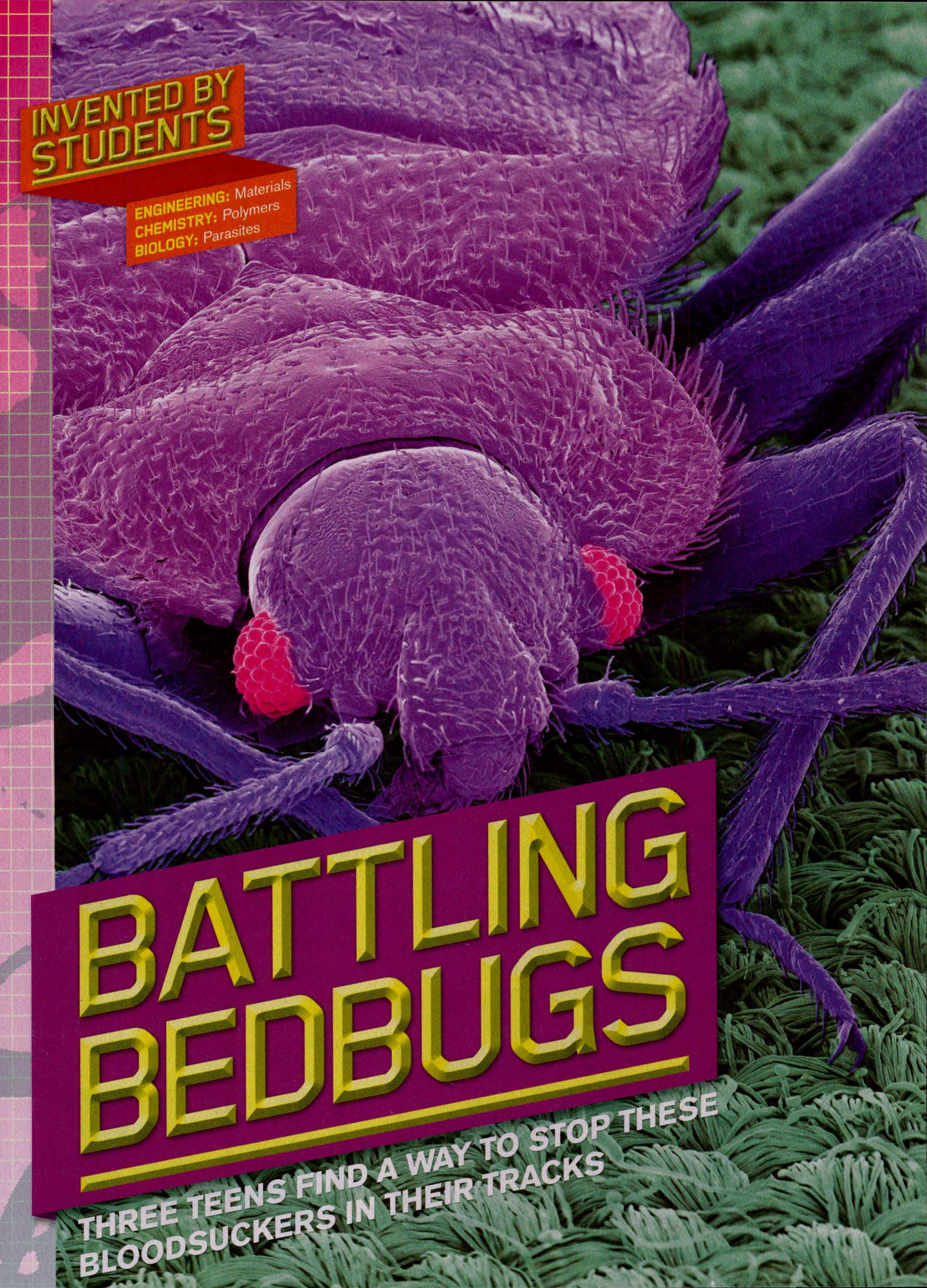
INVENTED BY STUDENTS
ENGINEERING: Materials
CHEMISTRY: Polymers
BIOLOGY: Parasites
BATTLING BEDBUGS
THREE TEENS FIND A WAY TO STOP THESE BLOODSUCKERS IN THEIR TRACKS

Not letting the bedbugs bite is easier said than done. But three teens from New York have created a new way to keep these unwelcome pests at bay. Their work made them finalists at this year's Intel International Science and Engineering Fair in Los Angeles.

Bedbugs, which grow to about the size of an apple seed, feed on blood. To be close to their unsuspecting victims, they often live in and around beds, hiding during the day and coming out to bite at night. Their bites can cause terrible itching and severe allergic reactions in some people. The bugs are very hardy and can survive for a year without a meal.

Bedbugs have tormented people for thousands of years. But in the 1950s, it seemed like the insects might become a thing of the past. Chemical pesticides like DDT had nearly eliminated them from the U.S.

But bedbugs weren't done with us yet. They developed resistance to many of the pesticides that were used against them and came back with a vengeance. Over the past several years, the insects have been reported in all 50 states.

CUTTING BACK ON CHEMICALS

High school students Michal Leibowitz, Jacob Plaut, and Daniel Rudin took up the fight against bedbugs last summer. They were attending a materials science program at Stony Brook University in New York. One day they went to a talk about the problem of pesticide use in bedbug extermination.

As the bugs evolve stronger resistance to pesticides, people have to turn to stronger chemical weapons to kill them. But harsh pesticides can harm the environment and can also cause health problems in people exposed to the chemicals. "The lecture addressed the need to somehow find an alternative," says Daniel.

Shortly after the talk, the students toured the materials science labs at the university. They encountered a piece of equipment called an *electrospinning apparatus*. Scientists can use this type of machine to create very thin fibers, which are used to make filters or surfaces for cells to grow on.

The device uses electrodes to apply opposite electric charges to a plate and to a material that has been dissolved in solution. A nozzle gradually pumps out the solution, which gets attracted to the plate, where a

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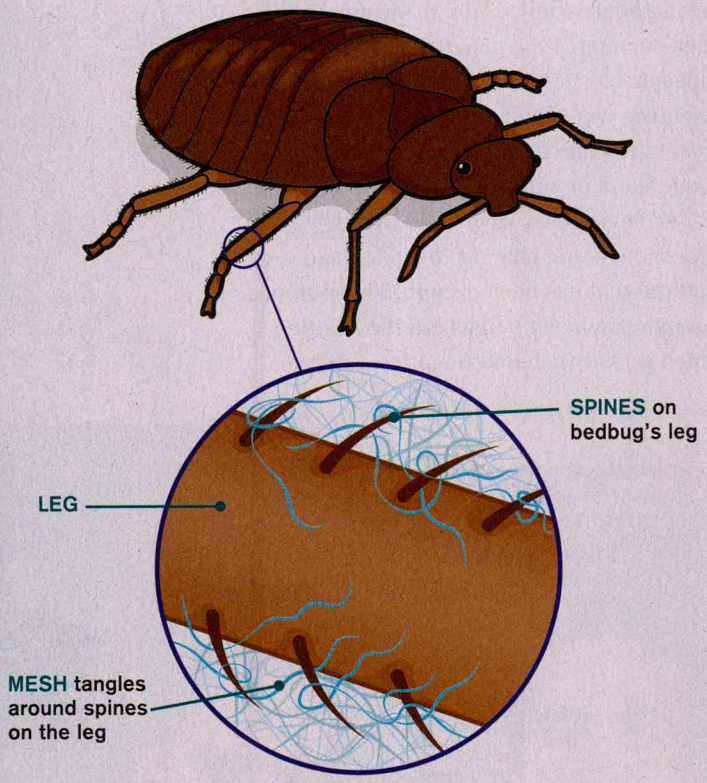
BUG-BATTLING TRIO: Left to right: Jacob, Daniel, and Michal at the Intel science fair

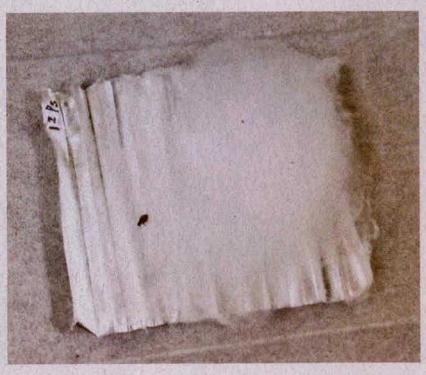
long, thin strand of the material piles up and forms a mesh.

The three students watched the electrospinning apparatus in action. "You could see how it spun out these almost cotton-candy-like structures," says Michal. They wondered whether they could use it to make a trap that could be placed around the legs of a bed to stop bugs from crawling up. If they could trap the bugs in a fiber mesh, that could eventually mean less need for pesticides.

TRAPPING A BEDBUG

The fiber mesh that the students developed traps bedbugs by entangling the hairlike structures on their legs.





TRAPPED! Once bedbugs encounter the mesh, they become stuck.

LAYING THE TRAP

First the trio had to think about materials they could use. An electrospinning apparatus makes fibers from *polymers*, which are molecules made of long chains of repeating structures (*see What's A Polymer?, p. 11*). The students wanted a cheap, environmentally friendly material, so they focused on polymers that were from recycled materials or were biodegradable.

Eventually, they settled on three: polylactic acid, or PLA, which they got by dissolving a clear plastic cup; polystyrene, which they got by dissolving a Styrofoam coffee cup; and ecoflex, a biodegradable material that they ordered from a supplier.

Miriam Rafailovich, a materials scientist who supervised the students in the lab, was impressed with their ideas for polymer materials. "It was refreshing—they were able to see things in a new way," she says. "Most biomedical electrospun materials are these very specialized, high-end materials. We probably never would have thought to use a coffee cup."

BRING ON THE BUGS

The students spun all three polymers into fiber meshes. Then they started thinking about which would make the best trap. "To figure out which fiber might be best, we looked at a bedbug under a microscope," says Jacob. "There's a guy in Connecticut who's an exterminator by day, but he also breeds and sells bedbugs to researchers, so we ordered some from him."

The students looked at the bedbug's legs, and examined the tiny hairlike barbs, or spines, on them. They hoped that the barbs would get caught in the fibers of their traps (*see Trapping a Bedbug, left*).

Next, they examined the fibers. Measuring under the microscope, they saw that for the PLA and ecoflex, the spaces between the fibers were probably too small for a bedbug's legs to slip between. But the polystyrene fiber mesh looked just right for a bug leg to fit into and get caught in.

HUNGRY BUG: A bedbug enjoys a blood meal on a human.

CORE QUESTION

Explain in your own words the process by which the students created their bedbug trap.

The team then tested the meshes by dropping bedbugs onto each one and recording what happened on video. "The ecoflex fiber was ineffective—the bedbugs just walked across," says Michal. "They struggled more on the PLA but could still move. But when we dropped a bedbug on the polystyrene, it got completely tangled. The more it flailed and tried to move, the more it got trapped."

The university lab, working with an outside company called Fibertrap, patented the new fiber trap. The company plans to develop it for sale. "This is a cheaper, safer alternative to chemicals," says Daniel.

After their strong showing at the Intel science fair, these teens have some tips for other young inventors: "Look at what's already been made and see how you can use it in a new or different way," says Michal.

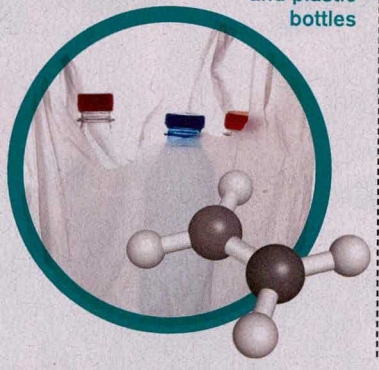
"Don't listen to people who say something isn't feasible," adds Jacob. "Just go out and do it." ⚛

— *Jennifer Barone*

WHAT'S A POLYMER?

A *polymer* is a chain-like molecule made of repeating structures called *subunits*. Polymers are common components of products like plastic bottles and electronics. This chart shows three everyday polymers and their subunits.

POLYETHYLENE — used in plastic bags and plastic bottles



POLYVINYL CHLORIDE — used in pipes and covering for electrical wires

POLYACRYLAMIDE — used in paint and spandex

KEY: carbon · hydrogen · oxygen · nitrogen · chlorine