Kaneohe Watershed Study

Objectives

The student will be able to do the following:

- Understand that humans influence ecology
- Define water quality as a catalyst for discussion of man's role in influencing aquatic ecology
- Describe some of the impacts of land use on water quality
- Define and connect types of pollution with water quality parameters
- Become familiar with the water quality tests
- Make and test hypotheses about water quality at S.W. King Intermediate School

Materials

- Water quality testing materials, separated per group
- Worksheet for each group or each student
- Cups, buckets, paper towels – as desired to control the flow of water in the classroom

Background

This lesson is designed to introduce students to water quality parameters as a way of understanding aquatic ecology. Essential concepts include understanding that organisms (to include humans) and their environment are interconnected and are impacted by one another. Earth scientists and engineers find and manage our fresh water resources, which are limited in supply. Water resources are essential for agriculture, manufacturing, energy production, and life. Humans affect the quality, availability, and distribution of Earth's water through modification of streams, lakes, and groundwater. In addition to withdrawing water faster than it is replenished, engineered structures such as canals, dams, and levees significantly alter water and sediment distribution. Pollution from sewage runoff, agriculture and industrial processes reduce water quality. Once fresh water is contaminated, its quality is difficult to restore.

Advance Preparation

Ensure that water quality kits have enough materials for each test and that there are enough kits per group. Each group should have a copy of the directions, which is provided in the kits or is on the worksheet.

Each group should have a reporting sheet.

Each group will need to access water from a drinking fountain, thus cups or buckets to facilitate this may be useful. The group will also need to leave the classroom and travel to gather water from campus locations, so students may want to prepare by wearing appropriate footwear, latex gloves, suncare, etc.

Procedure

1. Start by having students recall what they are studying

- What is ecology? (study of relationship between organisms and their environment)
- What are some basic tenets of ecology?(Things are connected)
- Remind students of the fact that humans are an essential part of the ecology of nearly every single ecosystem in the world. Ask for some examples of how humans influence the ecology of the Kaneohe watershed and bay ecosystem.

2. Ask what form of matter is essential to all ecosystems and influences the ecology (and is influenced by) in all ecosystems (Water; students may bring up carbon and these are all right).
3. State that we will focus on water, and that we'll use water as a way of understanding how humans might influence the ecology of a particular ecosystem. We will also use water as a way of seeing what the relationship is between other organisms and their environment.
4. Guide students to understand that examining what is going on with water may tell us about other relationships in an aquatic ecosystem.
5. STOP for a minute. CHANGE focus to the process. State that before we go into detail on water, you want to make sure they understand the scientific process. Review the methods – point out that they will need to make observations, hypotheses, and conclusions.
6. Focus again on aquatic ecology.
7. Ask students what are some ways that humans can influence aquatic ecosystems (many possible answers, FOCUS on pollution).
8. Review what pollution is (excess, additions, etc. that harm living things)
9. Brainstorm types of pollution in water. Write the list on the board:
    - Nitrogen (some is normal, but excess is pollution. Comes from human/animal wastes, decomposing organic matter, fertilizers). Influences the ability of blood to carry oxygen.
    - Phosphate (some is normal, but excess is pollution. Detergents are a major anthropogenic source). Can stimulate excessive growth.
    - Turbidity (from sedimentation/erosion or other suspended materials (can include algae), etc. Point out that the color of the water is not necessarily related to the level of turbidity.
    - Oil and gasoline
    - Chemicals
    - Heavy metals
    - Fecal coliform (naturally present in the digestive tracts of living organisms, but not naturally present in high levels in aquatic ecosystems). Fecal coliform are not by themselves pathogenic but tend to occur with other pathogens in sewage and thus serve as an indicator of sewage
    - Heat
    - Organic matter (in excess, it is pollution)
10. What are some other water quality parameters that are important?
    - Dissolved oxygen (dissolves from atmosphere and produced through photosynthesis). Levels below 4 ppm are stressful to most life.

- pH (a measure of the H^+ atoms in the water). Rapidly growing algae can remove O_2, so more H^+ and thus a higher pH (more basic). Acid rain can lower pH. 6.5 to 8.2 is optimal for most life.
- Diversity of aquatic life (micro and macrofauna)

11. Discuss (again) how examining water quality provides a means for understanding aquatic ecology and man's role in the aquatic ecosystem. Discuss that land uses around the water source (stream, pond, etc.) may influence the water quality. State that we will be testing the water quality of water sources in and around the school campus.
12. Go over some limitations. It is difficult to test for all of those parameters. We cannot test for oil, gasoline, chemicals, metals, and organic material directly. pH serves as an indicator. Cross these off the list. Tell students they will focus on the remaining parameters. State that observations, however, are important. Oil can be directly observed on the surface of a stream, for instance. Organic matter, in the form of leaf litter, etc. can be directly observed.
13. Find out if anyone has done water testing before.
14. State that in any scientific experiment, you should be familiar with your methods before you do any test. But, this "practice" often yields valuable information.
15. State that we will practice using the water quality tests with drinking water (from the fountain) and that we will be interested in the results. Mention REPLICATION.
16. Move into the activity. Make a chart resembling the table on the worksheet – water quality parameters to be tested, observations, hypotheses, etc.
17. As a group, make hypotheses about the tap water.
18. Break into groups and have everyone move through the stations testing tap water.
19. Come back together and pool data.
20. Discuss results
21. Discuss the next part of the activity. Each group should make a separate hypothesis for the stream water.
22. Go out to the stream and do the tests.
23. Come back to the classroom and share results. With replication, average if necessary to get group results.
24. Discuss the results versus the hypotheses.
25. To end, discuss the results versus the impact of man on the aquatic ecosystem, and discuss what these tests tell us about the aquatic ecology of the stream.

Name _____ Group members_____

Kaneohe Watershed Study

DRINKING WATER

Water Parameter	Observations	Hypothesis	Result	Interpretation
Nitrogen Nitrate value (in ppm)				
Phosphate (in ppm)				
Suspended material Turbidity value (in JTU)				
Fecal Coliform (positive or negative)				
Dissolved Oxygen (DO) (In % Saturation)				
pH (unitless)				
Aquatic Life (# species, description of species)				

Interpretation information

Test	Excellent	Good	Fair	Poor
Nitrate		0 ppm	5 ppm	20+ ppm
Phosphate	1 ppm	2 ppm	4 ppm	
Turbidity	0 JTU	>0 to 40 JTU	>40 to 100 JTU	>100 JTU
Fecal Coliform		Negative		Positive
DO (% saturation)	91-100%	71-90%	51-70%	<50%
pH	7	6, 8		4,5,9,10,11+
Aquatic life	Wide diversity of native sp.	Wide diversity of sp.	Dominated by 1-2 sp.	No life

STREAM WATER

Water Parameter	Observations	Hypothesis	Result	Interpretation
Nitrogen Nitrate value (in ppm)				
Phosphate (in ppm)				
Suspended material Turbidity value (in JTU)				
Fecal Coliform (positive or negative)				
Dissolved Oxygen (DO) (In % Saturation)				
pH (unitless)				
Aquatic Life (# species, description of species)				

Temp (C)	Dissolved Oxygen (% Saturation)		
	0 ppm	4 ppm	8 ppm
2	0	29	58
4	0	31	61
6	0	32	64
8	0	34	68
10	0	35	71
12	0	37	74
14	0	39	78
16	0	41	81
18	0	42	84
20	0	44	88
22	0	46	92
24	0	48	95
26	0	49	99
28	0	51	102
30	0	53	106

Name _____

Short Answer Questions

1. Describe three examples of how land use can impact water quality.

2. Describe what water quality can tell us about aquatic ecosystem health.

3. What are the sources of excess nitrogen pollution?

4. What is the major anthropogenic source of phosphate?

5. What causes turbidity?

6. How do we use pH as an indicator for measuring other pollutants?

7. What can you conclude about the health of the Kaneohe stream ecosystem? Why?