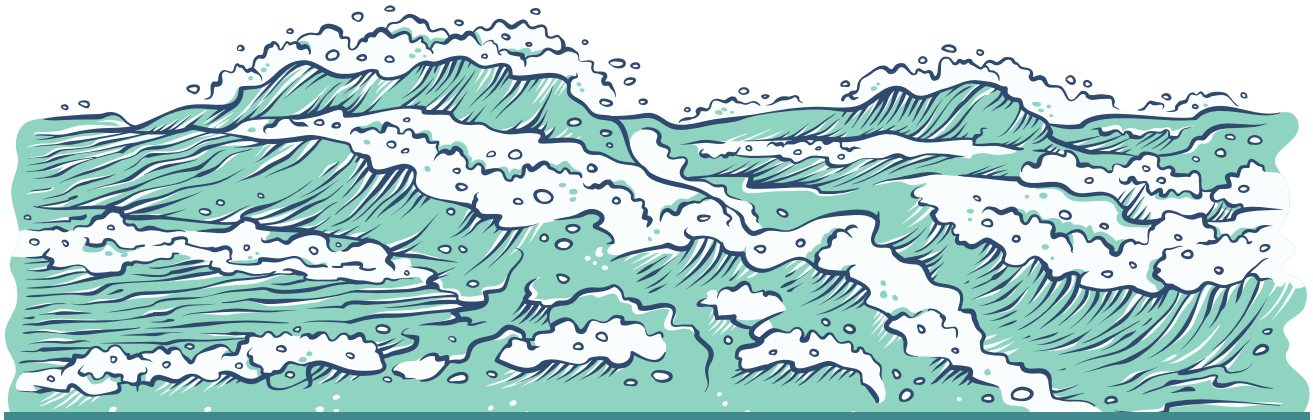


Stewards of the Sea

CONNECTING TO WATERSHEDS

Grades: 3-5

Background: The water cycle connects all the water on Earth and watersheds connect our local water to the ocean. Unless the ocean is a daily presence for students it might feel really distant. But every person on Earth lives in a watershed and every watershed connects to the ocean.

Objective: Through this 3-lesson mini-unit, students will understand watersheds, human impact on watersheds, and ways watersheds can be protected and conserved.

Sources: Geography: Teaching With The Stars, a project of The Gilbert M. Grosvenor Center for Geographic Education at Texas State University.

Connecting Classrooms and Communities through Watersheds

Teacher Author: Jeremy (JD) Stumpf, Lehman High School, Kyle Texas

UNIT DESCRIPTION

This unit includes three 50-minute classes focused on water-sheds. For background readings on watersheds, go the Geography: Teaching with the Stars web site at http://geoteach.org and click on the Teacher Resources page.

The purpose of this unit is to help students understand watersheds, human impact on water-sheds, and ways watersheds can be protected and conserved.

LEARNING OBJECTIVES

- Student will define watersheds.
- Students will identify land use activities within watersheds and describe the impact of human activities on watersheds.
- Student will define and give examples of non-point source and point source pollution that affects watersheds.

NATIONAL STANDARDS

National Science Standards
Strand 4: Earth and Space Science
Strand 6: Science in Personal and Social Perspectives

National environmental education standards
Strand 1: Questioning, Analysis and Interpretation (A, E, F, G)
Strand 2.1: Earth as a Physical System
Strand 2.4: Environment and Society
Strand 3.1: Analyzing and Investigating Environmental Issues
Strand 3.2: Decision-making and Citizenship Skills
Strand 4: Personal and Civic Responsibility

National Geography standards
Standard 1: How to Use Maps and Other Geographic Representations, Tools, and Technologies to Acquire, Process, and Report Information From a Spatial Perspective.
Standard 4:Physical and Human Characteristics of Places.
Standard 7:Physical Processes at Shape the Patterns of Earth's Surface.
Standard 14: How Human Actions Modify the Physical Environment.

ADVANCE PREPARATION

- Contact your local agricultural extension agent, parks and recreation department, river authority, or environmental department to identify resources on watersheds that can be used in this unit. You will need to arrange for a watershed clean up well in advance, if you choose to incorporate a service-learning activity in your unit.
- **Lesson One**
    - Use index cards to create two sets of watershed definition cards. One set uses the words—area, land, body, water, receives, runoff—with each word written on a separate card. The other set uses the words—land, drained, drops, precipitation, joins, others, particular, river, lake, stream, wetland—with each card written on a separate card.
    - Set up Google Earth for use in plotting students' home locations in the local watershed. Here is a web site that can help you with this activity:
    - Explore Your Watershed in Google Earth: http://serc.carleton.edu/eslabs/drought/2b.html (Retrieved 04.21.22). As an alternative, use large scale maps of the local watershed with pins or sticky notes to identify students' homes.)
    - Optional: Download video from Weather Channel on "What is a Water-shed?" (from YouTube at: http://www.youtube.com/watch?v=xUYWb8XTo58)
- **Lesson Two**
    - Create six stations around the classroom, one for each of the water quality fac-tors examined in the lesson. Label the stations 2 to 7. Place a different water quality factor information sheet (pages 8 to 13) at each station
    - You might want to use a deck of playing cards to create groups in the jigsaw activity in this lesson. (More detail in the lesson plan.)
      Lesson two: 3-4 marker boards (or large sheets of blank paper) and dry-erase markers
    - Make a copy of the Watershed Factors Checklist for each student (Page 14)
- **Lesson three:** This lesson calls for the use of a watershed model. Many agencies (for exam-ple, county agricultural extension offices) have these models and are willing to come to schools to demonstrate them. An alternative would be to demonstrate the model yourself or have students create these model watersheds themselves using this resource: http://serc.carleton.edu/eslabs/drought/2a.html (Retrieved 04.21.22)

Lesson One:
What is a Watershed?

OPENING THE LESSON

- Begin the class by asking student "What does *shed* mean?" *Many students will define "shed" as a small building.*
- Indicate that *shed* has other meanings. Give examples that illustrate the concept of shed as it is used in this unit, such as, someone taking off rain-soaked clothing, water dripping from a duck's back, a snake shedding its skin, or a dog shaking water out of its fur. Ask what else shed can mean, besides a small building, based on these examples.
- Encourage students to think of *shed* as also meaning "run off a surface," "to get rid of," or "spill".
- Then connect the idea of shed to the concept of *watershed*. On a chalk or poster board, write out the following statements leaving blank spots as indicated:
  Definition A: A watershed is a(n) _____ of _____ surrounding a _____ of _____ that _____ the _____. Definition B: A watershed is the _____ area that is _____ when _____ of rain or _____ _____ _____ to _____ to a _____, _____, _____, _____, or _____.
- Divide students into two groups. Indicate that they are going to work in groups to create a definition o the word watershed. Hand the first group a set of index cards, in no particular order, with a single word on each card: area, land, body, water, receives, runoff. Hand the second group a set of cards, in no particular order, with a single word on each card: land, drained, drops, precipitation, joins, others, flow, particular, river, lake, stream, wetland.

o Have the members in the first group work individually or in pairs to write/place their words in the correct location in Definition A and have the second group write/place their words into the correct slots in Definition B. Correct responses:

  - An *area* of *land* surrounding a *body* of *water* that *receives* the *runoff*.
  - The *land area* that is drained when drops of rain or precipitation joins others to flow to a particular, river, lake, stream, or wetland.

- Have students develop their own definitions of watersheds, based on this activity. Ask for volunteers to share their definitions with the class.
- **Optional**: This would be a good time to show the video "What is a Watershed?" from the Weather Channel.

DEVELOPING THE LESSON

- Ask students: What percentage of the class, do you think, lives in the local watershed, surrounding the school? Answers will vary. Indicate that this activity will help answer this question.
- Show a large scale (detailed) map of the watershed around the school and ask students to identify their homes, school, roadways, and local businesses on the map. Insert place markers (for example, sticky notes or pins) for their homes and the school. Describe the proximity of student homes to streams, creeks, and parks within the watershed, as they identify the locations of their homes.
- When all students' homes are plotted on the map, ask students to make observations about the percentage of those homes that appear in the local watershed. Ask for volunteers to share their observations. They will note that most of the homes are located within the local watershed surrounding the school. Point out that even those homes not in the local water-shed are in a watershed. *Note: If using Google Earth, zoom out to allow students to see all place marks that are within and outside of the local watershed boundaries.*

CLOSING THE LESSON

Indicate to students that the next lesson will focus on how human activities affect watersheds. Remind students that, as this lesson illustrates, everyone lives in a watershed. In fact, all human activities take place within watersheds. Then, to end the lesson, ask students how they think humans affect watersheds. Possible responses: littering, releasing chemicals or oil from cars through runoff, animal feces, using drinking water, building homes, building busiesses, using water from creeks.

Lesson Two

How do Humans Affect the Watershed?

1. Review with students the definition of a watershed they learned in Lesson One.
2. Indicate that this lesson will explore how human activities affect the quality and health of watersheds.
3. Begin this activity by dividing students into three or four groups, with six members in each group. Indicate that these groups are referred to as “Home Groups.” Then state that, later in the activity, each member of a Home Group will join one of six different “Study Groups.” Note: An efficient and equitable way to divide students into Home Groups and Study Groups is to use a deck of cards. For a class of 18 students, use the 2, 3, 4, 5, 6, and 7 cards of the hearts, clubs, and diamonds suits. Use the suits to designate the Home Group (3 groups of 6). Use the number cards to designate the Study Groups (6 groups of 3). Add the spades suit and six more number cards (2 to 7) for a class of 24 (this creates another Home Group and also results in a fourth member of each Study Group).
4. Have students form their Home Groups, based on the suits of their playing cards. Provide each group with a marker board (or large sheet of blank paper) and a marker. Distribute a copy of the Watershed Factors Checklist to each student. Encourage students to keep track of their work in this activity on their handouts.
5. Ask each group to divide their board into four columns. In the first column have them list six “Water Quality Factors”: Construction, Industrial Pollution, Urban Runoff, Residential Runoff, Wastewater Treatment Plants, and Agriculture. Ask them to label the second column “Pre-Ranking”, the third column “Final Ranking”, and the fourth column “Point or Non-Point Pollution Source.”
6. Ask each Home Group to use the Pre-Ranking column to rate each of the water quality fac-tors on a scale from 1 to 5, with one being the LEAST harmful to watersheds, and 5 being the MOST harmful to watersheds. Encourage group members to use what they currently know about the quality factors in making the rankings. Indicate that more than one quality factor can be rated as 3, 5, etc.
7. When the groups have completed their pre-rankings, introduce students to the six stations around the classroom, which should be identified as Stations 2 to 7 to reflect their playing card numbers. Have them set their marker boards aside and form Study Groups, using their card numbers to find their stations.
8. At each station, have students examine the information provided, determine whether the quality factor they are examining is a point or non-point source of pollution, and note something interesting and important about their factor that the Home Group needs to know about.

9. When the Study Groups have finished their analysis of the water quality factors, have them return to their Home Groups. Ask each member of the Home Group to share what was learned about the water quality factor they examined at the stations.

10. Then ask Study Groups to give a final ranking to the water quality factors, in the third column of their marker boards, based on what was learned at the stations. Also, have them indicate on their boards whether the factor is a point source or a non-point source of pollution. Indicate that each group should be able to explain its final rankings and changes in rankings.

CLOSING THE LESSON

11. To end this lesson, invite one member of each Home Group to share with the class the group's final rankings and to describe how and why their rankings of water quality sources changed or stayed the same as the result of what they learned at the stations. Also have each group indicate whether each factor was an example of point source or non-point source pollution and how that affected their ranking of that factor.

Water Quality Factors

Cities and Towns

Cities and towns contribute nonpoint source pollutants. This is sometimes called "urban runoff." Most street drains flow through pipes directly into streams or lakes—rainwater (storm water) is NOT treated!

Common pollutants found in urban runoff are:

- sediments from bare soils
- bacteria from wastes
- nutrients from fertilizers
- oil from parking lots
- gasoline
- metals
- antifreeze and grease
- pesticides
- trash, including dog feces

Impervious cover refers to parts of the landscape that cannot absorb water the way soil and vegetation do. Concrete, asphalt roads, and rooftops all create impervious cover. They increase the flow of water to streams, lakes and rivers.

Illegal dumping of trash along roads pollutes runoff.

Accidents and spills along highways and roads may be infrequent but can cause concentrated pollutants to enter the watershed in a short amount of time.

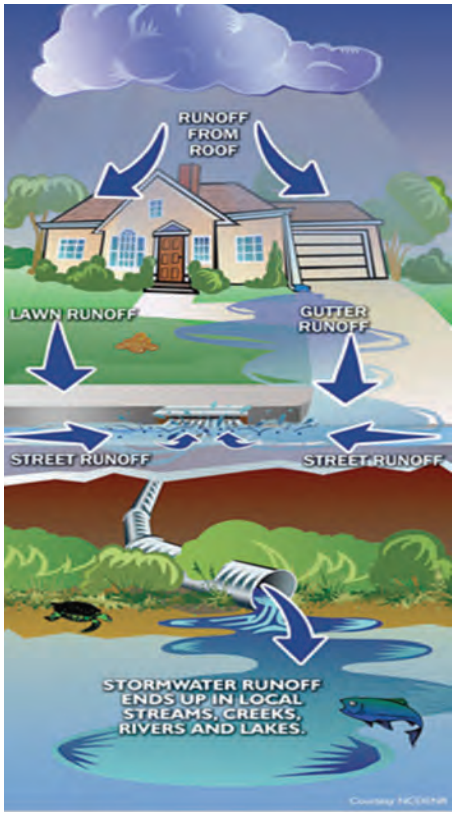
Non-point source pollution sites are much harder to discover and trace. This makes them harder to regulate and monitor.

Non-point source pollution is corrected by:

- preventing the pollution in the first place
- keeping the pollutants from reaching streams and rivers

Water Quality Factors

Residential Runoff



Impervious cover means parts of the landscape that cannot absorb water as well as soil and vegetation. Concrete, asphalt, and rooftops all create impervious cover. They increase the flow of water to streams, lakes and rivers.

Non-point source pollution sites are much harder to discover and trace. This makes them harder to regulate and monitor.

Non-point source pollution is corrected by:

- preventing the pollution in the first place
- keeping the pollutants from reaching streams and rivers.

Subdivisions and residential areas contribute nonpoint source pollutants. This is sometimes called "residential runoff." This runoff is NOT treated and goes through sewers directly into streams, rivers, and lakes. Common pollutants found in residential runoff are:

- lawn fertilizers
- sediments
- bacteria from pet wastes
- oil drained from cars
- septic tank overflows
- gasoline
- detergents used to wash cars
- antifreeze and grease
- pesticides
- trash

Water Quality Factors
Industrial Pollution

Industrial pollution sites are often thought of when people think of pollution. Industrial facilities are considered point sources of pollution. They can contribute numerous types of toxic substances, chemicals and products (depending on the type of industry).

Oil and gas facilities can be sources of pollution if they leak these products into the groundwater.

Effects of industrial pollution can include:

- color changes
- excessive algae
- odors
- absence of aquatic life
- fish kills
- elevated BOD (Biological Oxygen Demand)
- sewage fungus

The United States Environmental Protection Agency (EPA) and state environmental quality agencies are responsible for regulating point source pollution and how to treat it.

Point source pollution is relatively easy to find and trace—all you do is find the pipe. It is usually corrected by removing the pollution from the water before it leaves the pipe.

Water Quality Factors

Wastewater Treatment Plants

Municipal wastewater treatment plants are considered point sources of pollution. These facilities can release:

- nutrients
- bacteria
- sediments

The effects of these pollutants include:

- excess algae (algal blooms)
- white foam
- sludge deposits (brown or gray solids)
- absence of fish and insects
- variable DO levels
- high BOD
- sewage fungus

The United States Environmental Protection Agency (EPA) and the state environmental quality agencies are responsible for regulating point source pollution and how to treat it.

Point source pollution is relatively easy to find and trace—all you do is find the pipe. It is usually corrected by removing the pollution from the water before it leaves the pipe.

Water Quality Factors
Construction

Construction sites are considered non-point sources of pollution. These sources are hard to detect. These areas can cause high levels of sediments to reach waterways, as well as nutrients from fertilizers applied to new lawns and landscaping.

Sediments such as soil, clay and silt are a problem. They settle on aquatic plants and reduce the sunlight they can absorb. This reduces photosynthesis, which in turn reduces the oxygen available to animal life.

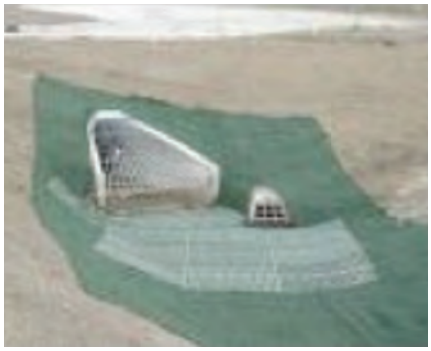
Sediments can cover nesting sites as well. They cause water to turn brown and muddy, and they increase turbidity.

Constructions workers are required by law to install erosion control devices and equipment. These include black cloth fencing to slow sediment, and sand bags and barriers in storm drains to slow runoff.

Non-point source pollution sites are much harder to discover and trace. This makes them harder to regulate and monitor.

Non-point source pollution is corrected by:

- preventing the pollution in the first place,
- keeping the pollutants from reaching streams and rivers.



Water Quality Factors
Agriculture

Crops, feedlots, and pastures can degrade water quality and are considered non-point source pollution sites. They come from many sources that are hard to detect. These sites can be a source of runoff that includes:

- fertilizers from crops
- sediments eroding from bare soils
- elevated bacteria from animal wastes
- ammonia
- pesticides, insecticides and herbicides

Livestock can overgraze, creating very short grass. This holds back less runoff than longer grasses.

Non-point source pollution sites are much harder to discover and trace. This makes them harder to regulate and monitor.

Non-point pollution is corrected by:

- preventing the pollution in the first place
- keeping the pollutants from reaching streams and rivers

Watershed Factors Checklist

Water Quality Factor	Your Home Group's Pre-Ranking	Non-point Source?/Point Source?	Your Home Group's Final Ranking	Justification/ Reasoning/ Support
Cities & Towns				
Wastewater Treatment Plants				
Residential Runoff				
Industrial Pollution				
Construction				
Agriculture				

Lesson Three

Watershed Model and Demonstration

Opening the Lesson

1. Begin by reviewing the previous days' lessons. Ask students if they have any questions about what they have learned so far in this unit.
2. Indicate that in this lesson students will be working with a guest speaker who will use a model of a watershed to further examine the interaction between human activities and the watershed.
3. Introduce the guest speaker, if applicable
4. Have the guest speaker talk generally to students about the local watershed, including, for example, the location and boundaries of the watershed, factors affecting the watershed, and agencies/laws that monitor water quality.

Developing the Lesson

5. Have the students gather around the watershed model.
6. Using the watershed model, have the guest speaker demonstrate the flow of water and pollu-tants through a watershed. The watershed model allows the guest speaker to demonstrate the flow of water from higher elevation to lower elevations and the flow of pollutants and sediments. It enables students to see the movement of water through subwatersheds within a larger watershed, pollution throughout the watershed, the impact of point and non-point source pollution, and how events that occur in one part of the watershed can affect what happens downstream.
7. Encourage students to ask questions about what they are seeing. It is important to get students actively involved in the watershed model demonstration. You may need to model question asking for them.

Closing the Lesson

8. When the watershed demonstration is completed, end the lesson by asking questions such as:
   a. Where does our drinking water come from?
   b. How can human activities affect the quality of that water?
   c. How does soil erosion contribute to water pollution?
   d. How can human activities upstream in a watershed affect water quality downstream?
   e. What type of pollution is more difficult to control—point source or non-point source pollution? Why?