Grades K–2

Standards-Based Investigations

Science Labs

Shell Education

Table of Contents

Table of Contents *(cont.)*

Introduction and Research Base

Why a Focus on Science?

Over three decades ago, the American Association for the Advancement of Science began a three-phase project to develop and promote science literacy: Project 2061. The project was established with the understanding that more is not effective (1989, p. 4).

Inquiry-Based Learning

As Project 2061 began, researchers questioned the appropriateness and effectiveness of science textbooks and methods of instruction. Since textbook instruction puts more emphasis on learning correct answers and less on exploration, collaboration, and inquiry, the Association asserts that this manner of instruction actually "impedes progress toward scientific literacy" (1989, p. 14).

This same concern resurfaced over a decade later by Daniels and Zemelman (2004) who call textbooks "unfriendly." When most adults are choosing literature, they do not pick up their son's or daughter's science textbook. Daniels and Zemelman assert that today's textbooks are best used as reference books when students need large amounts of information on a particular topic within a subject area. Instead, they recommend the use of "authentic" sources.

Project 2061 recommends pedagogical practices where the learning of science is as much about the process as the result or outcome (1989, p. 147). Following the nature of scientific inquiry, students ask questions and are actively engaged in the learning process. They collect data and are encouraged to work within teams of their peers to investigate the unknown. This method of process learning refocuses the students' learning from knowledge and comprehension to application and analysis. Students may also formulate opinions (synthesis and evaluation) and determine whether their processes were effective or needed revision (evaluation).

The National Science Education Standards view inquiry as "central to science learning" (p. 2 of Overview). In this way, students may develop their understanding of science concepts by combining knowledge with reasoning and thinking skills. Kreuger and Sutton (2001) also report an increase in students' comprehension of text when knowledge learning is coupled with hands-on science activities (p. 52).

Values, Attitudes, and Skills

Scientists work under a distinctive set of values. Therefore, according to the American Association for the Advancement of Science, science education should do the same (1989, p. 133). Students whose learning includes data, a testable hypothesis, and predictability in science will share in the values of the scientists they study. Additionally, "science education is in a particularly strong position to foster three [human] attitudes and values: curiosity, openness to new ideas, and skepticism" (1989, p. 134). Science Labs addresses each of these recommendations by engaging students in thought-provoking, open-ended discussions and projects.

Within the recommendations of skills needed for scientific literacy, the American Association for the Advancement of Science suggests attention to computation, manipulation and observation, communication, and critical response. These skills are best learned through the process of learning, rather than in the knowledge itself (1989, p. 135).

Water Cycle

This chapter provides activities that address McREL Science Standard 1.

Student understands atmospheric processes and the water cycle

Knows that short-term weather conditions (e.g., temperature, rain, snow) can change daily, and weather patterns change over the seasons	How Can I Make a Thermometer?, page 12 What Makes a Tornado?, page 13 Where Does Rain Come From?, page 14 Where Does Frost Come From?, page 15 Where Does Water Go?, page 17 How Does the Weather Change?, page 19 When Does the Sun Rise?, page 21
Knows that water can be a liquid or a solid and can be made to change from one form to the other, but the amount of water stays the same	How Strong Is the Wind?, page 22 How Can I Make Rain?, page 24 What Happens When Ice Melts?, page 25 How Much Water Is in Ice?, page 27

How to Teach the Water Cycle

Dihydrogen Oxide

Dihydrogen Oxide, AKA H_2O, AKA water, is a familiar material which offers a wealth of opportunities for play and exploration. Students will have seen water in several different forms—liquid water, solid ice, gaseous steam. Water changes state easily, back and forth, from one form to another. Other materials do the same—wax and chocolate, for example. But only water easily offers all three states—solid, liquid, and gas—in our everyday experience. And it's never possible to get the wax and chocolate back just the way they were!

Water

Water is the liquid state of the material. Liquid water is essential for life. Liquid water takes the shape of the container in which you put it, whether it be a bucket, cup, or jug. It flows downhill, but it won't go up except in a flood (although you can make a continuous column of water flow over and down if you use a siphon). Students will have had a lot of experience with water and its qualities in the bath, swimming pool, and ice cube tray.

Ice

Ice is the solid form of water. It is formed when pure water drops in temperature below 0°C. An amazing quality of water is that it expands as it freezes—tops are pushed off milk bottles and car radiators can be cracked. Frozen water takes up more space than it did as a liquid. As a result, the ice is less dense than water—the same amount of mass in a larger volume.

Steam

Strictly speaking, the billowing clouds that come from a boiling kettle are water vapor. Steam itself—water in its gaseous state—is invisible. You can see where it is by looking carefully at the spout of a boiling kettle—you can just see a clear space between the spout and the vapor. This invisible gas is true steam.

The stuff that fills the bathroom, making condensation run down the cold mirror and windows, is water vapor—liquid water in tiny droplets. It condenses on cold surfaces. This process is called condensation, and the liquid that condenses is called condensed water. However, if you tell your neighbors that you are having trouble with condensed water on your double-glazing, they may think you're a bit of a show off.

Lighter than Water

Water particles bonded together make ice. Unfortunately for the *Titanic*, ice is lighter than water. This is a very unusual but important fact that comes up time and again in this book. It is very unusual for a solid material to weigh less than its liquid. Apart from water, only a material called bismuth behaves like this. (You might have come across this pinkish metal if you have had a gastric ulcer. It is used in soothing medicines.)

Once you understand particle theory, you can understand why this should be. When water freezes, its particles form a kind of cage—a rigid pattern in which the particles are held away from each other. So there is more space in an ice cube than there is in water.

Where Does Rain Come From?

Rainwater isn't new. It's been round and round the water cycle since forever. All of Earth's water is trapped in this endless cycle of change. When you drink a glass of water, you can be fairly sure that at least one of the molecules at one time

How Can I Make a Thermometer?

Name ______________________________

What You Need:

- water
- rubbing alcohol
- plastic water bottle
- food coloring
- drinking straw
- modeling clay

What To Do:

1. Watch your teacher fill the bottle about halfway full with equal parts of water and rubbing alcohol.
2. Add food coloring to the water and rubbing alcohol mixture.
3. Place the straw in the bottle making sure the straw does not touch the bottom of the bottle.
4. Use the modeling clay to seal the top of the bottle closed and to hold the straw in place.
5. Place your hands around the bottle and tell the rest of the class what happens.
6. Pass the bottle around and have each classmate place his or her hands around the bottle to see what happens.

DO NOT DRINK THE WATER AND RUBBING ALCOHOL MIXTURE.

Next Question

What happens to the water and rubbing alcohol mixture as it is heated and cooled? How could you make the water bottle into a working thermometer?

Notebook Reflection

Describe the experiment in your science notebook. Be careful to record your observations. Use drawings as well as words.

What Makes a Tornado?

Name ______________________________

What You Need:

- 2 one-liter soda bottles
- rubber washer the same size as the bottle opening
- electrical tape
- water
- food coloring (optional)

What To Do:

1. Fill one of the bottles 2/3 full of water. If you want, add food coloring to the water.
2. Tape the sides of the washer over the mouth of the bottle. Be sure NOT to cover the hole in the middle of the washer.
3. Place the second bottle on top of the washer. (The tops of the bottles are touching each other.)
4. Use electrical tape to fasten the bottles together.
5. Turn the bottles over. Hold the empty bottom bottle still while rapidly moving the top bottle in circles.
6. Let the bottles go. What happens?

Next Question

Pretend you are stuck in the middle of the bottle tornado. What can you do to survive?

Notebook Reflection

Describe what happened to the water in this experiment.

Where Does Rain Come From?

Name ______________________

What You Need:

- ice (one cup of water frozen)
- clear transparent wrap
- measuring cup
- rubber band
- tall, clear drinking glass
- clean sheets of writing paper

What To Do:

1. Watch your teacher set out one cup of ice. Write or draw what you think will happen to the ice. How much water will there be?
2. Once the ice has melted, carefully measure the amount of liquid left behind.
3. Pour the water into the drinking glass. Cover the glass with a piece of transparent wrap. Use the rubber band to keep the clear transparent wrap secured in place. What do you notice happens to the water as time passes?

Next Question

How much water is in the drinking glass? What makes you think that? What would happen if the water in the drinking glass were frozen? How much water would there be?

Notebook Reflection

What would life be like if water stayed in only one form, solid ice, water, or vapor, and NEVER changed to another form?

