Brandon Taylor, a student at Pulaski County High School, examines an acrylamide gel loaded with a protein solution. The experiment is part of the Biotech-in-a-Box program, which provides an entryway for thousands of Virginia students to learn more about science and technology.
“We need steady hands and we need focus,” said science teacher Eileen Petzold.

Petzold is demonstrating a laboratory tool called a pipette for a class of Pulaski County High School biology students, who proceed to load protein solutions made from raw and cooked chicken, raw venison, raw beef, and raw pork, as well as hot dogs, canned food, kidney beans, and soy burgers, into holes in gel held between two plates.

When the fledgling scientists apply electricity to the acrylamide gel, the proteins migrate based on their mass in a process called electrophoresis. Then, the gel is placed in a solution to stain the proteins blue, allowing students to visually compare them.

The goal is to help the students understand the proteins and nutritional value found in each sample. The experiment, which the students did on a Wednesday, will sit overnight, giving them time to make hypotheses about what they will find. “I’m guessing they’ll have some similarities, depending on the relationship between the animals they came from,” said Tyler Bray, a Pulaski County High School senior. “In that sense, we can determine which ones are most closely related. Each one should be different since they’re not exactly the same organism.”

For five years, Petzold has supervised protein electrophoresis experiments, one of Fralin Life Science Institute’s Biotech-in-a-Box kits, which are loaned to Virginia high schools and community colleges. The seven kits educate on such topics as bioengineering, immunology, DNA biotechnology, column chromatography, polymerase chain reaction, and slime mold behavior. Kits come complete with manuals, suggested exercises, and equipment.

The Biotech-in-a-Box program reaches thousands of students in approximately 70 counties in Virginia each year. The institute pays round-trip shipping between Virginia Tech and the schools, made possible through the Fralin Endowment.

In 1993, the Fralin Biotechnology Center — before it merged with the Institute for Biomedical and Public Health Sciences in 2008 to form the Fralin Life Science Institute — started sponsoring biotechnology workshops, according to Kristi DeCourcy, a research associate and the laboratory manager at the Fralin Life Science Institute and manager of the Biotech-in-a-Box program.

Also during 1993, the Virginia Biotechnology Education Consortium — consisting of high school and community college educators from around Virginia — was organized to provide a sounding board for the direction of the institute’s outreach program.

Feedback from teachers indicated that while the workshops were helpful for learning biotechnology techniques, the teachers couldn’t afford to buy the equipment to do the experiments with their students. As a result, the equipment loan program was created.

During the 1994-95 school year, a single DNA biotechnology kit was circulated to eight schools in Virginia and 250 students. Currently, in the 2012-13 school year, 52 kits are being circulated across Virginia, from Southwest Virginia to Richmond to the Eastern Shore, providing for 15,000-20,000 student experiments per year.

“The success of the program is due to several factors, one of the most important being the longevity of the program,” DeCourcy said. “Because of the long-term support offered by Fralin, teachers know that the kits will be available year after year, so it is worth the investment of their time and energy.
to get familiar with the experiments offered. The kits were developed with input and feedback from teachers, so everything is as classroom-friendly as we can make it.”

For the school districts, they are wallet-friendly, as well. “In most schools, science budgets are limited,” DeCourcy said. “Few teachers can afford either the equipment or the materials needed for their students to undertake laboratory activities like those offered by Fralin. Teachers are very excited when they find out about Biotech-in-a-Box, and they enjoy expanding the activities that their students can experience.”

Petzold has employed the kits for five years. “I use the kits because they allow my students to be able to utilize equipment in the labs that are not readily available at the high school level,” Petzold said. “I like to have higher-level learning, higher-level thinking, and the Biotech-in-a-Box kits open the door for me to be able to provide that.”

Thursday arrives. Students view the gels they’d created from the day before, and are intrigued to find what the fundamental differences between the meats revealed. “We can tell which proteins have been denatured or not denatured, and which ones have been more processed than others and have been treated with more preservatives than others,” Bray said. Bray said that seeing the protein similarities and differences in the meat firsthand substantiated his family’s current eating practices. “My family already buys homegrown beef — we consume organic foods,” he said.

Students were also intrigued by the clear similarities between beef and pork. “It was neat to see the differences between the organisms on the gel. I learned how to analyze and really look at different gels, and how that contributes to comparing them,” said Devin Allen, a senior at Pulaski County High School.

While many of the students in the class said they did not plan to enter a scientific field in college, they found the Biotech-in-a-Box experiments, particularly this one, applicable to everyday life in terms of the foods that they eat.

Petzold said she added in new protein samples this year to expand the experiment; the kits are flexible and allow teachers to design diverse experiments using the same equipment and procedures. “It opened up a whole new avenue of discussion with the students,” Petzold said. “I can say, ‘Hey, when you’re eating processed foods, this is what you’re getting — nothing. There is no nutritional value. Whereas, if you look at all of the bands here (in a different sample), these are all proteins and accessible food that your body can use’.”

Teaching high school students how to use the tools of the biotechnology trade is a crucial component of building a knowledgeable work force in Virginia.

“Teachers are very excited when they find out about Biotech-in-a-Box, and they enjoy expanding the activities that their students can experience.”
Brock Dawson (left) and science teacher Eileen Petzold of Pulaski County High School concentrate on an experiment that will help students understand differences in proteins. Observing are Jessica Dean and Isaac Martin.

Below, Angel Hutson (from left), Jayla Kimbrough, Devin Allen, Briana Covey, and Kelsey Akers watch the movements of protein fragments through a gel.