Beyond Bacteria: Science and the Art of Food Safety

By Jennifer Richards

Bacteria growing in the human body, projectile vomiting, and diarrhea—all engaging topics for young adolescents, and all part of a food safety unit that teaches students about microbiology, proper hygiene, exponential growth, basic statistics, and socio-economic geography. Oh, and it also hones their nonfiction reading comprehension skills.

Why teach an interdisciplinary unit on food safety in middle school? The American Dietetics Association asserts that today's youth are more at risk of contracting a foodborne illness than previous generations. Therefore, the more they know about the proper way to handle food, the less likely they—and the people around them—will get sick.

Food Safety in the Classroom is an interdisciplinary unit that wraps food safety concepts around state standards for science, math, social studies, and language arts. This curriculum, funded by the USDA's National Integrated Food Safety Initiative and administered by the University of Tennessee's Food Science and Technology Department, was designed to improve food safety education among middle school students and offers middle school teachers the opportunity to couple standards-based science activities with interdisciplinary instruction.

In addition, the program directly addresses three This We Believe characteristics:
1. Relevant, challenging, integrative, exploratory curriculum
2. Active learning
3. Health, wellness, and safety.

Pilot tests of the curriculum indicate that the lessons and activities raise student content knowledge and significantly improve food handling. In addition, teachers who have used the curriculum describe their students as very engaged in the topic. One teacher shared that she sees 'changes in student behavior as a result of this program. They share E. coli breakouts in the news and discuss these among themselves as well, so students are listening to the news and discussing more'.

The interdisciplinary nature of the curriculum also is appealing as a means of providing students the opportunity to connect concepts across disciplines. One teacher explains that "the interrelation of material allows students to deal with all subject matter and make connections. It gives kids a chance to see how it all fits together so they see the forest and the trees."

Anatomy of the Unit

The food safety science lessons and activities are organized based on the inquiry approach of engage, explore, explain, elaborate, and evaluate.

First, students rate how clean they believe their hands are on a scale of 1 to 10 and then list the last 10 things they touched since washing their hands. Student responses are varied and often surprising: hair, other people, locker, shoes, guinea pigs, bathroom pass, trash can. Many students admit that they haven't washed their hands at all that day.

Through discussion, students begin to understand that they are exposed to hundreds of contaminated surfaces in the course of a normal day. Now they are ready to draw connections between the bacteria on these surfaces and the transfer from their hands to their food.

To explore the importance of hand washing, students conduct a lab experiment in which they test the effects
of various hand-washing techniques. Students establish a control plate by imprinting their unwashed hands onto the surface of the Petri plate. They imprint their other hand on a treatment plate after having performed one of three hand-washing treatments: 1) cold water with no soap for 5 seconds, 2) warm water with soap for 20 seconds, and 3) hand sanitizer only.

Throughout the lab, students practice the scientific method by creating hypotheses, observing their plates, and collecting data for two days. Students also adhere to standard laboratory protocols, including using gloves, sanitizing all work areas, and washing hands thoroughly.

Once the data collection is complete (after plates have incubated at room temperature for 48 hours), the data is aggregated to reflect class totals. From these aggregated totals, students discuss discrepancies in the data, make suggestions to improve the procedures to ensure greater reliability in future experiments, draw conclusions, and make recommendations on the most effective means of hand washing.

Making Connections

Now it's time to discuss the connection to food safety and improved health. To activate prior knowledge and provide a scaffold upon which to build future learning, the teacher acts as a facilitator to help students create a concept map of their existing knowledge of bacteria. Common responses include: you need a microscope to see them, they can make you sick, they grow everywhere, and they are used to make medicines.

The teacher then leads students through an interactive PowerPoint presentation that introduces students to basic concepts about bacteria, such as what bacteria look like, how they reproduce, how they eat, what are helpful bacteria, what a pathogen is, how they can avoid a pathogen.

To apply and synthesize their new knowledge, students work in small groups to create a RAFT (role, audience, format, and topic) product that communicates their newly acquired knowledge to a specific audience. A favorite RAFT choice is to assume the identity of helpful bacteria and write a rap song entitled, "Can I Help U?"

While a few students are reluctant to make presentations to the class, many enjoy the opportunity to show off their "mad rhyming skills." Other RAFT options include creating a Most Wanted poster of deadly pathogens and writing an autobiographical poem as told by a pathogen.

To elaborate on their new knowledge and practice safe food-handling behaviors, they use food items such as tortillas, pizza sauce, pepperoni, cheese, olives, and mushrooms to create edible cell models. This activity promotes a greater understanding of cell structure and function.

Assessing Knowledge

Students work in small groups to consider the results of their hand-washing experiment and create a list of things about which they would like to learn more. From this list, students choose the topic that intrigues them the most and rephrase that topic into a researchable question. They then brainstorm research procedures that would allow them to answer their researchable question and design a simple experiment.

Finally, students write an appropriate hypothesis for their experiment. Many students have used these experiment designs for local science fair projects. While not as objectively scored as a traditional pen and paper test, this assessment more accurately evaluates students' abilities to think critically and synthesize acquired knowledge about bacteria.

Across the Curriculum

Using inquiry learning as an organizational method, the science activities in the Food Safety in the Classroom curriculum allow students to assume the role of scientists as they experiment, learn more about bacteria, and generate new avenues for learning. These activities are part of a larger interdisciplinary unit on food safety. Supplemental and complementary activities were also designed for math, language arts, and social studies.

In math, students use modeling clay to demonstrate bacterial growth as a model of exponential growth, apply knowledge of exponential growth to solve real-world food safety scenarios, explore concepts of scale through the creation of scale models that correspond to the magnifications commonly found on school microscopes (4x, 10x, and 40x), and apply basic statistics to analyze bacterial growth on Petri plates from their science experiment.

The language arts component includes a jigsaw cooperative learning activity to teach students the four core concepts of food safety (cook, chill, separate, and clean) and then asks students to apply that knowledge by evaluating scenarios to find food-handling mistakes. In addition, students research nonfiction reading materials to gather information about foodborne illness that they then use to write a press release educating their community about the risks and ways to prevent outbreaks of foodborne illnesses.

Finally, social studies activities focus on informational research by investigating recent outbreaks of foodborne illness around the world. Students identify significant outbreaks and gather standard of living information for each country affected. They then draw connections between outbreaks of foodborne illnesses and countries' standards of living to determine what, if any, patterns exist. As a concluding activity, students bring these outbreaks into a geo-spatial context by creating outbreak maps.

Complete lesson plans and activities from Food Safety in the Classroom are available at www.foodsafetyintheclassroom.org.

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