Chemical tests to determine water quality

How can we analyze the abiotic components (chemical and physical tests) of the stream in order to determine the stream's overall water quality?

Background

A freshwater aquatic ecosystem is an ecosystem that exists in a body of water with a salinity of less than 0.05 percent. It consists of a community of aquatic organisms living interactively with their abiotic environment. Ecosystems with a higher biodiversity tend to be more stable with greater **resilience** in the face of disruption to the ecosystem. The following factors may impact the health of an aquatic ecosystem.

Temperature is very important to water quality. Temperature affects the amount of dissolved oxygen (DO) in the water, the rate of photosynthesis by aquatic plants, and the sensitivity of organisms to toxic wastes, parasites and disease.

Turbidity is the measure of the relative clarity of water. Turbid water is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter, and microscopic organisms. Turbidity should not be confused with color, since darkly colored water can still be clear but not turbid. Turbid may be the result of soil erosion, urban runoff, algal blooms, and bottom sediment disturbances.

pH is a measurement of the acidic or basic quality of water. The pH scale ranges from a value of 0 (very acidic) to 14 (very basic), with 7 being neutral. The pH of natural water is usually between 6.5 and 8.2. Most aquatic organisms are adapted to a specific pH level and may die if the pH of the water changes even slightly. pH can be affected by industrial waste, urban and agricultural runoff, or drainage from mining operations.

Dissolved Oxygen (DO) is important to the health of aquatic ecosystems. All aquatic animals need oxygen to survive. Natural waters will consistently high dissolved oxygen levels are most likely healthy and stable environments, and are capable of supporting a high biodiversity of organisms. Natural and human induced changes to the aquatic ecosystem can affect the availability of DO. Dissolved Oxygen % Saturation is an important measurement of water quality. Cold water can hold more DO than warm water. High levels of bacteria or large amount so decaying material can cause the % Saturation to decrease. This can cause large fluctuations in DO levels throughout the day, which can affect the ability of plants and animals to survive.

Nitrate is a nutrient needed by all aquatic plants and animals to build protein. The decomposition of dead organisms and the excretions of living animals release nitrate into the aquatic ecosystem. Excess nutrients like nitrate increase plant growth and decay, promote bacterial decomposition and consequently decrease the amount of DO available in the water. Sewage is the main source of excess nitrates added to natural waters, while fertilizer from urban and agricultural runoff also contribute to high levels of nitrate.

Phosphate is a nutrient needed for plant and animal growth. It is a limiting factor in aquatic plant growth. High levels of phosphates can lead to overgrowth of plants, increased bacterial activity and decreased DO levels.

Instructions

Temperature

Wear protective gloves. Place the thermometer 4 inches below the surface of the water for one minute. Record the temperature as degrees Celsius.

Temperature	°C

Turbidity

1. Fill the turbidity jar (white water quality monitoring kit) to the turbidity fill line located on the outside kit label.

2. Hold the Turbidity Chart on the top edge of the jar. Looking down into the jar, compare the appearance of the secchi disk icon in the jar to the chart. Record the results in JTU (Jackson Turbidity Units).

Turbidity	JTU

pH

1. Fill the test tube (0106) to the 10 mL line with the water sample.
2. Add on pH Wide Range TesTab (64459A).
3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.
4. Compare the color of the sample to the pH color chart. Record the result at pH.

pH	

Dissolved Oxygen (DO)

1. Record the temperature of the water sample from above.
2. Submerge the small tube (0125) in the water sample. Carefully remove the tube from the water sample, keeping the tube full to the top.
3. Drop 2 Dissolved Oxygen TesTabs (3976A) into the tube. Water will overflow when tablets are added.
4. Screw the cap on the tube. More water will overflow as the cap is tightened. Make sure no air bubbles are present in the sample.
5. Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes.
6. Wait 5 more minutes for the color to develop.
7. Compare the color of the sample to the Dissolved Oxygen color chart. Record the result as ppm DO.
8. Locate the temperature of the water sample of the % Saturation chart on the next page. Locate the DO result of the water sample at the top of the chart. The % Saturation of the water sample is where the Temperature row and the DO column intersect.

% Saturation

Temperature °C	Dissolved Oxygen		
	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

Dissolved Oxygen (DO) test

pH		ppm DO		% Saturation	

Nitrate

1. Fill the test tube (0106) to the 5 mL line with the water sample.
2. Add one Nitrate Wide Range CTA TesTab (3703A). Immediately slide the test tube into the Protective Sleeve (0106-FP). *If testing indoors, there is no need to use the protective sleeve which protects the reaction from UV light.
3. Cap and mix by inverting for 2 minutes to disintegrate the tablet. Bits of material may remain in the sample.
4. Wait 5 minutes for the red color to develop. Remove the tube from the Protective Sleeve.
5. Compare the color of the sample to the Nitrate color chart. Record the result as ppm Nitrate.

Nitrate	ppm

Phosphate

1. Fill the test tube (0106) to the 10 mL line with the water sample.
2. Add one Phosphate TesTab (5422A).
3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.
4. Wait 5 minutes for the blue color to develop.
   Note: If the sample does not develop a blue color (sample is colorless), record the result as 0 ppm.
5. Compare the color of the sample to the Phosphate color chart. Record the result as ppm Phosphate.

Phosphate	ppm

Ranking test results

Compare the data collected for each test with the ranking chart below. Record the scores in the final column.

Test factor	Result	Rank	Score
Temperature	°C	N/A	N/A
Turbidity	0 JTU >0 to 40 JTU >40 to 100 JTU >100 JTU	4 (excellent) 3 (good) 2 (fair) 1 (poor)	
pH	4 5 6 7 8 9 10	1 (poor) 1 (poor) 3 (good) 4 (excellent) 3 (good) 1 (poor) 1 (poor)	
Dissolved Oxygen (DO)	91–110% 71–90% 51–70% <50%	4 (excellent) 3 (good) 2 (fair) 1 (poor)	
Nitrate	5 ppm 20 ppm 40 pm	2 (fair) 1 (poor) 1 (poor)	
Phosphate	1 ppm 2 ppm 4 ppm	4 (excellent) 3 (good) 2 (fair)	

Reflection

1. How did your water sample results compare? How are they similar or different?

2. Did any test stand out? For example, did any test show different results than the rest? If so, why do you think this test was different?

3. How do the water quality tests interact with one another or potentially change throughout the year? For example, temperature has a direct impact on the % Saturation of Dissolved Oxygen. How could the local climate impact the biodiversity of the aquatic ecosystem if the % Saturation changes?

4. What tests, if any, demonstrate that the health of the aquatic ecosystem could be improved? What are some ways that humans can remediate their impact to improve water quality?