LESSON 42

Burning Questions

Grade level: 5-8
Subject Areas: Science, mathematics
Duration: 30 minutes
Setting: Indoors
Season: Any
Conceptual Framework Topics: Ecosystems, invasive species ecology, succession, weed management, controlled burning

OBJECTIVE

Students will understand that soil insulates the roots and rhizomes of plants during fire, and many plants can survive even the most intense fires. Students will understand that many invasive plants can outcompete native or other desirable plants after a fire.

METHOD

Students use a "model" to represent the soil layers surrounding plants during a burn in order to measure the rate and extent of temperature increase due to heating. One set of measurements (for one thickness of insulation) is obtained as a demonstration, then students gather additional data at an activity center.

MATERIALS

- ✎ Hair dryer
- ✎ Thermocouple or digital thermometer
- ✎ Graph paper
- ✎ Clock with seconds hand
- ✎ Rulers (cm)
- ✎ 50 pages of newspaper (a thickness of 5 pages will represent one layer of soil)
- ✎ Brown fabric approximately the size of a newspaper page
- ✎ Overhead projector and pens
- ✎ Matches

BACKGROUND

Soil insulates roots from heat, and heat rises up from the top of the burning layer of organic matter (primarily plant material) during a wildfire.

As teacher, begin this activity by demonstrating the lighting of a match, and have students observe that the flame rises upward, as does the heat it puts off as it burns. Ask students what would happen if the match were clamped upside down while it burns, would the heat still rise? You can safely demonstrate this if you have a stand with a clamp and a lab table available. You clamp a match upside down and light the match while students observe that the flame continues to rise even with the match is clamped upside-down. Summarize that since heat rises, we can expect fires on the ground to create more heat upward than downward below the soil surface. This activity illustrates that the combination of heat rising and the insulating effects of soil on the roots of plants may limit the use of fire as a weed management tool, since roots may not receive enough heat during a fire to be killed.

Adapted with permission from *FireWorks Curriculum*, USDA Forest Service

Extensions

1. If your class does this activity in teams, treat each set of student data as a replication of the experiment for the specific soil layers used. Calculate the average values, then graph the results. Discuss this graphed data summary with the class. Here are some possible lead questions:

a) In what ways is the graph of averages more useful or more informative than the individual graphs?

b) What information is lost in the graph of averages?

c) Are there ways to show "lost" information on the graph of averages?

d) Do any of the averages seem affected by "outlier" data points, data that seem unreasonable and might be observational errors?

e) What should a scientist do with "outlier" data?

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PROCEDURE

1. Place the thermocouple or digital thermometer on a table.

2. Plug in the hair dryer.

3. Each 5 pages of newspaper represents one layer of soil. The brown cloth represents the surface of the soil.

4. Go through the procedure the first time with only the brown cloth covering the thermometer. Then repeat the procedure using additional newspaper layers (increasing each experiment by 5 pages each time a "soil layer" is added) under the brown cloth. Use one full data sheet each time the insulating layers thickness is changed, recording the number of soil layers used at the top of the data sheet.

5. Assign students to the following tasks:

Heater: Hold the hair dryer 5 cm from the surface of the table where the thermometer is located (he or she should measure the distance with a 5-cm ruler). Keep this distance constant, no matter how much insulation (5 pages of newspaper represents one soil layer) is placed between the "soil" surface (brown fabric representing the top layer of soil) and the thermometer itself. Turn on the hair dryer on high when the Timer says "Go!" Run the dryer for 15 seconds then turn it off.

Timer: Begin timing the experiment as you call out "Go," which indicates that the Heater is to turn on the hair dryer. Call out "time" every 15 seconds during the 4-minute experiment, as follows: "Go"... then "15"... "30"... "45"... "1 minute"... "15"... "30"...

Reader: Quickly read and call out the "official" temperature each time the timer calls out "time," being careful to keep the sensor under the insulating layers as you take the reading. This will be every 15 seconds throughout the 4 minutes.

Recorder: Record the temperature at start of experiment and each time a temperature is called out by the Reader, which will be every 15 seconds throughout the 4 minutes. For the class demonstration, record the temperatures on a transparency of the chart for the entire class to see on the overhead projection.

6. Ask students to graph the data, with "Time" in 15-second intervals on the Y-axis and "Temperature" on the X- axis. To compare the data based on soil thickness (insulating layers), use different colored data points and connecting lines, being sure to label each color with the number of soil layers being represented.

7. Ask the class to try to explain the results of the graph.
(Teacher Help: Encourage students to notice that the thinner the insulation, the faster the temperature rises and the higher it goes. The thicker the insulation, the slower the temperature rises and falls; in fact, the temperature may continue to rise even after the heat source—hair dryer—is removed.)

EVALUATION

Does thick soil protect the roots from ground fire? Do you think that fire is a useful tool for weed control, and if so, when? Explain your answers fully.

Teacher Help: Surface fires usually burn quickly, and thick soil keeps the temperature below the ground surface from rising very fast. Ground fires burn very slowly. A ground fire may also heat the soil enough that many roots are killed.

Extensions, *continued*

2. Take the class on a field trip to a burned area that is adjacent to a similar area that did not burn. Make sure you know when the fire occurred, and what caused the fire. This could be a field that was burned intentionally for agricultural purposes, a lightning-caused wildfire, an accidental roadside fire, or even a prescribed burn in a local forest or prairie. Compare plant growth, with special attention to weed species and where they are found, and evidence of animal use between the burned and unburned areas. Predict what will occur over time if left alone, and brainstorm how the burned site could be managed for optimum agricultural use, wildlife habitat or other goal.

Name _____

Burning Questions Data Sheet

Layers of Soil Insulation (circle one): 0 4 6 8 10

Time (sec)	Root Temperature (Degrees C)
0	
15	
30	
45	
60	
75	
90	
105	
120 (2 min.)	
135	
150	
165	
180 (3 min.)	
195	
210	
225	
240 (4 min.)	

Now use your graph paper to graph the above data.
Use Time for the Y-axis and Temperature for the X-axis as follows: