Blue Beads of the Missouri River

When water passes by, where is it going?

Grade Level:
5–8

Subject Areas:
Geography, Earth Science, Environmental Science

Duration:
Preparation time:
15 minutes

Activity time:
30–45 minutes

Setting:
Outdoors or Classroom (depending on number of students)

Skills:
Compare and Contrast, Simulate, Interpret, Demonstrate

Vocabulary:
branching pattern, headwaters, main stem, rivulet, runoff, snowpack, tributary, watershed

Summary

Students participate in a whole body exercise to simulate the movement of water through the Missouri River and its watershed.

Objectives

Students will:

- demonstrate the movement of water through the Missouri River Watershed;
- compare and contrast the branching patterns of the Missouri River Watershed system with branching patterns found in nature and the constructed world;
- describe the major components of the Missouri River Watershed.

Materials

- *Copies of* ***Branching Patterns*** *Student Copy Page* (1 per student)
- *3–5 gallons of blue beads, pea gravel, beans, marbles, peanuts or similar objects* (depending on the number of students)
- *1 five-gallon bucket or other large container*
- *One-gallon pails or similar containers* (one per headwaters stream)
- *Optional – signs on sticks with pictures representing snow, rain, sun, and each of the seasons*
- *Optional – overhead projector, overhead transparency of* ***Branching Patterns*** *Student Copy Page*

Background

The Missouri River Watershed, also referred to as a drainage or basin, is the gathering-ground of a large river system. A watershed is an area of land that drains water toward a common river. The boundaries of watersheds can be identified on a map by tracing a line along the highest elevations (often a ridge) between two drainage areas. Large watersheds often contain many smaller watersheds.

Beginning at the highest elevations of a watershed, runoff (water from rain, melting snow, and ice) collects to form rivulets that merge into small headwater streams. As headwater streams flow downhill from the sides of the watershed, they gather more water and eventually join to become tributary streams. These tributaries flow into the main

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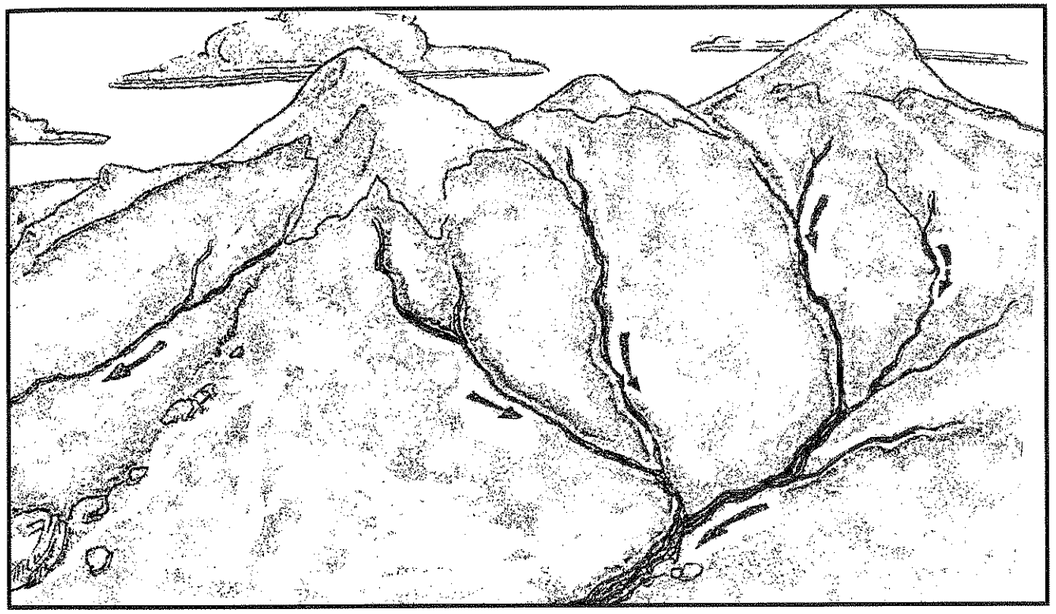

Small streams flowing together create a branching pattern in the headwaters of the Missouri Watershed.

stem of a river that, with exceptions such as closed basins, eventually flows to the sea. Overall, the many small streams flowing together create a branching pattern.

In aerial photographs and on some maps it is easy to see the branching of a watershed's streams and rivers. In the Missouri River Basin, the branching pattern starts in the high elevation headwaters of Montana, Wyoming, and Colorado. Moving down the watershed, tributaries made of smaller branches combine with the main stem to form even more branches. This pattern continues to the confluence with the Mississippi.

The pattern is found elsewhere in nature: trees in winter, fingers on our hands, stemming patterns on leaves, webs of arteries, vessels and capillaries in our bodies. It is an intricate system of the small feeding into the large to keep the whole system functioning. Humankind has made good use of branching patterns by applying them to highway systems, computers, and more.

The branching pattern of rivers is largely fed by runoff. Runoff is produced by precipitation and influenced by factors including climate, local weather patterns, and the topography, geology, soils, and vegetation of the region. Runoff generally comes from major rain events or from snowpack.

During winter, precipitation in the Missouri River Basin is stored as snow in snowpack (accumulated snow that is condensed and compressed by its own weight). In the high-elevation headwaters of the Missouri River Basin, the snowpack can build higher than twenty feet. Very little water will flow into streams at this time; what flow there is generally comes from springs, ground water, or periodic snowmelts.

With the arrival of spring and warmer temperatures, the snowpack begins to melt. For several weeks this water—often referred

to as the "spring melt" or "spring runoff"—saturates the ground and fills streams. If enough runs off at once or the precipitation is above average for an area, flooding can occur at low elevations in the river's floodplain (low area along a river's channel).

Downstream rivers rise as the temperature warms and melted snowpack accumulates in the main stem. Springs and ground water that have been recharged by melted snow discharge into streams that are also replenished by summer rainstorms. In fall, as temperatures cool and precipitation diminishes, streamflows decrease and the watershed lulls until winter arrives, bringing with it precipitation in the form of snow. The annual cycle has been repeated for thousands of years in the Missouri River Basin, and throughout geologic time the path of water from high ridges to wide plains has carved channels that fill with this repeated flow of water and create visible branching patterns.

Procedure

Warm Up

Distribute copies (or project overhead images) of a tree in winter, the human circulatory system, a road map, and ***Branching Patterns*** *Student Copy Page* (shows the outlines of a watershed's drainage pattern). Ask students to describe what all the pictures have in common.

Provide students with a definition of a watershed. Review the branching patterns listed above and then ask the class if they know how watersheds form a similar pattern on the land. Ask if they can figure out why a watershed has a branching pattern. To help them, discuss how topography, seasons, and weather affect watersheds and the flow of streams. Use the Missouri River Watershed map to find examples of branching.

The Activity

Part I

1. **Ideally, assemble students on a gently sloping hill to help reinforce the idea that water flows from higher elevations to lower elevations.** If a hill is not available, students can assemble on gymnasium bleachers. Another option would be to designate tall students to simulate higher elevations and shorter students to simulate lower elevations, in which case a playing field, a gymnasium floor, a classroom, or even a wide hallway will work.
2. **Assemble students in the branching formation in order to simulate streams in a watershed (see Forming Watersheds Teacher Copy Page Illustrations).**
3. **Missouri Headwaters Streams: At the top of the hill, have two to three students form a short line (fingertip to fingertip) leading down-slope.** Form a second line of two to three students next to the first with the two "lowest" students fingertip to fingertip (see illustration). Explain that these students represent streams that capture precipitation at the highest elevation in a watershed. Depending on the number of students participating, assemble two to three additional "headwaters streams" a short distance from the first group.
4. **Missouri Tributaries: Starting where the headwater streams join, assemble a line of students leading down-slope to represent tributary streams.** These tributaries should touch fingertips and "flow" towards each other but not connect as a whole—yet.
5. **Missouri Main Stem: Ask students what element of a watershed is still missing.** How will all the headwaters and tributaries join? Have the remainder of the students line up fingertip to fingertip in a gently S-shaped line starting at the topmost tributary and connecting the remaining tributaries as it winds downhill. Explain to these students that they represent the main stem of a river, and all smaller streams will flow towards it and connect. Have everyone touch fingertips. Where headwaters, tributaries, and the main stem connect, have students connect fingertips three-ways (creating a confluence).
6. **At the top of each headwaters stream, place a container of beads.**
7. **At the bottom of the main stem, place an empty five-gallon bucket or other container to receive beads. Label it "Mississippi."**

Part II

1. **To help students understand what will happen during this activity, instruct students at the top of the headwaters stream to pick up one bead and hand it to the person below them.** Have students continue to pass the bead "downstream" until it travels down through the tributaries and the main stem and is deposited in the bucket, representing the Mississippi River, at the bottom.
2. **Explain to students that they will now simulate the flow of water through the Missouri River Watershed through the seasons. Then begin the scenarios in Steps 3–6.** (*Option: Make large signs with symbols for snow, rain, sun, and each of the seasons. Attach these signs to sticks and hold these signs up to indicate/emphasize each scenario. This is especially helpful for large groups.)*
3. **Winter: Students at the top of the headwaters streams begin to pass beads slowly (count to three before passing the bead) downstream to simulate the very low flows typical of streams in winter.** Remember, during this cold time of year, precipitation is stored in its frozen form, as snowpack.
4. **Spring: Spring melt! Temperatures rise and begin to melt the winter snowpack.** Have "headwaters" students pass beads quickly. "Tributary streams" and the "main stem" students will need to pass beads as fast as they can. Inevitably some beads will be dropped or spilled. Don't worry. Let them represent the flooding which occurs when a stream channel exceeds its capacity.
5. **Summer: After the winter snowpack has melted and run off, streamflows decrease.** Instruct "headwaters" students to slow down and pass beads at a leisurely pace. Instruct "tributary" and "main stem" students to pick up beads that dropped during flooding and pass them downstream. This represents floodwaters receding and flows returning to normal. Simulate an isolated summer storm by quickly passing beads through one headwaters stream for twenty seconds. What did this do to the rest of the system? Many people are surprised to learn that a storm can drop significant amounts of rain in one part of a watershed while other parts remain dry.
6. **Fall: Streams generally have low flows during the fall months.** Have students pass beads slowly, but not quite at the winter pace (counting to one or two instead of three).

Part III

Optional modifications to this activity include the following:

1. **Construct a dam on the Missouri River main stem by placing a bucket between students.** Capture water in the dam during the spring runoff and release it later in the summer. Discuss how dams are used to capture water during periods of high flow and then release it slowly for purposes such as irrigation and hydroelectric power generation throughout the rest of the year.
2. **Have students draw a map of the watershed they created.** Have them mark and name their location during the activity.
3. **Calculate the flow of a headwaters stream, a tributary, and the main stem during each season.** First assign a value to each bead such as 1 bead=10 gallons, then assign a student to count how many beads pass by a given point in 15 seconds. Multiply by four to get the flow for one minute. Multiply this total by the assigned value of the beads.

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Using this information, have students make a graph and compare flows for each section of the river during each season. Graph the results, placing "time" on the X axis and "number of beads" on the Y axis.

Wrap Up

Gather students and have them describe their location in the watershed. What is it like to be a headwaters stream? What is the importance of a tributary? What is the role of the main stem in the watershed? What are the challenges for each watershed component? Which section does the class think works the hardest? Which section is most important to the watershed? How do the seasons and weather influence the flow of water through the watershed?

Assessment

Have students:

- compare and contrast the branching patterns of streams in the Missouri River Watershed and branching patterns found elsewhere in the natural or human environment (***Warm Up***);
- explain the parts of the Missouri River system (***Part I,*** Steps 1–5);
- describe the movement of water through the Missouri River Watershed during each season (***Part II,*** Steps 3–6);
- describe how local weather can affect stream systems within the Missouri River Watershed (***Part II,*** Step 5 and ***Wrap Up***).

Extensions

Have students draw a map of the Missouri River Watershed they enacted and compare it with a map of their local watershed.

Have students write a song or chant to sing during this activity as they pass beads through their watershed.

Have students string four blue beads onto a bracelet to remind them of the importance of water during each season of the year.

Resources

Project WET: Curriculum and Activity Guide. 1995. Bozeman, MT: The Watercourse.

e-Links

Missouri Department of Natural Resources
www.dnr.mo.gov/riverissues/river_basins.htm

Missouri River Basin Association
www.mrba-missouri-river.com

United States Environmental Protection Agency, Surf Your Watershed
www.epa.gov/surf

United States Geological Survey, Watershed Science
http://water.usgs.gov/wsc

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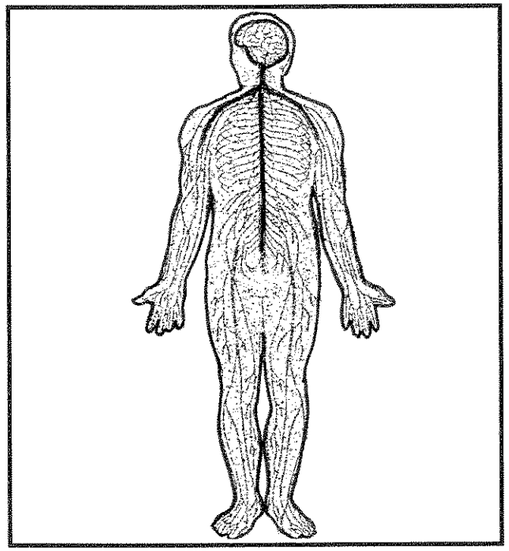
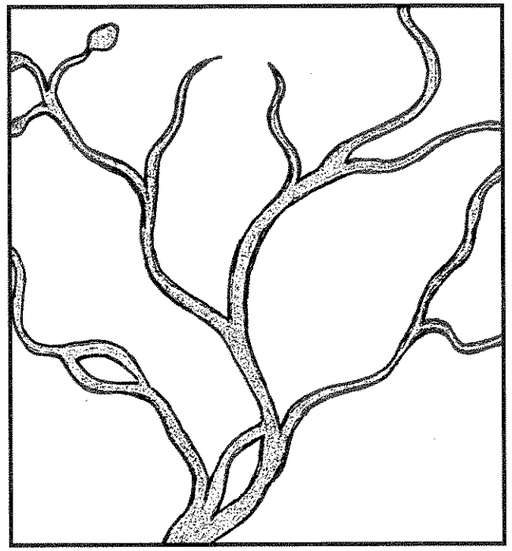
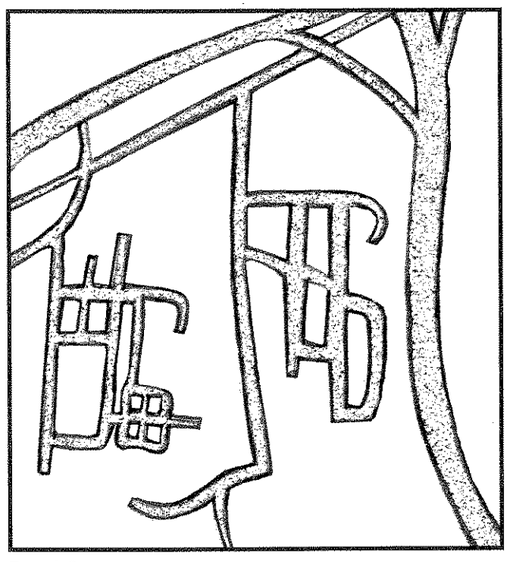
Blue Beads of the Missouri River
Branching Patterns



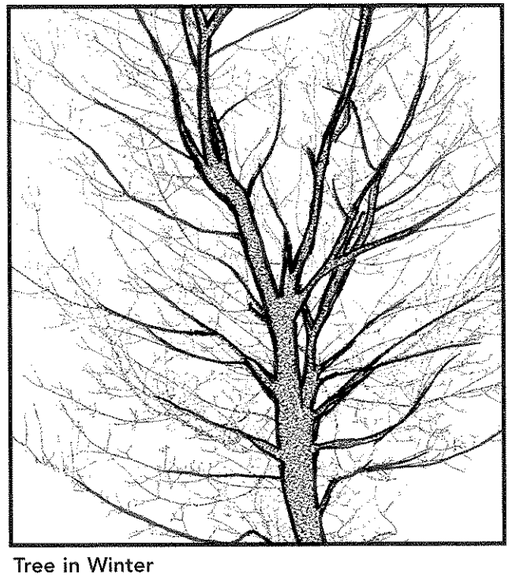
Human Nervous System



Watershed Drainage Pattern



Road System



Tree in Winter

Blue Beads of the Missouri River
Forming Watersheds

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