DEQ in the Classroom:

The Incredible, Edible Aquifer

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Grade Level:

Any; best fits grades 4–8

Time Required:

30 minutes (can be longer or shorter depending on discussion)

Objective:

To illustrate the geologic formation of an aquifer, how pollution can get into ground water, and how this pollution can end up in drinking water wells. Students will come to understand how our actions can affect ground water and drinking water.

Meets Idaho State Standards:

Grade 4: 4.S.1.2.3, 4.H.1.1.10
Grade 5: 5.SS.3.1.2, 5.SS.2.2.1, 5.S.1.2.3, 5.S.5.1.1, 5.H.1.1.8
Grade 6: 6-9.WHC.2.5.4, 6-9.GWH.2.5.2, 6-9.GWH.2.5.6, 6.S.1.2.3, 6.S.5.1.1, 6.H.1.1.10
Grade 7: 6-9.WHC.2.5.4, 6-9.GWH.2.5.2, 6-9.GWH.2.5.6, 7.S.1.2.3, 7-8.H.1.1.9
Grade 8: 6-9.WHC.2.5.4, 6-9.GWH.2.5.2, 6-9.GWH.2.5.6, 7-8.H.1.1.9

Focus:

Students will build their own edible aquifers and learn about different geologic layers, different types of aquifers, how aquifers become contaminated, and the need to protect and conserve ground water resources.

Materials: (Class of 25)

- Chocolate sprinkles: 2 (3 oz.) containers
- Clear plastic cups: 25–30 (12 or 16 oz.) cups
- Clear soda (e.g., lemon-lime): 4 liters
- Crushed ice (the smaller the better): ≈1 bag
- Mini marshmallows: 1 (16 oz.) bag
- Chocolate chips: 4 (12 oz.) bags
- Puffed cocoa cereal: ≈1/4 cup per student
- Red Kool-Aid® (sweetened and dry): 4 small pkgs.
- Spoons: 25–30
- Straws (preferably clear): 25–30
- Vanilla ice cream: 25–30 single serving cups

Background:

Ground water supplies 95% of the drinking water in Idaho. Wells are drilled through soil and rock into ground water aquifers to supply drinking water. Unfortunately, ground water can become contaminated by improper use or disposal of chemicals such as fertilizers and household cleaners. These chemicals can percolate down through the soil and rock into an aquifer and eventually into drinking water wells. This contamination can pose a significant threat to human health.

Vocabulary:

Aquifer: A natural underground area where large quantities of ground water fill the spaces between rocks and sediment.

Confined Aquifer: An aquifer overlain by one or more layers of impermeable rock or soil (aquitard/confining layer) that restrict water to within the aquifer.

Confining Layer: An underground layer over an aquifer that is impermeable or significantly less permeable than the aquifer below it. It helps protect the aquifer from contamination and is usually made of rock and/or clay. Also called an "aquitard."

Conserving Water: Not wasting water.

Porous: Full of pores (small spaces). Water can easily pass through it.

Protecting Water: Keeping water clean.

Saturated Zone: An underground layer or area where water fills most of the pores (spaces) in the soil and rock.

Unconfined Aquifer: An aquifer that is not overlain by a layer of impermeable rock or soil.

Unsaturated Zone: An underground layer or area where air fills most of the pores (spaces) in the soil and rock.

Water Table: The top of an unconfined aquifer.

Procedure:

Step 1. Fill a clear plastic cup 1/3 full (total) with a layer of crushed ice followed by a layer of each like the picture shows of mini marshmallows and chocolate chips.

These represent gravels and sands that make up the aquifer. Notice the different sizes and shapes and how the pieces have spaces or "voids" between them.

Step 2. Add enough soda to almost reach the top of the layer.

The soda represents ground water. Notice that the soda fills all of the spaces among the marshmallows, chocolate chips, and ice. The aquifer is now saturated with soda; it is a "saturated zone." In an unconfined aquifer (see Step 3), the top of the saturated zone is called the "water table."

Step 3. Add a layer of ice cream. (Optional.) (For a tight seal, gently spread out the ice cream to the inside edges of the cup and slightly up the sides using the back of a spoon.)

This layer, called a "confining layer" or an "aquitard," is impermeable or significantly less permeable than the aquifer below it (it is difficult for water to soak through). It helps protect the aquifer from contamination and is usually made of rock and/or clay. An aquifer under a confining layer is called a "confined aquifer." An aquifer without a confining layer or above a confining layer is called an "unconfined aquifer."

Some aquifers, such as the Spokane Valley-Rathdrum Prairie Aquifer in north Idaho, do not have a confining layer. If your local aquifer does not (or even if it does) have a confining layer, consider omitting the ice cream or having half the class use ice cream and half not to compare the results.

Step 4. Add puffed cocoa cereal (or use more crushed ice) on top of the confining layer/water table.

This represents the unsaturated zone, the area where air fills most of the pores (spaces) in the soil and rock.

Step 5. Scatter chocolate sprinkles over the top.

The sprinkles represent the soil, which is very porous.

The aquifer is now complete. Your aquifers will probably be messy and not look like the picture on the front page. That's OK! Real aquifers aren't neatly layered either. Next you will explore how contaminants and wells interact with your aquifer.

Step 6. Sprinkle Kool-Aid® over the top of the soil.

The Kool-Aid® represents contaminants on the ground (e.g., fertilizer). Does anything happen to the Kool- Aid® right away? (Usually nothing will happen.)

Step 7. Using a drinking straw, "drill" a "well" into the center of the aquifer.

Observe the aquifer and Kool-Aid®. What, if anything, happens when the well is drilled?

Step 8. Begin to "pump" the well by slowly sucking on the straw.

Watch the decline in the level of soda and observe what happens to the contaminants. Do contaminants (Kool-Aid®) leak through the confining area (ice cream) and get sucked into the well? If so, do more contaminants get into wells in confined or unconfined aquifers? (Applicable if your class made both; see Step 3.)

Step 9. Pour a small amount of soda over the top.

The soda represents precipitation. It recharges the aquifer (adds new water). Watch how the Kool-Aid® dissolves and moves into the aquifer. The same thing happens when contaminants are spilled on the ground. Do you think you could get the Kool-Aid® back out of the soda?

Review what you have learned and eat your aquifer! Use these questions to start the discussion.

Questions for Discussion:

1. What observations/results surprised you? What did not?
2. How did results compare among different aquifers? (Even if all students used the same option in Step 3, each aquifer will be somewhat different.)
3. What parts of the activity were most/least like what would happen with a real aquifer? Why?
4. What happens if all of the water is pumped out of an aquifer? Where does more ground water come from? How long do you think it would take? Is there always more ground water, or could we run out?
5. Do you think a contaminated aquifer can be cleaned? If so, how?
6. How can we conserve (save) ground water? What specifically can kids do?
7. How can we protect ground water (keep it clean)? What specifically can kids do?

Assessment/Follow-Up:

Before the Activity:

- Ask students to define "ground water" and "aquifer." Record their key words on a white board to compile relatively accurate definitions. Leave the definitions on the board.

After the Activity:

- Complete "Questions for Discussion," above.
- Refer back to the definitions students wrote before the activity. Ask if they would like to modify them.
- Have students list as many potential ground water contaminants as they can.
- Include vocabulary in spelling lists.
- Test on definitions of vocabulary.
- Have students research ground water and aquifers in your area and compile an oral or written report.

Additional Resources:

A Citizen's Guide to Ground Water Protection (US EPA website)
www.epa.gov/ebtpages/wategroundwaterprotection.html

DEQ Kids: Water Does a Lot for Us... What Can We Do For Water? (Publication on DEQ website)
www.deq.idaho.gov/media/570548-water_quality_kids_brochure.pdf

DEQ Kids: Water Quality in Idaho (Publication on DEQ website)
www.deq.idaho.gov/media/570573-water_kids_tips_fs_2006.pdf

Drinking Water and Ground Water Kids' Stuff (US EPA website)
www.epa.gov/safewater/kids/index.html

Eastern Snake River Plain Aquifer (Idaho State University website)
http://imnh.isu.edu/digitalatlas/hydr/snakervr/esrpa.htm

Ground Water in Idaho: Aquifers (DEQ website)
www.deq.idaho.gov/water-quality/ground-water/aquifers.aspx

Ground Water in Idaho: Overview (DEQ website)
www.deq.idaho.gov/water-quality/ground-water.aspx

The Groundwater Foundation: Get Informed
www.groundwater.org/gi/gi.html

The Groundwater Foundation: Kids Corner
www.groundwater.org/kc/kc.html

Spokane Valley-Rathdrum Prairie Aquifer (Eastern Washington University website)
http://web.ewu.edu/groups/geology/2003Newsletter.pdf

Water Quality: Educational Tools (DEQ website)
www.deq.idaho.gov/assistance-resources/educational-tools/teacher-resources.aspx