

AQUIFERS AND NON-POINT SOURCE POLLUTION

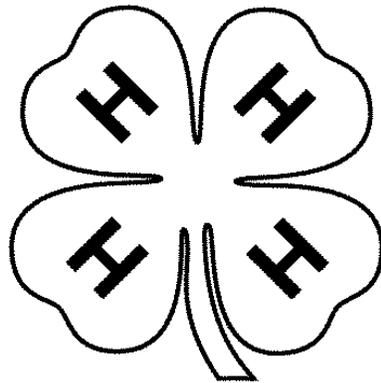
K-STATE RESEARCH AND EXTENSION- SEDGWICK COUNTY
7001 W. 21st St. North
Wichita, KS 67205-1759
(316) 722-7721
FAX (316) 722-7727
Drescher@oznet.ksu.edu
<http://www.sedgwickcountyextension.org>

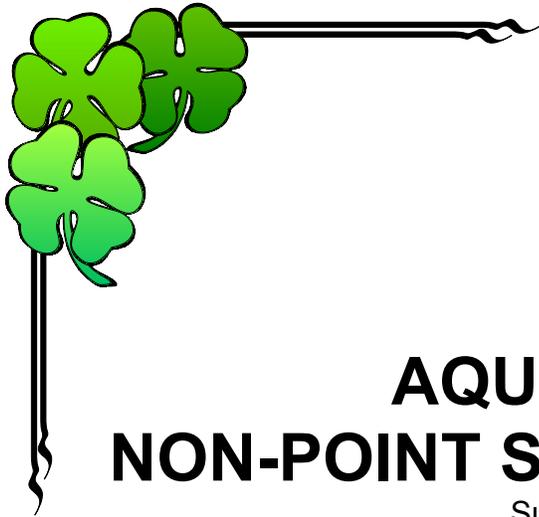




Cooperative Extension Service Sedgwick County
Extension Education Center
7001 W. 21st St. North
Wichita, KS 67205-1759
316-722-7721
FAX 316-722-7727

HOME PAGE
<http://www.oznet.ksu.edu/sedgwick>





AQUIFERS AND NON-POINT SOURCE POLLUTION

Suggested Grade: 3

If you dig deep enough in most areas of the world you will find water. It seeps into the ground through *infiltration* and *percolation* until it reaches a layer of rock that it can't get through. Water under the ground is called ground water. Ground water that settles in an underground reservoir of loose gravel and sand is called an aquifer (literally "water carrier"). Groundwater is the only source of drinking water for one half of the residents of the United States. It also supplies 35% of the municipal fresh water supplies, 40% of all irrigation water, and 26% of water used by industry.

Many communities obtain their drinking water from aquifers. Water supplier or utility companies often drill wells through soil and rock into aquifers to provide the public with drinking water, although sometimes the water from an aquifer emerges on the surface as a natural spring. The point at which a drill would reach an aquifer is called the water table. Aquifers with a high water table are near the earth's surface. Aquifers with a low water table are far below the earth's surface.

Most U.S. aquifers are within 2,500 feet of the Earth's surface; within easy reach of modern drilling equipment. In many regions water is pumped out of aquifers faster than it can be replenished. This not only uses up our existing natural resources, it can also cause the ground to contract and sink. This is called *subsidence*, and is a problem that many water-thirsty cities are facing throughout the world.

A large natural aquifer, called the Equus Beds, is located in Sedgwick County. It provides many people in Wichita with at least part of their drinking water. It has a very high water table (is close to the surface of the ground) and is located under very porous sandy soil. Because of the ease with which pollution is able to make its way into the Equus Beds, many people are concerned about protecting the environment so that the local community can continue to have safe and plentiful drinking water.

Even though soil, sand and rocks naturally purify water, sometimes the water carries pollutants that cannot easily be removed through natural filtration. Groundwater can become contaminated by improper use or disposal of harmful chemicals such as lawn care products and household cleaners. These chemicals can percolate down through the soil and rock into an aquifer and eventually into drinking water wells where they pose a serious threat to human health.

Where does our drinking water come from?

How can pollution in the environment threaten the safety of our drinking water?

OBJECTIVES

- U Demonstrate how water is stored in an aquifer

- U Demonstrate how pollution can enter the ground water from non point sources and end up in a drinking water well

MATERIALS

Each activity group will receive:

- 1 plastic container at least 6" to 8" deep, preferably with clear sides
- 2 to 3 cups sand
- 3 to 4 cups small stones
- 1 piece small wire mesh, about 6" X 8"
- Clear tape
- Spray bottle
- Red food coloring
- Eye dropper
- Water

PREPARATION ACTIVITIES

% Ask students to complete the two water mazes on pages 9 & 10. These mazes are representations of different types of soils; one with large particles and air spaces (pores), and one with small particles and air spaces. After students have completed the mazes, lead a class discussion using the following questions as a guide:

Which maze was easier to get through?

(The large maze should be easier for most students to navigate)

Why do you think it was easier?

(Size of spaces should be mentioned—larger spaces are easier)

These mazes are a lot like soil—some soils have large spaces between the particles and some have small spaces. Which type of soil do you think would be easiest for water to move through?

(Large spaces)

Where does the water in the soil come from?

(Rain)

Where does the water go after it rains?

(It seeps through the soil into an aquifer)

What is an aquifer?

(An aquifer is water that has seeped through the soil and settles in loose gravel and sand underground)

& Water moves through the soil by the processes of *infiltration* and *percolation*.

Infiltration is the process of water movement into the spaces (pores) between soil particles

Percolation is the process of water movement through the soil. Water that is percolating through soil often dissolves soil minerals, nutrients and/or pollution on its journey to the water table.

The speed of water movement through the soil is affected by the size of the spaces (*pores*) between the particles. The size of the spaces is determined by the size of the soil particles; the larger the particle, the larger the space.

To illustrate how the size of the pores affects the speed of infiltration and percolation through a soil, complete the following demonstration.

1. Fill a clear cup 3/4 full of small gravel. Fill another cup 3/4 full of sand. The difference in size between these two types of particles is similar to the difference in size between sand and silt, but the process of percolation is much more easily visible with sand and gravel than sand and silt.

Ask the class to describe the difference in pore size. Which one has larger spaces, or pores, between the particles? (*Gravel*) Which glass do they predict will allow water to move most quickly?

2. Pour ½ cup colored water into each glass as the students observe. In which glass did all the water reach the bottom first?

3. The water in this demonstration had food coloring added to it. What would happen if the water in our soil had pollution added to it?

& Pollution of our surface and ground water can happen in two very different ways.

Point sources are easy to identify. The pollution from point sources can be seen to come from a factory discharge pipe, ditch or waterway.

Non-point sources are more difficult to find because they come from unspecified sources spread over a large area. Some common sources of non-point source pollution are agricultural pesticides and fertilizers, petroleum products (like gas and oil leaks from automobiles and trucks), or wild and domestic animal wastes.

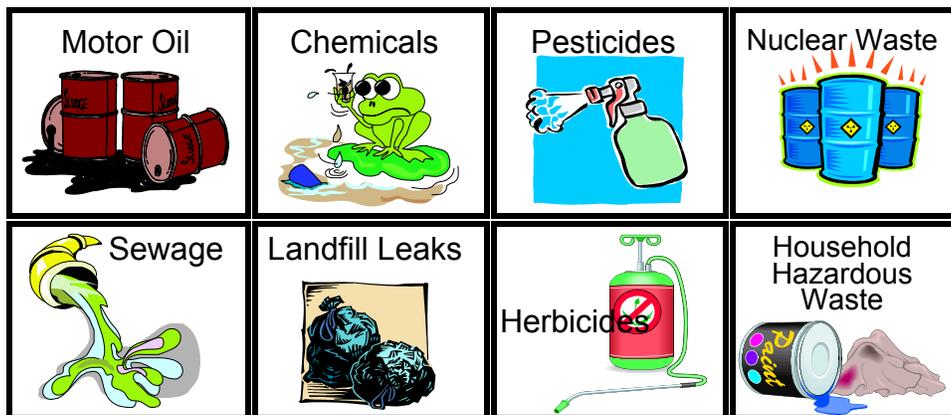
For example, a research study of pollution in the Arkansas River in 2002 determined that much of the river's pollution problem was caused by wild animal manure that got into the river when it rained on the fields and lawns that had been visited by local geese. It was fairly easy to discover what was polluting the river, but it would be almost impossible to find exactly which fields and lawns the pollution was coming from.

Discuss point and non-point source pollution, and make a list of possible sources of both types of pollution in the community. Brainstorm ways to reduce local non-point source pollution sources. Some suggestions might be:

- Be careful not to spill fuel when filling the car
- Fix oil leaks in car, truck, motorcycle, lawn mower and tractor engines
- Read and follow directions on garden fertilizers and pesticides,
- Take toxic products (like paint) to the hazardous waste recycle center

PROCEDURAL STEPS

- â Roll the wire mesh into a 1" to 2" cylinder that is 8" long and fasten it with one piece of clear tape
- ã Hold the cylinder in the center of the plastic container. Pour the stones into the container so they go around, but not into, the cylinder. The cylinder should be standing up in the center of the container when you are finished.
- ä Pour sand on top of the stones until the container is 2/3 to 3/4 full of sand. Do not pour sand inside the mesh cylinder! This cylinder represents a drinking water well.
- å Fill the spray bottle with clear water and "rain" on (spray) the surface of the land until you can see a little water in the well. This represents the drinking water that comes from an aquifer.
- æ Using an eye dropper, place a drop or two of red food coloring on the outside edge of the sand, far away from your well. The food coloring represents pollutants, such as pesticide, fertilizer or hazardous chemicals, that may be around homes, farms, and/or businesses. Copy and cut out the signs below and paste each on onto a toothpick or craft stick. Place one sign at each "pollution site" on your aquifer.



ç Continue to “rain” on your aquifer. What happens to the red food coloring? Time how long it takes for the food coloring to show up in the well.

è Hold a class discussion using the following questions as a guide:

Have you ever seen water after a rain in the gutter?

What does it look like? What pollutants might be in rainwater runoff?

Where does the runoff go? Do you think all the pollutants are filtered out before it gets there?

Where do we get our drinking water?

If there are pollutants on the land, are there other ways they might get into the ground water? How?

How far do you think pollutants can travel in the groundwater? Why do you think so?

How fast do you think pollutants can get into our drinking water?

Do you think the depth of the aquifer and the type of soil over it make a difference? Why or why not?

How could polluted water in a aquifer affect your drinking water?

Does polluted water concern you?

é Place the aquifers in a dry location where the water will evaporate. Look at the aquifers after several days. Did the water evaporate? How about the food coloring? Do you think that it would work the same way for pollutants? Why or why not?

INQUIRY AND FOLLOW UP ACTIVITIES

L Using the directions on page ??, construct a non-point source pollution model of your community. Use the model as directed and observe the path taken by pollutants in their way to the aquifer, noting any particular “trouble spots”.

Compare your observations of the model to the pollution problems in your community. How are they the same? How do they differ? Did your model help you see ways that you can reduce water pollution in your community? Record your thoughts.

Share your insights with community leaders and residents. Some possible ways to do this may be:

- Send a letter to the editor of your local newspaper
- Attend the meeting of a community forum
- Visit the local pollution control office
- Talk or write to your state legislators
- Prepare an illustrated talk or demonstrations to present at 4-H Club Day or to share with a younger class on Earth Day
- Draw a poster to display at your school, community center, or in a local business

- L Contact your community's water pollution control office to find out what is being done to reduce water pollution in your area.

RESOURCES

Information about the Equus Beds and maps of local aquifers can be obtained from:

The City of Wichita Public Works Office
City Hall 8th Floor
455 N. Main St
Wichita, KS 67203
(316) 268-4478

For more information about drinking water and ground water, check out the EPA's "Drinking Water for Kids" page. It includes games, lesson plans, health activities and a link to a special Spanish language web page.

<http://www.epa.gov/OGWDW/kids/>

The EPA has a great non-point source pollution kids page that includes “Masterbug Theatre”, “Darby Duck and the Aquatic Crusaders”, and the “Splash” game that allows students to see the effects of their environmental decisions. It can be found at:

<http://www.epa.gov/OWOW/NPS/kids/>

The U.S. Geological Service Learning Web is dedicated to K-12 learning and lifelong education. It has information and lesson plans for students, teachers, and others. Topics include anything on, in or around the earth: land, water, plants, animals and maps. The website is located at :

<http://www.usgs.gov/education/>

The U.S. Agricultural Research Service Sci4Kids website has a collection of short, simple success stories about a variety of environmental topics, including water and aquaculture. It may be found at:

<http://www.ars.usda.gov/is/kids/environment/environmentintro.htm>



LESSON SOURCE

Resources:Down To Earth

Robert D. Williamson, Ph.D. and Ellen P. Smoak, Ph.D.
North Carolina Cooperative Extension
North Carolina A & T University
P.O. Box 21928
Greensboro, NC 27420-1928

U.S. Environmental Protection Agency Lesson

Deep Subject- Wells and Ground Water

<http://www.epa.gov/teachers/>

Downloaded January 27, 2003

Non Point Source Pollution Education Program

British Columbia Conservation Foundation

#200A-1383 McGill Rd

Kamloops, BC, V2C 6K7

Website <http://www.bccf.com/kamloops/npsp/model/building.html>

Downloaded August 27, 2002

Webster's Seventh New Collegiate Dictionary

G. & C. Merriam and Company, Publishers

Copyright 1970

Springfield, Massachusetts

Written by:

Beth Drescher, County Extension Agent Youth Development

Sedgwick County Office, K-State Research and Extension

7001 W. 21st St. N.

Wichita, KS 67205

Drescher@oznet.ksu.edu

Lesson Reviewed by:

Sharon Hiebert, School 4-H Program Coordinator

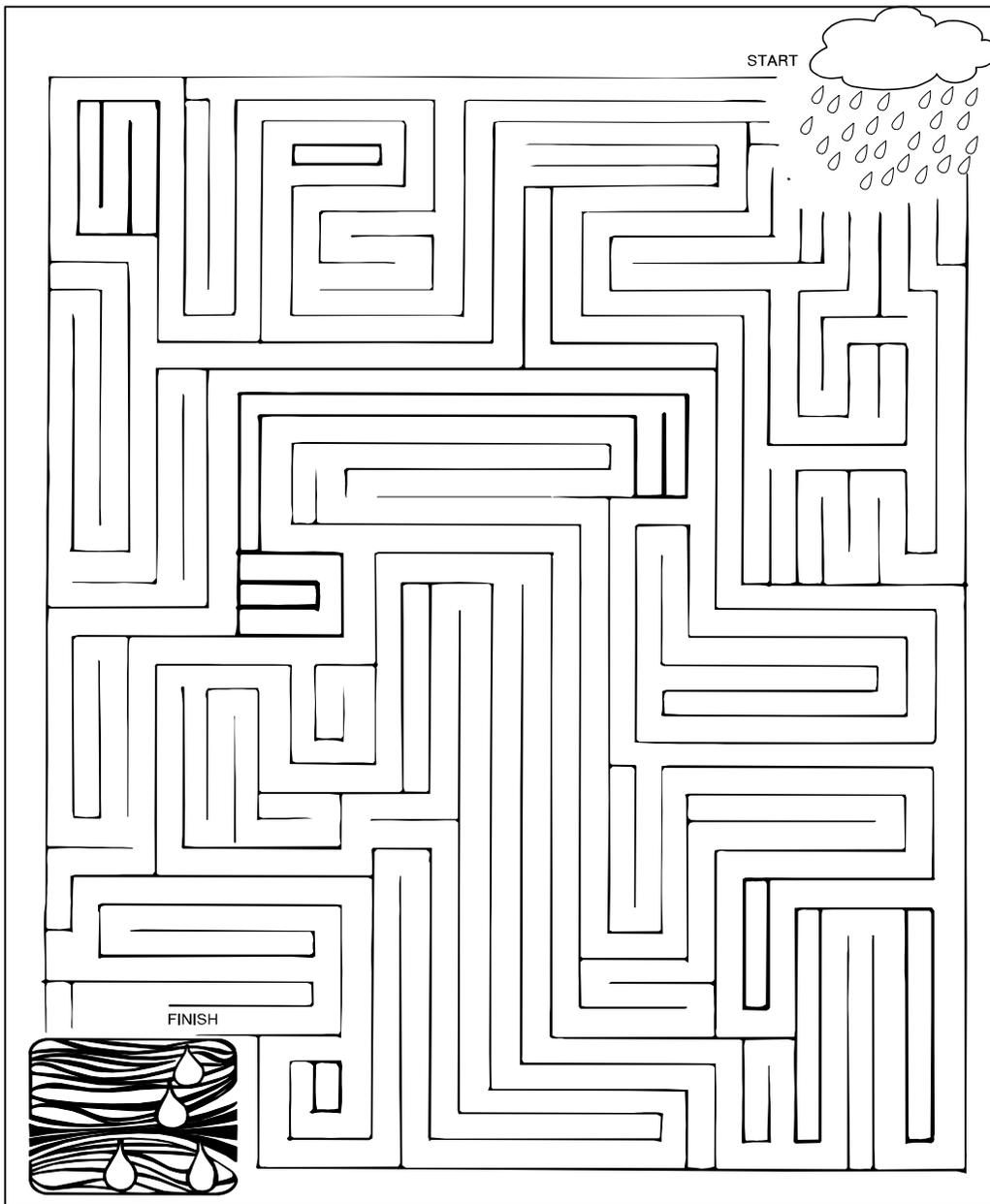
Sedgwick County Office, K-State Research and Extension

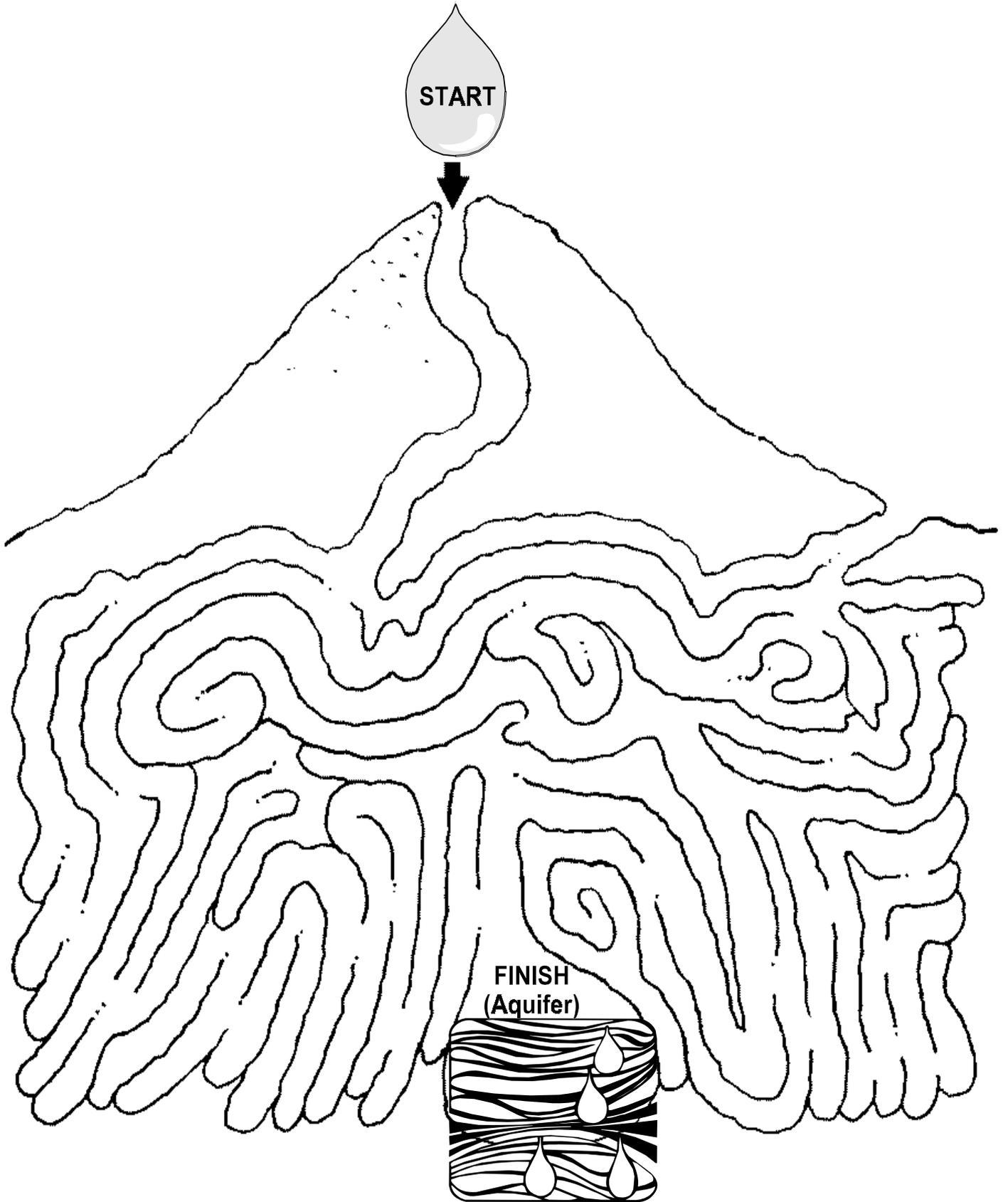
7001 W. 21st St. N.

Wichita, KS 67205

JOURNEY TO THE AQUIFER

Follow the route a raindrop takes to get from the sky to an aquifer underground as you complete the mazes on the next two pages. As you complete these mazes, pay special attention to the ease of finding your path. Is it easier to find your way in a maze with large spaces or a maze with smaller spaces? Do you think it works the same way for a raindrop traveling through the soil? Why or why not?





THE NON POINT SOURCE POLLUTION MODEL

This model helps visually demonstrate how pollution travels within a community and accumulates within local water bodies, like the Arkansas River in Wichita and Cheney lake in western Sedgwick County. Non-point source pollution comes from various sources on the model, and rain (with a spray bottle) shows how pollution travels through urban areas, storm drains, rivers, and onwards. The model is a miniature version of our community including agricultural, urban, residential, and rural areas. These models are easy and fun to make!



Although the models can be made any size, a smaller version may be more portable, waterproof, and cuts down on costs. This community is set directly into a plastic container and contains the basic fundamentals of the larger model.

Building the NPSP Model

1. Make a Plan.

Have your "City Planners" identify physical features and landmarks on a photo or map of the area to be represented by the model. Note the location of the river, which way it flows and what feeds it. List the main features to include!

2. Build a Frame

The model frames can come in a range of sizes and types, all depending on how you want to use your model. For more portable (and smaller) models, use a foam core to keep it light, or obtain a large plastic basin and insert the model directly within it. For larger, more permanent-in-place models, two sheets of 2' x 4' or even 4' x 8' plywood joined by dimension lumber and supported by two folding sawhorse style supports can work well. Slant the top so water runs to the bottom, where a container can catch the runoff. Cut strips from sheets of corrugated plastic and glue them around the edges to extend above the model and prevent water from spilling over the model's edges.

3. Rivers, urban areas, green areas.

Stack three large sheets of colored corrugated plastic: blue on bottom, black in the middle, green on top. Outlines of rivers and streams, urban areas and natural areas were drawn on the green layer using markers and paint. Locations of rivers and tributaries are shown by cutting through both green and black layers, leaving only the blue. Urban areas are shown by cutting through only the green layer, exposing black.

This method allows water to flow from green areas onto urban, and then to rivers. Seal the cut plastic edges with clear caulking. Rivers should feed into a container hooked at the end or built into the model frame.

4. Mountains

We used two pieces of painted styrofoam glued together. You can cut and shape it to your own liking. This works pretty well, but brainstorm your own ideas! Make sure whatever you use is as waterproof as possible!

5. Bridges

We made our bridges with long pieces of cut out pop cans (aluminum) and toothpicks holding the ends in either side.

6. Buildings

We cut ours from styrofoam (like the kind used in insulating) and painted them, but if you leave them white and mark them with permanent markers (windows, doors, etc), it looks pretty good too.

7. Groundwater

You can create a groundwater source by drilling holes through the top and setting a container underneath. Install a hand lotion pump set into the top and voila, you've got an aquifer and a well source!

8. Storm Drains

We installed storm drains in our model within urban areas using plastic piping and some caulking. The storm drain runs along underneath the model to enter directly into the final water body. (Remember to paint that yellow fish beside the storm drain!).

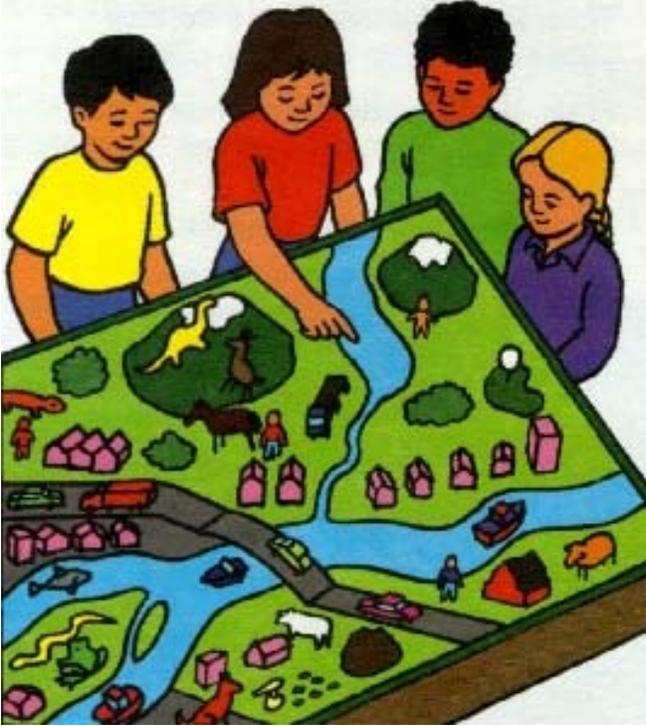
9. Clouds and Rain

For our model, we use a couple spray bottles and volunteer rain-makers to create the rain. You can also use a large, porous sponge attached to a desk lamp frame, and squeezed for rain.

10. People, animals, and vehicles

Check out resale shops, garage sales, or your back cupboards (don't worry about scale!). Keep in mind, you will likely want to caulk these pieces to the plastic model, so they can't be removed.

PRESENTING THE MODEL TO THE PUBLIC OR CLASSMATES



1. Show a real photograph or map of the area represented.

Have participants identify physical features and landmarks on a photo or map of your area, represented by the model. Note the location of the river, where it comes from and where it's going.

2. Point out landmarks on the model.

Invite the group to gather around the model, identifying the model as their community and see if they can identify where they live

3. Discuss pollution sources shown on the model.

Have the group identify as many pollution sources on the model as they can find. Emphasize that non point source pollution is contributed by all of us. Explain the difference between waste from inside the home and waste that may go down storm drains outside.

4. Polluters

Show an example of pollution (such as antifreeze), and demonstrate it (use strawberry syrup or dishwashing soap) on the model. Then separate your group into Polluters, Rainers, and Rivermakers. Have the Polluters sprinkle and squirt your pollution on appropriate locations on the model (use coco powder for feces, soya sauce for oil, sand, sudsy soap for carwashes and phosphates, and other non-harmful pretend pollutants to represent).

6. Rainers and Rivermakers

Have rainers rain everywhere on the model, elaborating on how important water is in moving NPSP to our waterways. Have the Rivermakers add water and monitor the rivers and collecting waterbodies.

7. Observe the pollution blob!

Look at all of the pollution mixed in together at the collected water body at the base of your river. Discuss again where this comes from, and where it goes. Discuss ways to avoid the "blob" and reduce pollution in our community!

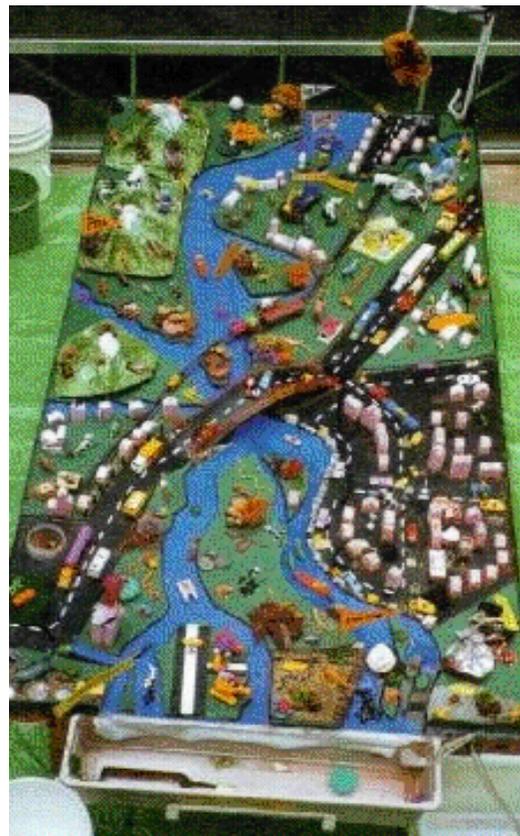
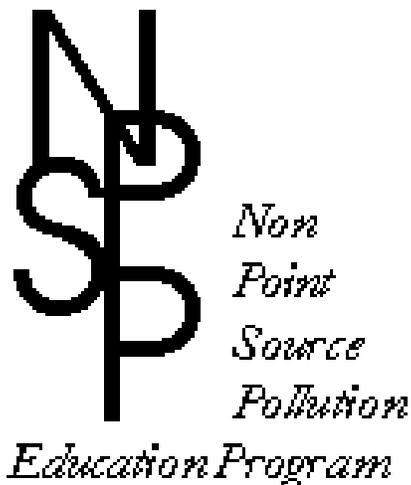
For more information about the Non Point Source Pollution Model, contact:

Kevin Walker, Pollution Prevention Coordinator
(250) 828-2551 ext.317
fax: (250) 828-2597
email: npsp@bccf.com

Lesson Source: Non Point Source Pollution Education Program

British Columbia Conservation Foundation
#200A-1383 McGill Rd
Kamloops, BC, V2C 6K7

Website <http://www.bccf.com/kamloops/npsp/model/building.html>



CURRICULAR CORRELATIONS

Kansas Science Standards

Standard 1 (Grades 3 to 8): Science as Inquiry

- h Benchmark 1: The Students will demonstrate abilities necessary to do the processes of scientific inquiry.

Indicator 1: Identify questions that can be answered through scientific investigations.

Indicator 2: Design and conduct a scientific investigation.

Indicator 3: Use appropriate tools, mathematics, technology, and techniques to gather, analyze and interpret data..

Indicator 4: Think critically to make the relationships between evidence and logical conclusions.

Standard 4: Earth and Space Science

- h Benchmark 1 (Grades 3 & 4): The students will develop an understanding of the properties of earth materials.

* *Indicator 2:* Collect, observe and become aware of properties of various earth materials.

* *Indicator 3:* Experiment with a variety of soils.

- h Benchmark 1 (Grades 5 to 8): Understand that the structure of the earth is constantly changing due to physical and chemical processes

* *Indicator 1:* Predict patterns from data collected.

* *Indicator 2:* Identify properties of the solid earth

- h Benchmark 2 (Grades 5 to 8): Understand that past and present earth processes are similar.

* *Indicator 1:* Understand the dynamics of earth's constructive and destructive force`s over time.

Standard 6 (Grades 5 to 8): Science in Personal and Environmental Perspectives

- h Benchmark 2: The students will understand the impact of human population and consumption on resources and environment.

Indicator 1: Investigate the effects of human activities on the environment.

* = assessed indicator