**Constance Myers**

MITEP Lesson Plan

**Lesson: Is Water Healthy???**

**Purpose:**

The purpose of the lesson is to enable students to fully understand and apply fundamental methods of testing water quality. This will include the collection, display, and interpretation of student data.

**Teacher Notes:** This lesson may be presented using an on-site water testing experiential lesson or an in- class water quality testing class session. Both require safety equipment which must be obtained and at hand before the experiments. The teacher needs to demonstrate the use of goggles, gloves if necessary, and the testing equipment. The instructor should model recording the data as well as use of the equipment. Your local school should have access to pH test kits. If not, there are many sources such as www.hydroponics.net to obtain the test kits.

**Objectives:**

*The learners will:*

- identify five characteristics of a healthy river/pond.
- measure the pH, nitrate, nitrite, hardness and alkalinity, and diversity of macroinvertebrates in local rivers/ponds
- record his/her data on a table and display the findings graphically.

**Engage:**

- demonstrate knowledge of the term "***Commons***" as it relates to water.
- Vocabulary:

| | |
|---|---|
| **Commons** | (n) Resources which are not owned, either privately or by the state, but are left open for free use by all comers |

- write a report stating a position relative to water quality, defending it with data and making the connection to stewardship.

## Standards:

1. S.IP.06.12.Design and conduct scientific investigations.
2. S.IP.06.15.Construct charts and graphs from data and observations.
3. S.IA.06.11.Analyze information from data tables and graphs to answer scientific questions.
4. S.RS.06.17.Describe the effect humans and other organisms have on the balance of the natural world.
5. L.EC.06.41.Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems.
6. S.IP.07.12.Design and conduct scientific investigations.
7. S.IP.07.15.Construct charts and graphs from data and observations.
8. S.IA.07.11.Analyze information from data tables and graphs to answer scientific questions.
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13. S.RS.07.17.Describe the effect humans and other organisms have on the balance of the natural world.

National Science Standards:

**ESS2.C: The Roles of Water in Earth's Surface Processes**

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)

**Developing and Using Models**

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-ESS2-1)
- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)

## Materials:

- Clothes that can be soiled
- Nets for each group - they may use: Kick Nets, D-Nets, Surber Nets, or Dip Nets (10)
- Gloves (10 per class)
- Soap
- 25-50 ml test tubes (10)
- pH test kit

    Wide Range Indicator Solution

Wide Range pH Comparator

- Graph paper
- Calculator
- Science curriculum materials/text of local school
- Student copies of **Attachment Two: *School /Home Interactive Homework***
- Student copies of **Attachment Three: *Safer Than a Taste Test***

All of these handouts are provided at the end of the lesson.

Handout 1
Key to Macroinvertebrate Life in the River
Handout 2
School/Home Interactive Homework
Handout 3
Water Quality Test Procedures and Purposes
Handout 4
Rubric for Scientific Experiment

**Procedure(s):**

1. **Prepare:**

Make sure that you have found a water source for your students to go to and prepared everything on the materials list. Setting up transportation and getting permission from parents you will need to do before.

2. **Elicit:**

*Fill a clean beaker with water. Put orange and green food coloring in water to make it appear dirty. Tell your students that you just got this water from the dirtiest local body of water. Ask your class why they think the water is so discolored. After some discussion on the filth of the water dramatically drink it! After their reaction, explain that all the water we drink comes from bodies of water that are polluted and it is essential for our survival to have clean water.*

***Expanding the Anticipatory Set**: Show the website of the Hudson Riverkeepers* http://www.riverkeeper.org/hudson-river/protection/ *to show the efforts of one group to clean up a watershed that was extremely polluted.*

*Also do a "diagram picture exploration". This is where you take a picture and divide it into 4 quadrants. Then you put up each quadrant and then have the students write what they see /observe. At the end talk about the big picture and what they think it is and how it relates to what they are going to be doing. You can also read an article that goes along with it as well.*

3. **Engage/Explore:**

***1.*** Teach the science content focusing on **Attachment One: *Key to Macroinvertebrate Life in the River.***

2. Learners are to begin their portfolio titled "Healthy Water."
3. Have students go into groups. With my class they might all be in pairs because it is a smaller class. Correlate a water quality test for each numbered group. Instruct the groups to create a five-minute presentation that will explain the instructions and purpose for their water quality test
4. Read and discuss materials on macroinvertebrates.
5. Time to test the water! Every group is responsible to perform the test that they presented as well as the water temperature, location, and time and date. Record your information neatly.

**Strategy One: Determine the on-site location, secure transportation, release time and authority, and obtain parental permission and volunteers to accompany your class. Provide safety goggles, gloves and boots if necessary, test kits and perform the four required tests. Model the behaviors expected of the students.**

**Strategy Two: Obtain many samples of river or stream water sufficient for successful completion of all tests and allow students to perform these tests within the class. It is suggested that a large aquarium full of river or stream water would suffice.**

- Compile all data. Students should display their group's test results for every test.
- Now compare your results to the other group's results using a bar graph for each test.
- Add up the values for each test type from every class and divide by the total number of tests. This will give you an average test value for each test.
- Write a short lab report stating the health of the river. Support your position with data results from every test performed.

**Explain**

- Discuss water pollution, citing examples of those things that contribute to unclean water.
- Assign the position paper and allow sufficient in-class and at-home time to complete. The instructor should write the foil according to the expected outcomes. An example of a foil may be:

**Directions**: In our reading and experiments we discovered many things. React to the following statement and give supportive data, definitions, identifications and reasons. Use as many facts as you can.

**In our water quality testing we found that there are too few macroinvertebrates. This is detrimental/not detrimental to our pond or river because…**

**Reflection Activities:** To be placed in their portfolios.

**Pre experience:** Write their expected outcomes of the experiments. What do they think they will find?

**During the experiment**: Evaluate the experience and their feelings of the obvious things they discover such as pop cans and other litter.

**Evaluate/ Assessment:**

- Use **Attachment Four: *Rubric for Scientific Experiment***
- Evaluate the oral presentations
- Teacher observation
- Teacher-constructed test on scientific content
- Monitor class discussions
- Evaluate the essay according to the following rubric:

| Points | Scientific Content/ELA |
|---|---|
| 4 | Takes a definite position, relates scientific language correctly, backs statements with scientific evidence and gives a minimum of three facts. Relates to class experiments. Uses elements of construction, grammar and phrasing with 90% accuracy. |
| 3 | Takes a definite position, relates to class experiments, gives two facts. Demonstrates elements of grammar, construction and phrasing with 80% accuracy. |
| 2 | Does not take a definite position but relates to the scientific experiment in class. Acceptable grammar within 60% accuracy. |
| 1 | Makes an attempt to answer the question posed. |
| 0 | No attempt made. |

**Extend:**

**School/Home Connection:**

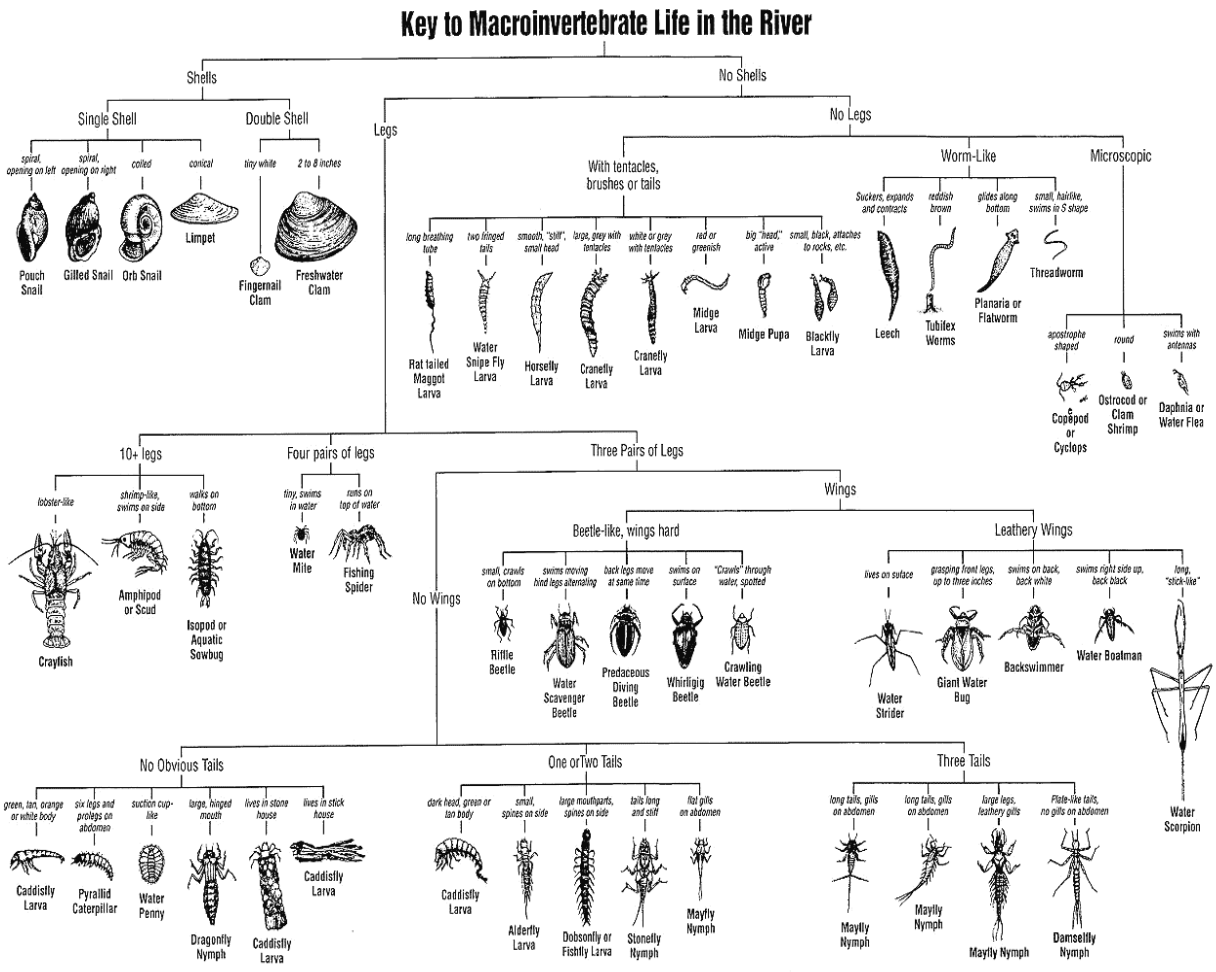
- **Interactive Parent / Student Homework: Attachment Two**
  **Assign Attachment Two: *School / Home Interactive Homework* at the conclusion of the first instructional session.**
  Ask the students to have the parent/guardian recall lake or river visits when they were children and compare to visits with them. Write their responses down and share at the beginning of the second class session. Have the learners ask their parent/guardian if they thought the water was safer for swimming when they were children than today and why.

**Cross-Curriculum Extensions:**

- Test other parts of the river and compare results, for example up stream and down stream, from an urban or industrial area.
- Compare results over time. For example, compare this year's results with previous years.

**Handout 1**

**Key to Macroinvertebrate Life in the River**






**Handout 2**

**School/Home Interactive Homework**

I discussed these questions with my: _____
(name and relation)

1. When you were my age what rivers or lakes did you most often visit?

2. What was your impression of the cleanliness of the lakes or rivers?

3. Did you ever hear about water pollution in the lake or river?

4. Do your think the water was cleaner then than now?

5. Were there any groups concerned about keeping the waterways safe from contaminants? Name them if your parent remembers.

6. Do you believe that we should act as stewards of our water for the future?

7. How can we help to keep our rivers and lakes free from pollution?

**Water Quality Rating**

**Test One**

pH

pH measures the H+ ion concentration of liquids and substances. The pH scale ranges from 0-14. Pure deionized water contains equal numbers of H+ and OH- ions and has a pH value of 7. If the sample has more OH- ions it is considered basic and has a higher value than 7. If the sample has more H+ ions than the sample it is considered acidic and has a lower value than 7. A change in the pH of a river may result in the death of species in that river.

Example pH levels of household supplies

| Household Supplies | pH |
|---|---|
| Battery Acid | 1 |
| Lemon Juice | 2 |
| Vinegar | 3 |
| Cola | 4 |
| Normal Rain | 5.6 |
| Distilled Water | 7 |
| Baking Soda | 8.2 |
| Ammonia | 11 |
| Bleach | 12 |

**PH Testing Procedure**

1. Use gloves to prevent touching your samples. Rinse out your test tube with your sample water.
2. Fill your test tube with 5 ml of your sample water.
3. Put the PH test strip into the water.
4. Match the sample color to a color standard.
5. Record the pH value.
6. Wash you hands.
7. Do this three times and average your pH. Do this by adding up your three pH values and dividing by three.

Test 3

Hardness and Alkalinity

What does this test?

Total Alkalinity: Total alkalinity is the measurement of all bases in the water and can be thought of as the buffering capacity of water, or its ability to resist change in pH. The most common and important base is carbonate. Total alkalinity is expressed as milligrams per liter (mg/L) or parts per million (ppm) of calcium carbonate ($CaCO_3$). In the aquarium industry, total alkalinity may be referred to as "carbonate hardness" or "KH," which is often measured in degrees (dKH) rather mg/L or ppm. One dKH is equal to 17.9 mg/L or 17.9 ppm.

Waters that have moderate to high levels (50 mg/L or greater) of total alkalinity and total hardness (see below) usually have a neutral to slightly basic pH. The pH is more stable and does not change greatly throughout the day because the presence of carbonates and bicarbonates neutralize, or "buffer," the carbon dioxide and other acids in the water.

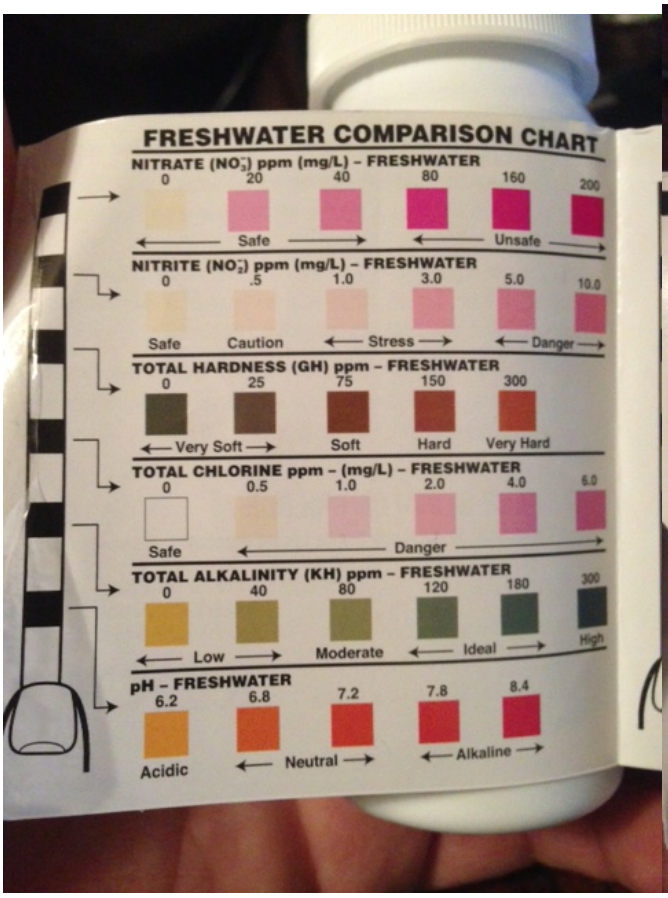
Total Hardness: Total hardness is the measurement of divalent cations (+2 ions) in the water and, like total alkalinity, is expressed as milligrams per liter (mg/L) or parts per million (ppm) of calcium carbonate ($CaCO_3$). In the aquarium industry, total hardness may be referred to as "general hardness" or "GH," which is often measured degrees (dGH) rather than mg/L or ppm. One dGH is equal to 17.9 mg/L or 17.9 ppm. The two most common elements that contribute to hardness are calcium and magnesium.

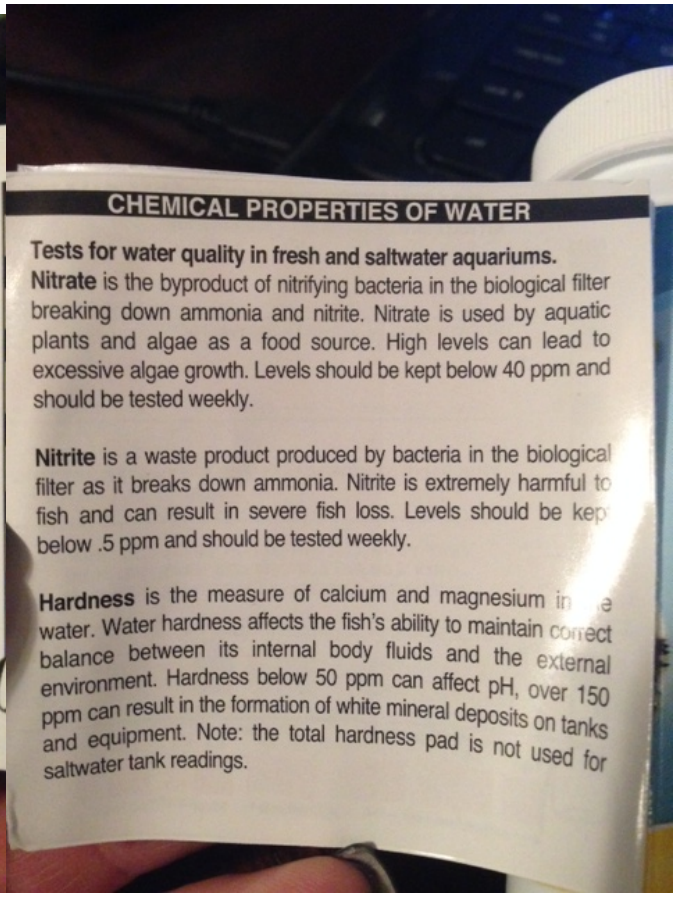
Total hardness is particularly important when spawning fish and raising fry because calcium is critical to egg, bone and tissue development. However, some tropical aquarium species that originate in areas with extremely soft water may require low hardness water to spawn and develop, so it is important to know the specific requirements for each species that will be spawned or maintained. Hardness ranges from 10mg/l to over 400mg/l depending on the region it comes from. Tropical rainforest rivers like the Amazon may have less than 10 mg/l, and the rift valley lakes of Africa can reach 500mg/l.

Test 4: Nitrate and Nitrite Test

Nitrate and nitrite are related nitrogen compounds that occur naturally in soil, water, plants and food. They are formed when microorganisms in the environment break down organic materials, such as plants, animal manure, and sewage. Nitrate can also be found in chemical fertilizers. Nitrite is used as a curing agent for meat. Nitrate is more commonly found in water than nitrite.

Nitrogen is essential for all living things as it is a component of protein. Nitrogen exists in the environment in many forms and changes forms as it moves through the nitrogen cycle. However, excessive concentrations of nitrate-nitrogen or nitrite-nitrogen in drinking water can be hazardous to health, especially for infants and pregnant women.



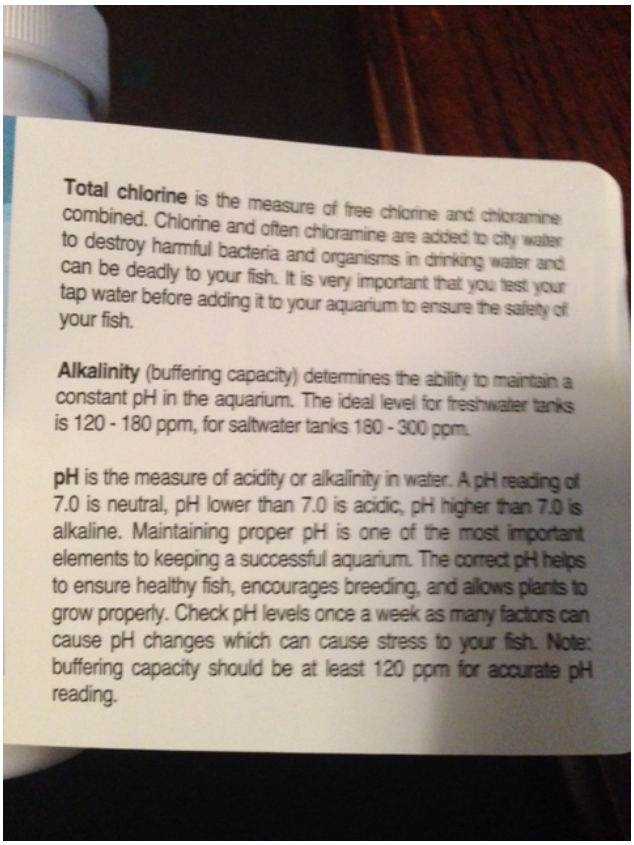
## CHEMICAL PROPERTIES OF WATER

**Tests for water quality in fresh and saltwater aquariums.**

**Nitrate** is the byproduct of nitrifying bacteria in the biological filter breaking down ammonia and nitrite. Nitrate is used by aquatic plants and algae as a food source. High levels can lead to excessive algae growth. Levels should be kept below 40 ppm and should be tested weekly.

**Nitrite** is a waste product produced by bacteria in the biological filter as it breaks down ammonia. Nitrite is extremely harmful to fish and can result in severe fish loss. Levels should be kept below .5 ppm and should be tested weekly.

**Hardness** is the measure of calcium and magnesium in the water. Water hardness affects the fish's ability to maintain correct balance between its internal body fluids and the external environment. Hardness below 50 ppm can affect pH, over 150 ppm can result in the formation of white mineral deposits on tanks and equipment. Note: the total hardness pad is not used for saltwater tank readings.



**Total chlorine** is the measure of free chlorine and chloramine combined. Chlorine and often chloramine are added to city water to destroy harmful bacteria and organisms in drinking water and can be deadly to your fish. It is very important that you test your tap water before adding it to your aquarium to ensure the safety of your fish.

**Alkalinity** (buffering capacity) determines the ability to maintain a constant pH in the aquarium. The ideal level for freshwater tanks is 120 - 180 ppm, for saltwater tanks 180 - 300 ppm.

**pH** is the measure of acidity or alkalinity in water. A pH reading of 7.0 is neutral, pH lower than 7.0 is acidic, pH higher than 7.0 is alkaline. Maintaining proper pH is one of the most important elements to keeping a successful aquarium. The correct pH helps to ensure healthy fish, encourages breeding, and allows plants to grow properly. Check pH levels once a week as many factors can cause pH changes which can cause stress to your fish. Note: buffering capacity should be at least 120 ppm for accurate pH reading.

**Handout 4**

## Rubric for Scientific Experiment

| | |
|---|---|
| Involvement in an accurate presentation | 10 points |
| Participation in sample collecting | 15 points |
| Neat personal data | 15 points |
| Accurate results | 10 points |
| Compiled class data graphs | 20 points |
| Accurate average data values | 10 points |
| Short lab report stating the health of the river with your position backed up with data values for every test performed. | 20 points |
| **Total Points** | **100** |

**Grading Scale**

| | |
|---|---|
| **100-90** | **A** |
| **90-80** | **B** |
| **80-70** | **C** |
| **70-60** | **D** |
| **60-0** | **F** |

Student Journal Pond Activity/Lab

Picture Diagram: (Write what you observe or see in each of the picture sections)

| | |
|---|---|
| Quadrant 4 | Quadrant 1 |
| Quadrant 3 | Quadrant 2 |

| | |
|---|---|
| | |

Student Data Sheet

| | Observations | pH | Hardness/ Alkalinity | Nitrate | Nitrite | Macroinvertibrates |
|---|---|---|---|---|---|---|
| Trial 1 | | | | | | |
| Trial 2 | ` | | | | | |
| Trial 3 | | | | | | |

**Graph your Information you found above:**