Amgen Award for Science Teaching EXCELLENCE

2008
Winning Lesson Plan from Coventry, Rhode Island

Water Testing

by Joyce Martinelli
Western Coventry Elementary School

Grade Level: 3

Duration: Participate in World Water Monitoring Day in October to introduce the idea of water testing, posting results on the web. Conduct water testing over a three week period in the spring.

Overview and Purpose

Third grade students test water from the pond on Western Coventry School property as a Service Learning Project and a real world extension of the third grade science curriculum. Service Learning Projects incorporate three components: student ownership, academic integrity, and apprentice citizenship. Students decide to test the pond, meet science standards, and work as apprentice citizens as they work in the field monitoring changes in the watershed. Activities target multiple intelligences: linguistic (reading directions and recording results), bodily-kinesthetic (manipulating tools), logical-mathematics and naturalistic (use numerical symbols and logic to evaluate the quality of pond water), interpersonal (discuss test results to build consensus and analyze data) and intrapersonal (write a reflection about their learning). Once students know the test procedures and vocabulary, they can look for patterns or changes in test results over time that might affect plant or animal life. Using data, students explore how changes in the environment can cause organisms to respond (survive, adapt, move away, die). Students discover that living things not only depend on each other but they depend on the habitat or natural resources to meet their needs.

This plan is innovative as it extends learning to an outdoor setting. Third graders use a nearby water source for a real world task, monitoring water in a watershed. Teachers need to take advantage of teachable moments and opportunities for learning. I contacted many sources and researched how to test the pond water. A graduate student from the University of Rhode Island presented information about the Watershed Watch. She suggested we participate in the World Water Monitoring Day www.WorldWaterMonitoringDay.org and can continue to monitor the water in our pond.

After collecting water samples, students make observations, analyze data, synthesize the information to draw conclusion about the quality of water and its ability to sustain life. As students conduct water testing they make connections between the science concepts learned in the Structure of Life unit, the Water unit, and the Animal Museum unit. The water testing takes a close look at one habitat. Students apply knowledge of many habitats gained through the Animal Museum. Students apply the knowledge of plants, animals, and water. They know the basic properties of water, the water cycle, and how water flows. The information they have gained has become previous knowledge for the water testing unit.

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Goals

1. Students will learn the habitat meets the needs of the organisms, by monitoring the elements of the pond, to determine constancy or patterns of change over time. They understand the concept of an ecosystem in which parts rely on each other to create the whole.
2. Students will learn the importance of clean water and the role of water quality monitoring within a watershed.
3. Students will learn how to conduct water tests; temperature, turbidity (clarity), dissolved oxygen, ammonia (Toxic Pollutants), nitrites (Toxic Pollutants), nitrates (Water Quality), and pH (Acidity/Alkalinity).
4. Students will learn the levels of each test needed to support life.
5. Students will learn new science vocabulary, for example ammonia, nitrite, nitrate, dissolved oxygen, turbidity.

Educational Standards Addressed

Grade Span Expectations

Life Science 3 (K-4) SAE-7

Using information (data or scenario), explain how changes in the environment can cause organisms to respond (e.g., survive there reproduce, move away, die).

LS3 (3-4)-7 Students demonstrate an understanding of equilibrium in an ecosystem.

By (7a) explaining what plants or animals might do if their environment changes (e.g., changing food supply, human impact, or sudden weather related changes).

Earth and Space Science 1

The earth and earth materials as we know them today have developed over long periods of time, through continual change processes.

ESS1 (K-4)INQ-1 Given certain earth materials, use physical properties to sort, classify, and describe them.

ESS1 (3-4)-1 Students demonstrate an understanding of earth materials by…

1d identifying the four basic materials of the earth (water, soil, rocks, air)

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Objectives

1. Students will follow directions for each water test, temperature, turbidity, pH, dissolved oxygen, ammonia, nitrites, and nitrates.
2. Students will read the level, discuss results, and agree before the recorder records the data.
3. Students will interpret the data in terms of being a good level or harmful level to support life.
4. Students will identify patterns or change in results over time.

Materials

Testing materials can be purchased through the World Water Monitoring Day site ($20.00 ea. Tests include: temperature, dissolved oxygen, pH, and turbidity). Or through Delta Education (Pond Test Kits approximately $20.00 ea 565-110-1462 Tests include: pH, ammonia, nitrite, nitrate).

For each group of four students:

- Procedures for Water Testing, Water Testing Data Sheet
- Tray, Container of water sample, safety glasses, protective gloves
- pH Test – Long tube and pH tablet
- Nitrite Test – Yellow tester, one yellow capsule
- Nitrate Test – Blue tester, one blue capsule
- Ammonia Test – Green tester, one light green capsule and one dark green capsule

For each class:

- 2 Air and Water Temperature Tests – thermometer
- 2 Dissolved Oxygen Tests – Small tube and two dissolved oxygen TesTabs
- 2 Turbidity Tests – Container from World Monitoring site with Secchi disk icon sticker in the bottom of the large white jar
- One Dissolved Oxygen/pH/Turbidity chart for comparison

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Procedures

(The directions for each test come from The Pond Kit and The Water Monitoring Website. The test procedures are written on a separate sheet to be used by the students as directions during the water testing.)

1. **Day 1:** Read Our Water Supply by Peggy Bresnick Kendler to introduce the water testing unit. The focus of the book is two guiding questions: Where does our water come from? How do we make our water safe?
2. **Day 2:** Watch The Magic School Bus Catches a Wave by Scholastic. There are three short stories, Wet All Over (life cycle of a water drop), Rocks & Rolls (journey of a boulder subject to water erosion), Ups & Downs (trip to the bottom of Walkerville Lake)
3. **Day 3:** Introduce the key vocabulary: ammonia, nitrite, nitrate, pH, dissolved oxygen, turbidity, liter. Make a chart with definitions to hang in the classroom. Review the steps in a Science Experiment: Choose a problem. Research your problem. Develop a hypothesis. (*if, then*) Write your procedures. (*control your variables*) Test your hypothesis. Organize your data. (*chart, table, graph*) State your conclusions.
4. **Day 4:** Read test procedures with the students explaining each step. Read the Water Monitoring chart. Discuss the Field Rubric that will be used as a self assessment.
5. **Day 5:** Collect water sample at the pond. Demonstrate each water test stressing the need to conduct each test two times for validity. Model recording of results on class chart. Discuss results and refer to Water Monitoring Chart.
6. **Day 6, 7 & 8:** Each student will have a job to encourage them to work together. Jobs are getter, reader, recorder, and reporter. The getter will get all the materials and return them when finished. The reader will read the directions for each test as the test is conducted. The recorder will record the data on the chart once all members confer and agree. The reporter will report the data to the class to be written on a class chart. Each student will conduct one test. Over three testing sessions the students will have a chance to conduct three different tests.

Discussion: At the end of the testing, students will analyze the data. Students make observations, propose explanations and raise questions. They compare results with the levels that support life to determine the water quality. Guiding Questions: What does the evidence show? What does it mean? What went well with the testing and what did not go well? Adjustments can be made for the next testing session.

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Assessments

- Students will use the Field Work Rubric as a self assessment.
- Students will be assessed on accurately recording and organizing the data on the group chart. Each cooperative learning group of four students will hand in one data chart.
- Teacher observation will assess student performance of following procedures during the water testing and student participation in the discussion on drawing conclusions based on the data.
- After three weeks of testing, students will write an explanation of data and write conclusions based on the data. Students will reflect on the experience and answer the question: What is our next step?

Activities Outside the Classroom

- Field trip to one of the Audubon Society sites for a Watershed Walk. Students learn about the role of a watershed and examine plant and animal life as they walk through fields, woods, and visit a pond.
- Students participate in the World Water Monitoring Day.
- Students walk to the pond to collect water samples.
- Students test the air and water temperature at the site.

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Procedures for Water Testing

(Information from the World Water Monitoring Site and the Pond Testing Kit.)

Temperature Tests

1. Hold the thermometer in the air for one minute.
2. Read the temperature and record the temperature as degrees Celsius.
3. Place the thermometer four inches below the water surface for one minute.
4. Remove the thermometer from the water, read the temperature and record the temperature as degrees Celsius.

Turbidity Test

1. Fill the jar to the turbidity line located on the outside kit label.
2. Hold the Turbidity Chart on the top edge of the jar. Looking down into the jar, compare the appearance of the Secchi disk icon in the jar to the chart. Record the results as Turbidity in JTU.

Dissolved Oxygen Test

1. Record the temperature of the water sample.
2. Submerge the small tube into the water sample. Carefully remove the tube from the water sample, keeping the tube full to the top. Drop two Dissolved Oxygen TesTabs into the tube. Put the cap on the tube.
3. Mix by inverting the tube over and over until the tablets have disintegrated. This takes about 4 minutes.
4. Let is stand for 5 more minutes for the color to develop.
5. Compare the color of the sample to the Dissolved Oxygen color chart. Record the result as ppm Dissolved Oxygen.
6. Locate the temperature of the water sample on the % Saturation chart. Locate the DO result of the water sample at the top of the chart.

pH Test

1. Fill the test tube to the 10ml line with the water sample.
2. Add one pH Wide Range TesTab.
3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.
4. Compare the color or the sample to the pH color chart. Record the result as pH.

Ammonia (Green/2 capsules) Nitrite (Yellow/1 capsule) Nitrate (Blue/1 capsule)

1. Fill both chambers with pond water to the level marks on the color chart.
2. The water should be at room temperature for best results.
3. Take one capsule and holding it vertically with the lid pointing up. Gently tap the bottom of the capsule against a hard surface to settle the contents. Carefully open the capsule over the test chamber by twisting the two halves apart. Pour the powder into the test chamber (small opening).
4. Put the cap on. Shake until the powder disappears.
5. Let it stand for 5 minutes. (Nitrite, Nitrate) (Allow 30 minutes for Ammonia).
6. Compare the colored solution in the test chamber with the color chart alongside. Select the colors against a white background (1in. away) using natural daylight (with the light source from the side).
7. Read your results and write them down.

Water Monitoring

(Information from the World Water Monitoring Website and Pond Test Kit)

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Water Test	Good Level to Support Life in Natural Waters	Not Good
Water Temperature	14 to 40 degrees Celsius	Water temperature too hot or too cold can have severe effects on fish and other aquatic life.
Turbidity (clarity) – measures the water's clarity. Less clear = more turbid. Turbidity affects photosynthesis, the ability of plants to make their own food.	0 JTU	Turbid water is caused by clay, silt, organic and inorganic matter, and microscopic organisms. Dark colored water can still be clear and not turbid. Turbid water can be the result of erosion, boat traffic, urban runoff and too much algae.
Dissolved Oxygen – measures the number of oxygen molecules in the water.	Greater that 5 to 6 ppm (parts per million) High DO levels support a healthy ecosystem.	Low levels of DO can weaken or kill fish and other aquatic life. Lots of leaves, tree branches, decaying grass use up the DO and lower the quality of water.
pH – a measure of acidity or alkalinity of a solution.	6.5 and 8.2 pH	Scale 0-14 1 (most acidic) increases pollutants and causes a shortage of oxygen 14 (most basic) can harm fish 7 (neutral) Industrial waste, agricultural runoff
Ammonia – a colorless gas with a strong smell.	0.0 mg/liter Ideal 0.2 mg/liter Caution	1.0 mg/liter Danger 3.0-5.0 mg/liter Fatal A high level of ammonia is harmful to fish. Remove as much debris as possible.
Nitrite levels reflect the balance between plant life and the number of fish in the pond.	0 mg/liter Ideal 0.1 mg/liter Acceptable 0.25 mg/liter Tolerable	0.5 mg/liter Caution 5.0 mg/liter Danger In ponds, nitrates are consumed by plants and algae as food. Remove as much debris as possible.
Nitrate – a salt, increases plant growth, too much can be harmful to fish.	2.5 mg/liter Very Good 5 mg/liter Good 15 mg/liter Acceptable	25 mg/liter Poor 50 mg/liter Very Poor

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Field Work Rubric

	1	2	3	4	5
Time on Task	90–100%	80–89%	70–79%	60–69%	Less that 60%
Impact on Group Work	Makes negative impact	Indifferent	Makes a small impact	Makes positive impact	Makes strong positive impact
Directions	Does not listen to and understand directions	Seldom listens to and understands directions	Generally listens to and understands directions	Consistently listens to and understands directions	Explains directions to others
Tools & Equipment	Does not listen to and understand directions	Seldom takes responsibility for use and care of tools equipment	Generally takes responsibility for use and care of tools equipment	Consistently takes responsibility for use and care of tools equipment	Takes extra responsibility for use and care of tools equipment

Water Testing Data Chart

Date				
Air Temperature				
Water Temperature				
Turbidity (Clarity)				
DO (Dissolved Oxygen)				
pH (Acidity/Alkalinity)				
Ammonia (Toxic/Pollutants)				
Nitrites (Water Quality)				
Nitrates (Water Quality)				