Watershed Lesson Plan
(5 days)

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Lesson Appropriate for these classes:
Advanced Algebra
Algebra
Science 9

Unit Overview: The purpose of this unit is to introduce students to the concepts of a watershed, stream flow and water quality.

Sources: Sweetwater Authority. What is a Watershed Lesson Plan (Online). http://www.sweetwater.org/education/lesson_plans.html

Abandoned Mine Drainage Education. Using Macroinvertebrates To Determine Water Quality (Online). http://www.geocities.com/~paulstan/lesson3.html

National Teacher Enhancement Network (NTEN). Measuring Stream Flow Lesson Plan (Online). http://www.scienceteacher.org/k12resources/lessons/lesson17.htm

Objectives: At the end of this unit, students will know the concept of a watershed and how pollution can travel within the watershed. They will measure the rate of flow in a stream and determine the quality of water in a stream. The students will also learn how much water Lake Superior holds in only the top foot of its surface.

Standards: Science Standard III.5

All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact.

Science Standard V.2

All students will describe the characteristics of water and demonstrate where water is found on earth; describe how water moves; and analyze the interaction of human activities with the hydrosphere.

Math Standard II.1

Students develop spatial sense, use shape as an analytic and descriptive tool, identify characteristics and define shapes, identify properties and describe relationships among shapes.

Math Standard III.1

Students collect and explore data, organize data into a useful form, and develop skill in representing and reading data displayed in different formats.

Day 1: Volume Loss in Lake Superior

Objective: Calculate the gallons of water lost if the water level of Lake Superior drops one foot.

Procedure: Students must first find the surface area of the lake by tracing a map of Lake Superior onto 1-cm grid paper. They can then calculate the approximate are of the lake using the formula:
Area = U*(I + B/2)
U = the area of one square (400 square miles in this problem)
I = the number of full squares
B = the number of border squares

Next, students must convert the surface area from square miles to square feet. (1 square mile = 27,878,400 square feet)

Now, the students can find the volume of water lost in cubic feet by multiplying by the depth of water lost (1 foot in this problem).

Finally, students can convert the volume from cubic feet to gallons by using the conversion: 1 cubic foot = 7.48 gallons.

Summary: Finally, we discussed the results as a class. Most students were amazed that dropping only one foot would mean a loss of approximately 7,000,000,000,000 gallons of water. Unfortunately, the number is so big that it is incomprehensible to most people!

Day 2 : Watershed Lesson Plan

Objective: Students will be introduced to the concept of a watershed and the effects of pollution.

Materials: brown paper bag
spray bottle
newspaper
paper towels (for clean up)
food coloring (to represent pollution)

Procedure: Define and discuss watershed, tributaries, rivers, upstream, downstream, pollution.

Have students scrunch up paper bag.

Students will form paper bag into the shape of a mountain.

Have students predict what will happen when it "rains" on the watershed.

Students will take turns spraying "rain" on the watershed.

Finally, the students will add food coloring to the mountain side to represent pollution within the watershed. (Different colors can be used to represent different types of pollution.)

We will conclude the class by discussing how the watershed drains water to a river or stream, how streams form, and the impact of pollution for people in all areas of the watershed.

Summary: What happens to a watershed when people pollute?
Where does the all of the water drain into?
What are some types of pollutants? (i.e. fertilizers, pesticides, oils, grease, chemicals, litter)

Day 3 : Measuring Stream Flow

Objective: To calculate the flow of water in a stream.

Materials: meter tape (50-100 meter length)
meter sticks
paper/pencil
calculator
timing device (stopwatch or watch with seconds delineated)
object to float down the stream

Safety, Handling, Disposal:

Safety near the water is essential. Review safety techniques prior to entering the field. It is suggested that a rope and/or personal flotation devices be readily at hand.

- Work with partners--keep track of each other.
- Use extreme caution in rapidly moving water areas.
- Leave as little impact on the area as possible (Clean up!)

Procedure:

1. Measure off a 50-meter stretch of stream.
2. Float an object (such as a stick) through the 50-meter stretch.
3. Time, in seconds, how long it takes for the stick to float 50 meters. Record the time. Repeat three times and find the average time.
4. Measure the width of the stream in a location along the 50-meter stretch. Measure the width in meters. Find the average.
5. Measure the depth of the stream along an imaginary line running perpendicular to the stream at the same point you measured the stream's average width. Take a minimum of 5 measurements along the perpendicular. Measure the depth in meters. Find the average depth.

6. Average Width X Average Depth = Cross-Sectional Area

7. Calculate the stream flow using the following formula:
   Stream Flow = Velocity (m/s) X Cross-Sectional Area (m^2)

8. The answer will be in cubic meters/second. Show calculations and record answers.

Extensions: *(if time allows)*

By multiplying the cubic meter/second number by 264, the number of gallons per second can be determined. Continuing on, multiply this number by 60 to determine the number of gallons per minute. Multiply again by 1440 to determine the number of gallons of water the stream carries in one day.

Summary: Discuss with students the amount of water passing a given point EVERY second. What happens in places where the cross-section area is smaller? (Velocity must increase) What happens in places where the cross-section area is greater? (Velocity must decrease)

Days 4 & 5: Using Macroinvertebrates To Determine Water Quality

Overview: Water "bugs" (macroinvertebrates such as insect larvae, snails, crawfish, sowbugs, clams, aquatic worms and leeches) are excellent indicators of water quality, as they live much of their life cycle in the same area of a stream or lake. This lesson demonstrates how to collect stream debris samples, locate, identify and sort "bugs" within the samples, and evaluate water quality based on species diversity and population. Students of all ages can also gain some understanding of the basic causes and significance of water quality problems, as well as potential solutions.

Objectives: Collect stream debris samples from suitable habitats (or have the sample brought to them)

Locate and identify macroinvertebrates in the samples

Evaluate water quality based on species diversity and population

Understand basic causes and significance of water quality problems along with potential solutions

Method: Ideally, students will be taken to a suitable (safe and wadeable) stream or lake where collection techniques will be demonstrated. If possible, students will be able to collect samples on their own in order to better learn collection techniques. If students cannot go to a water body, instructor can go before the demonstration and collect a large enough sample to divide evenly between groups. After sample collection is complete, students will pick through the debris to locate and then identify macroinvertebrates that can be used to estimate water quality.

Background: Aquatic macroinvertebrates include primarily larval forms of both common and uncommon insects. Commonly seen insect larvae include dragon flies and damselflies. Less common insects include stoneflies, mayflies, alderflies, midge fly and blackfly larvae. Non-insect indicators include snails, crawfish, sowbugs, clams, aquatic worms and leeches. These and a variety of other macroinvertebrates can be identified using an easy to read "Bug Sheet" which gives generalized body patterns for each of the indicator organisms along with brief characteristics. The sheet also shows which water quality group each indicator organism falls in. Water quality groups include: 1) pollution sensitive ("good water bugs"); 2) somewhat pollution tolerant ("moderate water bugs"); and 3) pollution tolerant ("bad water bugs").

Macroinvertebrates living in any body of water provide excellent indicators of water quality because they are generally forced to live out much if not all of their life cycle in the same area of a stream or

Unit Assessment:

Day One: Each group will turn in their overhead copy of Lake Superior, along with all of their work showing the conversions to the number of gallons of water. The days work will be worth 20 points according to the following rubric:

Accuracy in converting:	0-10 points
Accuracy in mapping:	0-5 points
Participation and neatness:	0-5 points

Day Two: I will monitor each group for accuracy and answer any questions that arise. The day will not consist of any formal grade however.

Day Three: Each group will turn in the results they gathered for the velocity of the stream. A table showing stream width measurements, stream depth measurements, and stream velocity measurements will be included. I will also check to make sure stream flow is then calculated correctly. The days activity will be worth 20 points according to the following rubric:

Correct Calculations:	0-10 points
Table Complete and Accurate:	0-5 points
Participation and Neatness:	0-5 points

Day Four and Five: Each group will turn in the results they gathered from collecting “bugs”. Since we will discuss the quality of the stream as a class, the students will not get graded on this. They will get a formal grade mostly for participation and attention to detail. The two-day activity will be worth a total of 40 points according to the following rubric:

Day-One: Participation in collecting macroinvertebrates: 0-20 points.

Day-Two: Accuracy in identification and participation: 0-20 points.