TEMPERATURE

Water temperature is an important variable in the health of a stream or other body of water. All living organisms, including humans, can survive only if the temperature of their environment is in the right range. This activity is a fairly simple one involving taking the temperature of the stream at a selected site. It usually does not require a lot of time to complete so be sure to keep the extension activity discussed below in mind.

Although the pre and post discussions are necessary to provide important information about each topic, it is the activity that is most vital to this unit. Be sure to allow plenty of time to complete the activity.

Pre-Activity Discussion (Answers can be found in the Background Information section below)

Before beginning the activity ask students: 1) Why is water temperature important? 2) How does temperature affect living creatures? 3) How does temperature affect the amount of oxygen in the water (dissolved oxygen)? 4) How is temperature affected by seasonal factors? The riparian buffer zone? Turbidity (siltiness)? Springs that feed the stream? Impervious surfaces? Human activity?

The Activity

Equipment

--Thermometer and pole
--Watch, preferably showing seconds (you need to measure 2 minutes)
--Boots or waders (optional though not generally needed))
--Data forms
--Small table (convenient but not essential)
--Clipboard for forms
--Display board
--Paper bag labeled Broken Glass in the event a thermometer breaks

Note: Remind students to handle thermometer carefully. It is filled with red-dyed alcohol and tied to the end of the pole. If one breaks, the adult should put the pieces in the paper bag labeled BROKEN GLASS. Dispose in waste can and notify Event Coordinator.

The Activity: Set-up and Procedure

Select a site at which you can easily immerse the thermometer in the main flow of the stream from a dry spot on the bank. Pick a spot that is not obstructed by bushes and brush and watch out for poison ivy, nettles and thorny plants. The thermometer is tied to a pole so that it can be dipped in the stream while standing on the bank. Each round of measuring requires a pole person who will dunk the thermometer, a timer, a thermometer reader and a data recorder. Rotate assignments among the group to keep each person as actively involved as possible.

1. The pole person lowers the thermometer into the water so that it is completely covered.
2. The timer uses the stopwatch to let the pole person know when 2 minutes have passed.

3. When the pole person removes the thermometer from the water after two minutes, it must be read immediately to get an accurate reading. Tell the recorder what the reading is and have it read back to be sure it was recorded properly.
4. Try to do this process a total of three times. Rotate the tasks among the group members.
5. Place the thermometer and stopwatch in safe storage
6. Calculate the average of the three temperature readings by adding them together and dividing by the number of readings. Record the result on the group's data sheet.
7. Answer the question on the data sheet.

Extension Activity

This activity does not require a lot of time so it is good to have a way extend the unit. Ask the students if they think that the temperature would vary if taken at different locations. As they identify other places to try, ask them to predict whether the temperatures will be warmer or colder. For each question, be sure to ask them to explain their responses. After taking temperatures at the other locations, revisit the predictions.

Post-activity discussion questions:

1) Were there variations among the four temperature readings? Why might that have occurred?
2) Would sampling from different spots (deep pools, sunny areas, shady areas, etc.) in the stream have yielded different temperatures? Why or why not?
3) What human activities can affect stream temperature? What can be done to mitigate against the effects of these factors?

Background Information

Fish, crustaceans (crayfish, scuds, shrimp), shellfish (snails, mussels, clams), and aquatic insect larvae and nymphs (juvenile forms) are all cold-blooded or ectothermic. They can't control their body temperatures. Having the right environmental temperature is therefore even more important for them than it is for humans who can put on a winter coat or turn up the heat on the furnace. Preferred temperatures for several fish species are as follows:

Species	Preferred temperature, deg. F
Catfish	74-78
Bluegill	73-77
Smallmouth bass	68-72
Northern pike	62-71
Steelhead	58-60
Coho salmon	54-55
Lake trout	48-52

When water temperatures are too high, fish and other water-dwelling creatures may fail to reproduce or even die. Such streams will have a smaller diversity of fish and may no longer host a healthy supply of the macroinvertebrates. These creatures play an important role in the food chain. Another consequence: If you lose your population of dragonflies, you lose an important source of mosquito control.

The warmer the water is, the less dissolved oxygen it can contain—and dissolved oxygen is essential for fish and other aquatic life to breathe. This is often a problem in the summer and early fall. See the table below showing the effect of temperature on carrying capacity of oxygen (oxygen solubility).

Temperature, deg. F	Temperature, deg. C	Oxygen solubility, sea level, mg/L
32.0	0.0	14.6
42.8	6.0	12.4
53.6	12.0	10.8
64.4	18.0	9.5
75.2	24.0	8.4
86.0	30.0	7.5

Many factors affect water temperature including:
1) Seasonal variations in air temperature
2) Latitude
3) The state of the riparian buffer zone. Streams shaded by trees are cooler than those that get a lot of direct sunlight
4) Industrial discharges (from power plants, for example) can raise the temperature of a stream significantly
5) The level of turbidity- Sunlight heats muddy water more readily than clear water
6) Water sources- Spring-fed streams and streams receiving groundwater tend to be cooler than those receiving mostly surface water.

On a local level there are ways that an individual can help protect a stream from rising temperatures. Some examples: Planting a rain garden or using a rain barrel will slow runoff of warm water. Allow shrubs, trees and wildflowers to grow along the banks of streams and lakes to slow runoff. Educate neighbors about the importance of these issues.

For this and all other units, advanced level information is available if desired. Contact the HRWC and request an electronic version of the unabridged manual.

Stream Temperature Data Sheet

Temperature Readings	Species	Preferred temperature	
		Degrees F	Degrees C
	Catfish	74-78	23.3 – 25.5
	Bluegill	73-77	22.7 - 25.0
	Smallmouth bass	68-72	20.0 – 22.2
	Northern pike	62-71	16.6 – 21.6
	Steelhead	58-60	14.4 – 15.5
	Coho salmon	54-55	12.2 – 12.8
	Lake trout	48-52	8.9 – 11.1
Sum of temperature readings _____			

Average temperature reading = Sum of readings divided by 3 (or number of readings): _____

1. On the basis of your average temperature reading, which of the fish listed could live comfortably in this stream today?

2. How do warmer temperatures affect the amount of dissolved oxygen in the water?

3. In addition to fish, what other organisms are affected by lower oxygen levels?

4. What human actions can affect the temperature of this stream?

KEY TO WORKSHEET QUESTIONS

Temperature Station

1. On the basis of your average temperature reading, which of the fish listed could live comfortably in this stream today?
   Answers will vary

2. How do warmer temperatures affect the amount of dissolved oxygen in the water?
   Less dissolved oxygen is found in warmer water.

3. In addition to fish, what other organisms are affected by lower oxygen levels?
   Crayfish, caddisfly larvae, mayfly larvae, stonefly larvae, and more.

4. What human actions can affect the temperature of this stream?

   A. Maintain trees and shrubs along the stream edges.
   B. Keep sediments out of the streams
   C. Limit paved surfaces
   D. Install a rain garden
   E.

Temperature Lesson Narrative

Intro. 5 minutes. The mission is to make these points: Water temperature can vary. Different organisms have different temperature ranges in which they can live. Water temperature can affect the amount of dissolved oxygen in the water.

1. 1. My name is _____ and I'm a volunteer with the Temperature station. Please tell me your names. (Go around)
2. What do you notice about the temperature here today? (Accept and repeat a couple of answers)
3. Is this a comfortable temperature for you? What would you do if it got a lot hotter? How about if it got a lot colder? (Students may mention taking off or adding layers of clothing, seeking shade or shelter, drinking water, etc.)
4. Ask if they think it could ever get too hot or too cold for a fish? What could the fish do? (Students may mention that the fish could seek shade, or swim away) Explain that different fish have different ranges of temperature in which they can live, and that if the water is hotter or colder, they may die. Show the range on the student page.
5. Now let's think about the stream? Do you think the water is warmer or colder than the air? Read the thermometer for the air temp, and ask for predictions for the stream.

The Activity. 5 minutes. Assign the roles.

6. Explain that the group is going to measure the temperature of the stream. Explain and assign the different ways that students will help. (Collect the water, take the temperature, record data.)
7. Collect two or three temperature readings.
8. Gather students together. Review the data. Ask what things might have caused differences in the results.

The Wrap Up: 5 minutes.

9. Gather the group back at the table/station. Ask "What variables might have affected our tests today?"
10. Ask what other variables might affect the temperature of the stream over the course of a day or a year?
11. Take another look at the temperature range for fish shown on the student page. Ask which fish could live here.
12. Explain that different aquatic insects also have different ranges, and can be affected when the water gets too hot or cold.
13. One way that humans affect the temperature of the water is by causing erosion. When dirt, or sediments are added, the water gets darker and holds more heat. Another way humans can affect stream temperature is by increasing runoff from paved surfaces. Summer runoff is often warmer than

the streams. Removing trees from the edges of streams can make the water warmer as well.

14. Explain that temperature can also affect the amount of dissolved oxygen in the water. Warmer water holds less dissolved oxygen than cold water. So warmer water is harder for aquatic creatures to get enough oxygen in.
15. Ask or tell how people might improve the situation? (Limit runoff, plant trees by streams, do not mow to stream edge, etc.)
16. Thanks for visiting with me today. It's time for you to go to your next station _____.