

Crumple a Watershed

Description: Students gain an intuitive knowledge of the physical aspects of watersheds by creating their own watershed models.

Learning Objectives: This activity gives students an approachable perspective on watersheds by making simple watershed models.

SCIENCE TOPICS

Geography
Geology
Watersheds

PROCESS SKILLS

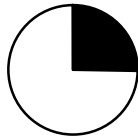
Modeling
Scale
Making Models

GRADE LEVEL

4

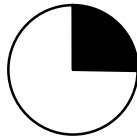
TIME REQUIRED

Advance Preparation



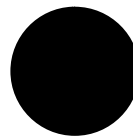
15 minutes

Set Up



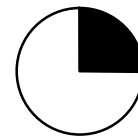
15 minutes

Activity



60 minutes

Clean Up



15 minutes

SUPPLIES

- One 8.5" x 11" sheet of paper per student, preferably graph paper.
- One sheet of cardboard or tag board approximately 8.5" x 11". (You do not have to be precise.)
- Several different colors of water-soluble, non-permanent, felt markers (e.g. Crayola). The best colors are dark colors, such as black, brown, purple, blue and green. It is best for each student to have at least one blue marker.
- Clean spray bottles. (You may want to have only one available.)
- Scotch tape, one roll for every two students (can be shared).
- Plastic relief map (if available).
- One shaded, paper relief map.
- Materials to photocopy: Science Background, Student Procedure, and Master A (1 each per student).

ADVANCE PREPARATION

- Fill clean spray bottles with tap water.
- Cut the cardboard or tag board to size, approximately 8.5" x 11".
- Find a plastic relief map to use as an example, they are relatively inexpensive and can be found for every region of the state.
- Find a paper, shaded relief map, also to be used as an example. You may want to cut one up to hand out a section to each student.
- Once materials are purchased the only preparation will be the 15 minutes required to cut cardboard or tag board if necessary.
- Make copies of Student Background, Student Procedure, and Master A for each student.

SET UP

- Have the supplies ready to hand out or stacked on tables.

INTRODUCING THE ACTIVITY

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

Begin by introducing the term "watershed" and then ask your students what the term represents. As they begin to form a definition of "watershed," ask them if they had ever been in a watershed or seen a watershed. After a rough definition has been worked out, tell the students that they will do a quick activity that will help them bring watersheds into focus.

Watersheds are constantly in the news. They are arguably THE defining environmental and political issue in the Northwest, and will be throughout the lifetime of your students. However, "watershed" can be difficult to describe in the classroom. The current working definition of a watershed is: an area of land from which all the rain flows to a specific river or lake (or underground aquifer for older students). The key point here is that a watershed is an area of land around a river or lake. It is not the river or lake itself. By definition, every piece of land on Earth is in a watershed (i.e., all rain goes somewhere).

Defining a watershed in a classroom is one thing, but intuitively appreciating the reality of a watershed is quite

another. Watersheds are best studied in the field, walking through the watershed itself. However, watersheds are generally very large, on a scale larger than humans tend to think. Unlike other large geological features such as mountains, they are difficult to see unless you are above them. This activity should give classroom students a more approachable perspective of watersheds as students make simple watershed models.

Where can drinking water come from?

It can come from groundwater or watersheds.

Where does *our* drinking water come from? How does it get here?

Answers will vary depending on your location.

What are some ways people can enjoy the features of a watershed?

Swimming, boating, fishing, watching wildlife, and enjoying scenery are mentioned in Science Background. Students may suggest other activities.

What might happen if the boundary between two countries runs through one watershed?

Allow students to speculate.

SCIENCE BACKGROUND

Background information can be found at the end of the activity. Print on a separate page for students to read before doing the activity.

Recipe for a Healthy Watershed

What is a **watershed**? A watershed is the area that collects water which drains to a river, stream, lake or ocean. Watersheds are the places we call home, where we go to school and where we play.



Scientists survey the Salmon River Watershed in Idaho
Source: NOAA Fisheries Service

Clean Water Is Essential

Whether your watershed drains into a stream, lake, or river, the area nearest the water greatly affects water quality. What you and others do on the land affects the quality of the water and other **natural resources**.

Healthy watersheds are important for a healthy environment and economy. Watersheds in the Pacific Northwest provide water for drinking, irrigation and industry. Many people also enjoy lakes and streams for recreational activities like swimming, boating and fishing and also to watch wildlife, and check out the beautiful scenery. Animal survival also depends on healthy watersheds as it provides food and shelter.

TEACHER DEMONSTRATION

You may want to model the activity by creating your own watershed model and demonstrating the procedure. Having a pre-made watershed available to show students what the final model looks like is often helpful.

CLASSROOM ACTIVITY

Students should work in groups of two or three.

For younger students, it is best to have them make a very loose wad. (The tighter the crumpling, the more complex the watershed modeling.) Ask the students if they can imagine being in an airplane above this landscape. Can they find the tallest mountain or the deepest canyon? Have them inspect their landscape from above and show them an example of a true plastic relief map or a shaded relief map. Have them look at their landscape from the side as if they were on a nearby plain looking up at the mountains. There are many geographical or landform terms that can be introduced or reviewed as appropriate to students' grade level.

Have the students select a dark-colored felt marker, other than blue, and gently shade the tops of the "mountain" ridges and divides. This may take a while.

Encourage the students to carefully follow ridges as far as they go, all the way to the edge of the tape if necessary. Take the time to explain that ridges define the boundaries of watersheds. Also have them look at their landscape from above and notice that some watersheds are entirely encircled by ridges, "closed watersheds," and some are open to the edge of the paper, "open watersheds." Careful observation will also show that big watersheds are made up of smaller watersheds. Some terms to discuss include: mountain pass, divide, saddle, basin, valley, and canyon.

Have the students select the blue marker and carefully draw where they think the rivers and lakes would be in their valleys. This can be tricky for younger students if their crumple patterns are too complicated or too narrow for the felt markers to fit into. Tell them that this requires some imagination and careful observation of the folds and elevation changes of the paper. For rivers, it is easiest to start at the bottom of a valley and follow it uphill or start from the side of a mountain and pretend to be a drop of water slowly moving down hill. At many points there will be valleys where they cannot go "down" any farther. That may be a place to draw a lake. Lakes can be drawn in little bowls on hillsides or at the bottom of long valleys with ridges at both ends. You can have them simulate a mountainous island by

Student Procedure: Crumple a Watershed

- 1 Take a sheet of paper and crumple it up into a wad.
The looser the wad, the better for this activity.



- 2 Uncrumple the paper and set it on the sheet of cardboard.
 - Tape the edges of the paper onto the cardboard base leaving at least an inch of cardboard exposed around the perimeter.

having them color the tape and cardboard blue as well. Ask students to find where waterfalls might occur or where the rivers are so flat that swamps might occur. Tell them that, even though watersheds are defined by the ridges, they are named by the rivers and streams. Make sure they write their names on the bottom of the cardboard before the next step.

Now tell the students that it is time to test how good they were at predicting the paths of the rivers. Take the spray bottle and simulate rain by misting the paper watershed while it is flat on a counter. Have them observe the water seep downhill through the paper. You can make different effects by how wet you make the paper. If you spray the paper heavily, actual drops will run down the sides of the paper and pool into “lakes.” This can be fun especially for younger grades. Have the students take turns spraying their own watersheds or take turns bringing them to you to spray. It is best to have one table or counter set aside for this.

While the models are drying, you can give the students the math activity on mapping. The paper will become even more colorful as the dark inks slowly separate into a rainbow of colors. Once they are dry, let the students take their watersheds back to their desks. Ask them if they correctly predicted where the water would flow into rivers and lakes. Finish by asking them again to define what a watershed is and, with a felt marker, have them outline one entire watershed.

CLASS DISCUSSION

Ask for student observations. Let students guide the discussion and present their hypotheses before discussing explanations.

Do the models look like real mountain ranges?

Ask students to explain how the models are similar and different.

Where did the water run?

The creases in the paper are streams and rivers that are bordered by wetlands.

Where did most of the water end?

The rivers flow into a basin, a large body of water, such as a lake.

Describe the relationship between small and large watersheds.

What can you do to keep bodies of water clean?

These answers will vary. In general, the watershed that collects the water needs to be clean for the body of water to be clean.

Ask students to interpret the different aspects of their watershed. You can use questions like: What is the highest point in your watershed? Where does this occur? What is the lowest point? Where does this occur?

OPTIONAL EXTENSIONS

Extension A—The group watershed model

Simply make a much larger paper landscape with butcher paper. This will provide for a more team-oriented approach to the activity.

You will need:

- One sheet of white butcher paper, any length (suggested 3' x 5')
- One sheet of cardboard the same size as the butcher paper
- 2 different colored, water-based felt markers (one should be blue)
- Spray bottles and scotch tape
- A large table

Extension B—Populating the paper watersheds

Once each student has made a paper watershed model or once each group has made one, tell the students it is time to add people to the landscape.

- Have them name the mountains and the rivers.
- Have them research any culture, including their own, and, with that information, ask them to place towns, roads, mines, farms, etc., on the model. Roads can be drawn with pencil. Towns can be drawn as well, or they can be represented by carefully gluing colored hole-punch disks.

Extension C—Mapping the paper watersheds

Using graph paper, have students render a two-dimensional map that represents their three-dimensional watersheds.

Have them decide on the scale of grid lines and then have them estimate the:

- length of each river
- height of each mountain
- area of each valley
- volume of water that would enter the watershed if one inch of rain fell in one of those valleys

Extension D—Finding Your Environmental Address

Show students a fictional name and street address on a letter and describe or ask how a letter carrier would use the address to deliver the letter. The address is actually read from bottom to top beginning with the zip code or state, then city or town, then street, and, finally, the specific house number on that street.

Now have students create their Environmental Address based on watersheds. For example, a student who lived 5 miles south of Haines, Oregon, would have an Environmental Address like this:

**Jane Smith
Willow Creek Watershed
Powder River Watershed
Snake River Watershed
Columbia River Watershed
North America**

To find Jane, you would start in North America, find the Columbia River Watershed, and so forth.

Extension E—Add a point source contamination

Sprinkle crystals of sugar-free gelatin crystals onto watersheds to simulate areas of pollution. Spray the watershed and watch what happens to the point of contamination. Sugar-free gelatin works best and is not sticky when it dries.

CROSS-CURRICULAR CONNECTIONS

SUBJECT	Activity
LANGUAGE ARTS	Dorris, Arthur. <i>Follow the Water from Brook to Ocean</i> . New York: Harper Collins, 1991. <i>Explains how water flows from brooks to rivers, over waterfalls, through dams and cities, to the ocean.</i> Locker, Thomas. <i>Where The River Begins</i> . New York: Penguin Books, 1984. <i>A three-day journey to find the source of a river amid changing landscapes.</i>
MATHEMATICS	Have students determine the area of their watersheds by counting squares on the graph paper. Also have students look at map scales and introduce the concept with their watershed models.

RESOURCES

<http://www.epa.gov/owow/watershed/>

The United States Environmental Protection Agency page on watersheds.

http://ars.usda.gov/Main/site_main.htm?modecode=53-62-00-00

The United States Department of Agriculture's Northwest Watershed Research Center.

<http://water.usgs.gov/index.html>

United States Geologic Survey page on water-related research.

GLOSSARY

Divide:	The summit area that makes up the watershed boundary between drainage basins that are next to each other.
Elevation:	The vertical distance of a point above or below a reference surface, such as sea level.
Model:	Something that allows for investigation of the properties of the system and, in some cases, prediction of future outcomes.
Natural Resources:	Materials that occur in nature and are essential or useful to humans, such as water, air, land, forests, fish, wildlife, topsoil, and minerals.
Pass:	Point used to cross a ridge that divides two watersheds.
Riparian:	Of or growing on a bank of a river or stream.
Saddle:	A low point on a ridge, generally a divide between the heads of streams flowing in opposite directions.
Topography:	The graphic representation of a landform on a map by the use of contour lines.
Watershed:	Land area where precipitation runs off into streams, rivers, lakes, and reservoirs.

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Educating the Public

Watershed education is an important tool for protecting and restoring our watersheds. Because we live in a watershed, we need to understand how to live within it and take care of it. Educational programs that create this awareness are extremely important.

At OMSI's Watershed Lab, visitors can learn more about how watersheds work. Stephanie Anderson, a science educator, helps museum visitors examine the individual role they play in a watershed and how their actions affect the overall health of the ecosystem. Stephanie can demonstrate the importance of a watershed by using various tools. One of the most popular activities in the lab is the "Stream Table" where visitors can build a **model** stream with running water, rocks, and "trees." Stephanie can show the public live salmon and trout from their local watershed and explain fish lifecycles or watch microscopic critters under the microscope and discover where and how they live.

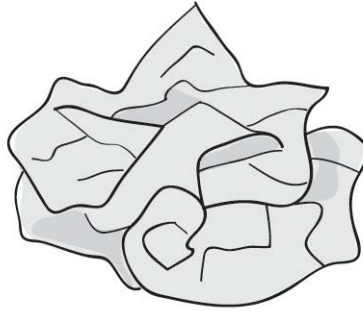


Educator Stephanie Anderson leading a stream table demonstration in OMSI's Watershed Lab

Student Procedure:

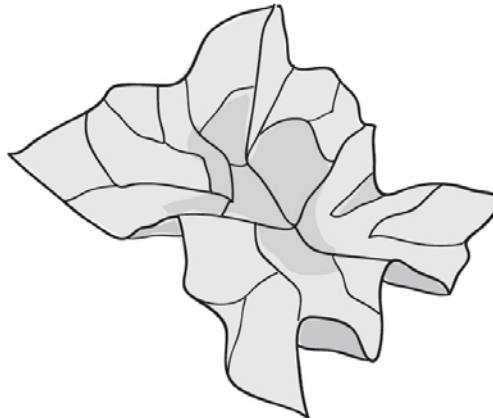
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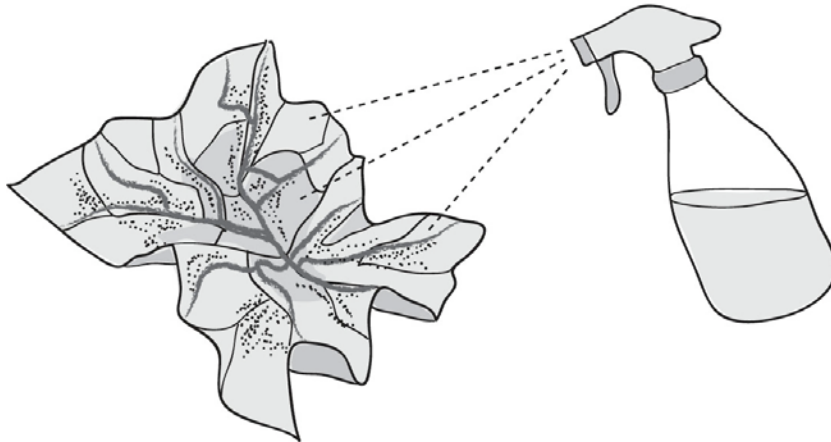
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5

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**6**

Let the paper watersheds dry.

- This may take 30 minutes or more.

Name of Scientist: _____ Date: _____

Questions:

Crumple a Watershed

Define “watershed.” What are the major features of a watershed?

How can you tell where the geographical boundaries of a watershed are?

How does the type of terrain in a watershed affect flooding or erosion? What type of terrain is there in our area?

What soil type contributes to flooding in a watershed and why? What type of soil have you observed in our area?

What good are wetlands and swamps? Why not just fill them in with dirt?

What are the impacts when people clear all the vegetation from the buffer zone or filter strip next to a stream in order to build on or farm the land?

What is the effect of constructing buildings, roads, and parking lots (impervious surfaces) through which water cannot be absorbed into the ground?

What is the name of the watershed in which your school is located?