Looking for questions

by Susan German

During the first day of school, our eighth-grade students often receive hour after hour of specific rules and classroom procedures. I take a different approach in science class. Sure, I read the requisite page from the student handbook each class period, but then I have students engage in an activity designed to generate questions. My objective is for students to learn that a scientific investigation begins with a question and that questions can come from many places.

The materials needed are small Styrofoam bowls, whole milk, food coloring, one toothpick, and dish soap. This activity costs approximately $20 to supply 150 students. Students work in groups of two. I instruct students to make a T-chart (Figure 1, p. 16), using one column for observations and a second column for questions that students may have about their observations during the activity. One student from each pair is in charge of gathering the materials from the front of the classroom.

Before students get their materials, I review safety and classroom-behavior guidelines. Students will need to wear chemical splash goggles at all times. Each group will be provided with only one toothpick, and students are reminded to avoid poking one another. Lastly, there is to be no eating or drinking in the classroom. Once food enters the room to be used for learning, it becomes unsafe to ingest. I am fairly theatrical about my safety explanations. Students usually chuckle, but I have little trouble with students following basic safety.

While students are gathering the materials from the front of the classroom, I have them dip one end of their toothpicks in the dish soap before heading back to their tables. There should be only about a centimeter of soap on the toothpick. Once students have their materials, I demonstrate the activity. I pour a cup or so of milk into a small bowl, and then I add a couple of drops of red, yellow, blue, and green food coloring. The drops are added as opposite pairs to look similar to the photo above.

Here is where I explain to students the difference between drops of food coloring and squirts of food coloring. Middle school students have a preference for squirts, which will deplete the food-coloring supplies before the end of the day. Similar to my safety explanation, I make a big theatrical deal about this and usually get students to laugh, which helps them remember to conserve. If possible, I try to give each pair of students a set of food coloring, but the sets can be shared.

Once students have the milk and food coloring in their bowls, I take a minute to review proper observation techniques and explain that the observations can be recorded as words or drawings in their T-chart. My next step is to point out that the chart has a second column—questions. While students are making observations, questions come to their minds that need to be captured on the T-chart. I give examples to the students such as, "I wonder why…." Last, I demonstrate to students how to place the toothpick in the middle of the four colors and observe. Students can then place their toothpicks into the bowls, with the soap side touching the milk, and begin observing and writing their questions.

The class gets a little excited and noisy at this point. Students start to ooh and aah over the action in their bowl. You will also hear a lot of questions from students about the activity. As the teacher, you will need to remind your students about the need to write their observations and questions into their T-chart. I also suggest to the class that one student at a time from each group should walk around the room to observe what is going on in other bowls. Even though I have demonstrated how to do the activity, students do not always follow my directions exactly, which results in some interesting patterns. During the activity, I am constantly circulating through the room to keep an eye on how well students are recording their observations and questions on their T-charts, and monitor their general behavior. Once students are finished, cleanup is relatively easy. Liquids are poured down the sink, and solids are placed in the trash. If the

bowls are in good shape, I have students rinse them out in the sink and set them aside for reuse.

I ask students to share with the class some of their observations on the board. During sharing time, I encourage students to question any observation being shared that seems to conflict with their own observations. I give students a couple of question choices, such as, "Could you please explain what you did during the activity?" or "My observations do not match your observations. I did x, y, z. What did you do during your activity?"

When we are done sharing our observations, I ask students, "Is what we did a scientific investigation?" This is a puzzling question for students. Often, even after a significant amount of wait time, students do not have an answer. So, to help students connect with their prior knowledge, I use a series of leading questions. "What do we know about science investigations?" is usually the start. Depending on the answers, I then help them organize the parts.

Eighth-grade students can usually come up with variables, procedures, hypothesis/question, observations, data, and conclusions. Just not in any particular order. Once we figure out the parts of an investigation, we go through them as a checklist to see how our activity fits within the framework. Then, I go back to my original question, "Is what we did a scientific investigation?" Students generally say, "No," because they see that the investigation did not start with a question. At this point, I am hoping that at least one student will volunteer that they could do a scientific investigation from this activity by taking one of their questions that they had during the activity and testing it. Very rarely do students disappoint me. We then further our discussion by brainstorming sources of scientific investigation questions, such as books, activities, demonstrations, and even other science investigations. If students fail to identify it as a source, I remind them that many questions arise from observations made from daily life.

For the rest of the school year, I use simple activities (what I refer to as "inquiry starters") to introduce new concepts. My reasoning for the simple activities is that I find that students have fewer and fewer science-related experiences that they can draw on to develop questions for investigations. By giving students time to make observations and experience phenomena, I provide them with the background needed to form better questions for investigations.

This activity can be followed by one involving gobstoppers (a candy), water, and a petri dish. For this activity, you can supply a class of 150 students for about $10. Before starting the lab, remind students to wear chemical splash goggles at all times, and not to eat the candy. To begin, student place the gobstoppers in the petri dish, which has enough water in it to almost completely cover the gobstoppers. I have students fill out another T-chart as they record their observations and generate questions they may have. The next step after cleaning up the activity is to answer four questions (Cothron 2002).

1. What materials are available to do experiments with _____?
   Students list the materials that were involved in the activity.
2. How does _____ act?
   Students describe the behavior of the object of the activity. In case of the gobstoppers, "the gobstoppers dissolved," "made interesting patterns," and "white stuff floated off of them" would be possible answers from students.
3. How can the set of materials for _____ be changed?
   Students look at the set of materials from question 1 to see if changes in the materials could be made. For example, water is a material for the gobstopper lab. How can the water be changed? The temperature, color, amount, density, or type could be possible answers.
4. How will you measure the response? Students sug-

FIGURE 1 T-chart for observations and questions; sample observations

Observations:	Questions:
The colors moved away from the toothpick.	I wonder if all types of milk would work the same?
The colors showed up near the toothpick.	Does temperature change things?
The colors stopped moving when the toothpick was taken out.	

INQUIRY INVESTIGATIONS™

12 TITLES!

FREY® scientific

EXCITE STUDENTS WITH HANDS-ON INVESTIGATIONS *PLUS* INNOVATIVE VIRTUAL LABS.

Grades 7–10

Inquiry Investigations™ Topics Include:

- Physical Science
- Biology
- Forensics
- Biotechnology
- Chemistry
- Earth and Environmental

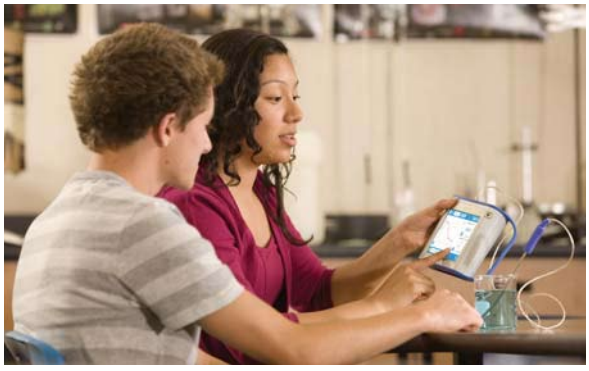
Complete information available including state correlations at *www.freyscientific.com/inquiryinvestigations*.

Contact your Frey Scientific Sales Representative to order today!

800-225-3739 • WWW.FREYSCIENTIFIC.COM

School Specialty Science

spark™ Science Learning System



It's an integrated science learning environment.

With its large, full-color display, finger-touch navigation and highly intuitive data collection and analysis capabilities, SPARK completely redefines the concept of easy-to-use -- so the focus remains on the learning of science. Its Reliable, Rugged design makes it easy to hold and protects the unit from drops or rough handling and the large, easily viewable screen is splash resistant.

The SPARK Science Learning System includes more than 60 free pre-installed SPARKlabs™ -- standards-based, guided inquiry labs in a unique electronic notebook format. These SPARKlabs completely integrate background content, data collection and analysis, even assessment--all within the same environment. Students no longer need to navigate to a separate file for instructions or even refer to paper manuals. Everything you and your students need is right there in context.

Over 60 pre-installed SPARKlabs™

Over 70 Available sensors

10 SPARK Unit Charging & Storage Station

World-Class Professional Development & Support

gest ways they could measure the behavior of the object noted in question 2. For example, students might suggest massing the gobstopper before and after the investigation or timing how long it takes for the gobstopper to dissolve.

The main purpose of this activity is for students to brainstorm the variables of the investigation and choose two variables to use in forming a testable question. From the initial milk-and-food-coloring activity, students already have questions written, but the questions may not be testable. This activity helps students to see the variables and re-form their initial questions into a testable question.

I usually have student groups discuss their answers to the four questions with the class. I then allow students to choose two variables to develop an investigation. But, because I am using the gobstopper activity at the beginning of a unit on solutions, I like to ask at least one group to investigate the effects of temperature on the rate at which gobstoppers dissolve. My reasoning is that later I will be discussing the effects of temperature on dissolving and would like to have data for students to look at as part of the discussion.

Because I provide guided experiences before asking students to write their own questions to investigate, I usually do not have any problem getting students to come up with testable questions.

Reference

Cothron, J. 1996. *Science experiments by the hundreds.* Dubuque, IA: Kendall Hunt.

Susan German *(sgerman@hallsville.org)* is a science teacher in the Hallsville R-IV School District in Hallsville, Missouri.