Weapons of Mass Destruction in the Global Age

At the end of this session, you should be able to understand
- The reasons for the acquisition of WMD's
- Facts about nuclear WMD's: distribution, weapon types, lethal effects
- The politics of WMD and proliferation
- Guest speaker Prof. Chuck Taber will introduce the class to historical, political, and technological issues related to nuclear weapons of mass destruction

Reasons for the Acquisition of Nuclear Weapons of Mass Destruction (WMD):
- Direct/extended deterrence of attack with purpose to avoid use of nuclear bombs
- Mutually Assured Destruction-MAD with second ICBM counter-strike
- Nuclear Utilization Threat-NUT in form of tactical weapons ➔ escalation risk
- Political symbolism (status, show of technological prowess)
- Economic/profit reasons ➔ Military Industrial Complex

Nuclear WMD Facts
- During Cold War up to 30,000 nuclear warheads in position of superpowers (Soviet Union, United States of America)
- Now: U.S. and Russia possess each about 5-6,000 warheads. Other “club members” are China, UK, France, India, Pakistan, Israel (undeclared). N. Korea likely soon.
- U.S. has about 1,200 Megatons destruction capacity (Hiroshima=0.13 MT)
- Carriers: ICBM’s, submarines, bombers, cruise missiles

Types of Nuclear Weapons
- Simple Fission Weapons
  - Rely on fission of plutonium or highly enriched uranium
  - Yields of around 20 kilotons (kT)
  - Easy to build — nine countries have made, several others close
- Advanced Fission Weapons
  - Very efficient use of plutonium, or incorporate a fusion “boost”
  - Yields up to 500kT
  - Harder to build; would be tough for “rogue states”
- Fusion Weapons
  - Fission bomb sets off a larger fusion bomb
  - Yields unlimited in theory; up to 50MT can fit in planes or missiles
  - Very complicated — testing is probably required
  - Probably used by only the five declared nuclear powers

Size of Nuclear Explosions
- Weapon yield is measured in “tons” (T)
  - One “ton” equals energy release of 1,000kg of TNT (4 * 10^9 Joules)
Energy Released from Nukes and Other Disasters

- Typical Gulf War bomb 0.5 ton
- Largest non-nuclear explosions 1-2 kilotons (kT)
- Hiroshima bomb 15 kT
- Typical U.S. nuclear bomb, 1997 200-500 kT
- Typical U.S. Nuclear bomb, 1965 5 megatons (MT)
- Mt. St. Helens eruption, 1980 10-20 MT
- Meteor Crater impact (Arizona) 20-40 MT
- Largest nuclear weapon test (USSR, 1960) 53 MT
- San Francisco earthquake, 1906 1,000 MT
- U.S./USSR total arsenals, 1981 12,000 MT
- “Dinosaur Killer” impact (65 Myr ago) 500 million MT

Nuclear Effects: Blast and Thermal

- Blast Effects
  - Shock wave hits like a sledgehammer; high wind creates flying debris
  - Scattered debris, broken fuel tanks, overturned stoves, etc., are very conducive to starting and spreading fires
- Thermal Radiation
  - Will char or ignite exposed materials, severely burn humans
  - Works with blast to create firestorms -- can turn whole city to ashes
- Radius for Damage by Weapon Yield
  - 20kt 500kT 10MT
  - Reinforced Buildings Collapse 0.5 miles 1.5 2.5
  - Wood-Frame Homes Collapse 2 miles 6 17
  - Windows Shatter 5 miles 15 32
  - Most Materials Ignite / Massive 3rd Degree Burns 1 mile 4 12
  - 2nd Degree Burns / Paper or Dry Leaves Ignite 2 miles 7 19

Nuclear Effects: Radiation

- Prompt radiation is not the major problem
  - Bomb produces intense neutron and gamma-ray flux
  - This radiation is readily absorbed by air
  - In general, anyone close enough to receive lethal radiation doses would be killed by blast/fire anyway
- Fallout: What is it?
  - Fission products and activated isotopes from bomb parts, dirt and rock
  - Material condenses, then “falls out” as dust in a few hours or days
  - Hard to predict -- depends on weather, type of bomb, and altitude of detonation (air bursts produce little; surface busts make tons)
- Fallout is a very serious hazard
  - Hiroshima-sized surface blast: lethal fallout for 5-10 miles downwind
  - 10MT surface blast: lethal for 75-150 miles, radiation sickness for 400!

Example: Nuclear Attack on Boston

- (Air Burst Above Logan Airport -- 3.5mi from MIT)
- **Hiroshima-Sized Bomb (20 kilotons)**
  - At MIT: Broken windows, but not much more
  - Overall: Airport terminals destroyed, East Boston houses badly damaged and on fire, burn injuries downtown
  - Fallout: Lethal fallout to Newton/Waltham (surface burst, wind to W)

- **Typical 1990s Weapon (500 kilotons)**
  - At MIT: Many buildings collapse, severe burn injuries, fires started
  - Overall: Airport/E. Boston incinerated, downtown buildings collapse, houses destroyed and fires rage throughout Cambridge/Somerville
  - Fallout: Lethal fallout to Worcester

- **Old-Fashioned “Citybuster” (10 MT)**
  - At MIT: Utter devastation; buildings destroyed, everything on fire
  - Overall: Severe damage extending several miles beyond Route 128
  - Fallout: Lethal fallout beyond Springfield, sickness to Rochester, NY

**Politics of WMD: Who wants to acquire or has already WMD?**
- Why acquire states WMD’s? ➔ deterrence, protection BUT not use
- Why do non-state actors want WMD’s? ➔ potential use as terror weapon
- Con’s of WMD possession: Cost to develop/maintain/dispose WMD’s, environmental & health hazards, risks of man-made failure, monopoly provokes proliferation,
- Con’s of WMD use: crossing nuclear “threshold” risks escalation of deathly spiral of retaliation, difficult to control environmental effects (“nuclear winter”), ethics (nuclear Holocaust)
- Pro’s and con’s of ballistic missile defense: Protection against accidental launch/small nuclear power BUT risk of proliferation, technological/human failure, no protection against “dirty suitcase” bombs…

**WMD proliferation**
- Carrot & stick approach—involvement of international agencies (IAEA, UN), unilateral actions (preventive wars)…but BUT Resentment against nuclear “club”
- How many weapons are enough? ➔ threshold rationale=superiority/parity/efficiency. ALWAYS “Overkill” risk.
- Conclusion…world would be safer without WMD’s…BUT….once the genie is out of the bottle it is difficult to get him back in…??!!!