Branching Out

Where does your water come from? Build a model watershed and predict where the water will travel across the land.

Concepts

- Water flows through and connects watersheds.
- Wherever you are, you are in a watershed.

Objectives

Students will:

- Investigate drainage patterns.
- Observe how watersheds distinguish different land areas.
- Discover the origin of the water used in their local community.

Duration

Two 50-minute periods. If making the permanent watershed, allow at least three days for materials to dry before conducting experiments.

Method

Small group model making followed by experiments and analyses.

California Science Content Standards

2. Shaping Earth's Surface

Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept:

2.a. Students know water running downhill is the dominant process in shaping the landscape, including California's landscape.

2.b. Students know rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns.

Background

The water cycle is the path water takes through its various states – vapor, liquid, and solid – as it moves through Earth's systems (oceans, atmosphere, ground water, streams, etc.). As we see a rushing stream or a river gushing during a major rainstorm, we may ask, "Where does all this water come from?" As we watch water flow down a street during a heavy rainstorm, we may ask, "Where does all the water go?" Answers may be found right in your own neighborhood! No matter how dry it looks, chances are there is water flowing far below your feet. Wherever you are, you are in a *watershed*, the land area from which surface runoff drains into a stream channel, lake, ocean, or other body of water. The Ballona Creek watershed, for example, is 127 square miles large, going inland to Hollywood, Inglewood, and more! The Ballona Wetlands formed where Ballona Creek meets the Santa Monica Bay.

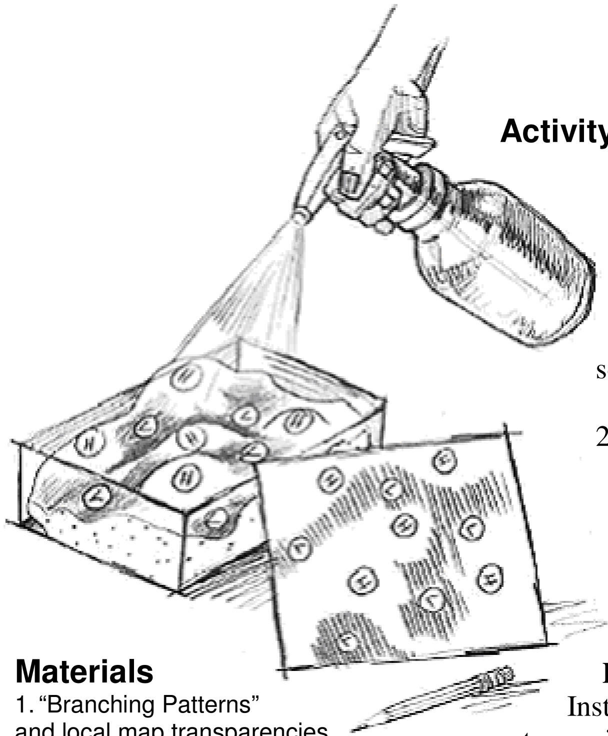
The pattern water makes as it flows through a watershed is familiar to students who have drawn pictures of trees or studied the nervous system. By investigating drainage patterns, we can better understand how watersheds distinguish different land areas.

When the ground is saturated or impermeable to water (when water cannot soak into the ground) during heavy rains or snowmelt, excess water flows over the surface of land as runoff. Eventually this water collects in channels such as streams. Watersheds are known by the major streams and rivers into which they drain.

Watersheds are separated from each other by areas of higher elevations called ridge lines or divides. Near the divide of a watershed, water channels are narrow and can contain fast-moving water. At lower elevations, the slope of the land decreases, causing water to flow more slowly. Eventually, water collects in a wide river that empties into a body of water, such as a lake or ocean.

From a bird's eye view, drainage patterns in a watershed resemble a network similar to the branching pattern of a tree. Tributaries, similar to twigs and small branches, flow into streams, the main branches of the tree. Like other branching patterns (e.g., road maps, veins in a leaf), the drainage pattern consists of smaller channels merging into larger ones.

Watersheds are either closed or open systems. In closed systems, such as Mono Lake in northeast California, water collects at a low point that lacks an outlet. The only way water leaves is by evaporation or seeping into the ground. Most watersheds are open – water collects in smaller drainage basins that overflow into outlet rivers and eventually open into the sea.



Activity

1. Ask the students what they know about watersheds. Is there one near their home? (*Trick question: Wherever you live, you are in a watershed, even if that watershed is covered with asphalt.*) What is in a watershed? How can you tell one from another? Can you name a local watershed? Tell students they are going to build a model of a watershed to see how water flows through a branching network of drainages.

2. Depending on whether a temporary or more permanent model is being built, students will do the following:

Temporary model:
Instruct students to select six rocks and wrap them with white scrap paper. Lay them in a square or rectangular aluminum tray. Place larger rocks near one end of the tray. Cover the paper-covered rocks with plastic wrap.

Permanent model:
Instruct students to lay rocks in a square or rectangular aluminum tray, with larger rocks near one end. Snugly cover the rocks and exposed areas of the tray with plastic wrap. Apply strips of papier-mâché to cover the rocks. For a sturdier model, apply several layers of papier-mâché. When the mâché has dried, coat the model with white paint and waterproof sealant, or waterproof white paint.

3. Students will sketch a bird's eye view of the model. They should mark points of higher elevations with "H"s and low spots with "L"s. To identify possible ridge lines, connect "H"s.

4. Tell students the model will soon experience a rainstorm. Where do they think water will flow and collect in the model? Have them sketch their prediction on their drawings. Indicate the crevices in their models and possible locations of watersheds.

5. Students will spray blue-colored water over the model and note where it flows. Water may need to be sprayed for several minutes to cause a continual flow. Assist students in identifying branching patterns as water from smaller channels merges into larger streams.

6. Students will use a blue pencil to mark on their drawings the actual branching patterns of water. Some imagination and logic may be required. Ask them to confirm the locations of watersheds by noting where water has collected in the model.

7. Ask students to determine if smaller watersheds overflow into larger ones. Does all the water in the model eventually drain into one collection site (open watershed system)? Does the model contain several closed water systems (collection sites that lack an outlet)?

8. Students will place tracing paper or an overhead transparency over their drawings and draw the drainage patterns. Groups compare and contrast each other's drawings. Discuss how the networks of smaller channels merge together to become larger.

Materials

1. "Branching Patterns" and local map transparencies
2. Blue-colored water
3. Spray bottles or sprinkling cans, one for each model
4. Drawing paper and pencil
5. Blue pencils
6. Tracing paper or blank transparency sheets
7. Photocopies of a local map showing rivers (watersheds also if available), one for each student
8. Overhead projector

Note: Students may build a temporary, simpler model, or a durable version that can e used for further experiments. Materials for both are listed here.

For both models:

1. Five to ten rocks, ranging from 2 to 6 inches (5 to 15 cm) in height. If groups of students are making their own models, each group will need its own rocks.
2. Square or rectangular aluminum tray, large enough to hold rocks. A large disposable baking or turkey roasting pan will work.
3. Plastic wrap (thick plastic wrap from a grocery or butcher shop works best).

For temporary model:
White scrap paper, newsprint, or butcher paper.

For permanent model
Note: Allow extra time to make this model. Begin it at least three days before the experiments are to be conducted – the papier-mâché needs to dry overnight, and then the paint needs time to dry completely.
1. Papier-mâché materials (strips of newspaper dipped in a thick mixture of flour and water)
2. Water-resistant sealer and white paint (or white waterproof paint)

Preparation
Collect materials, photocopy transparencies and maps, build models, and keep a space open in the room for the models to be worked on and displayed.

9. Hand out photocopied maps of local area with streams, rivers, and lakes. Students locate streams and rivers and draw a circle around land areas they think drain into the river.

10. Students pick one river on the map and follow its path in two directions (upstream and downstream). If the entire river is pictured, one direction should lead to the headwaters or source, and the other direction should merge with another river or empty into a body of water.

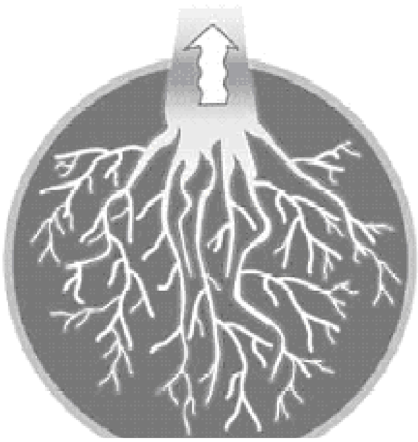
Results and Reflection
1. Students predict where water will flow and collect in the watershed model, and write their predictions on a piece of paper.
2. Students test their predictions and use the results to confirm or modify their projected drainage patterns.
3. Students will compare the drainage pattern of watersheds to other branching networks.
4. Students write a story about or draw a map of drainage patterns in their watershed. Label mountains, rivers, streams, reservoirs, lakes.

Conclusions
Watersheds have a branching pattern that distributes water from rain and snow into streams, rivers, and lakes. Water moves from high to low areas, collecting in drainage basins. These drainage basins are the source of water for most of our communities.

Extensions and Applications
1. If the model were a real land area, would the drainage patterns be the same thousands of years from now? Students should consider the effects of natural and human-introduced elements (e.g., landslides, floods, erosion, evaporation, water consumption by plants and animals, runoff from agricultural fields, droughts, dams). Have students write one page describing what the future watersheds look like.
2. Students may finish their models by painting landscapes and constructing scale models of trees, wetlands, and riparian areas. Introduce human influences, such as towns and roads.
3. As in the game "Pin the Tail on the Donkey," blindfold students and have them randomly touch a point on the map of California. Have students explain likely routes water would take in that area. Where is the closest large river? Lake? Ocean? Are there dams on the river?
4. Students may make a topographic map of their model. First, they totally waterproof the model. Next, they submerge it, one-half inch at a time, in water. At each increment, while viewing from above, they trace the water lever onto a sheet of glass or clear plastic held over the model. Students can make elevation lines and draw the map true to scale.

Additional Resources:
Urban Watershed Management Project: http://www.epa.gov/ednnrmrl/
Center for Watershed Protection: http://www.cwp.org/

Adapted by Friends of Ballona Wetlands from: "Branching Out" (p. 56-69) Waves, Wetlands, and Watersheds: California Coastal Commission Science Activity Guide.

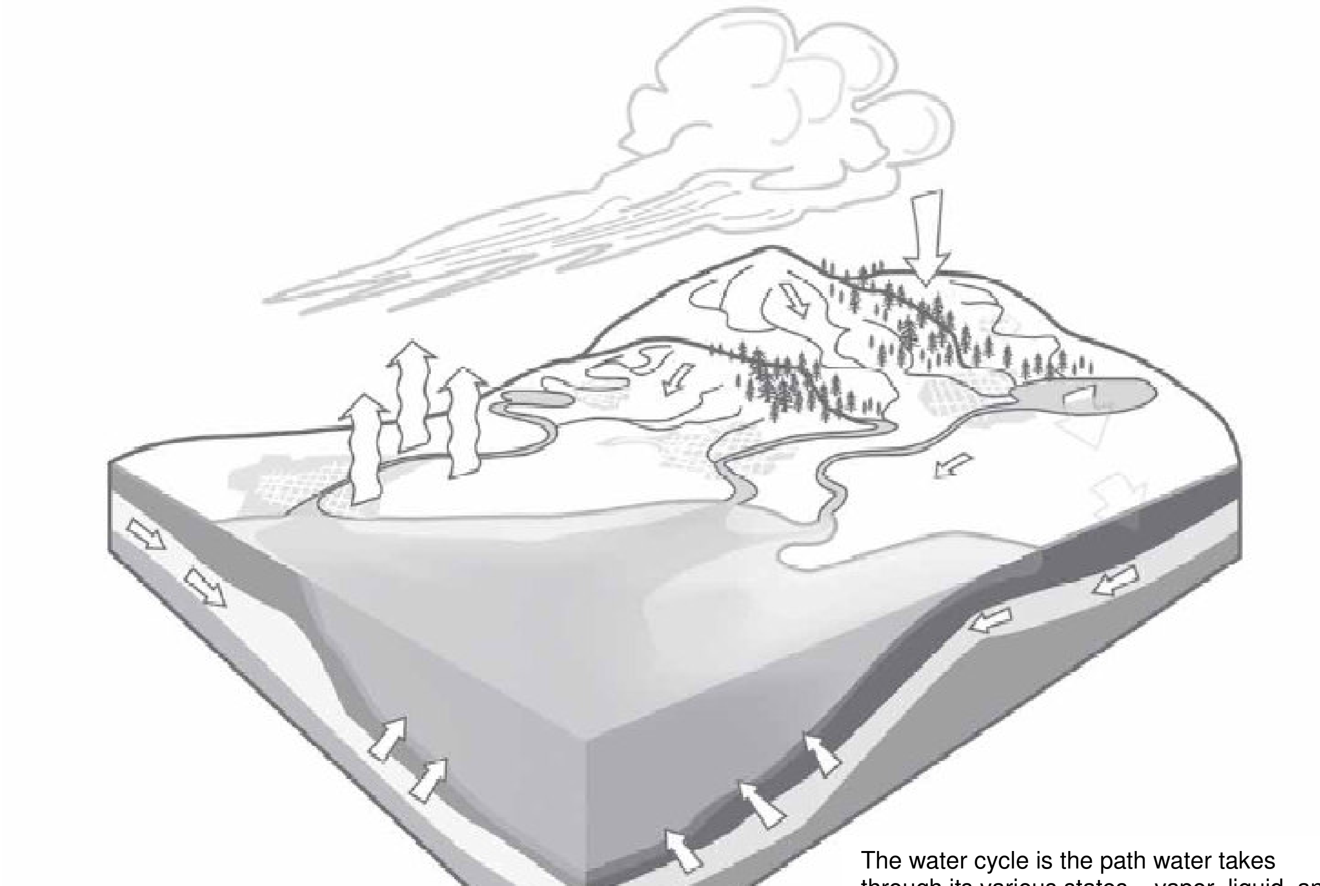


SECONDARY ROOTS FEEDING
PRIMARY TREE ROOTS

TRIBUTARIES FEEDING
MAIN WATERWAY

WATERSHED

The Water Cycle



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