Water and Our World

Teacher's Guide: Grade 10

Beaver Water District

Overview

Beaver Water District

Building Blocks to Water Education Program

What are the project objectives?

Objectives: To develop age-appropriate educational materials to teach students about Beaver Lake watershed protection and water treatment at Beaver Water District.

Why was this project developed?

This project was developed to ensure that drinking water education and watershed education, based on Beaver Lake and the Beaver Lake Watershed, would be available in schools located in areas that receive drinking water from Beaver Water District.

Desired student outcomes:

1. Students will understand drinking water sources.
2. Students will understand that water is a valuable resource necessary for quality of life in Northwest Arkansas.
3. Students will relate watershed health to water quality in Beaver Lake.
4. Students will learn definitions related to drinking water and watershed.
5. Students will learn about activities and behaviors that will promote watershed health in Beaver Lake, and thus become stakeholders when it comes to their own water quality.
6. Students will relate this information and these behaviors to their family members and friends and others in the community.
7. Students in higher grade levels (such as high school) will understand lake zones, a natural lake vs. a manmade lake, and technical terms such as trophic, mesotrophic, oligotrophic, lacustrine zone, riverine etc.

What is the history of the Beaver Water District?

Mission: Our mission is to serve our customers in the Benton and Washington County area by providing high quality drinking water that meets or exceeds all federal and state regulatory requirements in such quantities as meets their demands and is economically priced consistent with our quality standards.

History: Fifty years ago, visionary community leaders got together to discuss the need for a long-term supply of clean, safe water for Northwest Arkansas. With an eye to the future and knowledge that a large lake was the best source of water, these citizens worked to establish Beaver Lake Reservoir. Beaver Water District was created to pay for the drinking water supply allocation of the lake. The dam that created Beaver Reservoir and the first water treatment plant were completed in the mid-1960s. Since that time, the District has expanded facilities and improved to keep up with increased water demand and stricter drinking water standards. In addition, three other water utilities have been created to provide drinking water from Beaver Lake.

Where did the name originate?

The Beaver Water District got its name from Beaver Lake. Beaver Lake got its name from the town of Beaver, which is actually located in the Table Rock Lake region, according to the Corps of Engineers' office in Rogers, Arkansas.

What areas of Arkansas are covered and which towns and cities benefit from Beaver Water District?

Beaver Water District supplies safe, clean water to about 250,000 people and industries on Northwest Arkansas. The district sells water wholesale to **Fayetteville, Springdale, Rogers, and Bentonville**.

Fayetteville buys water from Beaver Water District and owns and operates the system in Fayetteville, Farmington, Greenland, Goshen, Wheeler, parts of Johnson and some rural areas in Washington County. Fayetteville also provides wholesale service to Elkins, West Fork, Mount Olive Rural Water Association, and Washington Water Authority (as needed).

Springdale Water Utilities buys water from Beaver Water District and sells to consumers in Springdale, Bethel Heights, Elm Springs, the northern part of Johnson, the southern part of Lowell, and unincorporated areas of Washington and Benton counties that are within its designated water service boundary. Bulk sales are made to consecutive water systems operated by the cities of Cave Springs and Tontitown.

Rogers buys water from Beaver Water District and resells it to Rogers and a portion of Lowell and to Benton County Rural Development Authority (RDA) No. 4 Frisco Springs.

The city of *Bentonville* buys water from Beaver Water District and resells it in Bentonville and Bella Vista. You can access a diagram at the District's website at www.bwdh2o.org.

How does Beaver Water District impact the Northwest Arkansas region?

Beaver Lake provides drinking water to more than 350,000 people and industries in Northwest Arkansas, including the largest concentration of food industries in the United States. Another way to put it is this: **One out of eight people in the state of Arkansas gets his or her drinking water from Beaver Lake**, which provides raw water to the District, as well as three other drinking water utilities.

According to a recent population study, there could be as many as 1.2 million people residing in Northwest Arkansas by 2055. Through its master planning process, Beaver Water District (BWD) stays ahead of a growing population's demand for industrial and residential water supplies and reduces the strains of rapid growth on infrastructure including wastewater treatment, roadway expansions, traffic management, waste disposal and other services.

The District's new Administration Center accommodates space needs for staff and increases **accessibility to the public for educational and other purposes**. The project is built in accordance with the Leadership in Energy and Environmental Design (LEED) program, a green building rating system. Educational components of the building include a drinking water plant model and a topographical wall sized map of the Beaver Lake Watershed.

Beaver Water District wants you to know that **your tap water is "food grade and table ready,"** and it has been since the plant began operations in the 1960s. The District operates around the clock to make sure that your water is safe to drink. So, the next time you turn on the tap or read an article comparing the merits of tap water versus bottled water, think about all the people beyond the pipe who make it possible for you to have potable water in Northwest Arkansas.

For more information & education resources send an email to:

education@bwdh2o.org
www.bwdh2o.org

Frameworks

Arkansas Framework Correlations have been aligned within each of the unit lessons. These frameworks can be found through the ***Arkansas Department of Education's web site for curriculum***

http://arkansased.org/teachers/frameworks.html

7 Es Teaching and Learning Model

Although the 7 Es Teaching and Learning Model (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extentions) is not specifically detailed within each lesson, it is implied throughout the unit. We referenced this model from ***Primary Connections*** http://www.science.org.au/primaryconnections/5Es.html

CHAPTER 1

Lesson 1: Biological Testing of Water in a Stream…Bugs Don't Lie

Purpose

This lesson involves the investigation of water quality in a local creek. The students will perform biological tests to determine types and distribution of macroinvertebrates in a stream. This will also help determine a stream's pollution level. This information will be used to determine possible sources of pollution upstream and possible solutions.

Objective

- Students will learn about the types of organisms and their diversity in a stream and relate the invertebrate community to overall water quality.
- Students will be able to enter a stream and identify benthic organisms and determine if a stream's pollution levels are high or low.

Arkansas Framework Correlation

Science

10th Grade

2.1, 2.3, 2.7, 2.9, 2.10, 3.2, 3.3, 3.5, 3.7 - Surface water, groundwater, aquifers, solutions to water shortages, freshwater pollution, labs

2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.10, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7 - Chemical/biological water testing methods, streams, macroinvertebrates, watersheds, local concerns, global concerns, many labs, point/nonpoint pollution, solutions)

Problem Question

What is the role of macroinvertebrates and how does their presence help determine the quality of water?

BACKGROUND INFORMATION

Teacher: Review the Arkansas Game and Fish Commission's Stream Team manual (www.agfc.com). Many water quality lesson materials and instruction are available. Also review the EPA's Protocol for Monitoring Aquatic Invertebrates at Ozark National Scenic Riverways, Missouri, and Buffalo National River, Arkansas (www.epa.gov). These sources will be helpful in learning procedures and tolerant/intolerant species of macroinvertebrates.

There are several good sources for this topic:
www.bwdh2o.org
www.epa.gov
www.agfc.com
http://www.k12science.org/curriculum/waterproj/index.shtml

Student: In Northwest Arkansas, there is an abundance of material related to this topic in the newspaper. The students will need some background on stream pollution and the consequences of pollution. The students will also need instruction on stream anatomy and pollution-sensitive invertebrates. Sampling methods and pollution sources will also need to be learned.

Keywords

- Macroinvertebrates: small organisms found under rocks and leaf packs that indicate water quality
- Intolerant species: macroinvertebrates that cannot survive (tolerate) in higher levels of pollution
- Tolerant species: macroinvertebrates that can survive (tolerate) higher levels of pollution
- Point pollution: pollution coming from a specific source that can be identified clearly. (Ex. Pipe discharging directly into a stream)
- Nonpoint pollution: pollution from an unknown source that is washed into surface water by rainfall (Ex. Runoff from a cow pasture or parking lot

Timeline

- **Day 1**: Give students background in class about local water quality issues, terms, and procedures.
- **Day 2**: Have students investigate a ditch, creek, stream, or any surface water to find. macroinvertebrates. The students can just turn over rocks or collect with kicknets and seines.
- **Day 3**: Accumulate data from stream findings and make determination of stream health.

Materials

- Macroinvertebrate flash cards
- Kick or D nets
- Seines (500 μm), panty hose tied between sticks have been used

Teacher Preparation

Find a local water source to conduct testing. Prepare material and space according to the 7 E's instructions (page 9). Detailed background information and worksheets on this subject can be found at http://www.bgsd.k12.wa.us/hml/jr_cam/macros/resources.html.

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 Biological Testing of Water in a Stream...Bugs Don't Lie

Elicit

Read news articles about water quality in your area. Have students brainstorm possibilities that may be causing these problems. The students will also have to brainstorm within their group to determine all possible sources of pollution upstream.

1. Read an article (http://www.epa.gov/) to the class about pollution levels in a body of water downstream from your location. Discuss the article and the impacts of humans on water quality.
2. Discuss where your drinking water comes from and who impacts the land around your water source. Explain "Everyone lives downstream."

Engage

Have students look at macroinvertebrate identification sheets or flashcards and determine pollution tolerant and intolerant species.

3. Hand out a macroinvertebrate information sheet available from:
    a. www.learnnc.org/media/lessons/.../Macrokey.ppt
    b. http://www.iwla.org/
    c. http://people.virginia.edu/~sos-iwla/Stream-Study/StreamStudyHomePage/SOS.HTML
    d. http://www.bgsd.k12.wa.us/hml/jr_cam/macros/resources.html
4. Explain the pollution tolerant and pollution intolerant sections of a macroinvertebrate sheet.
5. For a truly inquiry based lesson, allow students to first go out and collect whatever macroinvertebrates they can find and have them identify and sort as pollution tolerant or intolerant. Have students present their determination of stream health based on their findings. Then proceed with following steps. After the second round of sampling, have the students compare their results to their initial findings.
6. Show invertebrate flashcards (www.flinnscientific.com) or online pictures (previous websites mentioned) of actual organisms.
7. Explain possible sources of pollution upstream (point/nonpoint/urban/agricultural)
8. Describe stream anatomy (riffles, runs, pools).
9. Describe where to find the macroinvertebrates.

Explore

Take students to a local water source and:

10. Assign small groups and their sampling materials and move the class to the stream.
11. Have students collect organisms from the streambed in the riffles.
12. Return to the classroom and have groups count and identify their collection.

Explain

Have students determine the outcome of their discovery.

13. Based on their knowledge of tolerant and intolerant species, have the groups present their findings with a graph of tolerant/intolerant species per each testing site and make a determination of stream quality. Have students brainstorm possible sources of pollution upstream from your testing location and determine a hypothesis.

Elaborate

Review the EPA protocol for biological testing. There is much more detail involved in this type of monitoring. This lesson is a very basic way to introduce biological testing to students. This lesson is designed to spark their interest. True biological testing is much more involved.

Evaluate

- Students will be evaluated in the field by their collection techniques and participation with their group.
- Students will be evaluated in the class by their presentation and unit test.

Extensions

This is a small lesson that will mean more to students once chemical testing is introduced. This information leads to a study of watersheds and possibly Karst Topography. Riparian zone and its function are also connected to this activity.

Lesson 2: Chemical Testing of Water

Purpose

Students will measure and analyze nutrient levels in water to determine types of pollution present. Information learned from the field investigation will allow students to think about possible sources of pollution upstream.

Objective

- The students will be able to design an experiment.
- The students will investigate water quality and nutrient levels in surface water and learn possible sources of pollution found.
- The students will learn what each chemical test (nitrate, phosphate, chlorine, dissolved oxygen, ammonia, pH) is identifying as a possible source.

Arkansas Framework Correlation

Science

10th Grade

PD.1.ES.11 Describe the physical and chemical properties of water

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

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

BD.2.ES.9 Explain how limiting factors affect populations and ecosystems

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

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

NS.4.ES.1 Collect and analyze scientific data using appropriate mathematical calculations, figures and tables

NS.4.ES.2 Use appropriate equipment and technology as tools for solving problems e.g., microscopes, centrifuges, flexible arm cameras, computer software and hardware)

Problem Question

How do pollution sources affect a stream?

BACKGROUND INFORMATION

Teacher: There are several water quality monitoring test kits available. You can purchase inexpensive kits like the testab kits or really expensive, more technical kits from Hach. The inexpensive testab kits are easy and student-proof. It is a great way to introduce the topic. The kits give background and detailed information on each nutrient.

Websites for ordering test kits:

http://www.h2ou.com/L1980.pdf
http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=21605&noList=1
http://www.amazon.com/Mini-Oxygen-Test-Freshwater-Saltwater/dp/B0002ARBBO
http://www.lamotte.com/pages/edu/tablet.html

Good sources for this topic:
www.bwdh2o.org
www.epa.gov
www.agfc.com
http://www.k12science.org/curriculum/waterproj/index.shtml

Students: No background is needed if you want to do a true inquiry lab. If you want to have a guided lesson, then inform students about sources of these nutrients:

- Nitrate – animal waste
- Phosphate – soaps, fertilizers, wastewater
- Ammonia – decomposing organic waste
- Chlorine – treated water, city water
- Dissolved Oxygen – amount of free oxygen present in water
- pH – acidic/basic

Keywords

- Chemical testing
- Nitrate
- Phosphate
- Chlorine
- Ammonia
- Dissolved oxygen
- pH

Timeline

This lab can be performed in one class period. Student presentations would be another period.

Materials

- Lamotte water quality monitoring kit or Testab individual nutrient kits

Teacher Preparation

Very little preparation is needed. We suggest identifying your water location to be tested. How easy is it to get to the water? How long does it take to get there? You can also collect some water from your location and have it in the classroom to be tested.

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
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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 Chemical Testing of Water

Elicit

Look for stories of local water quality problems. Watch the "Troubled Water" video or other news stories about water quality. Propose to students an investigation is needed about a problem in the water. Use the test kits to try to identify the possible source of the problem.

Engage

Have the students investigate local water quality problems. Look at previous investigations and solutions. Develop teams in class and have them discuss their pre-investigation.

Explore

Have the teams of students assigned to one chemical test each. Each team reads the instructions in the kit. Have the students move to their class lab station and begin test on collected water or move students to the testing location outside. Students will then perform their chemical test with several repetitions and return to the classroom for analysis.

Explain

Have the students groups display their findings and explain possible sources of pollution upstream. Have students use Powerpoint, graphs, or other media to explain.

Elaborate

Students can explain possible urban and agricultural sources of pollution.

Evaluate

Evaluation can be performed for field study and lab techniques, display of information, and unit test.

Extensions

Further investigation could be performed throughout the area or in their neighborhood. Evaluate city or local water source problems. These test kits are very easy and inexpensive so the students can take them home.

Lesson 3: Stream Anatomy & Function

Purpose

Students will learn the various components that make up a stream and learn their functions.

Objective

Students will learn the order and functions of riffles, runs, pools, and riparian zones.

Arkansas Framework Correlation

Science

10th Grade

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

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

SP.3.ES.8 Compare and contrast man-made environments and natural environments

BD.2.ES.9 Explain how limiting factors affect populations and ecosystems

Problem Question

What are the components that make up a stream and what are their functions?

BACKGROUND INFORMATION

Teachers: Research local streams including on-campus. Investigate to check if the stream is dry part of the year or contains water the entire year. Ideally, you want the students to visit the stream and explore the components of the stream. Perform searches on-line for diagrams and images of stream components.

Students: No student preparation is needed.

Keywords

- Riffle: shallow, fast water functions: in-stream filter, adds oxygen
- Run: transition zone from riffle to pool – no function
- Pool: slow moving, deep water functions: slows and spreads water, allows settling of sediment and nutrients
- Riparian zone: trees, bushes, grasses on the sides of a stream functions: pre-stream filter, erosion control

Timeline

- One class period for instruction
- One class period for site visit of an on-campus stream

Materials

- Images and diagrams from the internet
- Markers for teacher or student drawings

Teacher Preparation

1. Give students instruction on riffle, run, and pool locations in a stream. Show riparian zone location (200 ft. on each bank of the stream).
2. Identify the functions of each (see keywords).
3. Demonstrate (stream table or drawing on the board) how water flowing in the stream is pushed through the gravel, filtered, and oxygen added by bouncing over the rocks. The water transitions in the run. Then the water spreads out and slows down in the pool in order for it to settle the remaining pollutants. This process happens over and over again producing cleaner and cleaner water.
4. Demonstrate (stream table or drawing on the board) how rainfall flows down a hill to the stream without any riparian zone present. Assume the riparian zone is mowed right up to the stream. Show how pollutants on the ground are washed quickly into the stream without any filtering or slowing down of the flow. The nonpoint pollution from the surface is washed directly into the stream.
5. Demonstrate (stream table or drawing on the board) this time how a healthy riparian zone acts as a pre-stream filter for nonpoint pollution running down the hill. The plinko game from "The Price is Right" is an excellent example. The disc in this game slides down a slanted board full of pegs. Those pegs slow the movement of the disc. A riparian zone acts the same as the pegs. The rainfall moving down the hill and picking up pollutants will be slowed by the grass, bushes, trees, and their roots. This slows the rainfall and allows the pollutants to settle into the soil.
6. Explain how this entire system is Mother Nature's way of cleaning water before it enters a stream, lake, or ocean.

Additional Resources

Resources for materials not included:
UA Center for Math & Science Education
http://www.uark.edu/~k12info/
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479.267.7450
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Know of other resources? Please let us know!
education@bwdh2o.org or 479.756.3651

7E's Stream Anatomy & Function

Elicit

Show images of streams in your area and of major rivers in the world. The Mississippi River is an excellent river to view. Google Earth will show images of streams and some will look muddy while some look blue. Have students discuss what they observe in and around the streams that may cause the differences.

Engage

Have students draw/diagram what these streams look like. Have them draw what they observe in the stream and surrounding the stream.

Explore

Have the students travel to ditches, creeks, or streams around your campus and observe what they see. Have the students draw this area. Have students identify riffles, runs, pools, and riparian zone. You can even set up a field lab practicum for a quick quiz to assess learning. Have students form teams and produce small presentations. They can investigate streams from their neighborhood or around town.

Explain

Have students return to class and display their drawings and presentation.

Elaborate

What areas are more prone to damage? What kind of damage can happen to a stream and its components? How is the ditch or small creeks components different from a larger stream?

Evaluate

The student drawings/diagrams can be evaluated. Assessment also takes place in a unit test or field lab practicum.

Extensions

What happens with geomorphology in the stream if the riparian zone is depleted? What happens with chemical or biological testing of the water if the components are damaged or missing? What is a large, low area of land that floods called? This is a wetland and is a backup component for cleaning the water in heavy rain events.

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.

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.

Additional Frameworks

English

Oral and Visual Communications

1. Speaking: Students shall demonstrate effective oral communication skills to express ideas and to present information.

2. Listening: Students shall demonstrate effective listening skills in formal and informal settings to facilitate communication

3. Media Literacy: Students shall demonstrate knowledge and understanding of media as a mode of communication.

Writing

1. Process: Students shall employ a wide range of strategies as they write, using the writing process appropriately.

2. Purpose, Topics, Forms and Audiences: Students shall demonstrate competency in writing for a variety of purposes, topics and audiences employing a wide range of forms.

Reading

1. Foundations of Reading: Students shall apply concepts of print, acquire knowledge of spoken words and understand the relationship of speech to print as they develop a foundation for literacy.

2. Comprehension: Students shall apply a variety of strategies to read and comprehend printed material.

3. Variety of text: Students shall read, examine, and respond to a wide range of texts for a variety of purposes

4. Vocabulary, Word Study and Fluency: Students shall acquire and apply skills in vocabulary development and word analysis to be able to read fluently.

Inquiring/Researching

1. Research/Inquiry Process: Students shall engage in inquiry and research to address questions, to make judgments about credibility, and to communicate ideas in ways that suit the purpose and audience.

Math

Algebra 1

1. Data Interpretation and Probability: Students will compare various methods of reporting data to make inferences or predictions.

Computer Mathematics

1. Problem Solving: Student will develop and apply logical reasoning skills to solve real-world problems through the development of mathematical models.

2. Program Design: Student will design a step-by-step plan to solve a given problem