What do scientists measure?

Temperature – When you don't feel well, chances are the first thing someone does is take your temperature. Scientists measure water temperature for several reasons. First, it determines the kinds of animals that can survive in a stream. If the temperature gets too hot or too cold for some organisms, they die. Temperature also can affect the chemistry of the water. For example, warm water holds less oxygen than cold water. A healthy cluster of trees and vegetation next to a stream or river helps keep temperatures cool for trout and other fish.

Dissolved oxygen – Scientists measure **dissolved oxygen**, or DO (pronounced dee-oh). This tells them how much oxygen is available in the water for fish and other aquatic organisms to breathe. Healthy waters generally have high levels

Dissolved oxygen probe

of DO (some areas, like swamps, naturally have low levels of DO). Just like human beings, aquatic life needs oxygen to survive. Several factors can affect how much DO is in the water. These include temperature, the amount and speed of flowing water, the plants and algae that produce oxygen during the day and take it back in at night, pollution in the water, and the composition of the stream bottom. (Gravelly or rocky bottoms stir up the water more than muddy ones do, creating bubbles that put more oxygen into the water.)
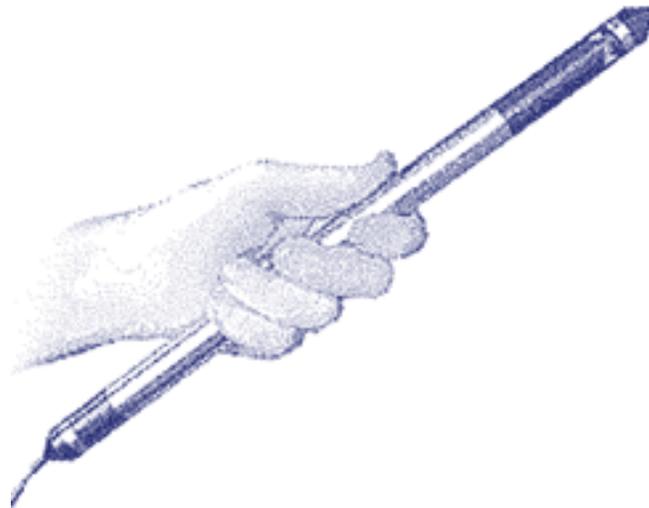
pH – Scientists measure **pH** to determine the concentration of hydrogen in the water

(The p stands for "potential of" and the H is hydrogen.) pH ranges from 0 (very acidic) to 14 (very basic), with 7 being neutral. Most waters range from 6.5 to 8.5. Changes in pH can affect how chemicals dissolve in the water and whether organisms are affected by them. High acidity can be deadly to fish and other aquatic organisms.

Nutrients – Just as **nutrients** are critical for you to grow (check out what's inside a box of cereal—essential nutrients), they are critical to plants and animals. The two major nutrients scientists measure are **nitrogen** and **phosphorus**. The presence of too many nutrients can hurt aquatic organisms by causing lots of algae to grow in the water. Nutrients can also affect pH, water clarity and temperature, and cause water to smell and look bad.

Toxic Substances – Scientists also test for many harmful (toxic) things like metal, pesticides, and oil. For example, scientists are finding mercury in certain types of fish, especially in lakes and estuaries. Mercury comes from mining, natural sources and air pollution from power plants and incinerators. People are warned not to fish if mercury or other harmful substances are a problem in a stream, lake or bay.

Turbidity – Scientists measure the **clarity** of water to determine how many particulates (little bitty particles of stuff) are floating around. If you're sitting on a dock in a pond on a warm summer day, you might be able to see to the bottom. That's low **turbidity**. On the other hand, if you visit the dock after a rainstorm when all the muck has been stirred up, you won't be able to see the bottom; that's high turbidity. Scientists use turbidity measurements to calculate the inputs from erosion and nutrients.

Bacteria – Scientists sample for certain types of bacteria that are found only in the intestinal tract of animals and humans. These bacteria, called **fecal coliforms**, are not necessarily harmful, but they usually hang out with some bad characters like viruses and pathogens, which can make you sick. The major sources of fecal coliforms are failing septic systems, wastewater treatment plant discharges, and animal waste (which covers a big range from Pup's droppings to cow manure).

Visual surveys – Not all measurements are chemical or physical. Scientists take measurements of the landscape surrounding a stream to determine things like the

amount of trees and shrubs along a stream, the amount of shade that is created by trees overhanging the stream, and woody debris (sticks and leaves) in the stream. The more vegetation, tree cover, and woody debris, the more habitat is created for wildlife and fish. Vegetation can even trap pollutants before they enter the stream. Tree cover also helps regulate water temperature, which is important to trout and other fish that need cold water to survive.

Biological sampling – Scientists determine the health of waters by taking samples of fish, plants and smaller organisms called **macroinvertebrates** (mack-row-in-ver-tuh-bretts). Macroinvertebrates include things like snails, worms, fly larvae, and crayfish ("crawdads"). You find them under rocks and tree roots in the water. These critters tell a story about the health of the stream. Some of them love to live in water that's dirty, so if scientists find a lot of those in a sample, they know there's a problem. Other organisms can survive only in water that's very clean, so finding those means the water is probably healthy.
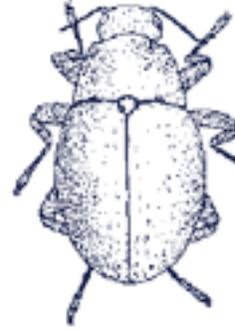
Riffle Beetle - Found in clean water