DEQ in the Classroom:

Eastern Snake River Plain Aquifer Placemat

Teaching Guide

IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY

1410 North Hilton
Boise, ID 83706
208/373-0502

www.deq.idaho.gov

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Placemat as a Stand-Alone Activity

(See pages 4 - 10 for expansion and follow-up ideas)

Grade Level:

Any; best fits grades 4 - 6

Time Required:

20 minutes

Objective:

To illustrate the size and importance of the Eastern Snake River Plain Aquifer and to explore how an aquifer functions and how it can become polluted.

Meets Idaho State Standards:

Grade 4: 4.SS.2.2.3, 4.H.1.1.10
Grade 5: 5.S.5.1.1, 5.H.1.1.8
Grade 6: 6-9.GWH.2.1.3, 6-9.GEH.2.1.3, 6.S.5.1.1

Focus:

Ground water/Eastern Snake River Plain Aquifer. Students complete activities, such as word scrambles and mazes, to help them understand how aquifers function and learn basic information about the Eastern Snake River Plain Aquifer.

Materials:

Placemats (1 per student)

Pencils or pens (1 per student)

Procedure:

Provide each student with a placemat and have them complete the activities on both sides. See pages 4 – 9 for expansion ideas and page 10 for suggested questions for discussion.

See page 2 for background information and vocabulary.

Note: Correlations with Idaho state standards (above) are based strictly on completing the placemat activities without discussion. See pages 4 - 10 for correlations that include using discussion and expansion ideas.

Background:

Ground water supplies 95% of the drinking water in Idaho. Ground water comes from rain and snow that seep into the ground. This water is stored in the open places (voids) between particles of sand and gravel and cracks in fractured rock. An aquifer is the sand, gravel, or fractured rock that stores usable quantities of water when pumped. Springs are ground water that comes to the surface. Ground water can become contaminated by improper use or disposal of chemicals such as fertilizers or household cleaners. These chemicals can seep 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.

The Eastern Snake River Plain Aquifer is the largest aquifer in Idaho and one of the most productive in the world. The Eastern Snake River Plain Aquifer lies beneath 10,800 square miles of southeastern to south-central Idaho. It is about 160 miles long and 60 miles across at its widest point. It is believed to contain more water than Lake Erie. The Eastern Snake River Plain Aquifer is a designated "sole source" aquifer, which means it is the only practical source of drinking water for the area.

Vocabulary:

Aquifer	A permeable unit of sand, gravel, or fractured rock that can store and yield useable quantities of water when pumped.
Aquitard	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 a "confining layer."
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	Using water wisely (and not wasting it).
Discharge	Water that leaves or is removed from a body of water (including an aquifer), such as through springs or pumping from wells.
Injection Well	A well used to put fluids underground. The fluids could be excess water from irrigation, stormwater from a parking lot, water to be heated for geothermal systems (such as in the geothermal heating districts in Boise), or salt water or carbon dioxide to recover oil from underground reservoirs. An injection well can be a source of contamination or a source of recharge to an aquifer.
Nonpoint Source Pollution	Pollution originating over a wide geographical area; not discharged from a specific location or "point." Nonpoint sources of pollution include roads and agricultural fields.
Permeable	A characteristic of an aquifer. Something that is permeable allows liquids or gases to pass through.
Porous	Full of pores (small spaces). Water can easily pass through something that is porous.

Protecting Ground Water	Actions taken to preserve high-quality ground water and improve poor-quality ground water.
Recharge	The processes by which water from surface sources is added to ground water, such as infiltration from rainfall, snow melt, or irrigation, or leakage from canals or rivers.
Saturated Zone	An underground layer or area where water fills most of the pores (spaces) in the soil and rock. The saturated zone is below the water table.
Sediment	Small pieces of sand, soil, or gravel.
Sole Source Aquifer	An aquifer that is the "sole or principal" source of drinking water for an area. The U.S. Environmental Protection Agency officially designates certain aquifers as "sole source aquifers."
Unsaturated Zone	An underground layer or area where air fills most of the pores (spaces) in the soil and rock. The unsaturated zone is above the water table.
Water Balance	The accounting of water that recharges and discharges from a water body (e.g., an aquifer). An aquifer is in "balance" ("equilibrium") when recharge approaches discharge. This accounting can also be called a "water budget."
Water Table	The top of an unconfined aquifer.

Expansion Ideas Using the Placemat:

Expansion activity #1: **Map Your Place(mat)**

Time Required:
30 minutes. May be done by individuals or in small groups.

Objective:
To illustrate the size of the Eastern Snake River Plain Aquifer and its significance in eastern and south-central Idaho.

Meets Idaho State Standards (In addition to those listed for the placemat alone on page 1):
Grade 4: 4.SS.2.1.1
Grade 5: 5.SS.2.1.1

Materials:
Placemats (1 per individual or group)

Permanent markers (1 per individual or group)

Idaho road maps (1 per individual or group)

Using the clues given on the placemat, map the approximate location of the Eastern Snake River Plain Aquifer on an Idaho road map, then answer the following questions:

- How many towns overlie the aquifer?
- What is the approximate combined population of those towns?
- What bodies of water overlie the aquifer?
- What other significant features overlie the aquifer?

Discuss.

Wrap-up with *Questions for Discussion* 1, 2, 3, 4, and 5 (page 9).

Expansion activity #2: **It's All Related**

Time Required:
15 minutes in class (plus time for oral reports, if desired), plus 1 – 3 hours outside of class for research and writing.

Objective:
To illustrate the significance of the Eastern Snake River Plain Aquifer in the settlement and economies of towns in eastern and south-central Idaho.

Meets Idaho State Standards (In addition to those listed for the placemat alone on page 1):
Grade 4: 4.SS.3.2.2

Materials:
Placemats (1 per individual or group)

Idaho road maps (optional; if using communities other than those on the placemat)

Internet and/or library access

Activity:
Divide students into groups. Have each group pick one community listed on the placemat, or another community that overlies the aquifer, and have them research the history and current industries and economic forces in that town. Answer the following questions about the town:

- Is the town's history, development, or economy related in some way to its location over the Eastern Snake River Plain Aquifer. If so, how?
- Based on your research, do you think the town would exist without the aquifer? If so, would it be different? How? If not, do you think something else would be in that location? What?

Have students prepare an oral or written report on their findings.

Wrap-up with *Question for Discussion* 4 (page 9).

Follow-Up to *It's All Related*:
Have students draw pictures of what the community or its surrounding area looks like now (based on their research) and what it might look like if it didn't have access to the aquifer.

Expansion activity #3: **Coming and Going**

Time Required:
25 minutes

Objective:
To illustrate the concepts of water balance, recharge, and discharge. To learn what causes recharge and discharge in the Eastern Snake River Plain Aquifer.

Meets Idaho State Standards (In addition to those listed for the placemat alone on page 1):
Grade 5: 5.SS.3.1.2
Grade 6: 6-9.GWH.2.5.2, 6-9.GEH.2.5.2, 6-9.WHC.2.5.4

Materials:
Placemats (1 per individual or group)

Permanent marker (1)

8 oz plastic cup about ½ full of marbles or small pebbles*, such as used for fish tanks (or similar container – a tall, thin container works best)

A larger cup or other container, ¾ full of water (not identical to the cup above)

Recharge cards (attached, print from pages 11 – 12 and cut out individual squares)

Discharge cards (attached, print from pages 11 - 12 and cut out individual squares)

Water dropper (1)

Activity:
Have the students look at their placemats and ask them how water from the aquifer is used.

Show the students the cup of pebbles. Have a student slowly pour water from the larger water container into the "aquifer" until the top of the water reaches the top of the pebbles. Tell the students that the pebbles/water represent the Eastern Snake River Plain Aquifer.

Using a permanent marker, have a student write "aquifer" on the cup, then draw a line on the outside of the cup that shows the location of the top of the water. This is the water table. Do this while the cup is sitting on a table or desk so that the line is accurate.

Randomly distribute the "recharge" and "discharge" cards to the students.

Pass the two cups of water and the water dropper around the class. Have each student do what his or her card says to do. Use the larger container of water to put the water removed during discharge and to get the water to add to the aquifer during recharge.

**A cup of sand also works and more realistically represents an aquifer. If you use a cup of sand; however, you will need to add additional water to sit on top of the sand/aquifer to use for the activity. The dropper will end up full of sand if you try to pull water from within saturated sand. If you do this, remind students that water usually does not sit in a puddle like this on top of an aquifer…the extra water is just to make the activity work correctly.*

As the "aquifer" is making its way around the class, discuss the following:

When water leaves or is taken from an aquifer, it is called "discharge." About 86% of the water leaving the Eastern Snake River Plain Aquifer (discharge) eventually flows into the Snake River. This is natural discharge. Ground water pumping accounts for the other 14% of the discharge. Of the ground water pumped, about 95% is used for irrigation. The rest is used for drinking water, industry, and livestock.

Water enters aquifers as well as leaves them. About 60% of the water going into the Eastern Snake River Plain Aquifer (called "recharge") comes from irrigation (water that seeps into the ground after it is applied for irrigation). Other recharge comes from small aquifers in valleys along the edge of the Eastern Snake River Plain (18%), infiltration from rivers and canals (13%), and precipitation (water that seeps into the ground after it rains or snows; 9%).

An aquifer is said to be in "balance" or "equilibrium" when recharge approaches discharge; that is, approximately the same amount of water is leaving an aquifer as is going in.

After the cup (aquifer) has completed its journey through the class, set the cup again on a table or desk and make another line where the new water table is. Observe.

Discuss:

- Has the water level changed? Why or why not? Is the aquifer in equilibrium (balance)?

- Where does recharge come from and discharge go to? Ask students what their role was (what their card said, e.g., recharge/precipitation, recharge/drought, discharge/Snake River, etc.) (use a show of hands to see how many fell into each category). Discuss the concept of water balance and how the balance can be disrupted by changes in recharge or discharge (e.g., drought, increase in ground water pumping, etc.). Discuss human's role in this process.

- Do you think all of the water could be discharged from the aquifer? What do you think would happen? Where would more ground water come from? How long do you think it would take? Is there always more ground water, or could we run out?

Wrap-up with *Questions for Discussion* 1, 2, and 5 (page 9).

Follow-Up to *Coming and Going*

Using the percentages listed above, have students make charts or graphs showing the proportions of where water is being discharged to and recharged from.

Expansion activity #4: **It All Adds Up!**

Time Required:
15 minutes

Objective:
To illustrate the concept of nonpoint source pollution and its affect on the Eastern Snake River Plain Aquifer.

Meets Idaho State Standards (In addition to those listed for the placemat alone on page 1):
Grade 5: 5.SS.3.1.2
Grade 6: 6-9.GWH.2.5.2, 6-9.GEH.2.5.2, 6-9.WHC.2.5.4

Materials:
Placemats (1 per individual)

Clear plastic container about ½ full of marbles or small pebbles and filled with water to the top of the marbles/pebbles (you can re-use the "aquifer" from the *Coming and Going* activity*).
(You can also use water alone [without the marbles/pebbles] if necessary).

Food coloring in a container that allows you to meter it out drop by drop

Activity:
Show the students the container of water with marbles/pebbles and tell them it represents the Eastern Snake River Plain Aquifer. (**If** you use a container of only water, remind students that an aquifer is actually sediment saturated with water and not just water). Take the food coloring and add 1 drop to the aquifer. Allow the class to observe what it looks like.

Pass the aquifer and the food coloring around the class and have each student add one more drop.

While the class is passing the aquifer around and "polluting" it…

Discuss the answers to the pollution sources word scramble on the placemat. Then discuss nonpoint source pollution (see Vocabulary, page 2). One thing the pollutants on the placemat all have in common is that they are "nonpoint" sources of pollution. This means that the pollution did not come from a single source (point), such as a ditch, pipe, or injection well. Most water pollution in Idaho (both ground water and surface water) comes from a lot of little sources (nonpoint sources), as opposed to a few big sources such as factories.

In our everyday actions, each of us contributes a little to water pollution, often without even realizing it. We can contribute to nonpoint source pollution when we don't pick up after our pet, when we pour things in the street or down storm drains, or if we use too much fertilizer on our lawns. Bacteria and nutrients from pet waste, chemicals dumped down storm drains (such as motor oil or even soda), and excess fertilizer can all seep into ground water. While each of our contributions is small, it all adds up and can become significant amounts of pollution. This activity will demonstrate this.

Once the aquifer has been "polluted" by everyone in the class, look at it again. Discuss how each person added just one drop, but it all added up to make the aquifer very polluted.

Wrap-up with *Questions for Discussion* 1, 2, 3, and 5 (page 9).

**Do not use saturated sand – use either pebbles, marbles, or plain water.*

Questions for Discussion (use with the placemat alone or with any of the expansion activities):

1. **Why is it important to conserve (not waste) and protect (preserve or improve water quality) the water in the aquifer?**

Look for answers such as: Need the water in the aquifer for drinking, agriculture, and aquaculture, or to preserve the beauty of the Snake River Canyon springs. Supports life and our economy. Not an endless supply. If gets dirty (contaminated), it is very difficult to clean.

2. **How can we conserve (save) ground water? What specifically can kids do?**

Look for answers such as: Only use as much water as you need. Turn off water when brushing teeth. Take short showers. Turn off the hose or use a bucket when washing the car (instead of letting the water run). Sweep the driveway and sidewalk instead of hosing them off. Water the lawn the minimum amount necessary.

3. **How can we protect ground water (preserve or improve water quality)? What specifically can kids do?**

Look for answers such as: Don't dump things (garbage, chemicals, etc.) down storm drains or in the street or parking lot. Clean up after your pet. Only use as much fertilizer and pesticides as instructions say.

4. **How has the Eastern Snake River Plain Aquifer impacted the people and economy of southeast and south-central Idaho? Are there industries that might not exist in this part of Idaho without the aquifer?**

Look for answers such as: Wouldn't be enough drinking water without the aquifer, so not as many people could live here. Couldn't have as much agriculture (including Idaho's famous potatoes) without the aquifer. Wouldn't have as much fish farming (aquaculture) without the aquifer. The "Thousand Springs" wouldn't exist without the aquifer, which could hurt tourism.

5. **How have humans impacted the Eastern Snake River Plain Aquifer? How have we caused these impacts? How could we lessen our impact?**

Look for answers such as: Humans have caused impacts by placing things on the ground surface or underground that have seeped (leached) through the ground into the aquifer and by pumping ground water, which increases the discharge of the aquifer. Humans have also impacted the aquifer by increasing the recharge into the aquifer through irrigation. Things that can get into the ground water and ways they can get there include road maintenance/road salt, farming, lawn care (fertilizers/pesticides), leaking underground storage tanks, waste from animals and humans (pets, stock yards, septic systems). We can lesson our impact by only using as much water as we need (conserving water), and by only using as many chemicals (road salt, fertilizer, pesticides) as necessary, cleaning up after pets, carefully maintaining septic systems, storage tanks, landfills, etc.

Meets Idaho State Standards (In addition to those listed for the placemat alone on page 1):

Grade 4: 4.SS.3.2.2
Grade 5: 5.SS.3.1.2
Grade 6: 6-9.GWH.2.5.2, 6-9.GEH.2.5.2, 6-9.WHC.2.5.4

Expansion and Follow-Up Ideas Beyond the Placemat:

Build edible aquifers to view (and eat!) your way to a better understanding of aquifers. See www.deq.idaho.gov/water/educ_tools.cfm#teacher for a lesson plan (*The Incredible Edible Aquifer*).

Build stormwater mazes to learn how stormwater affects our water resources. See www.deq.idaho.gov/water/educ_tools.cfm#teacher for a lesson plan (*The Rain Takes Pollution Mainly Down the Drain*).

Build mini landfills to observe how landfills work and how they are designed so they do not impact ground water. See www.deq.idaho.gov/waste/educ_tools.cfm#teacher for a lesson plan (*Making a Mini Landfill*).

Have students complete DEQ activity booklets (*Water Does a Lot For Us…What Can We Do For Water* and *Who Is Protecting Idaho's Clean Air, Land, and Water?*). Download from www.deq.idaho.gov/water/educ_tools.cfm#student or contact Amy Luft at amy.luft@deq.idaho.gov or (208) 373-0478 to order hard copies.

Visit www.groundwateradventurers.org/ for fun facts, water experiments, and stories about ground water.

Visit www.epa.gov/kids/water.htm and www.epa.gov/safewater/kids/index.html for on-line and printable water cycle and water quality activities.

Invite a DEQ staff member to visit your class with a ground water flow model (or to do other fun ground water activities). Contact Flint Hall (flint.hall@deq.idaho.gov or (208) 528-2650.

Additional Resources:

DEQ Kids: Water Quality in Idaho (Publication on DEQ Web site)
www.deq.idaho.gov/water/educ_tools/water_kids_tips_fs.pdf

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

Focus on the Eastern Snake River Plain Aquifer newsletter (Publication on DEQ Web site)
www.deq.idaho.gov/inl_oversight/library/newsletter_0505.pdf

Ground Water in Idaho: Aquifers (DEQ Web site)
www.deq.idaho.gov/water/prog_issues/ground_water/aquifers.cfm

Ground Water in Idaho: Overview (DEQ Web site)
www.deq.idaho.gov/water/prog_issues/ground_water/overview.cfm

INL Oversight Program: Environment (links to documents and Web pages about the Eastern Snake River Plain Aquifer) (DEQ Web site) www.deq.idaho.gov/inl_oversight/environment.cfm

Our Changing Aquifer newsletter (Publication on DEQ Web site)
www.deq.idaho.gov/inl_oversight/library/newsletter_0306.pdf

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

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

Water Quality: Educational Tools (DEQ Web site) www.deq.idaho.gov/water/educ_tools.cfm

You Are What You Drink: What Do You Know About Your Drinking Water?
http://www.deq.idaho.gov/water/educ_tools.cfm#student

Recharge Irrigation Add 10 drops	Recharge Irrigation Add 7 drops	Recharge Irrigation Add 8 drops	Recharge Irrigation Add 13 drops
Recharge Irrigation Add 11 drops	Recharge Irrigation Add 16 drops	Recharge Small aquifer Add 6 drops	Recharge Small aquifer Add 8 drops
Recharge Drought Do nothing	Recharge Drought Do nothing	Recharge Precipitation Add 9 drops	Recharge Rivers and canals Add 8 drops
Discharge Ground water pumping Remove 10 drops	Discharge Ground water pumping Remove 11 drops	Discharge Into Snake River Remove 11 drops	Discharge Into Snake River Remove 9 drops

Discharge	Discharge	Discharge	Discharge
Into Snake River Remove 12 drops	Into Snake River Remove 8 drops	Into Snake River Remove 13 drops	Into Snake River Remove 9 drops
Discharge	**Discharge**	**Discharge**	**Discharge**
Into Snake River Remove 10 drops	Into Snake River Remove 9 drops	Ground water pumping Remove 11 drops	Ground water pumping Remove 9 drops