Water and Our World

Teacher's Guide: Grade 9

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: Biochemical Oxygen Demand (BOD) on a Stream

Purpose

BOD is useful information in determining the health of a stream. Stream organisms are less likely to survive when oxygen is too low.

Objective

- Students will be able to design an experiment.
- Students will understand the importance of oxygen in the water.
- Students will be able to interpret data, graph, and display information.

Arkansas Framework Correlation

Science

9th 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 is BOD used in determining the health of a stream?

BACKGROUND INFORMATION

Teacher: Acquire a good BOD test kit and read the directions. You can perform this lab in the field or in the classroom. If you collect some water samples and have them for an in-class lab, refrigerate your samples.

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: No background is needed.

Keywords

- BOD: Biochemical Oxygen Demand

Timeline

- **One class period** explaining the importance of oxygen in the water and how it affects stream health.
- **One class period** is needed for the lab.
- Wait **five days** to read the results then have students finish their lab write up.
- **One class period** is needed for their presentation.

Materials

- BOD test kit
- Water samples or creek on site

Teacher Preparation

Very little preparation is needed if you have a stream on campus. If no stream, then you will need to collect some water samples in advance. Refrigerate your samples if you are not testing BOD immediately. Remember to time your lab in order to accommodate for the five day waiting period on the BOD test results.

The BOD test takes 5 days to complete and is performed using a dissolved oxygen test kit. The BOD level is determined by comparing the DO level of a water sample taken immediately with the DO level of a water sample that has been incubated in a dark location for 5 days. The difference between the two DO levels represents the amount of oxygen required for the decomposition of any organic material in the sample and is a good approximation of the BOD level.

Take 2 samples of water and record the DO level (ppm) of one immediately using the method described in the dissolved oxygen test. Place the second water sample in an incubator in complete darkness at 20 °C for 5 days. If you don't have an incubator, wrap the water sample bottle in aluminum foil or black electrical tape and store in a dark place at room temperature (20 °C or 68 °F). After 5 days, take another dissolved oxygen reading (ppm) using the dissolved oxygen test kit. The BOD level is determined by subtracting the Day 5 reading from the Day 1 reading. Record your final BOD result in ppm.

Use these sites for ordering information. A Google search for dissolved oxygen test kits gives you many options for inexpensive, easy kits to high tech, expensive 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

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 Biochemical Oxygen Demand on a Stream

Elicit

Show images from the internet showing healthy looking streams and polluted streams. Show images of a fish kill. Research articles about water quality problems where lakes have died or streams have been placed on the state impaired list.

Engage

Demonstrate the activity. Have students do the research on troubled bodies of water. What damage was done to wildlife? What were some solutions involved in the restoration?

Explore

Have the students form teams for investigation. Move the students to the lab location and collect their samples and begin the testing. Have the students record their observations and data collected.

Explain

Have the students interpret their data, graph their results, and list possible sources of the problem. Have the teams present their findings to the class.

Elaborate

Have questions for the teams during their presentation. Identify other streams or sources of depletion of oxygen. What could cause oxygen depletion in agricultural or urban settings?

Evaluate

Assess the student's lab skills, team work, presentation, and also with a unit test.

Extensions

Combine this lab with full array of chemical tests and also biological testing to determine total stream health.

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

9th 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 before the lab. 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
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 History of Water Treatment

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 what the source of the problem might be.

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 power point, 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.

*To borrow a copy of "Troubled Water," send an email to education@bwdh2o.org with your name, school name, mailing address, phone number and email address.

Lesson 3: Ground Water Infiltration

Purpose

This lesson provides students with an opportunity to create their own investigation. They are presented with a problem and asked to design an experiment to discover the best way to filter storm water runoff before it enters the stream. Two 2-liter bottles, simulated pollution solution, and sand, silt, clay, and small/large gravel will be needed. Students will be exploring a new wave in residential and commercial development and understand green technology.

Objective

- The students will be able to design an experiment.
- The students will be able to identify which substances or combination of substances best filter polluted water.

Arkansas Framework Correlation

Science

9th Grade

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.8 - Compare and contrast man-made environments and natural environments

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

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

Problem Question

What are the best filtration substrate types for storm water runoff?

BACKGROUND INFORMATION

Teachers: This is a very basic lab with very basic materials. Research your biome soil type and topography for final comparison. Research the most common stream pollutants in your area to assemble your lab simulated pollutants. Investigate green technology for discussion.

Students: The students will need information on point and nonpoint pollution. The students will also need instructions on assembling their filtration column

Keywords

- Substrate: various materials that make up the layers of earth
- 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)
- Filtration: the removal of substances in water by moving through porous layer

Timeline

This lab can be performed in one class period.

Materials

- Tap water
- Fertilizer
- Soil
- Silt
- Clay
- Sand
- Small gravel
- Large gravel
- Students bring in 2-liter bottles

Teacher Preparation

Have materials prepared and conduct in a safe location.

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 History of Water Treatment

Elicit

Have students brainstorm ideas for how to deal with storm runoff in a store parking lot. What might happen if the trash, oil, antifreeze, gas, etc. is washed directly into a creek? What might happen to the living things in the creek? Show pictures of parking lots or agricultural areas draining.

1. Explain to students that they are to design a filtration system to filter nonpoint pollution from a parking lot at a busy shopping center. The shopping center is trying to be more sustainable and wants to filter their storm water runoff before it enters the creek. Discuss what parking lot islands with planting beds and drains would look like.
2. Model the correct filtration column assembly.
    a. Have students bring to class two empty 2-liter bottles rinsed and with the labels removed.
    b. Cut bottle one in half. Top for a funnel and bottom for collection of filtered water.
    c. Cut the top off of bottle two and discard. Puncture the base of bottle two several times to allow the water to slowly leak into the collection base of bottle one.
    d. Take the base of bottle one and place under the bottom of bottle two for filtered water collection.
    e. Invert the top of bottle one (funnel) and place into the top of bottle two.
    f. Layers of substrate will be assembled in the bottle two base.
3. Show students the filtration materials you have in the classroom.
    a. Obtain soil, sand, clay, small gravel, large gravel and place in containers in the classroom.

Engage

Have students organize the group's thoughts and ideas. Have students plan their filtering structure and predict outcome.

Explore

4. Have students collect desired materials to layer into their bottle assembly.
    a. Prepare a simulated pollution sample.
5. Combine water (tap/chlorinated) and fertilizer.
6. Have students collect 20 ml of simulated pollution and use a testab water quality kit (includes instructions) to determine levels of phosphate and chlorine.
7. Have students prepare the filtration column with layers and complete assembly.
8. Have students pour solution into the top funnel piece and then remove bottom piece with filtered solution.
9. Have students perform water quality tests on filtered solution to obtain data on pollution levels.
10. Have students compare before-filtration levels to after-filtration levels.
11. Have students repeat procedure with four different filtration setups to determine best system. Perform four to five replications per design.

Explain

12. Have students do a lab write-up stating their objectives, hypothesis, procedures, results (graphs of data), and conclusion.
13. Each group presents their findings and suggestions.

Elaborate

Have students discuss importance of protecting water quality in local streams. Use a local store parking lot and its proximity to water to explain in detail possible solutions.

Evaluate

Assessment will be performed through grading their lab write-up and their group presentation.

Extensions

After their investigation, students can research current sustainability practices used by green technology and development. Students may want to explore if their system can filter other types of pollutants as well.

Lesson 4: Total Suspended Solids & Turbidity in Streams

Purpose

This lesson provides students with an opportunity to learn about total suspended solids (TSS) and turbidity in streams and how this affects the health of streams.

Objective

- Students will be able to design an experiment.
- Students will learn about TSS and turbidity, where the solids may come from, and how they affect the health of the stream.
- Students will be able to interpret data, graph, and present their results.

Arkansas Framework Correlation

Science

9th Grade

PD.1.ES.6 Describe the processes of degradation by weathering and erosion

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

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

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)

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)

NS.4.ES.3 Utilize technology to communicate research findings

Problem Question

What are total suspended solids (TSS) and turbidity and how do they affect the health of streams?

BACKGROUND INFORMATION

Teachers: Total suspended solids (TSS) concentrations and turbidity both indicate the amount of solids suspended in the water, whether mineral (e.g., soil particles) or organic (e.g., algae). However, the TSS test measures an actual weight of material per volume of water, while turbidity measures the amount of light scattered from a sample (more suspended particles cause greater scattering). This difference becomes important when trying to calculate total quantities of material within or entering a stream. Such calculations are possible with TSS values but not with turbidity readings. High concentrations of particulate matter can cause increased sedimentation and siltation in a stream, which in turn can ruin important habitat areas for fish and other aquatic life. Suspended particles also provide attachment places for other pollutants, such as metals and bacteria. High suspended solids or turbidity readings thus can be used as "indicators" of other potential pollutants.

TSS and turbidity values vary naturally for two main reasons – one physical, the other biological. Heavy rains and fast-moving water are erosive. They can pick up and carry enough dirt and debris to make any stream look dirty. So, heavy rainfall may cause higher TSS concentrations or turbidity, unless the additional particles are dispersed throughout large volumes of flood water.

Land use is probably the greatest factor influencing changes in TSS or turbidity in streams. As watersheds develop, there is an increase in disturbed areas (e.g., cropland or construction sites), a decrease in vegetation, and increases in the rate of runoff. These all cause increases in erosion, particulate matter, and nutrients, which in turn promote increased algal growth. For example, loss of vegetation due to urbanization exposes more soil to erosion, allows more runoff to form, and simultaneously reduces the watershed's ability to filter runoff before in reaches the stream.

Students: No background is needed

Keywords

Total Suspended Solids (TSS)
Turbitity

Timeline

This lab will require:

- one class period for instruction about the topic
- one class period for the lab
- one class period for presentations

Materials

- glass fiber filters
- distilled water
- filtering flask
- nephelometer or Jackson turbidimeter
- pump

Teacher Preparation

Collect water samples from an undisturbed location

TSS

1. Before sampling, prepare glass fiber filters by first soaking them in distilled water, drying them at 103° C, and weighing and recording their weights.
2. Place the dried, weighed glass fiber filter onto a filtering flask – wrinkled side up. Shake the sample bottle first, then pour in the water and turn on the pump. (The amount of water you need to filter may change according to water conditions. Start with 100 mL. Use less volume if the filter gets clogged too quickly and more if the water filters through very fast.) Record the volume of water filtered.
3. Dry the filter at 103 to 105° C, let it cool to room temperature, and weigh it. Dry it, cool it, and weigh it again. Continue until the fiber reaches a constant weight. Record the end weight.
4. The increase in weight represents TSS. Calculate TSS by using the equation below.

TSS (mg/L) = ([A-B]*1000)/C

Where A = End weight of the filter

B = Initial weight of the filter

C = Volume of water

Turbidity

More technical: Shake your water sample and place in a nephelometer or Jackson turbidimeter. Compare this result to a reference solution or blank. Turbidity is a measure of light scattered by particles.

Easiest: Acquire a turbidity test kit and follow the procedures listed. There are many test kits out there. Probes can be found but are more expensive. Here is a website that has turbidity and other test kits.

http://www.acornnaturalists.com/TURBIDITY-TEST-KIT-P444C390.aspx?UserID=33563908&SessionID=iPdCEhSuqrF{PrMVf37S

http://www.acornnaturalists.com/LaMotte-Water-Quality-Test-Kits-C390.aspx

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 Total Suspended Solids & Turbidity in Streams

Elicit

Show images from the internet of muddy streams. Ask students what might be causing the extra sediment in the stream. Show images of polluted streams that have produced a fish kill. Ask students what could have caused wildlife death.

Engage

Have students form their lab teams and discuss agricultural and urban sources that might affect BOD and turbidity. Have students research streams and look at Google Earth and explain differences in what they see in the surrounding areas of the streams. Have the teams look at their stream characteristics and list where extra sediment would be washed in.

Explore

Have students perform the lab with the collected water samples. It would be best to have the students collect the sample from the stream and see the surrounding area.

Explain

Have the teams interpret the data, graph their results, and present their findings to the class.

Elaborate

Make sure the teams explain their stream characteristics and the surrounding area. Have them list possible sources of extra sediment that has entered the stream. What nutrients might decrease the amount of oxygen present?

Evaluate

Assess the students on their lab techniques, safety, 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