



Doing Good Science in Middle School

A Practical Guide to
Inquiry-Based
Instruction

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Includes 10 Sample Activities

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Sewer Lice

They're alive! Or are they? "Sewer Lice" is a fun (if sneaky) way to teach about the behavior of gases in a liquid. It is an attention-getting activity using common household materials that will definitely stimulate interest, generate discussion, and stretch everyone's thinking.

Standards

Science (NRC 1996))

Math (NCTM 2000)

Language (NCTE/IRA 1996)

Inquiry, Physical Science, Nature of Science

Reasoning and Proof

Research, Pose Problems, Gather and Evaluate Data, and Communicate Findings; Use Language for Exchange of Information



Integration

Science: Science observations; study of gases and dissolved gases

Math: Data analysis; mathematical terminology

Language: Written records/descriptive writing



Topic: Gases

Go to: www.SciLinks.org

Code: DGS65

Objectives

- Students will make observations.
- Students will problem solve and explain the discrepant event.

Key Words

buoyancy—the upward force on an object floating in a liquid or gas. Buoyancy allows a boat to float on water.

carbon dioxide—a gas that has no color or odor and is produced whenever anything containing carbon, such as wood or gasoline, is burned. It is breathed out of the lungs of animals and taken in by plants for use in photosynthesis. Carbon dioxide contains two atoms of oxygen for every atom of carbon; its chemical formula is CO_2 .

density—a measure of how much matter there is in a certain amount of space. Salt water has a greater density than fresh water.

displacement—the amount of fluid that is pushed out of the way when an object floats in the fluid. The amount of water that is pushed out of the way by a person floating in a pool is the displacement. The weight of that water is also known as the displacement.

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inference—an assumption arrived at based on examining the evidence that seems to support it
observation—the act of watching something closely and recording how it behaves or changes under certain conditions
skepticism—a doubtful attitude



Topic: Buoyancy

Go to: www.SciLinks.org

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Focus Questions

- “How could you identify and describe the object I am holding up?”
- “How can you describe what’s happening inside the container on the table?”

Background

In this activity, the wrinkles in the surface of the raisins catch the carbon dioxide (CO₂) bubbles released from the soda. When enough bubbles collect on a raisin, it rises (“swims”) to the surface where the bubbles begin to “pop” and the raisin drops or appears to swim back to the bottom of the container.

Tips

- Use only ice-cold, freshly opened, carbonated cans of soda. (Bubbles are vital to this demonstration, and cans of soda contain more carbonation than plastic bottles.) Mountain Dew works well because it has some color and can be explained as “a nutrient solution to keep the sewer lice alive during shipping and lab time.” Other sodas can be used, but the raisins are too easy to identify as raisins when you use a colorless soda such as Sprite, and you can’t see the raisins enough to know what they are if you use a cola.
- Soak the raisins in water for an hour before you need them, or use fresh, moist raisins.

Preparation and Management

- *Prep time:* 15 min. to prepare sewer lice culture. (Mountain Dew looks like a nutrient solution, and the raisins appear to be small, beetle-like swimming creatures that we call “sewer lice.”)
- *Teaching time:* 45 min. plus 5 min. to pull the lice out of the soda at the end of class and wash up. (*Note:* If you will be using this activity in more than one class, you will want to use an unopened can of ice-cold soda and fresh raisins for each class.)
- *Materials:*

For teacher demonstration:

- 1000 mL graduated cylinder or other narrow cylinder (Save a special glass cylinder for this demonstration—clear and clean—and see safety note below.)
- 1 can Mountain Dew soft drink (ice-cold soda works best)
- 15–20 raisins

For classroom exploration lab (for each lab group of 3–4 students):

- 1 clear 6–8 oz. plastic cup
- 1 can (12 oz.) Mountain Dew or other soft drink (ice cold)
- snack box of raisins (or equivalent amount)

Procedures

Before you bring out the culture of sewer lice, start with a story—perhaps something like the following:

“One of the biologists from [name a local university or college] recently discovered a new life form at the mouth of the [local] River. The zoologists at the university are still working on the DNA analysis to determine if it is a new species or a mutation of one of the aquatic insects found further upstream. It supposedly was in the newspaper but, truthfully, I never saw the story.”

(If you do this demonstration year after year, you may change the story to explain that you just received the sewer lice you had ordered for their next lab. This works well if you can use a box from a supply company and pour a jar—which you take out of the box—of sewer lice culture into a 1000 mL graduated cylinder. Pour slowly down the side of the cylinder to “minimize injury to the insects.”)

Keep the cylinder on a front table at first. Explain:

“I have been able to procure these few for the sake of scientific study with students. Let’s take out our lab notebooks and record some initial observations. Some questions you might answer are (1) What are the insects doing? (2) What do they look like (size, shape, color)? (3) What questions can you write down that might help us investigate and learn about these animals?”

After they have recorded their initial observations, you may give additional information.

“Evidently the insect is a mutation of a known life-form, the common louse. Scientists are studying it and its behavior. Although it is a bit early to tell for sure, one of the outcomes they have determined is that this louse is edible and a terrific source of protein! Can you believe it?!

“Another preliminary finding is that these insects also clean up the water and actually help purify it. This is great news in our efforts to clean up pollution in water systems. This particular sample is still a bit unclear but supposedly totally drinkable.”

At this point, if you’ve successfully convinced your students that these are indeed sewer lice, you can reach into the culture, catch a louse, and put it in your mouth. After a moment of hesitation and concern, take a small sip to wash it down.

The confirmation that you successfully convinced your students that the raisins were sewer lice is based on the level of verbal and nonverbal feedback you receive from the students. At this point, you may have a discussion about observations and inferences. We also suggest that you talk with your students about issues of trust. Make sure they understand that the story you told had a purpose and that, intentionally or not, many of our observations are biased by what we believe to be true. In science, we attempt to remove as much bias as possible, but there is always a point at which we have to decide what we are going to believe.

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After your demonstration it is time for the students to make their own cultures. (See the safety note below, and reinforce with students at this point that they are not to eat or drink in the science lab). Groups of students use small, clear plastic cups and add fresh soda and a few raisins. Students discuss the “behavior” of the “sewer lice” in the soft drink. They list their observations, questions, and answers to their questions.

As with “The Incredible, Edible Candle,” you will want to commit the class to a solemn oath of scientific secrecy. We have found it helpful to tell students they can tell others about the “really cool sewer lice demonstration in science class.” However, their friends will have to wait until they have your class to have the opportunity to investigate the amazing behavior of the sewer lice. We would also tell students that if their friends ask too many questions later in the day, they can send their friends to us for answers about the sewer lice and we would perpetuate the story with these students.

Safety Note: In this activity, students should repeatedly be reminded that they should *never* eat or drink from laboratory equipment and that you’ve used a cylinder that’s used *only* for this demonstration every year.

Discussion

- How does this work? The gas involved is carbon dioxide, and it is dissolved in the soda. This is accomplished by keeping the soft drink container pressurized. Temperature is also a critical factor. The colder the liquid, the more gas that can be dissolved. This is why trout, which require high levels of oxygen in the water, are found in colder water than bass or carp, which don’t need as much oxygen and are found in warmer water.
- The students will see the bubbles on the raisins, and explain the “swimming” to the surface as the addition of bubbles. They may notice an increase in size of some of the bubbles. This may be the addition of more carbon dioxide as it continues to bubble out of the solution (soft drink/carbon dioxide mixture). Ask the students to then explain the evidence for the “sewer lice swimming back down to the bottom.”
- Ask your students to use words such as *density*, *carbon dioxide*, *buoyancy*, and *displacement*. The use of technically correct terms minimizes misconceptions and increases scientific literacy.
- This is an excellent lab to guide students through the process of thinking about their thinking and then have them discuss (or write about) their thinking. Ask them what they thought when you gave your introduction to the demonstration and why they thought that way. For example, they may have been skeptical at first, but as you explained the details of the story, it became more convincing. (What is it about believable details that makes us more willing to believe someone?) Or the students may have believed you because you are the teacher. (This may be the time to build acceptable behaviors for challenging scientific findings.) Then have them compare their thoughts before and after they performed the demonstration/activity

themselves—how did it alter their thinking? These are the kind of rich discussions that can develop from thinking about discrepant events.

Extensions (application and inquiry opportunities)

- Have students repeat the demonstration using a peeled and unpeeled grape; hard, dry raisins; fresh, juicy raisins; soaked raisins—even paper clips. However, we always require students to get approval of their plan before carrying it out. We also require a written proposal (one that we evaluate based partially on whether it is developmentally appropriate to the student). Remind students that all activities are to be carried out in the classroom under teacher supervision.
- Students who believe they know how to explain this phenomenon can present their ideas to the rest of the class.

Assessment

- Have students record their observations instead of using their usual experimental science lab report (Appendix B).
- Have students create posters or diagrams of what happened and why.