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?

Materials

- Dissolved Oxygen snap test
- pH test strips
- Nitrate test strips
- Phosphate test kit
- Thermometer

Directions

Perform the following tests and use the accompanying background information to interpret your results.

a. Dissolved Oxygen

1. Fill the sample cup to the 25 mL mark with the sample to be tested.
2. Place ampoule, tip first, into sample cup. Snap the tip. The ampoule will fill, leaving a bubble for mixing.
3. To mix the ampoule, invert it several times; the bubble to will travel from end to end.
4. Dry the ampoule and wait 2 minutes for color development.
5. Obtain a test result by placing the ampoule between the color standards until the best color match is found.

Dissolved Oxygen test result: _____

Background: Vital to aquatic life, oxygen enters the water by diffusion from the atmosphere or through plant photosynthesis. Actual solubility is directly proportional to the partial pressure in the gas phase, to salt concentration and temperature. The dissolved oxygen level in water is constantly changing and represents a balance between respiration and decomposition that deplete oxygen and photosynthetic activity that increases it. Organic waste may overload a natural system causing a serious depletion of the oxygen supply in the water that in turn leads to fish kills. Likewise, eutrophic waters, those rich in nutrients, achieve the same result through causing algal blooms whose eventual decomposition uses up the available dissolved oxygen. *Recommended minimum dissolved oxygen levels for fresh water fish are as follows: warm water fish: 5.0 mg/L (ppm) and cold water fish: 6.0 mg/L (ppm)*

b. Nitrite/Nitrate

Both tests are found on the same test strip. Please keep the bottle tightly closed after removing a test strip.

1. Dip a strip into the sample water for 1 second and remove. *Do not shake* excess water from the test strip.
2. Hold the strip level, with pad side up for 30 seconds. Compare the *Nitrite* test pad (bottom pad) to the color chart above.
3. At 60 seconds, compare the *Nitrate* test pad (top pad) to the color chart. Estimate results if the color on the test pad falls between two color blocks.

Nitrite test result: _____

Nitrate test result: _____

Nitrite background: Nitrite (NO_2–) is produced in the water by the biological filter. Beneficial bacteria convert ammonia into nitrite. The biological filter then converts nitrite into nitrate (NO_3–). Nitrite will prevent fish from carrying on normal respiration, and high levels will quickly lead to fish death. Even trace amounts of nitrite stress fish, suppressing their immune system and increasing the likelihood of disease. *Total nitrite levels exceeding 5 mg/L (ppm) are considered unhealthy for lakes. It is recommended 0–1 ppm; any level above 0 can harm fish in freshwater systems.*

Nitrate background: Nitrates occur in water as the end product in the biological breakdown of organic nitrogen, being produced through the oxidation of ammonia. Although not particularly toxic to fish, excess nitrates in the water are often used as an indicator of poor water quality. Under anaerobic conditions, such as in the sludge or soil at the bottom of a pond, lake or aquarium, denitrification can be used to convert nitrate back to nitrite and from

there to nitrogen gas, removing total nitrogen from the aquatic system. *Levels exceeding 50 mg/L (ppm) nitrate-nitrogen are considered unhealthy for lakes. It is recommended 0–1 ppm and 1–5 ppm for optimum growth in freshwater systems.*

c. Phosphate

1. Take the cap off the test tube, rinse with distilled water, then fill with sample water up to the marked line.
2. Open and pour one phosphate test pouch into the test tube filled with sample water. Be careful not to spill the test reagent.
3. Place the lid on the test tube and shake vigorously for 60 seconds.
4. Set the test color chart on a flat surface, place the test tube on top of the outlined circle. Look down through the test tube and read the result by comparing with the color chart listed.

   Phosphate test result: _____

   Background: High phosphate concentrations in surface waters may indicate fertilizer runoff, domestic waste discharge, or the presence of industrial effluents or detergents. If high phosphate levels persist, algae and other aquatic life will flourish due to cultural eutrophication, eventually decreasing the level of dissolved oxygen due to the accelerated decay of organic matter. Algae blooms are encouraged by levels of phosphate greater than 25 micrograms/L. *Phosphorous Discharge Standards: Total Phosphorous for discharge < 100 micrograms/L; Where stream enters lake < 50 micrograms/L; Discharge into a lake < 25 micrograms/L;*
   Algae blooms are encouraged by levels of phosphate > 25 micrograms/L;
   Phosphate phosphorous > 100 micrograms/L may interfere with coagulation process in water treatment plant.

d. Temperature

1. Place the thermometer in the water sample or stream and record the temperature below.

   Temperature: _____

   Background: All fish species have an optimum range of water temperature in which they are most active. Cold water holds more dissolved oxygen than warm water so a fish's metabolism is evolved to perform best within a temperature range that will accommodate its need for dissolved oxygen. For example, a largemouth bass performs best at 70°F, but may be able to tolerate a range of 50 to 86 degrees with increasing stress.

e. pH

1. Dip the pH test strip into the water sample and record the results below.

   pH: _____

   Background: The majority of aquatic creatures prefer a pH range of 6.5-8.0, though some can live in water with pH levels outside of this range. As pH levels move away from this range (up or down) it can stress animal systems and reduce hatching and survival rates. The further outside of the optimum pH range a value is, the higher the mortality rates. The more sensitive a species, the more affected it is by changes in pH. In addition to biological effects, extreme pH levels usually increase the solubility of elements and compounds, making toxic chemicals more "mobile" and increasing the risk of absorption by aquatic life.

Reflection

1. Describe the present water quality according to your chemical/physical testing.
2. Predict the taxa group (1: sensitive; 2: semi-sensitive; 3: tolerant) that could live in your stream according to your results.
3. Describe a chemical or physical change that could rapidly make your water quality go from excellent to poor. How would this change impact the biodiversity of the stream?