Soil & Water

Piece Like a River

Science, Economics, Geography, Reading

Grade Level: 5-6

Time: 2 days

Standards:
Science
Economics
Geography
Reading

Materials

For class:
Two Puzzled Rivers cut into sections - use two long pieces of butcher paper and draw a river (squiggly lines) down the middle on either side
Computer/library access
String for "reconstructing" Puzzled River
Additional piece of butcher paper for bottle cap activity

Per group of 2 students:
Copy of instructions/handout for each student
Markers or colored pencils
Piece of Puzzled River

Overview

Students will develop their puzzle piece of a Puzzled River into any industry they want. Discussion will follow that focuses on what environmental impact their industry will have on the river. Students will read conservation information that informs them of possible solutions to problems. They will also complete and discuss the bottle cap activity, and then they will "redevelop" their puzzle piece to focus on conservation and water quality.

Objectives

1. Students will use information on industry to determine how to best utilize their piece of the river.
2. Students will discuss environmental footprints left by the industries represented in the classroom.
3. Students will determine what practices to use to best conserve and protect their piece of the river after it has been developed.
4. Students will write a newspaper article about their local piece of the river, including what industry was once located on the river, the impact that industry had on water quality and what measures were taken to conserve and protect their piece of the river.

Instant Expert

Exploring Kansas Natural Resources Educator's Guide. Unit 7 – Streams & Rivers (111-132). Kansas Foundation for Agriculture in the Classroom. *To order, visit www.ksagclassroom.org.*

Piece Like a River

Background Information

Though once considered part of the Great American Desert, there are 134,458 miles of streams and rivers in Kansas. Streams and rivers played an important role in the development of the United States and Kansas. In the absence of roads, early explorers and settlers followed streams and rivers. As the country expanded, rivers became the "highways" used to transport people and goods back and forth between the frontier and cities and towns.

Streams and rivers were also a source of fuel for industry for the settlers in Kansas. The power of water flowing in rivers and streams was used to operate gristmills (grain mills for local farmers), flour mills and sawmills. Hydroelectric power, where the forces of water are harnessed to produce electrical energy, started in the mid-1800's. The settlement of Kansas was also dependent upon the location and availability of water. Some of the earliest towns were located at the sites of river crossings or early ferries. Ferries, which transported people, animals, and goods from one side of the river to the other, were used in Kansas before bridges were built. At one time, there were at least 400 licensed ferries in the state of Kansas.

Everyone lives in a watershed, no matter where they live. A **watershed** is an area of land that drains towards a downhill point. That point can be a stream segment, a river, a pond, or a lake. Since gravity directs the movement of water, land with higher points of elevation separates watersheds. Water quality is a serious issue in all watersheds.

Humans have a huge impact on the environment because we are capable of altering the environment to meet our needs. These alternations tend to remove the filters that are naturally in place that protect our watersheds. **Erosion** is the process by which the surface of the earth is worn down by water, waves, wind, glaciers, etc. Even though this is a natural process, developments made to the surrounding land can increase the amount of erosion taking place and eventually cause the quality of the water in the watershed to decrease. Sediment (soil particles, rocks, pebbles, etc.) carried by moving water limits the amount of sun light penetration in the water and limits the amount of photosynthesis that aquatic plants can perform.

Human activities may add materials to surface water that affect its suitability for aquatic plants and animals or human uses. Some materials form a filmy or oily layer on the surface or cause a physical mess. Others are invisible, but may alter the chemistry of the water and stimulate excessive growth of some plants or algae, crowding out and reducing oxygen and nutrients available to other species. For example, phosphorus, which encourages plant growth, is used as fertilizer for agricultural crops, lawns, and gardens and is also found in many detergents. When overused or disposed of improperly, phosphorus will attach to soil particles and may eventually end up in surface water. There, excess phosphorus in the water can turn sandbars into weed patches, cover clean rocks with slime and moss, and turn clear water cloudy due to an over abundance of microscopic plant life. The added plant life can eventually rob the water of its oxygen supply, which – in worst cases – can suffocate fish and aquatic animals. Agricultural producers are addressing concerns over phosphorus and other fertilizers, herbicides, and pesticides through a variety of management practices designed to keep potential contaminants from reaching surface waters. However, per square foot of application, urban (non-agricultural)

applications of fertilizers, insecticides, and herbicides often exceed agricultural applications. This is a challenge that needs to be addressed by all of us.

Information adapted from Exploring Kansas Natural Resources Educator's Guide. Unit 7 – Streams & Rivers (111-132). Kansas Foundation for Agriculture in the Classroom. To order, visit www.ksagclassroom.org.

Preparation

Instruct students the day or week before lesson to each bring 2-5 bottle caps for the bottle cap activity.

Instructional Format

1. Share background information with students, and give each student a copy of the handout.
2. Students will follow procedures outlined in the handout, which will be followed by the bottle cap activity.
3. Upon completing the lesson, students will discuss the activity and write a newspaper article.

Procedures

Piece Like a River

1. Draw a river on both sides of a length of butcher paper. Be sure the paper is long enough that each group gets approximately an 18-20 inch piece to detail their industry. The river can be as simple as a few squiggly lines drawn down the middle, and it can be cut prior to class or during class, so that each student has a section of Puzzled River.
2. Tell the students they have been given an enormous amount of money to develop the land by Puzzled River or the river itself into whatever they wish. Lead the students in reading the **Conservation Information** given in their handout. Find pictures of each type of industry. Possibilities include milling, manufacturing, agriculture, utilities, water travel/recreation, etc.
3. Find the watersheds located in your county and have students determine what watershed they live in and where the school is located. Determine what body of water into which the runoff will flow.

   Go to http://cfpub.epa.gov/surf/locate/index.cfm.
   Step 1: Pick your geographic unit: select county name or city.
   Step 2: Enter geographic information: type in county/city and state.
   Push **Submit**.
   Watersheds on map are labeled with a numeric code that corresponds to the names under the map.
4. Have students draw what their industry would look like on the front of their section of Puzzled River. Make sure they are detailed in including where supplies will come into their facility and then back out (road, boats, etc.), a name of the business, how big their buildings will be, what the area surrounding their business looks like (trees, bushes, parking lots, fields, etc.), etc.
5. Have each group present their industry to the class. Each person in the group needs to present an equal amount of information (name of business, what surrounds business, what services they will provide, etc.).

6. Begin a discussion with the class about how each type of industry might affect the ecosystem of the river.
7. Have students turn over their section of Puzzled River. They should have a similar segment of river on this side as well. Instruct students to develop plans to conserve their section of Puzzled River and have them draw what effects those conservation techniques would have. They can either keep their industry in place with conservation techniques or remove their industry and draw what types of plants and animals that would be located near the river with clean water available.
8. To show results, students will write a newspaper article for the "Puzzled River Reviewer" to showcase what industry was developed and how it affected the water quality. In the article, they will discuss what conservation techniques were applied and how they improved the water quality and wildlife of Puzzled River.
9. To display activity, reconstruct each portion of Puzzled River by taping it along the strings and cuts. Make sure to have each copy (before conservation efforts and after) displayed. You can also (if allowed by district policies) display each group's newspaper article near their section of Puzzled River.

Bottle Cap Activity

This activity is optional if time is an issue, but it does get students thinking about and discussing pollution and how to prevent it.

1. Have student gather bottle caps.
2. Arrange students on the floor or in chairs in two lines facing each other.
3. Place a large sheet of butcher paper in between the lines of students. The crease needs to be in the shape of a "V" between the students. The lines of students need to be close enough so that each student can hold onto the paper.
4. Have the students "upstream" hold their section of paper higher than those down stream to create the natural slope that a river follows from higher elevation to lower elevation. Have students create a "current" by gently lifting the paper up and down so the bottle caps begin to "flow" downstream.
5. Have each student slowly add their bottle caps into the river until all bottle caps have been added.
6. Keep the current going until all/most of the bottle caps end up on the floor downstream.
   Comparisons from activity to real life:
   Bottle caps represent different types of pollution that are added to rivers.
   Bottle caps ended up on the floor (tub) in this activity, but would continue on to a lake, larger river, or ocean/sea.
7. Compare point source (has a definite, identifiable source) and nonpoint source (does not have a definite, identifiable source) pollution in streams and rivers.
8. Reiterate the point that even if students don't live near a river or stream, EVERYONE lives in a watershed area; therefore EVERYONE can work to improve water quality!

Conclusion Questions (Assessments)

Bottle Cap Activity

1. Who can identify their bottle cap?

2. Where would these bottle caps be if they were in a real river?

3. Pretend there is an unlimited supply of bottle caps that continue to get added to Puzzled River; how would the class go about stopping the pollution in the river? How would they identify where the pollution is coming from?

Resource

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Additional Resources

Kansas Forest Service. What is a watershed? http://www.kansasforests.org/riparian/what_is_watershed.shtml

Kansas Water Office. http://www.kwo.org/

Kansas Watershed Restoration and Protection Strategy (WRAPS). http://www.kswraps.org/

Natural Resources Conservation Service. Kansas watersheds – no matter where you live…you live in a watershed! http://www.ks.nrcs.usda.gov/technical/RWA/kansas_watersheds.html

State Conservation Commission. Welcome to the SCC. http://www.scc.ks.gov/

U.S. Environmental Protection Agency (EPA). Environmental kids club. http://www.epa.gov/kids/index.htm

U.S. Geological Survey. USGS real-time water data for Kansas. http://waterdata.usgs.gov/ks/nwis/rt

Want More? Extensions

Visit the websites listed in the Resources section of this lesson plan to learn more about conservation techniques.

Invite a local NRCS or conservation district employee come to present conservation efforts that have been utilized in your county/area.

To add technology, have students draw their section of Puzzled River on the computer. They can then save their section of the river and create a PowerPoint of the activity from beginning to end.

Want More? Extensions, continued

Have students develop a one page (front and back) newsletter (using Publisher, Word, WordPerfect, or other word processing software) about their section of Puzzled River. Have them include informative articles that describe conservation techniques in a watershed, cartoons, pictures of their section of the river, the information that would have been in the newspaper article, etc.

Name:

Piece Like a River
Activity Instructions

1. Draw a detailed image of what the industry you have chosen will look like on your section of Puzzled River. Be sure to include:
   - Name for your business
   - Where supplies will come into the facility and then back out (road, boats, etc.)
   - Buildings that need to be constructed
   - What the area surrounding the business looks like (trees, bushes, parking lots, fields, etc.)
   - How much water your industry will use on average
   - Any water regulations that may be in place for your industry.

2. Follow teacher's instructions on presenting your section of the river to the class.

3. Read **Conservation Information** handout.

4. Follow teacher's instructions to complete activity.

5. Write a newspaper article for the *Puzzled River Reviewer* to showcase what industry was developed and how it affected the water quality. All newspaper articles need to have a title. Then discuss what conservation technique was applied and how it improved the water quality and wildlife of Puzzled River.

Piece Like a River

Since European settlement the landscape of Kansas has changed dramatically. Although erosion is a natural process, the development of land for agriculture, housing, and industry has increased the amount of erosion taking place areas. **Erosion** is the process by which the surface of the earth is worn down by water, waves, wind, glaciers, etc. **Streambank erosion** happens when the support system, such as tree roots and grasses, along the side of the stream has been disrupted and the stream carries large amounts of sediment (dirt, debris, pebbles, rocks, etc.). Large eroded streambanks can contribute more than 50,000 tons of sediment to a stream or river each year. That is enough soil to fill an area 10 feet high, 20 feet wide, and almost one mile long! Sediment is typically not considered a human health hazard, however it can lead to undesirable water conditions by clouding the water and reducing the amount of light that can penetrate the surface of the water. This reduces photosynthesis for plant growth which affects organisms that feed on those plants which, in turn, affects the entire food chain. Conservation practices can improve water quality by reducing the amount of sediment in streams, rivers, and other bodies of water. Anything that slows the water will cause particles to settle.

There are many different practices used to conserve watersheds. **Streambank stabilization** is the slowing or stopping of erosion along a streambank. This may include installing rock structures such as bendway weirs or rock vanes, which are low rock structures designed to slow the speed of the water and redirect the water flow away from the streambank. This allows riparian areas, which are areas of streamside vegetation including plants and trees, to become established. Erosion may be so extreme in some areas that the streambank is vertical. In these situations, the streambank may be re-shaped to provide a sloped surface for planting a mixture of appropriate grasses and trees. Approval from one or more government agencies must be received before beginning any streambank stabilization or restoration project.

Other conservation practices widely used are **riparian forest buffers** and **grass filter strips**. These areas are planted to grass or other permanent vegetation along the streambank. They range in width from 30-120 feet from the streambank and run the entire length of the property. The width is determined by how much water needs to be filtered, owner's concerns, and uses of the property. Riparian forest buffers and grass filter strips trap sediments (both mineral and organic), absorb and transform potential pollutants (fertilizers, herbicides, or other types of chemicals) into nontoxic compounds, and provide food and habitat for wildlife. They may also create corridors for wildlife movement and may recharge groundwater supplies.

Improved farming practices have also enhanced water quality in a watershed. **Terraces** are raised earth embankments constructed across a slope that follows the contour of the land. A shallow channel on the uphill side of the terrace is designed to capture water and slow it down, while the terrace redirects the water into slower moving channels such as grassed waterways or outlets. Another agricultural practice that was developed for conservation purposes is **contour farming**. When a field is farmed on the contour, all the tillage and planting operations go around or back and forth across the slope of the land. The furrows wrap gently around the slope and each acts as a small dam, preventing water from running wildly down the slopes. Farming on the contour can reduce soil and water losses by as much as 50 percent.

Piece Like a River

Another agricultural practice used by farmers is **no-till farming** (also called zero tillage). In no-till farming, farmers plant their crops on a rotational basis without disturbing the land with tillage equipment. During the planting process, less than 10 percent of the soil surface and existing crop residue are disturbed. No-till farming increases the amount of organic matter left in the soil, improves the water holding ability of soils, minimizes soil and nutrient losses, improves soil fertility, reduces water losses due to evaporation and decreases soil erosion significantly. By not disturbing the soil with each planting, soil microbes, arthropods and earthworms become more numerous and improve soil stability, aeration, fertility and water infiltration.

Industrial parks and development areas also implement conservation techniques that improve water quality. Special **pavers** in parking lots allow water to be absorbed into the soil beneath it, rather than run off. These are a significant improvement from solid pavement which causes water to run off at excessive speeds. Water runoff that travels at excessive speeds can pick up many pollutants that will end up in our watersheds. The use of **fabric barriers** at building sites is another conservation technique. These fabric barriers slow down water run-off over soils that have been disturbed which decreases the amount of possible contaminates poured into our watersheds.

Many diverse organisms play an important role in a stream's ecosystem. These organisms include plants, animals, fish, insects, and macroinvertebrates. Rivers serve as a water source, hunting grounds, shelter, habitat and a variety of other purposes for these organisms. All streams and rivers have a beginning and an end but the water in those streams and rivers never reaches a final destination. It only changes form as it is recycled through the water cycle.