

Spring Fever: Taking a Prairie's Temperature

(Activity Notes for Teachers)

Note: The following research idea has not been fully developed into an activity but has been tried in some workshops and classrooms. If you try it, let us know how it went by sending a note to epp@mhub.facstaff.wisc.edu.

BACKGROUND

This activity is designed to help students understand that soil temperature is an important environmental signal that helps to activate plant growth in the spring. Soil temperature is much more constant than air temperature, and changes more slowly. In fact, soil acts very much like an insulator. So, in the winter the soil is generally warmer than the air (especially when covered with a blanket of snow). And in the summer, the soil is often cooler than the air (especially when vegetation and ground litter provide shade).

During the winter, the prairie has ***cold feet!*** Living prairie plant roots wait in the soil for environmental signals that winter is over. In the spring, the surface soil gradually warms up in response to warmer air temperatures, and this gives plant roots a signal to begin their season's growth. Other important environmental signals to plants are moisture (rainfall) and, for some plants, daylength.

Soil temperature is different at different depths in the soil. The temperature of the "surface soil" (top 1" or so) changes most rapidly to changing air temperatures, while the soil at greater depths has a more constant temperature throughout the year. Soil ten feet or more below the ground's surface is fairly constant throughout the year (at approximately 40 degrees F). So during the winter, the surface soil is colder than the deeper soil (surface soil in Wisconsin freezes during the winter). During the summer, the surface soil is warmer than the deeper soil. Prairie plant roots can extend to great depths in the soil, sometimes more than 10 ft. (3 meters). So roots near the surface "*feel*" the seasonal changes in soil temperature, while deeper roots live in a more constant environment.

Farmers know about the importance of soil temperature, and in the springtime they measure soil temperature daily in order to determine when the soil is warm enough to plant.

Recall that fire is an important part of prairie ecosystems. When a fire sweeps across a prairie, dramatic changes occur in air temperature and surface soil temperature. Interestingly, the heat of a prairie fire does not penetrate very far into the ground, so the soil just a few inches below the surface often remains cool during a prairie fire. Prairie plants and animals are adapted to survive fires. Some animals (such as birds and large mammals) can escape a fire by simply flying or running away. Some animals (such as rabbits) go underground, where the cooler

soil temperatures protect them. Soil organisms (such as earthworms and soil insects) move downward in the soil, seeking cooler temperatures. And plants, well, they can't go anywhere! But their deep roots are protected from the heat of prairie fires, and the living roots are the starting point for new growth after a fire. In fact, the blackened ground surface after a spring prairie fire warms the surface soil rapidly, and this helps to initiate plant growth.

USING THE ACTIVITY

Materials needed:

- Soil probe thermometers
- Regular air thermometers
- Student worksheets

Student inquiry: Before measuring soil and air temperature, have students predict which will be warmer, the air, the surface soil, or the deep soil. Guide them in thinking about "why" they predicted as they did.

How to use the soil probe: The soil probe is designed so the temperature is sensed by the 2 1/2 inches at the end of the probe. There is a small notch on the probe at 2 1/2 inches from the end. So, to measure the temperature of the surface soil, push the probe into the soil, vertically, until the notch is at ground level. To measure the temperature deeper in the soil, push the probe into the soil as far as it will go. Leave the thermometers for at least 5 minutes, then the temperature can be read directly (in degrees F or C) off the dial at the top of the probe. Temperatures should be read as precisely as possible, because plants can "feel" even a few degrees difference.

The soil probes are relatively inexpensive (Weksler soil thermometer in Forestry Suppliers catalog is \$20.00). The Arboretum has six of these that can go out on loan to Earth Partnership schools.

Questions for discussion: The questions on the student worksheets can be used as a starting point for class discussion.

- Which was warmer, the air or the soil?
- Which was warmer, the surface soil or the soil 3" deep?
- What do you think the soil temperature would be at 10 ft. below ground level? 100 ft.?
- How different were the temperatures you measured, and what might this mean to plants/plant roots?

- How do prairie plants know when to start growing in the spring? What are the signals?
- What temperatures do deep roots "feel"?
- How are prairie plants and animals adapted to surviving fire?

Extensions for further exploration:

Have students monitor air and soil temperatures over several weeks or months in the spring. Weekly or daily temperatures of air, surface soil, and deep soil can be plotted on graph paper. Begin the project early in the spring, while it is still cold and before growth begins. Soil temperatures can even be taken beneath the snow! If possible, take each measurement at about the same time of day. Each student can start by predicting what soil temperature is needed for plant growth to begin. Then, by tracking temperature and watching for the appearance of green shoots, students can test their predictions.

If you burn your school prairie, you can have students investigate the effect of the burn on temperatures by measuring soil temperatures before and after the burn, or in burned and unburned areas. We are currently developing classroom methods for measuring temperatures *during* a prairie burn.