The Quality of Water

Grade Level:
Upper Elementary, Middle School

Subject Area:
Earth Science – Water Quality

Duration:
Subject Introduction: 10 to 15 minutes
Activity Time: 30 to 40 minutes

Location:
Outdoor setting
(Can be conducted indoors if samples are collected before hand)

Objective:

1. To introduce the concept of water quality testing, utilizing kits and/or scientific instruments.
2. To link the importance of good water quality for humans and other living things.

NYC Performance Standards:
Science:
Physical Sciences Concepts – S1a
Life Sciences Concepts – S2a,
Earth & Space Sciences Concepts – S3a, S3d
Scientific Connections & Applications – S4a, S4c, S4d,
Scientific Thinking – S5a, S5b, S5c, S5f
Scientific Tools and Technologies-S6a, S6b
Scientific Communication – S7a, S7b, S7d
Scientific Investigation – S8a, S8b, S8d
Math:
Arithmetic and Number Concepts – M1a, M1d,
Function and Algebra Concepts – M3a

Background Information:
Many students have a general understanding that good water quality is essential to their survival. However they are often unaware of how water quality affects other organisms, especially those that live within an aquatic environment

Water quality is in continuous flux and slight changes in one parameter can lead to large changes in another. For example, as water temperature increase, the amount of dissolved oxygen decreases. Its what you see when you boil a pot of water. As the water begins to heat, the water molecules begin to move faster, literally pushing the oxygen molecules out of the water. We first notice it as bubbles on the bottom of the pan and eventually those bubbles begin to escape.

There are six water quality parameters that are easy for students to test: pH, temperature, dissolved oxygen, nitrogen, phosphorous and turbidity.

The **pH** is the measurement of the concentration of acid or base in a system and is measured on a scale of 0 to 14. Pure water has a pH of 7 (neutral), acids are between 0 and 7, and bases are between 7 and 14. Examples of acids include vinegar, citrus, and most colas. Bases are often things such as drain cleaner, ammonia, baking soda and soaps. Most water bodies are naturally mildly acidic or basic, depending on the geology of the watershed. The majority of aquatic organisms live within a narrow range of 6.5 to 8.6 on the pH scale.

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Water temperature is naturally affected by seasonal and daily fluctuations and has a huge impact on the biological and chemical processes in an aquatic system. As mentioned above, warm water holds less oxygen which in turn results in less diverse plant and animal communities. One example of this is the difference between tropical marine systems and temperate marine systems. The water in the tropics is usually clear and the water seems to be teeming with life. However that clarity in the water is a result of not enough oxygen in the system to support a large number of marine organisms because the water temperature is so warm. In temperate zones the water often looks murky, but that murkiness is due to millions of microscopic plants and animals that are thriving in the cold, oxygen rich environment.

Much like a glass of water can only dissolve a certain amount of lemonade powder, water can only **dissolve** a certain amount of **oxygen**. The amount of oxygen water can hold is completely dependent on the water temperature as well as the amount of oxygen that is consumed and produced within the aquatic system. If more oxygen is consumed by aquatic organisms than is produced, the dissolved oxygen levels decline and the system becomes unsuitable for sensitive aquatic species.

Phosphorous and **nitrogen** are two nutrients that are essential for plant and animal growth. But as the old saying goes "a little goes a long way" applies to these two nutrients. Excess nitrates and phosphates in an aquatic system can result in an increased plant growth (often algal growth) called eutrophication. Eutrophication results in decreased dissolved oxygen levels and sometimes increased temperature.

Turbidity measures the amount of suspended particles in water that scatter light. It is basically a measurement of cloudiness (color is not part of a turbidity measurement). Suspended particles can absorb more heat than water that can increase the temperature and decrease the dissolved oxygen. Turbid waters also decrease the amount of penetrating light, which can inhibit photosynthesis, which in turn reduces the rate oxygen is produced in water as well as the amount of available plant food for aquatic organisms.

Vocabulary:

Water Quality – The physical, chemical and biological characteristics of water that tells the health of the water system.

pH – The measure of the concentration of acids and bases.

Eutrophication – The addition of nutrients to a water body, which often indirectly leads to depleted oxygen concentrations

Turbidity – Murkiness or cloudiness of water caused by particles, such as a fine sediment (silts, clays) and algae.

Dissolved Oxygen – Oxygen that has been dissolved in water.

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Materials:

2 Thermometers
1 pH test kit and tabs
1 Nitrate test kit and tabs
1 Phosphate test kit and tabs
1 Dissolved Oxygen test kit and tabs
1 Turbidity test kit
1 Waste jar
1 Picture of tropical marine system
1 Picture of temperate marine system
5 Water collection vessels
2 Boxes of plastic gloves

Procedures:

Warm-Up:

1. Show the students the two marine pictures and ask them which system has the most aquatic life in it.
2. Have the students list what the aquatic animals will need to survive (e.g. oxygen, food, climate etc).
3. Explain to them that they are going to be highly sensitive scientific experiments that can change with the time of day.
4. Go over the scientific method briefly.

Main Activity:

1. Divide students up into five groups and assign each group one water quality parameter to test.
2. Explain to all the groups how they are to measure the water out in each measurement test tube. Make sure the water meniscus is in line with the measurement quantity.
3. Divide the student groups between NYRP staff. Each instructor will help to model the test with the individual student groups. Each test has laminated instructions inside for students to follow; however the NYRP staff should help students as much as possible and explain what is happening.
4. Distribute gloves to all students who are going to do the experiments.
5. Have students collect water from the end of the Swindler Cove bridge using the water collection vessels. Students will use this water for their tests.
6. While students are waiting for their test results, take the opportunity to explain why the parameter they are measuring is important.
7. Bring all the groups together and have each group present their results to the entire class. Each group needs to explain why they measured this parameter and how it will affect the other water quality measurements.
8. All students should record the results on their worksheet data sheets.

Wrap-Up

1. Final review of results with students that looks at whether the results each group measured coincide with what is happening around Swindler Cove, with the time of year, and whether they think it's a healthy environment.