HOW DO PEOPLE USE SOIL AND WATER RESOURCES?

UNIT 8: Natural Resources
Lesson 19 — Grade 4-5
INSTRUCTIONS

Overview

In this lesson students will learn about sources of drinking water, how water can become polluted, and create their own model of a groundwater aquifer.

Objectives

On successful completion of this lesson, students will be able to:

- identify water as a renewable resource;
- list potential sources of water pollution; and
- explain why groundwater is used as a source for drinking water.

Alaska Science Standards / Grade Level Expectations

[4, 5] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.

[4] SA1.2 The student demonstrates an understanding of the processes of science by observing, measuring, and collecting data from explorations and using this information to classify, predict and communicate.

[4] SA3.1 The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by listing the positive and negative effects of a scientific discovery.

[5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations to create inferences and predictions.

[5] SA3.1 The student demonstrates an understanding of how scientific discoveries and technological innovations affect our lives and society by describing the various effects of an innovation on the safety, health, and environment of the local community.

Alaska Cultural Standards

[B] Culturally- knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B3] make appropriate choices regarding the long-term consequences of their actions.

[B4] identify appropriate forms of technology and anticipate the consequences of their use for improving the quality of life in the community.

HOW DO PEOPLE USE SOIL AND WATER RESOURCES?

Bering Strait School District Scope & Sequence

4th Grade Sequence #2: Making & Using Electricity

E. Use scientific processes and inquiry to directly support concepts on conserving natural resources

5th Grade Sequence #10: Conserving Natural Resources

A. Understand how people conserve natural resources
B. Understand how people use soil and water resources
C. Use scientific processes and inquiry to explore conserving natural resources

Materials

- 9 oz Dixie Crystal Clear plastic cups (one per student)
- White play sand (about ¼ cup per student)
- Modeling clay (about 1" piece per student)
- Natural-colored aquarium gravel (about ¼ cup per student)
- Red food coloring (one bottle)
- Measuring cups (two)
- Pitcher
- Clean water (sink nearby, or a jug of water for refilling the pitcher)

Multimedia

REACH Multimedia 4-6: "Water Cycle"

Available at: www.k12reach.org

Additional Resources

HSP IV: Ch. 5, Lesson 3

HSP V: Ch. 6, Lesson 3; Ch. 10, Lessons 1-2

Activity Preparations

1. Read through the entire lesson, including the Whole Picture for background information.
2. If you are unsure of where the drinking water comes from in your community, ask and find out.
3. Divide sticks of clay so there is one piece for each student.
4. If the aquarium gravel is new, rinse first to remove residual powder.
5. Get a jug of water if you do not have a sink in your classroom.

6. Organize supplies so that you will be able to quickly fill each student's model aquifer. You may also want to invite another adult to assist with this activity. You will need stations for sand, clay, gravel, and water.
7. Make an example aquifer model ahead of time.

Whole Picture

Soil and water are natural resources crucial to every day life, but they are so ordinary that sometimes their value goes overlooked. Nevertheless, without these two vital resources, life would be difficult to sustain.

Soils

Soil provides the literal foundation on which our modern lives are built; as well, it provides the basis for healthy ecosystems, and mineral-rich soils have been used for their pigments.

From a literal perspective, soils provide the stable foundation for buildings, roads, and other infrastructure, like sewer, water, and gas facilities (like the pipeline). When the ground becomes unstable (as is the situation when permafrost thaws or erosion happens), the structures that are built upon it can become damaged or lost. It is easy to see the value of stable soils when one looks around villages like Shishmaref, Shaktoolik, and Teller — where loss of soil has caused buildings and infrastructure to tumble and the village councils to consider relocation.

Healthy soil is also an important medium for growing, and its quality determines what can grow in a particular area. Where soils are depleted of nutrients, or contaminated with toxins, life cannot thrive. Healthy soils are nutrient rich, provide adequate drainage for the plants that grow in them, and provide habitat for tiny organisms and bugs that help to break down organic matter, acting as fertilizers for the local ecosystem. When soils are unhealthy or have become contaminated, plants do not receive the nutrients they need, and struggle to survive. Further, contaminated soils can impact drinking water and cause illness in animals and humans. As such, keeping local soil healthy is important not only for the plants that grow in it, but for the humans and animals who depend on those plants and soils.

Finally, mineral-rich soils have been coveted the world over for their color. Traditionally, Alaska Native people have used soils for their pigment. On Nelson and Nunivak Islands, where ancient volcanism left behind "valuable mineral deposits of uiteraq (red ocher) and qesuuraq (vivianite), in addition to urasqaq (white kaolin clay)" and coal, people have made use of the soils to decorate art and clothing, as well as to act as a stain in preserving wooden tools (Fienup-Riordan and Rearden, 2012, p. 45). Even today, these mineral-rich soils are highly regarded, and people continue to use them.

Water

Water, like soil, is a necessary component of life; without it, a person could not survive longer than a week. Additionally, water can also be used to generate power, and it provides critical habitat for plants and animals — many of which people depend on for subsistence.

People depend on water resources every day — water sustains life! Clean, safe water is required for drinking, cooking, and personal hygiene; consumption and use of unsafe water can cause gastrointestinal and pneumococcal illnesses, respiratory infections, skin diseases, reproductive problems, and neurological disorders (Rosa, 2013). In many urban areas, people give little thought to this vital resource; however, in rural villages, water security is a more pressing matter, and clean, potable water can be scarce and difficult to access. Many villages have only small areas that are piped for water and sewage. As a result, the cost of water can be a "significant economic issue" (Rosa, 2015), and many people must haul their water from the school or local water treatment facility. As a daily resource, it is invaluable.

Beyond its necessity to sustain life, moving water holds a great deal of kinetic energy that can be transformed and used for other purposes. Traditionally, Alaska Native peoples harnessed the power of the river to aid in fishing by developing the fish wheel. These wheels consist of paddles and two large baskets, which are connected to a floating platform. The platform is placed in the river and turns with the power of the moving water. As fish swim upstream, they are captured in the baskets and dumped into holding tanks, where people can easily access them.

The kinetic energy held in moving waters has also been used to generate electricity. Hydropower — the electricity generated by capturing the force of falling or flowing water — produces nearly 24% of the state's electricity (REAP, 2015). Though rivers provide the main source of electrical generation from water, new technologies are being developed globally to harness the kinetic energy in waves. However, while the potential for wave energy is great in Alaska, the technology is new and the state is not yet developing this resource (REAP, 2015).

Finally, clean water resources (including healthy sea ice) are crucial for the survival of many subsistence species. Healthy rivers and lakes enable the survival of a variety of fish and waterfowl, including "salmon, sheefish, burbot, Dolly Varden, rainbow trout, blackfish, Northern pike, whitefish, and grayling" (Kawagley, 2006, p. 13), as well as ducks, geese, swans, loons, and grebes. At the same time, marine species like herring, halibut, seals, walruses, and whales, in addition to avian species like auks, murres, puffins, cormorants, and gulls depend on healthy oceans and sea ice. Without clean healthy waters, these and other important aquatic and marine species would not be able to survive.

In coastal villages, where people depend almost exclusively on marine mammals for subsistence, the importance of healthy waters and ice are becoming ever more apparent as climate induced changes affect local habitats. For example, on St. Lawrence Island people are being forced "to learn new ways of doing things in terms of getting food" (Noongwook, 2010). In the past, for example, people could safely use large ice floes as platforms for butchering and hunting of seals and walrus, because they were thick and not dangerous. Now, "ice floes have gotten thinner, and some break into pieces when [people] go on top of them" (Fienup-Riordan and Rearden, 2012, p. 307). People are being forced to reconsider traditional uses of the ocean and sea ice as matters of safety.

The changes people are experiencing as a result of climate change seem to be highlighting the importance of many resources, but especially soil and water. Without these two important resources, people could not survive. Our continued use of soil and water, and consequent survival, depends on our ability to use and conserve them wisely.

Vocabulary

aquifer – underground area with layers of rock, sand, or gravel that hold water

renewable resource – a resource that can be replaced in a reasonable amount of time

nonrewable resource – a resource that, once used, cannot be replaced in a reasonable amount of time

pollutant – a waste product that can harm living things and damage an ecosystem

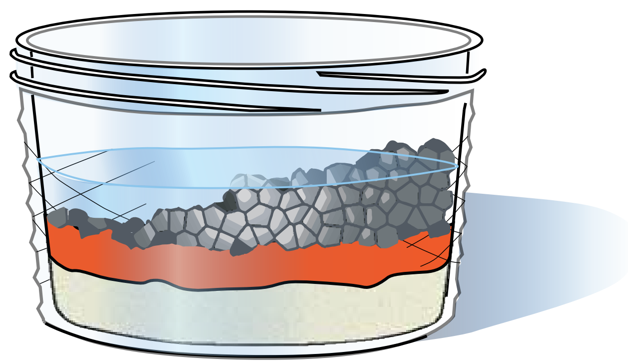
Activity Procedure

This activity is adapted from the lesson plan "Aquifer in a Cup" by the U.S. EPA Office of Water.

1. Review the water cycle. You may want to use HSP IV Ch. 9 Lesson 1, HSP V Ch. 11 Lesson 2, or the REACH Multimedia 4-6: *Water Cycle*.
2. Review the vocabulary terms: renewable resource and nonrenewable resource. Next, ask students if water is a renewable or nonrenewable resource. Divide students into small groups and have them discuss whether water is renewable or nonrenewable. Have the group write their decision on a piece of paper, along with the reason for their choice. Tape the group decisions on the board then read the decisions and reasoning to the whole class. Finish with a class discussion and see if the whole class is in agreement if water is renewable or nonrenewable. The answer is that water is, technically, considered a renewable resource, because it always reenters the water cycle and does not get used up. However, for water to be safe for people to drink, it must be clean. There is not an unending supply of clean water.
3. Ask students if they know where their drinking water comes from (aside from the faucet or the jug on the counter). Prompt students by asking if they drink water directly from the ocean, rivers, or lakes. People cannot drink saltwater, and it is difficult to desalinate saltwater. Glacial streams contain a lot of silt that is difficult to filter. Spring fed rivers or lake water may have bacteria from wildlife waste or other pollutants in it, and needs to be disinfected first. Also, students may be surprised by how much dirt is in water from melted snow. Depending on your location, your community may utilize surface water

(including ice), snowmelt, a natural spring, or a drilled well. Water may be piped to homes, or people may haul their water from a central filling station where it is stored in a holding tank. Whatever the source, it is filtered and disinfected somehow.

4. Ask students to think of some ways that their ancestors could have obtained drinking water. List their ideas on the board. Ask what has changed in the way we collect water from how our ancestors collected water. Long ago, people in the Bering Strait region were semi-nomadic. They did not live in the same place year round, the soil and water could recover from the small amount of pollution they created. Today, people live in the village year round, with more people living in a smaller area. Ask students how this could lead to increased risk of water pollution. Answers may include bacteria from human sewage. The potential for human waste contaminating drinking water is particularly concerning in communities where people live without running water and dispose of their waste individually. Reiterate to students that bacteria from waste can make people sick. Water can also become unhealthy to drink from spilled fuel or other chemicals that run off into streams or leach down to the groundwater table.
5. Explain that today we are going to learn more about groundwater, which is an important source of drinking water in many areas. With groundwater, the water is filtered naturally as it percolates (passes through the porous ground) through the layers of the Earth. Show the aquifer model you prepared ahead of time and explain that it is like seeing a side view of the Earth's layers.



Next, show the students how you made your groundwater model:

a. Scoop approximately ¼ cup of white sand into the bottom of the cup, completely covering the bottom of the container. Pour water into the sand, wetting it completely (there should be no standing water on top of sand). Let the students see how the water is absorbed, settling in around the grains of sand.
b. Flatten a piece of modeling clay and cover 1/2 of the sand with the clay, pressing the clay to one side of the container to seal off that side. The clay represents a "confining layer" that keeps water from passing through it. Pour a small amount of water onto the clay. Let the students see how the water remains on top of the clay, only flowing into the sand below in areas not covered by the clay.
c. Use the aquarium rocks to form the next layer of earth. Place the rocks over the sand and clay, covering the entire container. To one side of your cup, slope the rocks, forming a high hill and a valley (see illustration above). Explain to students that these layers represent some of the many layers contained in the earth's surface. Now pour water into your aquifer until the water in the valley is even with your hill. Students will see the water stored around the rocks.

d. Explain that people can drill wells and pump the groundwater to the surface. They will also notice a "surface" supply of water (a small lake) has formed. This will give them a view of both the ground and surface water supplies that can be used for drinking water purposes.

e. Use the food coloring and put a few drops on top of the rock hill, as close to the inside wall of the cup as possible. Explain to students that this represents contaminants like those discussed earlier. Allow time for students to observe carefully. They will see that the color spreads not only through the rocks, but also to the surface water and into the white sand at the bottom of the cup. This is one way pollutants can spread throughout the aquifer over time.

6. Next explain the procedure for each student to construct their own aquifer model. Students may vary the order and amount of material as they create layers of sand, clay, and gravel.
7. Have students return to their seats with their groundwater models for the pollution demonstration. The teacher or another adult will place a few drops of food coloring into their cup, representing pollutants. Allow time for students to observe the movement of the food coloring.
8. To review, have students share their aquifer model with a partner. Have them describe what the different parts represent, and explain why groundwater can be used as a source for drinking water.

Extension Activities

- Add a layer to the aquifer models to represent permafrost. Saturate small pieces of sponge and freeze ahead of time. As the ice in the sponge melts, it would simulate permafrost thaw. The sponge would be impermeable when frozen, then generally allow more water to pass as the ice melts.
- Allow students to drain off the water in their cups and carry home their container to refill with water and show their parents how food coloring illustrates pollutants that can affect surface and groundwater. Students should discuss with parents what steps they can take as a household to prevent water pollution.
- HSP IV Investigate "Losing It: Observing Erosion" Ch. 5, Lesson 3
- HSP V Investigate "Cleaning Water" Ch. 10, Lesson 1
- HSP V Investigate "Rivers and Sand" Ch. 9, Lesson 2

References

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