The Education Program at the
New Jersey Sea Grant Consortium
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WATER QUALITY MONITORING

OVERVIEW This lesson describes testing methods for four important parameters of water quality, dissolved oxygen, **pH, salinity** and **clarity/turbidity**.

OBJECTIVES Following completion of this lesson, the students will be able to:

- Understand four parameters of water quality.
  Be able to perform tests for **salinity**, dissolved oxygen, **pH** and **clarity/turbidity**
- Understand why scientists and environmental managers monitor water quality and aquatic resources.

GRADE LEVELS 6^{th} -12^{th} grades

NJCC STANDARDS **Science Indicators:**
5.1, 5.3, 5.4, 5.5, 5.7, 5.8, 5.10

MATERIALS

- **Hydrometer**, LaMotte Winkler - Titration Method Dissolved
- Oxygen, bucket, water sample, chemical waste receptacle,
- Thermometer, Ammonia test kit, secchi disk, Hach **pH** test kit.

PROCEDURES **Dissolved Oxygen Test Instructions:**

1. Rinse the sample bottle three times. Obtain an air-tight sample by submerging the sample bottle fully under the water and slowly allow the water to fill the bottle and cap the bottle under water.
2. Uncap sample bottle, making sure that the plastic cone from the cap stays in the cap. This plastic cone in the cap displaces the proper amount of water to allow room for the chemicals to be added to the sample. Keep the plastic cone in the cap at all times.
3. Add 8 drops of Manganous Sulfate solution (pinkish solution) and 8 drops of Alkaline Potassium Iodide Azide Solution (same size bottle, clear solution).
4. Cap the sample bottle and mix by inverting several times. A precipitate will form.
5. Place the bottle in an undisturbed area and allow precipitate to settle below the shoulder of the bottle. (About 5 minutes.)
6. Add 8 drops of Sulfuric Acid (clear solution with red cap). Cap and gently shake until precipitate is completely dissolved.
7. Fill titration tube (glass bottle and cap with hole in top) to the 20 ml mark.

8. Fill the direct reading titrator (syringe) with Sodium Thiosulfate. When filling the direct reading titrator, the upper part of the black rubber stopper should be even with the zero mark. Make sure that there are no air bubbles in the column.
9. Insert the direct reading titrator into the center hole of the titration tube cap.
10. Add one drop of Sodium Thiosulfate and gently swirl the tube. Continue one drop at a time until the yellow-brown color is reduced to a very faint yellow. The term "very faint" is subjective. It is helpful to bring a piece of white paper with you to hold the sample up against to determine the faintness of the color.
11. Remove the titration tube cap, being careful not to disturb the plunger. Add 8 drops of the Starch Indicator Solution and gently swirl.
12. Replace the titration cap. Continue adding one drop of Sodium Thiosulfate at a time and swirl until the blue solution turns clear.
13. Read the test result where the plunger tip meets the scale. Record as ppm (parts per million) of dissolved oxygen.

pH Testing Procedure:

1. Rinse each test tube with the water sample. Gloves should be worn if hands need to be in contact with the water.
2. Fill both tubes with sample water to the first line (5 ml mark).
3. Add 6 drops of Wide Range 4 **pH** indicator solution into one tube and swirl to mix. This is your prepared sample.
4. Place the tube of the prepared sample into the right opening of the comparator.
5. Place the other tube into the other opening as a blank comparison.
6. Hold the comparator up to the light source (or sun). Match the color on the comparator to the color of the prepared sample.
7. The number on the comparator that best matches with the sample is the **pH**.
8. Record the **pH** value.
9. Wash your hands.

Discussion

1. What can happen if there is a sudden change in the **pH** value of the water? Why is it important to know the **pH** of the water?
   What living things are very vulnerable to a change in **pH**?

Clarity and Turbidity Test Procedure

1. Lower the Secchi Disk into the waterbody.
2. Stop when you can no longer see the disk.
3. Slowly pull the disk out of the water and see how deep it went into the water by measurements on the rope before it was out of view. Repeat the procedure. Average the two readings.

4. How many "knots" or meters deep did it go? Record your answer.

Discussion

1. What factors contribute to **turbidity**?
2. What happens to loose soil from construction sites?
3. What happens to the large population of plankton in summer?
4. What happens to the sediment from bare lawns and unprotected shorelines?
5. What happens when excess nutrients from run off cause the growth of algae?
6. Why is there usually higher **turbidity** in the summer than the winter?
7. What happens if underwater plants do not get enough light?

Measuring Salinity

1. Fill a 100 ml graduated cylinder with your water sample.
2. Using a thermometer record the temperature, then remove the thermometer.
3. Place the **hydrometer** in the cylinder. Wait until the **hydrometer** has stopped bobbing around.
4. Read and record the specific gravity, the number on the **hydrometer** that is in line with the water level. Be sure your eye is even with the water level in the jar, viewing up or down or at an angle can give an inaccurate reading
5. Use the **salinity** conversion table to get the **salinity** reading in parts per thousand.

BACKGROUND

Discussion

1. Why is it important to know the **salinity** of a body of water?
2. How could changes in **salinity** effect organisms living saltwater?
3. What factors could lower or increase **salinity**?
4. Why don't we use specific gravity only to measure the amount of salt in the water?

Water quality refers to the quality of water... that is, how clean or dirty it is. Healthy, clean water is essential to all living things. Water quality testing is done for several main reasons. First, to maintain a high water quality standard for domestic and institutional use, (i.e. for humans to drink and clean with) and also to ensure that our streams, rivers, estuaries, and oceans are clean enough to support the great variety of life in and around them, including fish, insects, birds, mammals, plants, and even bacteria.

Taking a single measurement of water quality is actually less important than looking at how the quality varies over time. For example, if you take the **pH** of the creek behind your school and find that it is 6.0, you might say, "Wow, this water is acidic!" But, a **pH** of 6.0 might be "normal" for that creek. It is similar to how normal body temperatures work (when we're not sick) someone may have a normal temperature at about 97.5 degrees, but my normal temperature is "really normal" -- right on the 98.6 mark. As with our temperatures, if the **pH** of your creek begins to change, then you might suspect that something is going on somewhere that is affecting the water, and possibly, the water quality. So, often, the ***changes*** in water measurements are more important than the actual measured values.

Dissolved oxygen (D.O) refers to the amount of free oxygen dissolved in water which available to respiring aquatic organisms. Although water is composed of two parts hydrogen to one part oxygen, organisms cannot use the oxygen that makes up water. This is because the oxygen and hydrogen are bonded together, and the oxygen needs to be free for the organisms to breathe. Aquatic plants are primarily responsible for releasing oxygen into water, which happens during **ph**otosynthesis, plus oxygen can enter the water when mixing with air as the water flows, or during wind or wave action. **D.O.** is affected by many factors. Cold, fresh water holds more oxygen than warm or salty water. When the weather conditions are dry and hot, the water temperature increases, which may result in evaporation, causing oxygen concentrations to decrease. Loss of oxygen also occurs when plants die and begin to degrade. Aquatic organisms and plants consume oxygen during respiration. **D.O.** levels may be seriously depleted when too many animals and plants are present in a body of water. Minimum concentrations of **D.O.** must be maintained in order to support life as well as be of beneficial use. Levels of **D.O** are measured in parts per million (PPM). **D.O** levels below 5-6 ppm can affect fish health, and levels below 3 ppm can be lethal to almost all aquatic organisms. A reading of 9.0 ppm in a body of water would indicate a very healthy system with plenty of oxygen for all forms of life. Using the **D. O**. test kit you can determine the dissolved oxygen in the water sample.

The method described in the lesson plan is straightforward, easy to follow and reads like a recipe **pH** represents how acidic or alkaline (basic) a solution is and measured on a scale of 0 to 14. A **pH** below 7.0 is considered acidic and a **pH** above 7.0 is alkaline. The midpoint of 7.0 on the **pH** scale represents a "neutral" solution that is neither acidic nor alkaline**. pH** is an important indicator of water that is chemically changing. Changes in the **pH** value of water are important to many organisms. Most organisms have adapted to life in water of a specific **pH**,

immature stages of aquatic insects and immature fish are extremely sensitive to **pH** values. Some species are so sensitive to changes in the **pH**, and they may perish if the **pH** changes even slightly. At extremely high or low **pH** values (9.6 or 4.5) the water becomes unsuitable for most organisms. A **pH** value that is changing in a body of water can be a great indicator of increasing pollution or some other environmental factor. As with the sample collected for the dissolved oxygen test, the water sample for the **pH** test should be collected away from the riverbank and below the surface. The sample must be measured immediately because changes in temperature can affect the **pH** value. See instruction sheet in the activity section of the lesson plan.

Turbidity is a measurement of the cloudiness in water and is caused by suspended sediments that have been trapped in the water. The sediments come from eroded and/or disturbed soil, which flow with runoff into water sources. Algae can also add to the **turbidity** problem. **Turbidity** blocks the sunlight that is so vital to aquatic life. **Turbidity** also chokes fish, oysters, and other creatures whose gills are clogged by sediment. The suspended particles absorb heat from sunlight and warm the water, decreasing dissolved oxygen. Light penetration is important to aquatic habitats. Submerged plants need light for growth; the plants give off oxygen which helps keep the water environment healthy. Many animals depend upon these plants for food. One way **turbidity** is determined is by measuring for **clarity** with **a Secchi Disk**, a white and black disk on a calibrated line that is lowered into the water until it can no longer be seen. It is then raised until it reappears. The average of these two readings is then recorded. A low **clarity** reading may indicate high **turbidity**. Follow the test procedures in the activity section of the lesson plan.

Salinity is the total of all salts dissolved in water, usually expressed as parts per thousand (ppt). The ocean has an average **salinity** of 35 ppt, streams and rivers are mostly freshwater and have a **salinity** of 0-3 ppt.

In an estuary, the flow of fresh water from streams and rivers mixes with salty ocean water, producing a range of **salinity** from 0 to 35ppt. The salt content of water affects the distribution of animal and plant species according to the amount of **salinity** they can tolerate. Some animals may tolerate a range of different salinities, however most organisms cannot. **Salinity** may be calculated by measuring the specific gravity of a sample of water using a **hydrometer**, correcting for the effect of temperature and converting the readings to **salinity** by means of a **salinity** conversion table. A **hydrometer** is a floating instrument used to determine specific gravities or densities of liquids. Fill a 100 ml graduated cylinder with your water sample, using a thermometer get a temperature reading. Then remove the thermometer and place the **hydrometer** in the cylinder. Wait until the **hydrometer** has stopped bobbing around. Be sure your eye is even with the water level in the cylinder. Viewing up or down or at an angle can give an inaccurate reading. Read and record the specific gravity. Use the **salinity** conversion table to get the **salinity** reading in parts per thousand. See activity section for complete instructions.
Clarity- the measure of light that is penetrating through the water.

VOCABULARY

D.O. - Dissolved Oxygen- a free oxygen molecule dissolved in water for use by respiring organisms and plants.

Hydrometer - A floating instrument used to determine the specific gravities of liquids.

pH- a measure of how acidic or basic a solution is measured on a scale from 0-14.

Salinity- the amount of salts dissolved in water.

Turbity- the cloudiness of water caused by total amount of suspended solids in the water.

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