

Water Education For All

Lesson: Watersheds and Pollution

Elementary School

Time: 3 hours

Objectives:

- Define, watershed
- Describe how urban runoff happens and how it impacts a watershed
- Use evidence to make a claim about the biggest threat to their own watershed
- Design and communicate solutions to pollution

Summary: In this lesson, students learn how different types of pollution move through watersheds to reach the ocean. They explore the impacts of pollution on their environment by analyzing real water quality data. At the end of the lesson, they use creative projects to share solutions with their community.

Standards alignment:

NGSS Standards: K-2

Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. K-ESS3-3

ESS2.A: Earth Materials and Systems. Wind and water can change the shape of the land.

ESS2.C: The Roles of Water in Earth's Surface Processes. Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.

ESS3.A: Natural Resources. Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.

ESS3.C: Human Impacts on Earth Systems. Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.

NGSS Standards: 3-5

Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. 3-LS4-4

Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. 4-ESS3-2

Develop a model using an example to describe ways the geosphere, biosphere,

hydrosphere, and/or atmosphere interact. 5-ESS2-1

Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. 5-ESS3-1

ESS2.A: Earth Materials and Systems. Water helps to shape the land and affects the types of living things found in a region. Earth's major systems are the geosphere, the hydrosphere, the atmosphere, and the biosphere. These systems interact in multiple ways to affect Earth's surface materials and processes.

ESS2.C: The Roles of Water in Earth's Surface Processes. Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

ESS3.C: Human Impacts on Earth Systems. Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.

Science Words:

Pollution
Urban runoff
Storm drain

Water cycle
Water quality

Watershed
Wetland

Materials

- Paint tray liner or aluminum foil pan
- Cardboard
- Sponges
- Fake vegetation
- Toy cars, houses, people, animals
- Food coloring
- Shredded paper
- Spray bottle

ENGAGE

Background information:

A **watershed** is an area of land where all water drains into one place. The natural geographic features of watersheds-- like mountains, hills, and valleys-- act as natural funnels that direct rain downhill. These natural features also act as the boundaries of watersheds. Watersheds don't care about human boundaries like cities, counties, neighborhoods, or even countries; the only boundaries they care about are natural landforms. A great example is the Tijuana Watershed, which spans the U.S.-Mexico border and connects San Diego to our neighbors in Tijuana.

Everyone on earth lives in a watershed! Some watersheds drain directly to the ocean, like many of the watersheds in San Diego. Some watersheds may drain to different places first-- like a lake or river-- but they are all connected to the ocean.

1. Ask students to think-pair-share using the question: What is a watershed?
 - a. THINK: What is a watershed? Does this word remind you of anything? Take a moment to think to yourself about what this means.
 - b. PAIR: Partner with the person next to you. Discuss what you think a watershed is. Were your ideas the same or different?
 - c. SHARE: Share your or your partner's ideas with the class. What do you think a watershed is?
2. Define watershed: A watershed is an area of land where all water drains into one place.
 - a. Ask if the definition is a surprise. Did anyone think it was a shed full of water? While this is a common idea, it is actually pretty different!
3. Display the watershed picture (Figure 1). Work with students to identify key aspects of the watershed.
 - a. Where does the water come from? (The clouds, in the form of rain.)
 - b. Where are the sides of the watershed? (The mountains and hills naturally form the sides of the watershed. They act like the sides of a funnel, directing the water towards the end of the watershed.)
 - c. What is higher in elevation: the beginning or end of a watershed? (Watersheds start in areas of higher elevation, like mountains, and end in areas of lower elevation, like a lake or ocean. This means the water travels down as it goes through the watershed.)
 - d. Where does the watershed drain?
 - e. Do you live in a watershed? Why or why not?
4. Tell students that everyone in the world lives in a watershed.

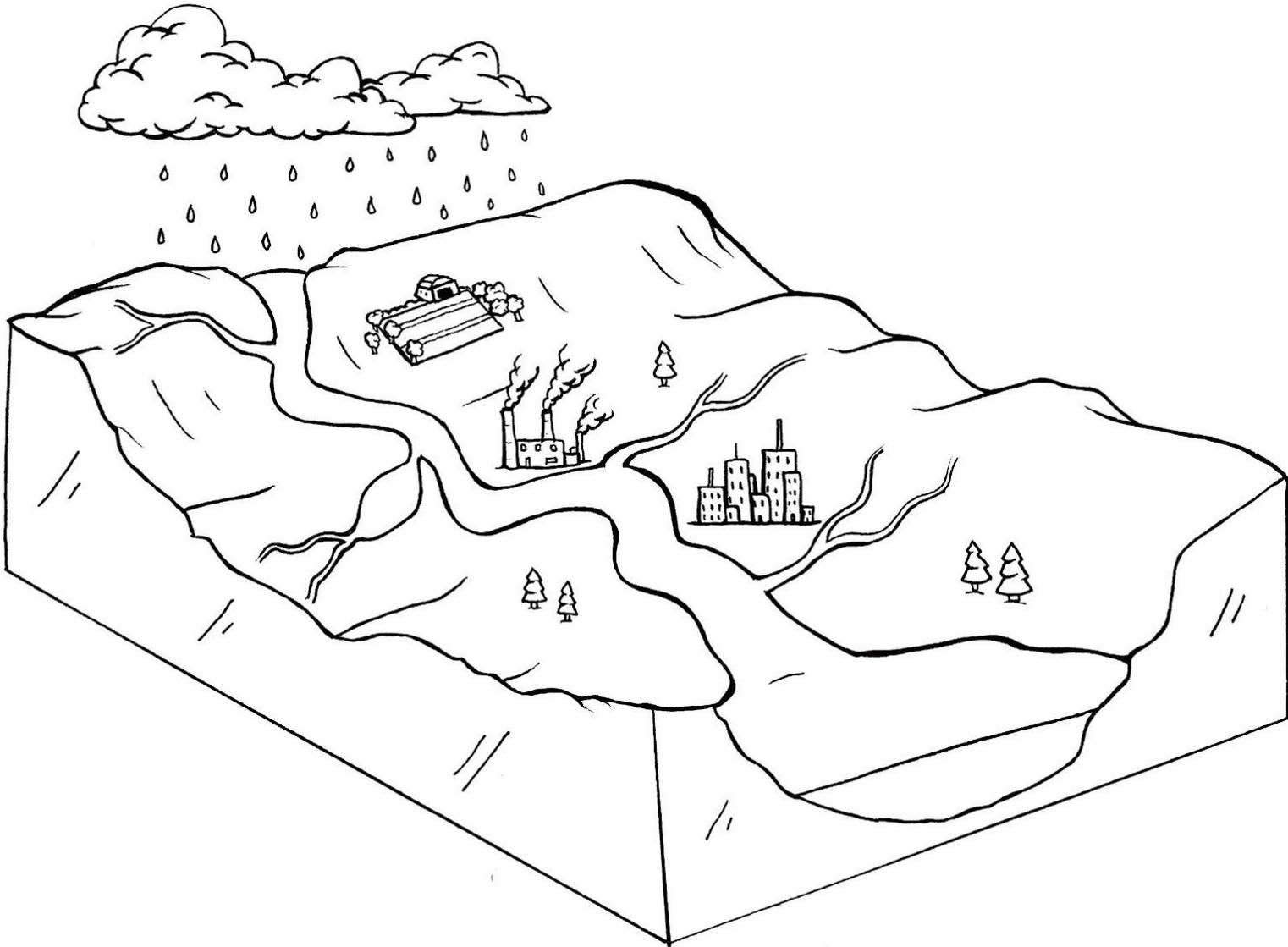


Figure 1. Illustration of a watershed. Source: San Diego Coastkeeper education intern Jack Kelly (2017).

EXPLORE

Activity: Modeling Pollution

Materials:

- Paint tray liner or aluminum foil pan
- Cardboard
- Fake vegetation
- Toy cars, houses, people, and/or animals
- Food coloring
- Shredded paper or sprinkles
- Spray bottle

Preparing materials:

1. Gather all materials. There should be one set of materials (listed above) for each group of 3-5 students. Before conducting the activity with your class, set up a central “materials station” for groups to gather materials.

Directions:

1. Tell students that they will be building their own watersheds. They will use the watersheds to see what happens to the rain and what happens when people pollute their watershed.
2. Distribute materials.
3. The paint tray or aluminum foil pan will represent the watershed for this activity.
 - a. Ask: “Where do watersheds start?” (*In the mountains or areas of higher elevation.*)
 - b. Instruct students to tape their mountains into one side of their base. If using a paint tray, use the shorter side of the paint tray that is parallel to the deeper basin.
4. Now that the basic watershed is set up, it’s time to add features.
 - a. Create the “natural” parts with fake trees or green felt to represent grass.
 - b. Use toy houses, cars, buildings, people, and animals to represent human influences on the watershed. Put these anywhere on the “land” part of the watersheds.
5. First, watch when it happens when it rains without any pollution. One person will start spritzing the spray bottle at the top of the watershed to represent rain.
 - a. As it starts to “rain,” observe where the water goes. Allow time for them to make observations within their groups.
6. Share observations. Ask students: What did you notice? Where did the water go?
7. Ask students to think about the question: What is pollution?
8. Once they’ve thought about the question for a minute, have them pair up with the person sitting next to them to discuss their ideas. Give them 2 minutes to share their ideas with each other.

9. Ask the class what ideas they or their partner discussed. Facilitate a conversation about pollution, including examples.
10. Now, they will see what happens when pollution is added into this watershed. Show students the solid and liquid pollution.
 - a. Liquid pollution: car oil, gasoline, and lawn chemicals. Different colors of food coloring can serve as the different types (red as car oil, green as fertilizer or pesticides, etc).
 - b. Solid pollution: trash and pet waste that wasn't cleaned up. Represented by sprinkles and/or shredded paper.
 - c. Ask the groups to predict what will happen when it rains. Where will the pollution go?
11. Once both kinds of pollution are on the models, they can spray the rest of their spray bottles to simulate rain.
12. Make and share observations. Explain that the process they just modeled is called urban runoff. Some guiding questions for discussion include:
 - a. Where did the solid pollution go? The liquids?
 - b. Which moved easier-- the food dye or the sprinkles? Do you think that liquid or solid pollution moves easier in real life?
 - c. How could these types of pollution impact the water quality downstream? What effects could it have on the aquatic ecosystem?
 - d. Do you have ideas on how we could prevent urban runoff?
13. When cleaning up, the water in the models (including food coloring and sprinkles) can be safely dumped down the drain. Use a strainer to remove the shredded paper from the waste water before pouring down the drain. Most of the materials to decorate the watershed can be rinsed, dried, and re-used for future watershed models.

EXPLAIN

Activity: How Healthy Is Your Watershed?

Water quality is measured by tests that tell us if a body of water is healthy or polluted. The data in the tables below is from San Diego Coastkeeper's Water Quality Monitoring Program. The volunteers in this program were trained to collect and test samples of water from over 30 local creeks. The samples were taken once a month for 10 years. Each year, our staff scientist used the data to calculate a water quality score. The score shows how healthy or polluted the watershed was that year.

Use the water quality scores below to research how "healthy" their watershed was that year.

Table 1. San Diego County watershed quality scores in 2016. Source: San Diego Coastkeeper.

Watershed	Average Score	Water Quality
Los Penasquitos	81	Good
San Diego	81	Good
San Luis Rey	79	Fair
San Dieguito	72	Fair
Carlsbad	64	Marginal
Sweetwater	64	Marginal
Pueblo	59	Marginal
Otay	49	Marginal
Tijuana	14	Poor

Students will conduct research to find out the biggest threat to their watershed. They can use the [2016 San Diego Coastkeeper water quality report](#) to learn more about the types of pollution in each watershed. Students can present this information to the class or write a research report. They should explain what they learned using the following questions:

- How healthy is your watershed?
- What was the worst type of pollution in your watershed? Where does it come from (factories, homes, etc)?
- What problems does pollution cause in your watershed? How are people, plants, and animals affected?
- What could people do to help their watershed?

ELABORATE

Activity: Solutions to Pollution

When teaching about the environment, it is more important to leave students with a message of action rather than simply facts. The main takeaway from this lesson is that kids can help prevent pollution.

What can you do to keep the watershed clean? Students may answer this question in a variety of ways-- with a picture, a short writing prompt, or with a creative project.

Some ideas are listed below, but be sure to encourage students to think of their own ideas in groups or on their own before sharing any answers with them. If they are stumped, refer them

back to the pollutants from their watershed models and ask how they could stop those pollutants before the rain can wash them away. Choose one (or more!) of the options below to get students thinking about how they can make a difference.

- Research ways to prevent urban runoff. Create a poster or drawing to show how people can help.
- Create an educational campaign at your school. Hang posters or present to classmates about the biggest threats to your watershed and ways they can prevent pollution.
- Create a volunteer “litter patrol.” Students can volunteer to clean up litter during a few minutes of their lunch or recess.
- Get creative! Make a YouTube video, social media campaign, art piece, blog, infographic or brochure that highlights ways to reduce pollution.

Box 1. Solutions to pollution: How kids can help keep our water clean!

1. Don't throw your trash on the streets! When lawn sprinklers are on, when it rains, or when it's windy, the trash can travel through the watershed and into the oceans. Once it gets to the ocean, it can hurt wildlife and people swimming there.
2. Clean up after your pet so that pet waste doesn't run off into the ocean.
3. Wash your car in a car wash. If you have to wash it in your house, make sure the soap and dirty water gets in the lawn, not into the street/the storm drain. Also, remember to conserve water using a water bucket, not a hose.
4. If you see litter, throw it out-- as long as it is safe, try to clean up and leave things better than you found it! Even if it's not your trash, picking it up helps the environment, plants, and animals.
5. Make less trash by using reusable items. The less trash we make, the less trash will get outside and into our environment. Some good reusable items to switch to at home or school include: lunchboxes, grocery bags, glass food containers, snack bags, travel forks/knives/spoons/chopsticks instead of disposable, water bottles, straws, and coffee/tea tumblers.
6. Plan or attend a cleanup- San Diego Coastkeeper hosts monthly beach cleanups in conjunction with Surfrider San Diego. San Diego Coastkeeper also has resources on how to rent a free “beach cleanup in a box” for students to host their own schoolyard cleanup!

EVALUATE

Evaluate students on the pollution prevention projects from the previous activity.

Glossary

Pollution- the introduction of harmful materials into the environment (National Geographic, 2011).

Storm drain- a drain built to carry water from the streets to water bodies such as rivers, creeks, and/or the ocean.

Urban runoff- the water that flows through cities and into bodies of rivers, creeks, and/or the ocean.

Water cycle- the continuous movement of water through the earth, atmosphere, and oceans as it changes states of matter.

Water quality- measures how clean or dirty a given sample of water is; “a measure of the suitability of water for a particular use based on selected physical, chemical, and biological characteristics” (USGS, n.d.).

Watershed- An area of land that channels rain and melting snow to creeks, streams, and rivers, and eventually drains to the ocean (National Ocean Service, 2020).

Wetland- an ecosystem that is partially or fully flooded with water.

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