area. They were not science experts. The assistant superintendent from Using Teachers as Educational Consultants also explained how it would be helpful to have science certified teachers teaching sixth grade science. According to Carolan (2013) students that had a subject-specific teacher in fifth grade in science outperformed students that were taught by a teacher responsible for teaching all of the academic subjects due to the curriculum and instruction.

5.8 Building Grade-level Configuration

The difficulty of the sixth-grade teachers being housed in a different building than the seventh and eighth grade science teachers was a common theme. However, the presence of a district-wide science supervisor seemed to bridge this gap by coordinating meetings between the different grade-level teachers. For instance, at One Unit at a Time the teachers from grades 6, 7, and 8 worked together on summer curriculum writing projects. In addition, both the sixth and seventh-grade teachers described common meetings over the course of the school year that were arranged by the K-12 science supervisor.

A similar response was given at If It Ain’t Broke. Although the sixth grade was housed in an elementary building, the K-12 science coordinator arranged for the sixth, seventh, and eighth grade teachers to meet several times a year to discuss curriculum matters.

At the two districts with a junior high school model, Wait and See and Using Teachers as Educational Consultants, the teachers discussed not knowing what was being taught in the sixth grade and how it was an issue. At Using Teachers as Educational Consultants, a total of five secondary science teachers worked with the sixth-grade science teachers. However, since they did not formally observe them, but were there as consultants, they could only advise the teachers, not supervise them. This lack of supervision was described as being an issue.

The science department chairs spent a substantial portion of their day teaching. There was no coordination between the different buildings at Wait and See because the chairperson did not supervise the sixth-grade teachers. At Using Teachers as Educational Consultants, the science chairperson was working with the sixth-grade teachers at one of the elementary schools, but this was a temporary fix. He admitted that he felt his absence at the junior high school negatively impacted the Regents-level Earth science students whom he taught. A better solution would be to have a district-wide K-12 science director as the district had for the social studies department.

At New Leader, the K-12 science coordinator explained how he had only started supervising the sixth-grade teachers the previous year. He had waited until he was their supervisor to start making curriculum changes to sixth-grade science. He also was a consultant to the elementary teachers, however, not all teachers were as receptive to his help.

It appeared that the role and the responsibilities of the science supervisor were more important than the building grade-level configuration in and of itself. In other words, even if the sixth grade was housed in a different building, the presence of a K-12 supervisor helped open the lines of communication and got teachers together for meetings and curriculum writing projects. As for certification considerations, the districts had to work with the teachers they had. This constraint determined the accelerated course at both Wait and See and New Leader. It also was the impetus for Using Teachers as Educational Consultants to move toward an integrated curriculum so the sixth-grade teachers would teach the most basic concepts from life, physical, and Earth & space science.
The acceleration model adopted had the biggest impact on the implementation of NYSSLS at the middle-level grades. By offering a Regents-level high school course in eighth grade, districts had to decide between offering the middle-level standards over two years, or teaching the middle-level standards and the high school standards concurrently in the eighth grade. For the districts choosing to do the latter, it may not seem like an issue yet since the Regents exams have not changed, but once they are aligned with NYSSLS in 2023, this could become an issue.

5.9 Decision-making Process

Another commonality in the responses had to do with the decision-making process. This theme helped answer the third research question: How were curriculum changes made and who was part of the decision-making process?

At many of the districts there was a curriculum committee composed of either teachers, or a mix of teachers and administrators that met together to make decisions. However, in some districts, the account of how teacher input was valued varied depending on who was being interviewed.

At New Leader, according to the science coordinator, teacher input was utilized in deciding to move toward an integrated teaching approach. He described the decision-making process as being collaborative. However, when the eighth-grade teacher was interviewed, she described it very differently. She felt that the coordinator made decisions on his own without asking the teachers for their input. She was not happy with the way certain topics were placed in some grades. She felt as if the teachers’ opinions were not taken into account. Yet, this teacher admitted that what she taught was not necessarily aligned with what she was supposed to teach. If there were certain topics that she thought her students would benefit from learning, she taught them regardless if they were in the curriculum. This idea that teachers can do what they want once they close the classroom door was supported by Cuban (1990) in his research that the success of reforms ultimately relied on the implementation by the teachers,

A similar sentiment was expressed by the teacher at Wait and See. She felt that the curricular decisions were made by the principal and assistant principal with the district-level administration without any consideration of the teachers’ opinions. She described a top-down approach to decision-making with no opportunity for teacher input. When the assistant superintendent of curriculum and instruction described curricular changes, she described a Curriculum Advisory Council (CAC) comprised of both teachers and administrators that met to research different programs and make recommendations. As the assistant superintendent noted, there were no science teachers on the CAC. However, when it came to science, according to the science chair, a K-7 curriculum committee had met the previous year, but had no plans for reconvening this year. At Wait and See, the chairperson had tried to arrange for professional development for her teachers on NYSSLS during Superintendent’s Conference Day, but the plans were not supported by the Board of Education. The sentiment was that science was not valued as much as some of the other tested areas. With students not taking the ILS exam, science was placed on the backburner until students started to take Regents-level courses. The assistant superintendent discussed changes at the Regents-level courses such as a new bilingual living environment course, but as stated by the science chairperson, the ELL students and special education students were being taught the same way the mainstream students were being taught. Wait and See was a high-need district, and as reported in the Report of the 2018 NSSME+ (Banilower et al., 2018) teachers in high-needs districts tended to report having less control over curricular decisions.
By contrast, at That’s Why We Have Directors, the teachers, science director and assistant superintendent all described how teacher input was valued. The director explained how an NGSS sub-committee was established comprised solely of teachers that served as a ‘soundboard’ for different teaching strategies that teachers were trying in their classroom. By first working with this group of teachers, other teachers heard about what their peers were doing, became curious, and then started trying some of these strategies on their own. The decision to move physical science to sixth grade and offer ‘baby’ Earth science in eighth grade was discussed with the teachers first as opposed to just being made without teacher input. The teachers on the NGSS sub-committee were asked to put out ‘feelers’ to see what their colleagues thought of the idea. Although it was unanimously agreed that it was ultimately the director’s decision to move toward a domain-specific curriculum, the teachers felt that their voices were heard and that their input was valued. Although the director had the authority and autonomy to make the decision on his own, he used the teacher input to ultimately drive his decision.

At Using Teachers as Educational Consultants, the teachers were the ones that ultimately led to the change from a domain-specific to an integrated teaching approach. They were part of a middle-level science committee that consisted of the science chairs, principals and the assistant superintendent for educational services. This committee included teachers from grades 6, 7 and 8. This change clearly was made from the ground-level as it was proposed by a junior high school teacher. As the assistant superintendent explained, by going with an integrated approach, where students were exposed to concepts from life, physical and Earth & space science each year, the issue of students missing an entire domain in physics in eighth grade was eliminated.

At If It Ain’t Broke, the assistant superintendent, science coordinator, and teacher all described a place where collaborative decisions were made. Although there was not a curriculum committee per se, the teacher felt that teacher input was valued and taken into account when decisions were being made.

Districts that allowed the teachers in the decision-making process had greater buy-in from the teachers. The top-down approach was not well-received by the teachers and led to programs that were less likely to be successful. These programs either led to poor results or were likely to change in the foreseeable future. The districts such as That’s Why We Have Directors, that utilized a grass-roots approach led by the teachers had a good chance for success.

5.10 Recommendations

The following recommendations are based upon the findings from the 6 case studies and from the research questions that guided the research.

Grade specific standards for grades 6-8. The New York State Education Department might be advised to follow the lead by states such as Kentucky by delineating which performance expectations should be taught in each grade 6, 7, and 8. By having a grade-band, if students from Long Island were to move a couple of miles, they could be in a different school district where the science curricula do not match. This mismatch would lead to gaps in their foundation in middle school science which would result in their being unprepared for high school-level science.

This practice is currently not an issue in pre-K- grade 5 because there are grade specific standards for these grades. Likewise, it is not an issue at the high school-level because if a student were enrolled in Regents-level Earth science and were to move, he or she would be
placed into a Regents-level Earth science class in the new school regardless of his or her grade-level. This practice of being placed in the same content is not going to happen at one particular-level, the middle-level grades. Students in Science 7 in their old school would be placed into Science 7 in their new school regardless of the curriculum.

If a student were to move from a school where physical science was taught in seventh grade, to a new school where life science was taught in seventh grade, the school would not place this student in physical science. The student would simply be enrolled in seventh grade science, despite it being an entirely different course. With an influx of transient students in the country’s suburbs expected to grow in the upcoming decades (Hodgkinson, 2001), movement from one district to another is becoming more common. This movement can lead to gaps in students’ middle-level science education which will leave them unprepared for the high school-level grade-band.

**Creation of K-12 district-wide science supervisors.** School districts should consider creating a position for a K-12 science supervisor. This position would allow there to be a consistent approach to science instruction for all grades within a school district. In addition, if there are grades split between buildings, which happens frequently with the middle-level grades, this supervisor would be able to maintain open lines of communication between the teachers in different buildings. In addition, professional development and vertical and horizontal articulation are more obtainable with a person whose sole focus is on science instruction. As the assistant superintendent from *If It Ain’t Broke* mentioned, the science coordinator used to have a teaching responsibility, but it was removed because “the job was too big”.

**Secondary certification might be changed to grades 6-12.** Policy-wise, since NYSSLS delineates a middle school science grade-band of 6-8 and a high school grade-band of 9-12, the New York State Education Department might consider creating a new secondary science certification for grades 6-12. By making this change, science teachers would be certified in specific disciplines to teach in any grade 6-12 and would align the teacher certification with the curriculum. It is more appropriate to have a science teacher teach sixth-grade science than a teacher with common branch certification. In the case study districts, some sixth-grade teachers in an elementary building, such as *Using Teachers as Educational Consultants*, taught multiple subjects, whereas sixth-grade teachers housed in elementary schools in smaller districts such as *If It Ain’t Broke* and One Unit as a Time taught science to all of the sixth graders. Although the assistant superintendent from *If It Ain’t Broke* explained that the sixth-grade science specialists had received extensive professional development, he conceded that there were not science experts because they lacked science certification. Since sixth grade is included in the 6-8 grade band, it would more appropriately be taught by a teacher with secondary science certification. Moving forward secondary science teachers could be required to take course work that will allow their certification to be 6-12 rather than 7-12. In addition, current certified secondary science teachers could retro-actively be considered highly qualified to teach sixth-grade science.

Since more schools are also teaching a full-year of middle school Earth & space science, New York State should identify teachers that have Earth science certification as being highly qualified to teach middle-level Earth & Space science. That specific wording does not currently exist.

As Toban and Tyack (1994) explained change in schools is very complex. If the move to 6-12 certification is too big of a leap, perhaps districts can offer incentives for secondary teachers to complete the required coursework to obtain the 5/6 extension.
De-coupling of state assessments and teacher evaluation. Since the opt-out movement is so large on Long Island, New York State has to find ways to entice students to participate in the grade 3-8 state testing in math, science and English language arts. One way they can do this is by permanently separating students’ performance on these exams from the teachers’ Annual Professional Performance Review (APPR). Ever since the scores have been tied to teachers’ APPR there has been a large opt-out movement. By not tying APPR scores to these exams, hopefully students would start taking these exams again. If large number of students continue to opt-out of the ILS exam, what reason will teachers have to change their teaching pedagogy to align with NYSSLS?

This opt-out problem is not an issue at the high school-level because the Regents exam are required for graduation. For districts with universal acceleration, the state should consider requiring students to take the ILS exam. This is not as much of an issue for math, because there are math tests each year in grades 3 through 8. However, in science there is only one exam for the middle-level learner, the ILS exam. Before students take a Regents-level course, they should be required to take the ILS exam, or if they learn the NYSSLS middle-level standards concurrently while they are in an eighth grade accelerated Regents-level course, they should be required to take both the ILS exam and the Regents exam. Otherwise, districts that practice universal acceleration do not have an assessment on the middle-level science standards. More effort is placed on preparing students for the Regents exams they would take in eighth grade than on providing a strong foundation in science at the middle-level. This practice would hold schools responsible for assessing how well their middle school program is doing. Schools could be given the option of having students either take the ILS exam at the end of seventh grade or at the end of eighth grade depending on when the middle-level standards are completed.

It is hoped that these potential policy changes will be made to encourage more students to continue with rigorous STEM courses after the middle-level grades. Since students do not have the choice of what they take in middle-school, this is a small window of opportunity to expose all students to a foundation in all of the science disciplines so when they have more choices available to them once they start high school, hopefully a greater percentage of students will challenge themselves to take more rigorous science courses. According to Maltese and Tai (2011) students that decided by eighth grade that they were to pursue a STEM career met their aspirations. As New York State schools begin to implement NYSSLS and the assessments begin to change in the next five years, we are at a time where more students can be encouraged to pursue a STEM career. Regardless if students chose to pursue a STEM career, having a greater appreciation for how science impacts their lives and how our actions will impact the environment and future generations should be a goal for all educators.

5.11 Further Research

Once the new Next Generation assessments are released in 2022, for grades 5 and 8, 2023 for Life Sciences: Biology and Earth & space sciences, and 2024 for Physical Sciences: Chemistry and Physical Sciences: Physics, further research should study the alignment between the curriculum, instruction, and the new NYSSLS -aligned state assessments. As Fulmer, Tannis and Weiss (2018) concluded, alignment between all three is necessary for its success. Once these new assessments are implemented quantitative studies could be used to determine if an
integrated approach or a domain-specific approach is correlated with higher test scores on the Next Generation Intermediate-level Science Exam. In addition, since most research on acceleration has focused on mathematics, there should be a quantitative study to determine the impact of science acceleration on the percentage of students continuing to more rigorous science coursework. Of particular interest would be if universal acceleration in science leads to a greater percentage of students enrolling in 4 years of science.

Schools need to start making shifts toward these new standards. Regardless if a domain-specific or integrated approach is used, having communication between the teachers from different grades and allowing teachers’ voices to be heard will lead to smoother transitions and greater success and learning for the students. It is recommended that districts have district-wide K-12 science supervisors to ensure that there is a uniform, consistent message delivered across the grade-levels regarding the importance of science education and the approach to preparing students to apply what they have learned to novel situations. With more guidance from the state, and greater communication between teachers and administrators, we can help middle school be a time for students to explore and discover their passions. Middle school will always be a time of transition, but with support from professionals, students will seamlessly slide through these years rather than being stuck in the middle.
References


American Association for the Advancement of Science. (1994). *Benchmarks for science literacy:* Oxford University Press.


Appendix A: Institutional Review Board Approval

Stony Brook University Institutional Review Board (IRB)

DATE: August 28, 2017
TO: Keith Sheppard, Ed.D.
FROM: Office of Research Compliance
STUDY TITLE: [1088656-2] Stuck in the Middle: Middle School Science and the Next Generation Science Standards
CORIHS#: 2017-4192-F
ACTION: CONFIRMATION OF EXEMPTION
DECISION DATE: August 28, 2017
EXPIRATION DATE: August 27, 2020

The project referenced above was reviewed by the Office of Research Compliance and a determination was made that this project qualifies for exemption in accordance with federal exemption category #45 CFR 46.101.b.1.

If this activity has components that require approval from additional compliance committees (e.g., IACUC, IRB, IBC, SCRO, COI) it is your responsibility to not commence with the study until these approvals have been secured as well.

Please Note:

- Approval includes the Protocol version and survey/interview guide uploaded on 8/23/17
- This study meets the criteria for a waiver of documentation of consent for the online questionnaire per 45 CFR 46.117(c).
- Consent forms signed by subjects in this study must be kept by the investigator for 6 (six) years from study termination, or indefinitely (if so indicated in the consent form).

Changes of any kind must not be implemented until first reviewed and approved by this office.

Where obtaining informed consent/permission/assent is required as a condition of approval, be sure to assess subject capacity in every case, and continue to monitor the subject’s willingness to be in the study throughout its/their duration of participation. Only use current CORIHS-stamped forms in the consent process. Each subject must receive a copy of his/her signed consent/permission/assent document.

Unanticipated problems (including serious adverse events) must be reported to this office in accordance with SBU Policy at: https://web.stonybrook.edu/research/humans-scp/Shared%20Documents/Section08.aspx.

Any complaints or issues of non-compliance must be immediately reported to this office.

If you have any questions or comments about this correspondence, please contact:

Office of Research Compliance
Division of Human Subject Protections
Stony Brook University
Stony Brook, NY 11794-3368.
Appendix B: Letter Introducing the Study

May 7, 2017

To Whom It May Concern:

My name is Robert J. Wankmuller. I am a doctoral student enrolled in the Ph.D. program in science education at Stony Brook University. I am the K-12 Director of Science, Technology and Research for Hauppauge Public Schools and have served in this role for the past thirteen years. I participated in the science sequencing meetings at Western Suffolk BOCES. I am doing a follow-up research study to see what districts plan to do in regard to implementing one of the proposed science sequences that was developed.

I am asking that all participating districts consider participating in this study by completing the attached survey on Google Forms. Here is a link to the Google Form: https://docs.google.com/a/stonybrook.edu/forms/d/1F0P9gJf4Q2XNoH4xjui6gKt1WWl.souFQhGaJiFEyLGK/edit.

Participants will be given pseudonyms and districts will not be identifiable.

Select science chairpersons, coordinators, or directors will be asked to participate in an interview to gain further insight into how the middle school science sequence will be implemented.

The results from this study can be very useful for your district and will be shared with all districts that participate in this study. If you have any questions about participating in this study, please do not hesitate to contact me via e-mail at robert.wankmuller@stonybrook.edu or by phone at (631) 807-5701. You can also contact the principal investigator from Stony Brook University, Keith Sheppard, Ed.D. via e-mail at Keith.Sheppard@stonybrook.edu or by phone at (631) 632-2989.

I have received Internal Review Board permission, IRBNet # 884296-1, and have completed all the CITI and HIPPA training necessary to work with human subjects. Your participation in this study is voluntary and if you agree to participate, you can withdraw from the study at any time. Thank you for your time and consideration.

Sincerely,

Robert J. Wankmuller
Doctoral student in Science Education at Stony Brook University
Appendix C: Questions for Interviews.

1) What is the building grade-level configuration of your district?

2) Which teachers do you supervise? Which teachers do you formally observe?

3) How are the NYSSLS being implemented this year and next year?

4) How are the NYSSLS being implemented specifically at the middle school (grades 6-8) level?

5) Is an integrated approach or discipline specific approach being used? 
   What were the factors that impacted this decision?

6) Do you accelerate students into a Regents-level science course in 8th grade? 
   Which course(s) is (are) offered? 
   How are students selected? 
   How does this impact their science instruction in grades 6 and 7?

7) Who was involved in the decision-making process?

8) How did teaching certifications held by the middle school science teachers impact the decision?

9) How does the current science scope and sequence compare to the one to be implemented this year or next year?

10) What are the biggest challenges in implementing the NYSSLS?

11) What are you planning to do to assess if the program is working?