Lesson 2

Watershed Boundaries

Cognitive Demand:

Interpreting Concepts (C)

Science Literacy (D)

Technological Design (T)

Recalling Science (R)

Overview:

Students gain an understanding of the physical aspects of watersheds, and how the boundaries are determined by creating their own watershed models using paper.

Materials:

- One 8.5” x 11” sheet of paper per student, preferably graph paper.
- One sheet of cardboard or tag board (~8.5” x 11”) per student.
- Water-soluble, non-permanent felt markers (preferably dark colors).
- One blue colored pencil per student.
- Spray bottles with tap

Teacher Background:

- A watershed is an area of land that drains into a water body – such as a river, lake, or bay. Watershed boundaries are generally defined geographically by a ridge or line of highest elevation encompassing areas of lower elevation.
- Water flowing underground (“subsurface” flow), and surface waters meet at streams and rivers, then flow to the watershed outlet, which can be a larger stream or river, a lake, a bay or even an entire ocean.
- Every place on the earth is a part of a watershed. It is mainly topography that determines where, and how water flows from one area to the next.
- Watersheds can be large or small. Every stream or river has an associated watershed. Smaller “tributary” watersheds join to become larger watersheds. It is relatively easy to delineate watersheds using a topographic map that shows stream channels. Watershed boundaries follow major ridgelines around channels and meet at the lowest point where water flows out of the watershed, commonly referred to as the stream or river’s mouth.
- Each large drainage basin can be broken into smaller, tributary drainage basins called sub-watersheds. The flow of water (and whatever carried with it) is influenced by large features such as continental divides, but one can also focus on drainage around an individual river. Thus, watersheds come in all shapes and sizes. This also means that almost every watershed has a sub-watershed.
- A watershed system eventually drains into the ultimate water bodies—the ocean or an inland lake or sea.

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Acquisition of Learning:

1. Take a sheet of plain white paper and crumple it up into a wad. The tighter the crumpling, the more complex the watershed modeling.

2. Uncrumple the paper and set it on the sheet of cardboard. Tape the edges of the paper onto the cardboard base, leaving about an inch of cardboard exposed around the perimeter- this will create a miniature landscape of mountains and valleys. Ask the students to identify the tallest mountain or the deepest canyon.

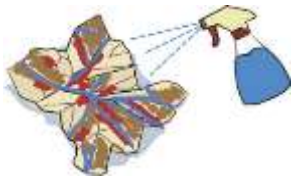
3. Have them inspect their landscape from above. Have them look at their landscape from the side as if they were on a nearby plain looking up at the mountains.

4. Use a dark-color water soluble marker, other than blue, and gently trace the tops of the "mountain" ridges and divides. Encourage the students to carefully follow ridges as far as they go. This may take a little time.

5. Take the time to explain that ridges define the boundaries of watersheds. Careful observation will also show that big watersheds are made up of smaller watersheds.

6. Ask the students to use a blue colored pencil and carefully draw where they think the rivers and lakes would be in their valleys.

7. For rivers, it is easiest to start at the bottom of a valley, and follow it uphill. If there are valleys where they cannot go "down" any further, that may be a place to draw a lake.



8. Although watersheds are defined by the ridges, they are named by the rivers and streams. Have students write their names on the bottom of the cardboard before the next step.

9. Now have the students test their predictions of the paths of the rivers. Take the spray bottle and simulate rain by misting the paper watershed while it is flat on a counter. **Don't spray directly on the paper, but have the droplets fall on the paper.**

10. Have students observe as the water seeps downhill through the paper. You can make different effects by adjusting 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."

11. Let the paper watersheds dry. The paper will become even more colorful as the dark inks slowly separate into a rainbow of colors.

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Closure:

Once the models are dry, have students determine whether 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 new color or marker, have them outline one entire watershed on their model. Show the students a map that has Ohio's watersheds. Discuss how the boundaries to the watersheds are determined.

Extensions:

1. Have the students investigate the geographical features that are divides for Ohio's watersheds.

2. Create a 2-D map using the paper watersheds: Use graph paper and have each student render a two-dimensional map that represents their three-dimensional watersheds.

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

- The lengths of the rivers
- The heights of the mountains
- The area of the valleys
- The volume of water that would enter the watershed if one inch of rain fell in one of those valleys.

3. Explore global watersheds: Ask students to find their location on a globe of the Earth (or Google Maps), then guess in which ocean's watershed they live. (i.e., To what ocean does water eventually go if you pour it on the ground outside our building?) This can be repeated for other cities around the globe.

Next, have students explore the globe in search of isolated lakes and inland seas, i.e., those that have no river outlet or strait connecting them directly – or indirectly – to any ocean.

Have each student [or team of students] identify as many inland seas and isolated lakes as they can by name [+1 point for each] on the globe, without including lakes with outlets into an ocean-bound river [-1 point for each]. Where there's ambiguity, students can research via Wikipedia [or just count as 0 points].

Hint: The North American, and East African Great Lakes flow into northbound rivers, as do many Western European lakes; Salt Lake in Utah, Lake Chad in West Africa, and the big water bodies East of the Black Sea in Asia [Aral Sean, Caspian Sea and Lake Baikal – the largest-volume lake on Earth] are all inland lakes and seas.