

Clear As Mud



SUBJECTS: Science

GRADES: 4-8

ACTIVITY SUMMARY: Students will analyze “water” samples taken from a “spring” on 2 different occasions.

DURATION: Approximately 45 minutes

OBJECTIVES:

The students will be able to:

1. Recognize the different kinds of pollution that affect water.
2. Define turbidity and non-point source pollution and discuss how they relate to their water samples.

TEKS ADDRESSED:

4th grade

1A-demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations.

2B-collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps.

2C-construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data.

2D-analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured.

2F-communicate valid, oral, and written results supported by data.

3C-represent the natural world using models such as rivers, stream tables, or fossils and identify their limitations, including accuracy and size.

7B-observe and identify slow changes to Earth’s surface caused by weathering, erosion, and deposition from water, wind, and ice.

7C-identify and classify Earth’s renewable resources, including air, plants, water, and animals; and nonrenewable resources, including coal, oil, and natural gas; and the importance of conservation.

5th grade

1A-demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations.

2C-collect information by detailed observations and accurate measuring.

2D-analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence.

2F-communicate valid conclusions in both written and verbal forms.

9C-predict the effects of changes in ecosystems caused by living organisms, including humans, such as the overpopulation of grazers or the building of highways.

6th grade

1A-demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards.

2C-collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.

2D-construct tables and graphs, using repeated trials and means, to organize data and identify patterns.

2E-analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

3B-use models to represent aspects of the natural world such as a model of Earth’s layers.

3C-identify advantages and limitations of models such as size, scale, properties, and materials.

7th grade

1A-demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards.

2C-collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.

2D-construct tables and graphs, using repeated trials and means, to organize data and identify patterns.

2E-analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

3B-use models to represent aspects of the natural world such as human body systems and plant and animal cells.

3C-identify advantages and limitations of models such as size, scale, properties, and materials.

8A-predict and describe how different types of catastrophic events impact ecosystems such as floods, hurricanes, or tornadoes.

8B-analyze the effects of weathering, erosion, and deposition on the environment in ecoregions of Texas.

8C-model the effects of human activity on groundwater and surface water in a watershed.

8th grade

1A-demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards.

2C-collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.

2D-construct tables and graphs, using repeated trials and means, to organize data and identify patterns.

2E-analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

3B-use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature.

3C-identify advantages and limitations of models such as size, scale, properties, and materials.

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NATIONAL SCIENCE STANDARDS:

Content Standard F: Science in Personal and Social Perspectives

Grades K-4

Changes in Environments

- Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad. Pollution is a change in the environment that can influence the health, survival, or activities of organisms, including humans.
- Some environmental changes occur slowly, and others occur rapidly. Students should understand the different consequences of changing environments in small increments over long periods as compared with changing environments in large increments over short periods.

VOCABULARY: Pollution, chemical, organic, ecological, point and non-point source pollution, ground water, runoff, watershed, karst, turbidity and boundaries

MATERIALS REQUIRED:

- Three different colors of construction paper- blue, gold (or brown), and red. Use two sheets of each to make tokens (Note: Sequins in various colors could be purchased to avoid hole punching)
- Crayons/colored pencils
- Paper punch
- One teaspoon measure (for paper punch tokens)
- One tablespoon measure (if ½ inch tokens are chosen)
- Two empty wide mouth peanut butter jars
- Wax paper and Saran Wrap
- “Clear as Mud” Research Forms

BACKGROUND:

All of the water that has ever been available is on the earth right now. In some of your studies you may have come across information stating that we are drinking the same water the dinosaurs did millions of years ago. In many ways this is true. The same water is just recycled over and over.

Here is an interesting analogy of the biosphere’s hydrologic cycle. If all the water in the world were equal to 1,000 gallons, we would find approximately 971 gallons in the oceans and seas, 20 gallons in the ice caps and glaciers, 6 gallons underground, 2 gallons in the atmosphere, 1 quart in fresh water lakes, 1 cup suspended in the soil, and 1 teaspoon in our rivers. With this analogy in mind, it is apparent how fragile this vital resource is. Yet each day we hear about water being damaged by pollution. Sometimes pollution stresses ecosystems beyond their capabilities to support life.

Pollution is a complex topic. There are three main types of pollution that affect bodies of water. They are:

Chemical Pollution: The introduction of toxic substances into an ecosystem, e.g., contamination of a water supply by pesticides, or toxic spills from railroads and interstates.

Organic Pollution: over-supplying an ecosystem with organic material such as bacteria or nutrients, e.g., agricultural fertilizer.

Ecological Pollution: stresses ordinarily created by natural processes, e.g., abnormal increase of sediments in runoff producing large quantities of silt. This can be caused by heavy logging, leaving no roots to hold the soil in place, construction, and some farming practices.

For the most part, pollution is invisible; it usually takes a great deal of time to exhibit its impact. Turbidity is the exception. The definition of turbidity is: the degree of cloudiness due to material suspended in water.

“Turbidity is the result of suspended solids in the water. Turbidity is the opposite of clarity. At higher levels of turbidity, water loses its ability to support a diversity of aquatic organisms. Water becomes warmer as suspended particles absorb heat from sunlight proportionate to the concentration of particles. Remember, warm water holds less oxygen than cooler water. Less light penetrating the water decreases photosynthesis,

which in turn reduces oxygen concentrations. Suspended solids may clog fish gills, reduce growth rates and decrease resistance to disease as well as preventing egg and larval development. Particles of silt, clay, and organic materials may settle to the river bottom, especially in impounded and slow moving rivers. These settled particles can accumulate and smother eggs of fish and aquatic insects resting on the river bottom" (*Field Manual for Water Quality Monitoring*, Mitchell & Stapp, 1988).


Turbidity can have a great impact on the health of water and is largely due to soil erosion.

Groundwater is continually being affected by pollution. Some pollution enters water from a localized source, such as a factory, and is quite easily traced. This is called point source pollution. Other pollution enters from a variety of less traceable sources, for example, when rain washes over fields, forest floors, meadows, and rock outcroppings, carrying sediment into a water source. This is called non-point source pollution.

Hydrologists are people who study water. Hydrologists study the way water travels in the watershed (a region or area that drains into a body of water). In its meandering, water may be contaminated in various ways. In many instances water is altered to the extent that it becomes a hazard to wildlife, wildlife habitats, and humans.

PROCEDURE:

1. Before the activity begins, make tokens out of construction paper (using a paper punch) or purchase sequins. For the first water sample (Jar #1), make 1,960 blue tokens (representing water), 40 red tokens (representing other pollutants such as chemical or organic pollution), and 400 gold tokens (representing sediment, ecological pollution). For the second water sample (Jar #2) make 970 blue, 70 red and 1,360 gold. (If you feel your students would do better with larger tokens, you may want to cut ½ inch squares instead of using a paper punch.) Stir them so all the colors are thoroughly mixed. Make copies of the Clear as Mud activity sheets for each group (class will be divided into groups of two or three) as well as an extra teacher copy.
2. List the three major categories of pollution (chemical, organic and ecological) on the board and discuss each. Refer to the background section for a description.
3. Divide the class into groups of two or three. Each group will be acting as a research team and will analyze two samples of water from a local spring. Distribute the Clear as Mud activity sheets at this time.
4. Distribute the colored paper tokens of sample one, by having one member of each group measure 1 teaspoon of the paper punched tokens or 1 tablespoon of the cut ½ inch square tokens from Jar #1.
5. Instruct students to separate the colored tokens into different piles, according to color. Once this is done, they should count the number of each color and use crayons/colored pencils to fill in the bar graphs on their activity sheet. The units per sample (number of each color) should go up the side (y-axis) and the components (three different elements found in the sample; water – blue, sediment – gold, and other pollutants – red) across the bottom (x-axis). This will make it easier to compare each team's findings. Remind the class that each group has taken a sample from a slightly different location of the spring and at a slightly different time. Samples will be similar but not identical. All samples are carefully returned to the jar. Remind the students that in "real" water sampling, the sample would not be returned to the water source.
6. After the bar graphs are completed, compare each team's results and record them on the blackboard. Then repeat the same process with sample two. What is different? Why? Remind students that they are sampling from the same location. After discussion, students should be able to identify that the second sample was taken on a different day. The teacher asks, "What speculations can you make about this particular day?" The students should make the correlation between rain and erosion. More sediment has been added to the water because of a change in weather. This additional sediment has increased what is referred to as turbidity or the cloudiness of the water. If the water has higher turbidity levels that means more sediment or dirt is in the



water making the water cloudy so less light is able to travel through. Is that good or bad? How? Is it pollution? What kind?

7. Define turbidity as: the degree of cloudiness due to material suspended (held) in the water. Turbidity is measured by how much light can travel through a water sample. Show the students a piece of saran wrap and a piece of wax paper. Which of the two would have a higher degree of turbidity? The student's answer should be the waxed paper.
8. Discuss how natural elements are considered to be pollution when the elements' presence is out of balance with natural order. Discuss how runoff into sinkholes, from forest, field, meadows, etc. can travel into the water, thus changing the health of the water. Because water in this region comes from a large area it is difficult to pinpoint the exact source of pollution. This would be called non-point source pollution.
9. The students work in groups to complete their activity sheets. The class can discuss the answers as they finish.

EVALUATION: The teacher is able to evaluate the students by observing their interaction while working in groups and by observing the bar graphs and activity sheets in each group.

EXTENSION:

1. The students could research the current national and state laws protecting water quality in Texas and the U.S. The students could write a short history of the U.S. Clean Water Act.
 2. The students could invite a guest speaker from a local agricultural, conservation or other similar agency to speak about what their organization is doing to protect water.
 3. Students could travel to a stream or river to collect water and test it for various elements such as pH or dissolved oxygen.
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Research Team: _____

CLEAR AS MUD

Have you ever thought about what affects the water we drink? Many things that happen in our community or in surrounding areas may affect our drinking water either directly or indirectly. Maybe some of the things we do around our homes affect our water.

Pollution is a complex topic. There are three kinds of pollution affecting bodies of water in our area. They are:

Ecological Pollution: stresses ordinarily created by natural processes, e.g., abnormal increase of sediments in runoff producing large quantities of silt.

Chemical Pollution: the introduction of toxic substances into an ecosystem, e.g., contamination of a water supply by pesticides, or toxic spills from railroads and interstates.

Organic Pollution: over-supplying an ecosystem with nutrients, e.g., agricultural fertilizer.

In a few minutes you will be taking a sample of water collected from a spring. As a team you will need to measure the components of the sample which include: water (blue dots), ecological pollution=silt and sediment (gold dots), and other pollutants=chemical and organic (red dots). As in all research, it is important to be precise and accurate.

To set up your graph: to the left side of each graph (y-axis), you will put the number of units by 5 (0, 5, 10, 15, etc.) going up. Across the bottom (x-axis) you will list what you found in your sample (water, sediment, other pollutants). After you have counted the parts of your sample and prepared your graph, color in the rows with colored pencils.

Sample 1.

Sample 2.

Collector: _____

Collector: _____

[illegible][illegible]



Analysis Questions

1. Was there a big difference between sample one and sample two? Why or why not?
2. We have talked about turbidity being the amount of sediment in water. The higher the amount of sediment the less light that can pass through the water. If we were to compare saran wrap and wax paper to our sample –

Sample One would be more like _____

Sample Two would be more like _____

3. Write a definition and give an example for each of the following:
Point source pollution –

Non-point source pollution –

4. Name three problems that high turbidity could cause to a river ecosystem.

1.

2.

3.
