Temperature

What is Temperature?
Temperature is the measure of how much heat energy water contains. A stream's temperature is affected by the season, the source of water, the geographic area of the stream, the shape of the channel and whether the stream is shaded. Most aquatic organisms require a specific temperature range, and many of our sport fish require cold water.

Refer to the Utah Stream Team manual for more information on the definition and importance of temperature to fish and other aquatic life, and how natural and human activities affect temperature levels.

Temperature must be measured in the field. The temperature will change if the water is collected and stored, and will not reflect the true value at the site.

Discussion Questions for Temperature:

1. Draw a graph of the temperature of a high mountain stream over an entire year. Draw another line on the graph to show how the temperature might change as you move farther down the river.

Temperatures in streams can change beyond the obvious seasonal differences. Temperatures in streams are often cold near the headwaters especially if they originate from snowmelt or shallow springs, and get warm from the sun as they move down through the watershed. Shading (riparian vegetation), and the width and depth of the stream will all affect a stream's temperature.

2. How will groundwater entering a stream affect its temperature?

Groundwater is usually colder than surface water and therefore it would probably cool the stream. Some areas in Utah, however, have hot springs which introduce heat and minerals to a stream. Because the temperature of groundwater doesn't fluctuate much throughout a year, a stream with a major groundwater component may show less seasonal variability than a stream fed entirely by surface runoff.

Temperature, Continued

3. Discuss how different land uses (logging, road building, agriculture, urban uses) might affect temperature.

The major influences on temperature in a stream are exposure to the sun, and exposure to heated surfaces. Any activity that causes a stream to become shallower and wider (this can happen when too much sediment enters a stream) will cause the stream to heat more rapidly. When trees along the banks are removed, the loss of shading can cause the stream to heat up. Water that is diverted (such as for irrigation) and then returned to the stream usually heats up. Finally, streams with small flows will heat faster than streams with lots of water, so removing water from a stream can cause an increase in temperature.

Suggested sources of water samples, with expected results and explanation.

Water Source	Expected Result	Explanation
A stream or river in the late summer / early fall	warmer	Warm air temperatures, plus no source of cold water (e.g., snowmelt) cause streams to be warmer in the later summer / early fall.
A stream or river in the spring or winter	cooler	Cold air temperatures plus snowmelt in the spring lower the temperatures of the water.
A stream near its headwaters	cool	The water source is snowmelt or ground water. These streams are also usually shaded by trees and bushes.
A stream after it has traveled through a large valley or through a city	warmer (compared to the headwater stream)	The water warms as it travels away from the headwaters due to solar radiation and heat transfer from the streambed and banks. Areas with little riparian vegetation (no shading) will heat faster. Streams with concrete banks (e.g., urban areas) will absorb heat from these artificial banks.
Near a hot spring	warmer	Hot spring water will mix with the stream water, raising the temperature.

Dissolved Oxygen

What is Dissolved Oxygen?
Dissolved oxygen (DO) is a measurement the concentration of O_2 molecules actually dissolved in water. This is the form of oxygen that fish and aquatic insects need.

Oxygen is not very soluble in water. Usually, about 12 parts of oxygen can dissolve into a million parts of water. In very cold water however, concentrations can be as much as 14 mg/1. The maximum amount of oxygen that can dissolve in water is called its saturation concentration. The saturation concentration decreases as water temperature or elevation increase.

Refer to Utah Stream Team manual for more information on the definition and importance of DO to fish and other aquatic life, and how natural and human activities affect the DO levels.

DO must be measured in the field. The DO will change if the water is collected and stored, and will not reflect the true value at the site.

Discussion Questions for Dissolved Oxygen:

1. How does oxygen get into water?

Oxygen is dissolved into water by contact with the atmosphere, or from aquatic plants that produce oxygen during photosynthesis. Therefore, oxygen will be higher in turbulent stream water (lots of mixing with the atmosphere) or in water with lots of plants (but only during the day, when photosynthesis can occur).

2. How does oxygen get used in water?

The respiration of animals and plants uses oxygen. Bacterial decomposition of dead organic materials can be a major factor, and may cause the dissolved oxygen to be completely consumed in deep pools or lakes. Some chemical reactions (oxidation reactions) also require and consume oxygen.

3. How will dissolved oxygen concentrations be affected by the dumping of yard clippings or the runoff of animal manure?

The decomposition of organic materials such as these may use all the available oxygen in the water. Secondary treatment by municipal treatment plants removes the organic material from the water for just this purpose. Before municipal wastewater was treated properly, many rivers and streams had fish kills and dead zones caused by low oxygen as this waste was decomposed.

Dissolved Oxygen, Continued

Suggested sources of water samples, with expected results and explanation.

Water Source	Expected Results	Explanation
Fast moving, cool stream	high (>10 mg/l)	Turbulence mixes atmospheric oxygen into the water. The water may even be supersaturated.
Still water (e.g., productive pond water)	may vary throughout the day: lower at night (<4 mg/l) and much higher in the late afternoon. (>10 mg/l)	No turbulence to mix the oxygen. Plants produce oxygen, but the plant respiration and decay may also use it up.
Warm water	low (<8 mg/l)	Warm water holds less oxygen than cold water.
Stream water in a closed jar without any plants	low to moderate (6-8 mg/l)	No plants to produce oxygen, no opportunity for mixing with atmospheric oxygen. Note: microscopic plants may complicate results.
Stream water in a closed jar with leaf litter (dead or decaying plants)	low (<6 mg/l)	Decaying plants/leaf litter use the oxygen in the water.