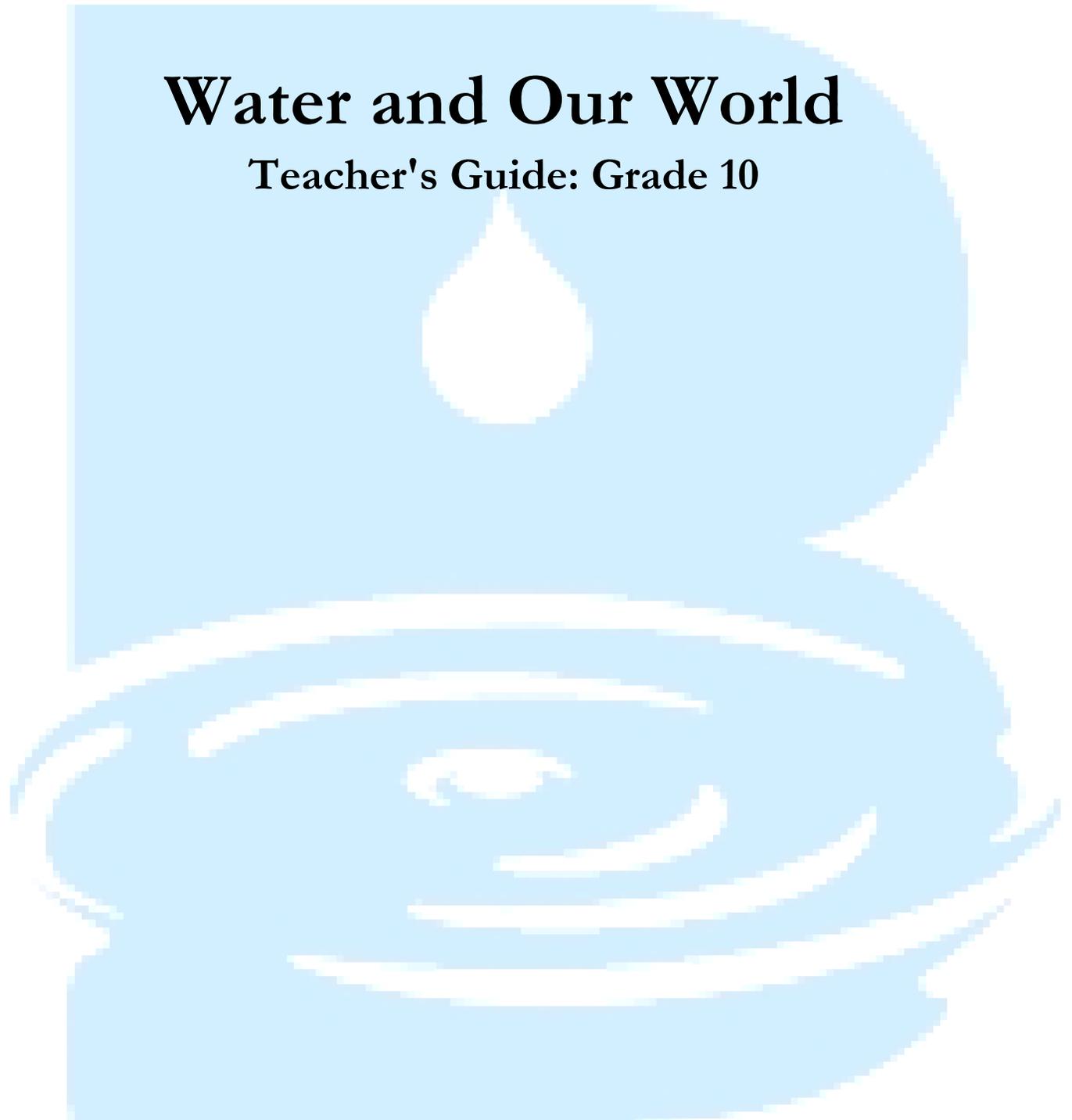


Water and Our World

Teacher's Guide: Grade 10



Beaver **Water** District

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Lesson 4: Building a Watershed Model

Purpose

Students can use an inquiry or guided lesson to learn what a watershed is and how it affects the surrounding environment.

Objective

- Students will learn to design an experiment.
 - Students will learn about watersheds.
 - Students will learn how urban and agricultural point and nonpoint pollution travels through a watershed.
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Arkansas Framework Correlation

Science

10th Grade

PD.1.ES.19 Describe the cycling of materials and energy:

- nitrogen
- oxygen
- carbon
- phosphorous
- hydrological
- sulfur

SP.3.ES.2 Investigate the relationships between human consumption of natural resources and the stewardship responsibility for reclamations including disposal of hazardous and non-hazardous waste

SP.3.ES.3 Explain common problems related to water quality:

- conservation
- usage
- supply
- treatment
- pollutants (point and non-point sources)

SP.3.ES.10 Predict the long-term societal impact of specific health, population, resource, and environmental issues

SP.3.ES.11 Investigate the effect of public policy decisions on health, population, resource, and environmental issues

NS.5.ES.3 Evaluate long-range plans concerning resource use and by-product disposal for environmental, economical and political impact

Problem Question

How do the surrounding environment and activities (point and nonpoint source pollution) affect a watershed?

BACKGROUND INFORMATION

Teachers: Teachers should research local watersheds and various activities within them. Know the name of your watershed and others near you. Research ecological problems associated with these watersheds.

Students: No background is needed.

Keywords

- Watershed
- Point source pollution
- Non point source pollution

Timeline

This activity can be performed in one to two class periods.

Materials

- table covers or tarps
- spray bottles
- plastic bags, newspaper, sod, soil, etc. for landscape
- Pollutants: brown cake sprinkles (dog waste), cocoa powder (dirt), green food coloring or cake sprinkles (fertilizer), red food coloring (toxic waste), cooking spray or oil or honey (oil from cars on pavement or machinery), dish soap or baking soda (detergents from laundry and car wash soapy water). You can get creative with these materials.

Teacher Preparation

- Display a map of watersheds (internet sites or maps) from your state and the country. These are also available from Beaver Water District by emailing a request to education@bwdh2o.org (include reference to this 10th grade lesson and your mailing address). Use a pool cover for the easiest explanation of what a watershed is. Identify the watershed where your school is located and other watersheds near yours.
- For an inquiry based lesson, have students gather materials provided by you and start building their own model. Have students observe and explain what happens when water is applied through use of the spray bottles.
- Use google earth to view satellite images of your area.
- Have students display their results/findings by group.

Directions from Green.org

1. Lay one tarp flat on ground and throw plastic bags, newspapers and assorted trash items onto tarp.
 2. Ask participants to stand around edge of tarp with toes on edge of tarp, hand trash to different people and a spray bottle to every fifth person. Participants may kneel in the front row or encourage people to stand in rows so everyone can see.
 3. Have participants “fluff” bags and newspaper and throw onto the tarp towards the middle. Arrange any items around the center, away from edges of tarp.
 4. Ask three volunteers to open second tarp and cover items in middle of tarp, lying tarp on top. Arrange second tarp so it is directly over bottom tarp. Push down on top tarp where there are gaps between the materials, creating “topography.”
 5. Ask participants to imagine this is their community. If there are any “peaks” or “hills,” ask the students to identify these land features; unfortunately, this may be a landfill in some communities.
 6. Ask those individuals with spray bottles to make it “rain,” directing them to spray towards the middle of the tarp. [Try putting three of the spray bottles on stream and the remaining two on spray.] After water begins to run down the hills and collect in depressions in the landscape, stop the rain and ask the participants to report on what they are observing.
 7. Ask participants to identify the bodies of the water they see on the tarp as streams, wetlands, lakes, rivers, etc. in their community. Ask the participants if a drop of water falls on one side of a particular hill where it goes, and if it falls on the other side of a hill, where it goes. This visual observation is demonstrating how a watershed is delineated, using topography and gravity to determine where water eventually flows to when it falls on the land. Ask participants to identify a “watershed,” defined as an area of land that drains the rainwater (or snowmelt) into one location such as a stream, lake, or wetland. Any pollutants from streets, fields and lawns will eventually drain into those streams, lakes or wetlands when rain falls or snow melts, and those pollutants can be identified as nonpoint source pollutants.
- Optional: Place string on top of tarp to illustrate municipality boundaries. Ask participants if the watershed boundaries and runoff reflect these boundaries. Discuss the importance of watershed management between municipalities.
8. Add two drops of red food coloring to one of the tarps and have it rain again with all spray bottles, students may observe this air pollutant (acid rain) as it mixes with the fresh or clean water on the watershed. Stop raining.

9. Beginning with chocolate cake sprinkles, demonstrate nonpoint and point source pollutants that individuals may find in their watershed.

Brown cake sprinkles = dog waste

Ask the students who have dogs to tell a short story of how this individual is on a walk with their dog and of course there is dog waste as a result – what if the owner does not pick up the dog waste? Let the sprinkles remain on tarp.

Cocoa powder = loose dirt

Choose another section of the tarp and sprinkle some cocoa powder, explaining to participants that this part of the watershed used to be a forest but it was recently clear-cut and all the trees were removed, exposing what (loose soil that is carried with rainwater and snowmelt as runoff into nearby bodies of water)?

Green food coloring or green cake sprinkles = fertilizer

Identify a third section of the watershed (near the dog trail area) where there are many nice homes that have very green grass. Ask participants what types of chemicals are used for green grass, discussing over application of fertilizer will oftentimes not improve the growth of the grass or shrubs and may enter the storm drain as runoff.

Fertilizers are also applied to golf courses and public and private parks and gardens.

Red food coloring = toxic waste

Discuss a family who finds a container of hazardous waste in their garage and wants to get rid of it in a hurry so they dump it down the storm drain in front of their house. Use only a few drops of food coloring for adequate effect.

Cooking spray or oil or honey or soy sauce = oil from cars or machinery

Ask who drove to the location and drop oil or honey along an imagined road, discussing how car owners were not properly maintaining their cars and oil is leaking.

Dish soap, Alka-Seltzer or baking soda = detergents

Identify a few homes where people are washing their cars in front of their homes on the driveway, letting the soapy water run down the driveway into the storm drain.

Other nonpoint and point source pollutants – feel free to add!

10. Here comes the rain! Ask participants to identify what they see happening to the pollutants in the watershed, how do they mix with the bodies of freshwater, what pollutants are remaining, what will happen to the remaining pollutants still on the land and in the water?

11. Discuss approaches or techniques those human beings responsible for the different pollutants could have done differently. How could you educate people about these pollutants and runoff affecting water quality in your watershed? Possible best management practices or watershed management techniques that could be discussed:

- Pick up dog waste and put into trash can or decomposing waste bags
- Plant tree saplings, shrubs or ground cover in areas where there is exposed soil
- Apply fertilizer according to container directions, try organic gardening or growing
- Contact your Environmental Protection Agency for Hazardous Waste Household Pick-Up Days or Waste Collection Programs
- Keep your car maintained and watch for oil spots on your garage floor
- Wash your car at a facility that recycles wastewater or sends it directly to a treatment facility
- Keep animals out of waterways (fences)

Additional Resources

Resources for materials not included:

UA Center for Math & Science Education

<http://www.uark.edu/~k12info/>

479.575.3875

Northwest Arkansas Education Co-Op

<http://starfish.k12.ar.us/web/>

479.267.7450

Beaver Water District

www.bwdh2o.org

479.717.3807

Know of other resources? Please let us know!

education@bwdh2o.org or 479.756.3651

7E's Building a Watershed Model

Elicit

Show video clips from Beaver Water District or other available media about watersheds and their problems. "Troubled Water" is an excellent video with many watersheds discussed. To obtain a borrowed copy, send an email to education@bwdh2o.org. Include your name, school name, mailing address, phone number and email address.

Engage

Have students form groups and brainstorm possible sources of pollution in a watershed. Have students brainstorm what happens with the area and pollution sources just around your school and where the water drains when it rains at school.

Explore

Have student teams gather materials and build their model inside the classroom or in the field. Students can measure mass of materials, nutrient levels (testab water quality kit), or any other element involved. Have students spray water on their model. Imitate a light rain and a heavy rain. Have students examine the model after their rain event.

Explain

Have student teams report their findings to the class. Explain if they used an urban, agricultural, or combination of both setting for their model. Have the teams explain their pollution sources and how much runoff and pollution was produced.

Elaborate

After completing their model and process, have them look at their local watershed and compare and contrast differences from their model.

Evaluate

Students can be assessed by evaluating their model, their results, presentation, and unit test.

Extensions

Use this lesson along with other chemical tests and biological testing to determine total stream health. Form a community project to assess stream health and involve the community.