Putting Water in the Shed*

Time
two or more 30- to 60-minute periods

Vocabulary
aquatic, dam, erode, habitat, pollutant, pollution, precipitation, runoff, sediment, tradeoffs, turbidity, water quality, watershed

Objectives
Students will:

- ☐ describe the characteristics of watersheds.
- ☐ discuss the role of watersheds in providing wildlife habitat as well as human habitats.
- ☐ give examples of how watersheds can be conserved and protected.

Method
Students measure the area of a small watershed and calculate the amount of water it receives each year, compare and contrast their findings to the Raccoon River, and discuss changes in the Raccoon River watershed since the Dragoons traveled its shores and the varied roles watersheds play in human and wildlife habitat.

Materials
six stakes or markers
hammer
two 50-foot measuring tapes
two 100-foot measuring tapes (or twine or heavy string)
writing materials
clipboards
large pad of paper for display
access to the internet
graphing paper
local topographic maps

Background
The Dragoons explored the courses of many of Iowa's rivers, including the Raccoon. Riding their horses, the men also traveled across land through various **watersheds**. A watershed is an area of land that drains into a particular body of water. Boundaries of a watershed are determined by the land surface surrounding that stream, river, or lake. Because **runoff** (water that drains or flows off the surface of the land) must flow somewhere, all land areas are a part of some watershed.

Captain James Allen and his men saw tall grass prairie with occasional wetlands, or "potholes," as they traveled through the Raccoon River watershed on their return to Fort Des Moines from the Big Sioux. The wetlands and prairies served as filters and sponges and were vital components of the Raccoon River's watershed. Today, over 95% of original wetlands and 99.9% of original prairies are gone from our watersheds.

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* Based on the activity "Watershed," Project WILD Aquatic K-12 Curriculum & Activity Guide, Council for Environmental Education, Houston Texas, 2001.

The watershed is a complex system of soil and topography linking all living things within its boundaries. Plant and animal life depend on the water within each watershed. Watercourses also transport water, organisms, nutrients, and other materials. What affects one watershed eventually affects other sites downstream.

One material moving through the watershed is soil. Because rivers constantly **erode** (remove or wear away) the lands that contain it, suspended **sediments** (fine soil and other particles that settle to the bottom of a liquid) are part of the natural dynamics. However, human activities such as clearing land, building dams, farming, and industrial development accelerate this process. Runoff carries loose soil into the water system, which may increase **turbidity** (cloudiness) of water. Turbidity can interfere with light reaching plants to make food or with fish receiving oxygen.

Contaminants in the water are of particular concern. Contaminants include excessive nutrients (such as nitrates and phosphates) that overload natural systems and harmful chemicals introduced into the water. Fertilizers, pesticides, and bacteria are major agricultural contaminants. Industrial wastewater can contain a myriad of contaminants from oil to heavy metals.

Contamination of watersheds is a serious problem for humans. It also is a problem for wildlife. Most often it is wildlife – particularly **aquatic** (growing, living in, or frequenting water) wildlife – that suffers most directly and immediately from contaminated water. Silt buries crucial **habitat** (arrangement of food, water, shelter or cover, and space suitable to animals' needs). Ammonia can kill all aquatic life in a stream immediately. Nutrients cause profuse growth of algae that die and deplete oxygen.

Watersheds feed and are fed by groundwater. Surface contamination can penetrate into the earth and contaminate groundwater supplies. Water can move so rapidly across the surface it is often expressed in cubic feet (or cubic meters) per second. Below the ground's surface, water movement might be expressed in *inches* (or centimeters) per *year*. Therefore, groundwater can remain contaminated for centuries.

Another human activity that affects watersheds is diverting water from its natural flow. We often divert water or modify its flow to meet human needs. In Iowa, **dams** (impoundments) have been built to provide a constant water supply for towns or industries, to create lakes for recreation, and to maintain water levels for navigation and provide hydropower (Mississippi River). While dams provide predictable water supplies, they also may radically alter the habitats in and near a river.

Past efforts to improve **water quality** (condition of water) focused on specific sources of **pollution** (contamination of soil, water, or atmosphere by the discharge of harmful substances), such as sewage discharges or on specific water resources, such as a segment of a river or wetland. This approach may address specific problems, but it often does not address subtle, chronic problems in the watershed. For example, pollution from a sewage treatment plant might be reduced significantly after new technology is installed, but habitat destruction or other sources of polluted runoff in the watershed may still impact water quality. Managing the watershed unit as an integrated system helps resource managers determine what factors impact water quality and actions needed to protect or restore a water body.

The Raccoon River drains all or part of 17 Iowa counties before reaching the Des Moines River in Des Moines. More than 370,000 people – 13% of Iowa's population – rely on water sources within the watershed for drinking. Sections of the Raccoon River have been identified by the Environmental Protection Agency as being impaired from fecal coliform bacteria and nitrates.

The watershed's high concentration of nitrates have exceeded the federal maximum contaminant level (MCL) standard with enough frequency since the late 1980s that Des Moines Water Works (DMWW) installed and currently operates the world's largest nitrate removal facility. The DMWW can produce 10 million gallons of processed water per day. In 2000 the facility was operated almost one out of three days. Since it costs $3,000/day to operate the facility, almost $330,000 was spent that year to remove nitrates from the Des Moines drinking water supply. (Nitrates are returned to the river downstream of Des Moines.) Most scientists feel it is far more economical to prevent contaminants from entering water systems than to clean up pollution after it takes place.

Several factors contribute to pollution problems in the river. Almost ¾ of the 2.3 million acres of the Raccoon's watershed are in agriculture (corn, soybeans, livestock, poultry). Some 850,000 are in corn with an estimate over 55,000 tons, or 3,900 dump trucks, of fertilizer applied every year. Much of what was wetland has been converted to cropland. Wetlands were drained by tiles to remove water from the area. Tiles are direct pipelines into the river, so speed up drainage, but also reduce or eliminate absorption of chemicals into the soil.

Urban issues also affect water quality. Development, impermeable surfaces (such as parking lots), and storm water systems speed the rate water flows and eliminate any filtration of **pollutants** (substances that may contaminate air, water, or soil).

In the early 1990s, the state associations of corn and soybean growers and cattle, pork, and poultry producers partnered with the Iowa Agribusiness Association and Iowa Farm Bureau to form the Iowa Nutrient Management Task Force. This task force recommended numerous ways to improve water quality. The Agriculture's Clean Water Alliance (formerly known as the Raccoon River Watershed Project) was organized to keep nutrients out of the Raccoon River and its tributaries using these recommendations.

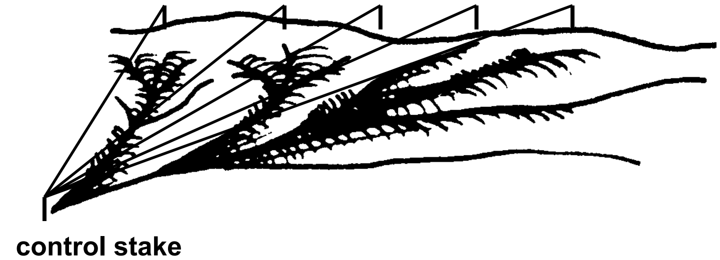
The Agriculture's Clean Water Alliance is composed of 11 agribusiness retailers in the watershed. One of the initiatives adopted by the group is to support an "Environmental Code of Practice." The Code establishes reasonable and practicable guidelines that all members stand behind. For example, Iowa State University recommends farmers not apply anhydrous ammonia until soil temperatures fall below 50 degrees. The Alliance made this recommendation into a policy and agreed not to sell anhydrous until soil temperatures dropped. People in the Raccoon watershed are working to reduce the amount of pollution entering the river.

To learn more about the Dragoons, refer to *Iowa's Water,* page 4.

Procedure

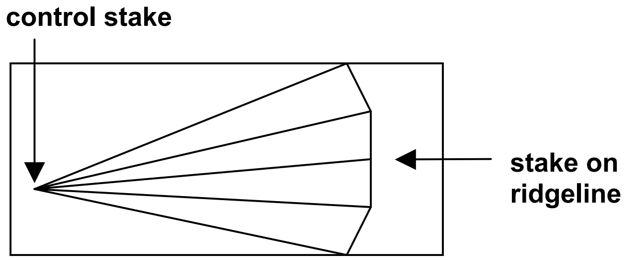
1. Discuss the concept of a watershed. Use local maps and local stream systems as examples. Topographical maps or raised relief maps are valuable tools. (You can get watershed boundary maps of local streams or lakes by calling the Geological Survey Bureau at 319/335-1575 and asking for watershed maps.) Emphasize that watersheds range in size from those of tiny tributaries (like the stream near your school) to total river systems like the Raccoon and Mississippi Rivers.
2. Introduce the concept that a ridgeline is the border between two designated watersheds. Use topographical maps of local areas to show how the boundaries of a watershed can be determined by tracing ridgelines between adjacent watersheds. Trace a watershed on a transparent overlay over a topographical map. Introduce the notion of the ridgeline (highest contour line in an area) being the border between two designated watersheds.
3. Select a site (approximately 100 feet square) that resembles a small watershed. If possible, there should be a visible drainage pattern. There needs to be enough slope so students can visualize the watershed concept. Explain to students that they will be going to a small watershed and will be measuring its area in much the same way large watersheds are measured.
4. Show students the equipment that you will be taking along and explain how five stakes will be used to mark the top of the ridgeline of the watershed. Indicate the "control" stake that will represent the bottom of the drainage system (e.g. pond, river, lake). Illustrate the process of measuring a watershed on the chalkboard or overhead before going to the site. You also can use a large pad and markers to review the procedures visually at the site.

5. At the site, divide students into teams of three to five. Determine the ridgeline of the watershed. Drive stakes or markers along the upper boundary of the watershed (ridgeline). Stakes should be 20 to 40 feet apart.



6. As a group, have students determine the location for the control stake at the "bottom" of the watershed. Students will measure from the control stake to each of the stakes along the ridgeline. The control stake should be 60 to 100 feet from the ridge stakes.
7. Measure from the control stake to each ridge stake and between ridge stakes. Sketch the stakes on a large piece of paper and note the distance between each stake. Convert the sketch to a scale drawing of the "watershed" by transferring it to a piece of graphing paper (see Diagram A).

Diagram A

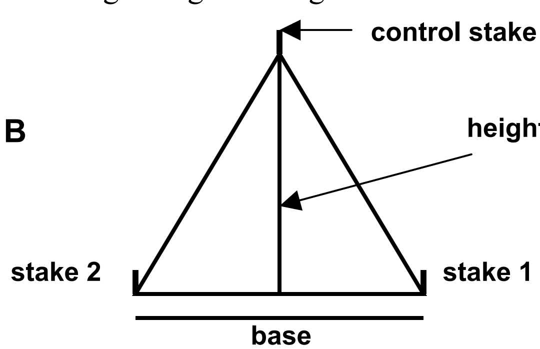


8. Have each team determine the area of the watershed, following these procedures (see Diagram B):
   - Determine the area of each triangle using the following formula

     ½ Base x Height = Area of a triangle (in square feet)

   - Repeat for each triangle.
   - Add the areas of all five triangles together to get the area of the watershed (in square feet).

Diagram B



9. Calculate the volume of **precipitation** (any form of water falling from the sky) that falls on the miniature watershed each year. You will need to know the annual precipitation in your area. Convert the amount to feet:

number of inches / 12 = number of feet

Multiply the annual precipitation by the area of the watershed to calculate the annual volume of precipitation.

Precipitation x Area = Volume of Precipitation (cubic feet)