Temperature

INTRODUCTION

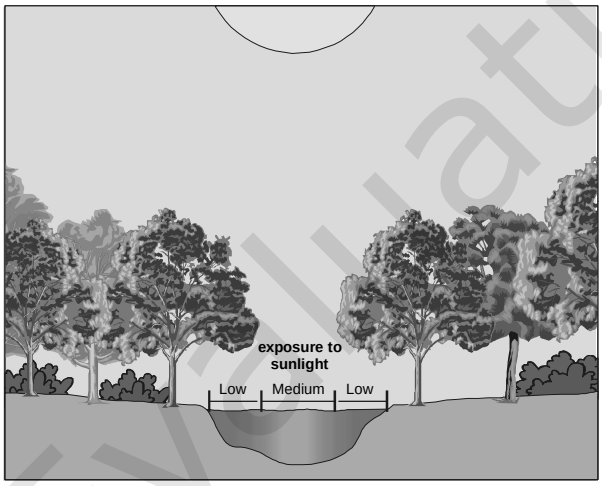
The temperature of a body of water influences its overall quality. Water temperatures outside the "normal" range for a stream or river can cause harm to the aquatic organisms that live there. It is for this reason that the *change* in the temperature of the water over a section of a stream is measured, not just the temperature at one location. If the water temperature changes by even a few degrees over a one-mile stretch of the stream, it could indicate a source of thermal pollution.

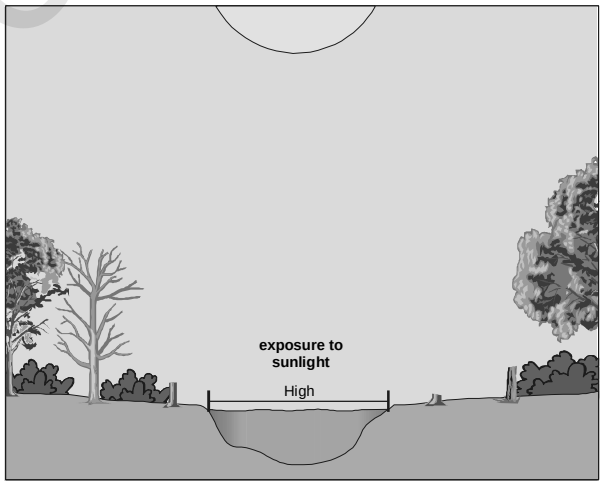
Factors that Affect Water Temperature

- Air temperature
- Amount of shade
- Soil erosion increasing turbidity
- Thermal pollution from human activities
- Confluence of streams

Thermal pollution caused by human activities is one factor that can affect water temperature. Many industries use river water in their processes. The water is treated before it is returned to the river, but is warmer than it was before. Runoff entering a stream from parking lots and rooftops is often warmer than the stream and will increase its overall temperature.

Shade is very important to the health of a stream because of the warming influences of direct sunlight. Some human activities may remove shade trees from the area, which will allow more sunlight to reach the water, causing the water temperature to rise.





Another factor that may affect water temperature is the temperature of the air above the water. The extent of its influence has a great deal to do with the depth of the water. A shallow stream is more susceptible to changes in temperature than a deep river would be.

Effects of Water Temperature

- Solubility of dissolved oxygen
- Rate of plant growth
- Metabolic rate of organisms
- Resistance in organisms

While many factors can contribute to the warming of surface water, few cause it to be cooled. One way water can be cooled is by cold air temperatures. A second, natural method of cooling a river or lake comes from the introduction of colder water from a tributary or a spring.

Table 1: Optimal Temperature Ranges	
Organism	Temperature Range (°C)
Trout	5 – 20
Smallmouth bass	5 – 28
Caddisfly larvae	10 – 25
Mayfly larvae	10 – 25
Stonefly larvae	10 – 25
Water boatmen	10 – 25
Carp	10 – 25
Mosquito	10 – 25
Catfish	20 – 25

One important aspect of water temperature is its effect on the solubility of gases, such as oxygen. More gas can be dissolved in cold water than in warm water. Animals, such as salmon, that require a high level of dissolved oxygen will only thrive in cold water.

Increased water temperature can also cause an increase in the photosynthetic rate of aquatic plants and algae. This can lead to increased plant growth and algal blooms, which can be harmful to the local ecosystem.

A change in water temperature can affect the general health of the aquatic organisms, thus changing the quality of the stream. Table 1 lists the optimal temperature ranges of some selected aquatic organisms. When the water temperature becomes too hot or too cold, organisms become stressed, lowering their resistance to pollutants, diseases, and parasites.

Expected Levels

Water temperatures can range from 0°C in the winter to above 30°C in the summer. Cooler water in a stream is generally considered healthier than warmer water, but there are no definitive standards. Problems generally occur when changes in water temperature are noted along one stream on the same day. Some sample data are listed in Table 2.

Table 2: Water Temperatures of Selected Rivers				
Site	Season	Temperature (°C)	Season	Temperature (°C)
Hudson River, Poughkeepsie, NY	Winter	5	Summer	25
Missouri River, Garrison Dam,	Winter	3	Summer	14
Rio Grande, El Paso, TX	Winter	16	Summer	21
Mississippi River, Memphis, TN	Winter	7	Summer	29
Willamette River, Portland, OR	Winter	9	Summer	22

Summary of Method

You will use a Vernier Temperature Probe to measure the temperature of the water at one site and at a second site upstream (one mile upstream is the standard, but a shorter distance may be used). Because water temperatures can fluctuate so greatly from region to region and season to season (see Table 2), it is the *difference* in temperatures along one stretch of a particular stream or river on a single day that is measured.

TEMPERATURE

Materials Checklist

___ computer
___ Vernier computer interface
___ Logger *Pro*
___ Vernier Temperature Probe
___ small paper or plastic cup(optional)

Collection and Storage of Samples

1. Water temperature must be measured on site by either placing the probe directly in the stream or by collecting a sample and immediately measuring its temperature.
2. If you need to collect a sample to measure on site, it is important to obtain the water sample from below the surface of the water and as far away from the shore as is safe. If suitable areas of the stream appear to be unreachable, samplers consisting of a rod and container can be constructed for collection. Refer to page Intro-4 of the Introduction for more details.

Testing Procedure

1. Position the computer safely away from the water. Keep water away from the computer at all times.
2. Plug the Temperature Probe into Channel 1 of the Vernier interface.
3. Prepare the computer for data collection. Open "01 Temperature" from the *Water Quality with Vernier* experiment folder of Logger *Pro*.
4. You are now ready to collect temperature data.
   a. Place the tip of the probe into the stream at Site 1, or into a cup with sample water just taken from the stream. Submerge the probe tip to a depth of about 6 cm.
   a. Click Collect to begin data collection.
   b. Click Keep to begin a 10 s sampling run. **Important:** Leave the probe tip submerged for the 10 seconds that data is being collected.
   c. When the sampling run is complete, stop data collection and record the average temperature on the Data & Calculations sheet.
5. Return to Step 4 to obtain a second reading at Site 1.
6. Repeat Steps 1-6 at Site 2, one mile upstream from Site 1.

DATA & CALCULATIONS

Temperature

Stream or lake: _____ Date: _____

Site 1 name: _____ Time of day (Site 1): _____

Site 1 number: _____ Time of day (Site 2): _____

Site 2 name: _____ Student name: _____

Site 2 number: _____ Student name: _____

Distance between sites: _____ Student name: _____

Column	A	B	C	D
Site	Temperature 1 (°C)	Temperature 2 (°C)	Average temperature (°C)	Temperature change (°C)
1				
2				

Column Procedure:

A. Record first water temperature reading at each site.
B. Record second water temperature reading at each site.
C. Average the water temperature at each site = (A + B) / 2
D. Temperature change = Average temperature Site 1 – Average temperature Site 2

Field Observations (e.g., weather, geography, vegetation along stream) _____

_____

_____

_____

Test Completed: _____ Date: _____

Vernier Lab Safety Instructions Disclaimer

THIS IS AN EVALUATION COPY OF THE VERNIER STUDENT LAB.

This copy does not include:

- **Safety information**
- **Essential instructor background information**
- **Directions for preparing solutions**
- **Important tips for successfully doing these labs**

The complete *Water Quality with Vernier* lab manual includes 16 water quality tests and essential teacher information. The full lab book is available for purchase at: http://www.vernier.com/cmat/wqv.html

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