WETLAND WATER TESTING

Summary

Using card games, hands-on activities, computer activities, and water quality vocabulary, students understand some different properties that affect water quality, and learn to measure one chemical characteristic that helps determine water quality.

Objectives

Students will:

- know water and water quality vocabulary
- know that different properties affect water quality.
- learn to measure the presence of a chemical property that helps determine water quality.

CA Standards Addressed:

Grade Six - *Science investigation and experimentation 7.b:* "Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data."
Grade Seven - *Science investigation and experimentation 7.a:* "Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data."

Outline

1) Activity: Can You See Water Pollution? (15 minutes)
2) Water vocabulary concentration game (20 minutes)
3) pH testing computer activity (15 minutes)
4) Practice pH testing on 6 various common liquids (25 minutes)
5) Journal prompt (5 minutes)
6) Closing circle (5 minutes)

The Basics:

Grade Level:
6 - 8

Subject areas:
Physical science

Duration
85 minutes

Materials:

Prep for the pollution activity:
1. Five clear glasses, each containing a sample of one of the following: wetland water, tap water, bottled water, water with food coloring, water with rubbing alcohol
2. Erasable crayon to mark each glass A, B, C, D, or E

For card game:
1. One deck of water vocabulary cards (teacher's kit) for every 3-4 students

Prep on each computer, before
1. Launch "Wet Your Waders."
2. Click "skip credits"
3. Click "skip introduction"
4. The next page says "Where Am I?" Click on the shape of California (it will say you are in the Southwest). Click "continue"
5. The next page asks which tests you want to practice. Choose "pH." Click "continue."
6. The next page asks the area to sample. Click "farmland"
7. Click "continue."
8. The software is now ready for the students.

For the water testing lab:
1. Samples of different liquids (e.g. lemon juice, cola, Windex, bottled water, slough water, Miracle-Gro.)
2. WERC's water testing kit with pH testing supplies

for each student:
1. One copy each of the following handouts: pH Computer Lab Worksheet, Water Lab Worksheet and Journal Prompt 5
2. Science notebooks and pencil, colored pencils or markers

Background Material

excerpted from "Measuring Stream Health" in Save Our Streams

Water is essential to human life and to the health of the environment. As a valuable natural resource, it comprises marine, estuarine, freshwater (river and lakes) and groundwater environments, across coastal and inland areas. Water has two dimensions that are closely linked - quantity and quality. Water quality is commonly defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics. A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health. Water quality in a body of water influences the way in which communities use the water for activities such as drinking, swimming or commercial purposes. More specifically, the community may use the water for:

- supplying drinking water
- recreation (swimming, boating)
- irrigating crops and watering stock
- industrial processes
- navigation and shipping
- production of edible fish, shellfish and crustaceans
- protection of aquatic ecosystems
- wildlife habitats
- scientific study and education

Why is water quality important?

Our water resources are of major environmental, social and economic value, and if water quality becomes degraded this resource will lose its value. Water quality is important not only to protect public health - water provides ecosystem habitats, is used for farming, fishing and mining, and contributes to recreation and tourism. If water quality is not maintained, it is not just the environment that will suffer - the commercial and recreational value of our water resources will also diminish.

What affects the quality of our water?

Water quality is closely linked to the surrounding environment and land use. Other than in its vapor form, water is never pure and is affected by community uses such as agriculture, urban and industrial use, and recreation. The modification of natural stream flows by dams and weirs can also affect water quality. The weather, too, can have a major impact on water quality. Groundwater is an integral part of our water supply. At times of low river flow groundwater enters the rivers, maintaining river flow. Although data on groundwater quality is limited, it is clear that, like other bodies of water, groundwater close to urban or industrial development is vulnerable to contamination.

Generally the water quality of rivers is best in the headwaters, where rainfall is often abundant. Water quality often declines as rivers flow through regions where land use and water use are intense and pollution from intensive agriculture, large towns, industry and recreational areas increases. There are of course exceptions to the rule and water quality may improve downstream, behind dams and weirs, at points where tributaries or better quality groundwater enter the mainstream, and in wetlands.

Rivers frequently act as conduits for pollutants by collecting and carrying wastewater

from catchments and, ultimately, discharging it into the ocean. Storm water, which can also be rich in nutrients, organic matter and pollutants, finds its way into rivers and oceans mostly via the storm water drain network. Beach water quality may also be affected by bacteria from sewer overflows or other runoff into storm water drains.

How is water quality measured?

The presence of contaminants and the characteristics of water are used to indicate the quality of water. These water quality indicators can be categorized as:

- **Biological:** bacteria, algae
- **Physical:** temperature, turbidity and clarity, color, salinity, suspended solids, dissolved solids
- **Chemical:** pH, dissolved oxygen, biological oxygen demand, nutrients (including nitrogen and phosphorus), organic and inorganic compounds (including toxicants)
- **Aesthetic:** odors, taints, color, floating matter
- **Radioactive:** alpha, beta and gamma radiation emitters.

Measurements of these indicators can be used to determine and monitor changes in water quality and determine whether the quality of the water is suitable for the health of the natural environment and the uses for which the water is required.

How does water quality affect aquatic ecosystems?

An ecosystem is a community of organisms - plants, animals, fungi and bacteria - interacting with one another and with the environment in which they live. Protecting aquatic ecosystems is in many ways as important as maintaining water quality, for the following reasons:

- Aquatic ecosystems are an integral part of our environment. They need to be maintained if the environment is to continue to support people. World conservation strategies stress the importance of maintaining healthy ecosystems and genetic diversity.
- Aquatic ecosystems play an important role in maintaining water quality and are a valuable indicator of water quality and the suitability of the water for other uses.
- Aquatic ecosystems are valuable resources. Aquatic life is a major source of protein for humans. In most countries, commercial and sport fishing is economically important.
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pH

pH is a common measure of water quality. pH stands for "potential hydrogen," which is a measure of the hydrogen or hydroxyl ion concentration of the water, which determines whether the water is acidic or basic (alkaline). The pH scale is logarithmic, with values of 1 to 7 (acidic) and 7 to 14 (alkaline). Because the scale is logarithmic, a pH of 2 is 10 times more acidic than a pH of 3. pH levels of 1 are equivalent to battery acid, and a pH of 3 to vinegar. Ammonia, on the other hand, has a pH of between 11 and 12 (alkaline).

Rainwater is somewhat acidic with a pH of about 6.5. The pH concentration of water is extremely important to aquatic life. pH affects respiration rates of fish as well as the solubility of many chemicals and metals. Most fish species have pH tolerance ranges from 6 to 8.5. If pH is above or below these levels, fish numbers and reproduction rates are affected. Low pH affects the solubility of metal ions; it can liberate harmful metals such as aluminum that are naturally present in the soil but to not become mobile until leached by acid water. These metals can reach surface and groundwater, contaminating fish and poisoning aquatic life.

Procedure

1) Activity: Can You See Water Pollution? (15 minutes)

- Gather students in a circle. Review the meaning of the word "pollution." Tell students they will be starting out with an activity to see how easy it is to tell whether or not water is polluted. Tell students that you are going to pass some samples of water around. Ask students to use their senses of smell and sight to observe the water. After each glass goes around, ask students to say why they believe the glass is polluted or not, then discuss the correct answers:
    1. Glass with tap water: This water is polluted because tap water contains chlorine. Although people need chlorine in tap water to kill bacteria and other microorganism that are harmful to people, chlorine is extremely toxic to fish and other aquatic live, even below detectable levels.
    2. Glass with bottled water: This water may be able to support aquatic life. It has not been treated with chemicals, but instead has been filtered. It probably is not polluted.
    3. Glass of water with food coloring: This water looks polluted because it is discolored. Although the EPA does not categorize color as a pollutant, color can pollute water by blocking light to underwater plants, preventing photosynthesis, during which plants make oxygen critical to aquatic life.
    4. Glass of water with rubbing alcohol: This water looks clean but smells terrible. This water obviously is polluted even though it looks perfectly clear. This sample reminds students that their sense of smell often is very important in determining if water is polluted. Water may look clean but smell like sewage or other pollutants.
    5. Glass with wetland water: This water may or may not be polluted - you cannot tell just by looking. Tests need to be done to determine if pollution is present.
- Discuss the following questions:
    1. Is it easy to tell if water is polluted?
    2. What are some things that can pollute water? How do these pollutants get in the water?
    3. What is water quality? Why is water quality important?
    4. Do you know any laws that are designed to protect clean water? (Clean Water Act of 1972)
    5. Do you think clean water laws are always enforced?

2) Water vocabulary concentration game (15 minutes)

- Seat students in groups of 3-4 at classroom tables. Give each group a deck of water vocabulary cards.

- Tell students they will play the card game called Concentration to learn some vocabulary water words about water and water quality.
- Go over the rules of the game: Lay the cards facedown in a square. Students take turns turning over two cards at a time. Students are looking for vocabulary words with matching definitions. If they find a match, the student keeps that pair and takes another turn. If the pair does not match, the next student takes his or her turn. Players take turns until all the pairs are matched. The winner is the student with the most pairs.

3) pH testing computer activity

1. Direct each student or pair of students to sit at a computer. Give each student their science notebook, a pencil, and a copy of pH Computer Lab Worksheet
2. Tell students that they will use the computer to learn about one test that scientists use to test water quality. This test measures the pH of the water.
3. Tell students that they will watch a short movie telling them more about pH and it is an important measure of in water quality. Then they will answer a couple of review questions. Tell them that after watching the movie and answering the questions, they will learn how to do testing for these properties.
4. Ask students to write down at least one question they think of about the material, and to also record any observations, or unfamiliar vocabulary words in their science notebook.
5. Monitor the students as they work through the lesson. When everyone is finished, gather the students in a circle. Ask students to go around the circle and ask a question they thought of.

4) Water quality testing lab

1. Give students one copy of the page pH Testing Lab to document results.
2. Tell students they will practice doing pH testing on lemon juice, cola, Windex, bottled water, slough water, Miracle-Gro (if you are testing on other liquids, incorporate those into your discussion).
3. Ask students for some predictions on what they expect to find. Write predictions on the white board. (Example: Based on your computer activity, what do you think the pH of lemon juice might be? of tap water?). Direct students to write down their predictions in the appropriate column on the Lab Worksheet.
4. Divide students into groups and direct them to the lab to begin testing.
5. When testing is complete, gather the students together in a group. Discuss: What did student discover? Did each group get similar results? Go back and revisit your predictions - how did the actual numbers compare to the predictions? Was the pH of the tap water different from the wetland water? How were the numbers for the cola different from the numbers for the water? What about the juice?
6. Ask students: Do you remember the range of pH that fish can safely live in? Would wetland life be able to live in any of these liquids? Why or why not?

7) Journal prompt (5 minutes)

8) **Closing circle (5 minutes)**
Gather students in a circle and ask each to say one thing they can do to help keep water clean. Optional - pass out water quality literature for each student to take home and share with their families.

Extensions:

1. Go out into the field to practice water quality testing at several sites in the Watsonville Sloughs. Discuss your findings.
2. Over the course of several months, visit the same sites to collect water quality data. Make a chart to record your findings.
3. Watch the movie "Strange Days on Planet Earth: Troubled Waters" (a National Geographic movie, available at the Fitz WERC)

Bibliography/Resources used:

Firehock, Karen. 1995. Hands on save our streams. The Izaak Walton League of America, Inc. Gaithersburg, MD.

WETLAND COMPUTER LAB WORKSHEET pH

Name: _____Date:_____

Use the space below to write down any questions or comments you have while you are doing the pH computer activity:

When you are finished, write how a pH measurement gives a clue about water quality

WATER LAB WORKSHEET WATER QUALITY: pH

Name: _____Date:_____

description or name of liquid:	predicted pH	actual pH	comments

WETLAND NOTEBOOK JOURNAL ENTRY
WETLAND WATER TESTING

NAME_____DATE_____

Draw a poster you can use to tell other people about water pollution and water quality in the wetlands. Use some of the vocabulary words you learned today.

❖ Erosion ❖	❍ Oxygen ❍	☆ Nutrient ☆
❖ a process by which soil is carried from one place to another ❖	❍ a colorless gas that all animals and plants need to survive ❍	☆ foods or chemicals that plants and animals need to live and grow ☆
☺ Conservation ☺	♒ Water Cycle ♒	☟ Groundwater ☟
☺ the preservation and wise use of natural resources ☺	♒ water's continuous movement between the land, oceans, and atmosphere ♒	☟ water that is found beneath the surface of the earth ☟

⓪ Percolation ⓪	☹ Pollutant ☹	☠ Water Pollution ☠
⓪ water movement through spaces in soil ⓪	☹ a harmful chemical or waste material released in to the water, air, or soil ☹	☠ the presence of chemicals in bodies of water that can harm plants and animals ☠
♋ Water Quality ♋	⚹ pH ⚹	⛲ Watershed ⛲
♋ a phrase that describes how well a body of water can support different forms of life ♋	⚹ a measure of how acid or alkaline/base the water is ⚹	⛲ an area of land that drains into the same body of water ⛲

Water	Precipitation
a colorless liquid needed by all living things	fog, mist, rain, hail, or snow that falls from clouds

Can survive pH of 5.5 and above

Mussels
Stoneflies
Mayflies
Alderflies
Snipeflies
Riffle Beetles

Can Survive pH of 4.5 and above

Damselflies
Dragonflies
Crayfish
Caddisflies
Snails
Amphipods

Can Survive pH of 4 and above
Worms
Midgeflies
Leeches