

K-12 IYS Activity



Summary

Soil temperature plays an important role in many processes that take place in the soil, such as chemical reactions and biological activity. This includes important processes like seed germination, activity of bugs and microbes that live in the soil, and how quickly dead plants break down and decompose. In colder soils, decomposition is slower and more carbon can be stored in the soil.

Materials Needed

- Two aluminum 9-inch circular pie pans
- Two 1-quart zip-lock plastic bags filled with ice
- Approximately 8 cups of moist potting soil at room temperature. Potting soil can be purchased at garden supply centers. Alternatively, any local soil can be collected and used.
- One paper lunch bag full of fallen tree leaves. This can be either hardwood tree leaves or pine needles. Students can be asked to collect the leaves and bring them to class for this.
- Thermometer. A digital cooking thermometer with a metal tip works best
- Graph paper, ruler, and pencil
- Newspaper, plastic, or other material to protect desks or tables from spilled soil if exercise is done indoors

Don't Lose Your Cool: Fallen Leaves Insulate the Soil

Ages

K-12

Where could you offer this?

Local school, library, or home

Where could you offer this?

Individual, less than 20

What type of room do you need?

Lab/work benches

Type of Lesson

Hands-on (participants touch the stuff)

Experiment (follow procedure, get results, interpret results)

Time Needed

Scientist prep time + clean up time: 15 minutes

Participant/class time: 45 minutes

Learning Objective

- Investigate the influence of fallen leaves on the temperature in soil. When soils get too hot or too cold or the soil temperature fluctuates too rapidly, the activity of the living organisms in the soil changes, which can negatively affect the health of the soil and the survival of plants.
- Reinforce math and analytical skills by collecting data and graphing temperature changes through time to test a hypothesis.

Leaves that fall from trees in the autumn not only are beautiful but also help to keep forest soils healthy and productive. Fallen leaves that cover the surface of the soil act like a blanket and help to protect the soil. Leaves that fall from trees in the forest help to insulate the soil and protect it from rapid temperature changes. Soil temperature can be changed to simulate when it gets cold in the winter by placing a bag of ice on the surface of the bare soil and measuring the temperature over time. This change in temperature can then be compared with the temperature change that occurs in the soil when it is covered by a layer of tree leaves to learn how leaves can insulate the soil.

Method

1. If the exercise is done indoors, cover tables with newspaper, plastic or other material to protect them from spilled soil and to facilitate cleanup
2. Fill both of the aluminum pie pans with about 1 inch of soil (this is approximately 2 cups of soil). Note: make sure soil is at room temperature before the start of the demonstration.
3. Cover the surface of the soil in one of the pie pans with about 6 inches of loosely piled tree leaves.



Celebrating the



2015

International
Year of Soils

soils.org/IYS

—continued next page

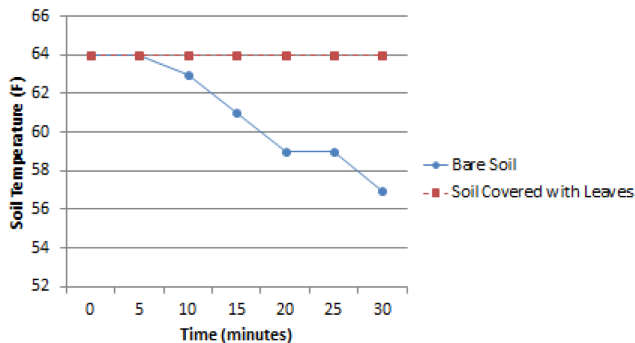
Don't Lose Your Cool: Fallen Leaves Insulate the Soil

4. Create a data table on the graph paper. Use three columns to record the results:

| Time (minutes) | Soil Temperature (No Leaves on Top of Soil) | Soil Temperature (Tree Leaves on Top of Soil) |
|-------------------|------------------------------------------------|--------------------------------------------------|
| 0 (initial) | | |
| 5 | | |
| 10 | | |
| 15 | | |
| 20 | | |
| 25 | | |
| 30 | | |

5. Use the thermometer to measure the temperature near the top of the soil in each pie pan at the start. This is the initial temperature. Record this on the data table.
6. Place a plastic bag of ice on top of the pie pan with the bare soil and another bag plastic bag of ice on top of the pie pan with the soil covered by the tree leaves.
7. Use the thermometer to record the temperature at the top of the soil (about one inch below the surface) at 5 minute intervals for a total of 30 minutes.
8. After 30 minutes (or less depending on the time available and how quickly the soil temperature changes), create a graph of the results similar to the one shown below. Time should be plotted on the horizontal axis and the soil temperature on the vertical axis of the graph. Use a circle to show the data for the temperature of the soil with no leaves on top and a square to show the data for the temperature of the soil with the leaves on top. Connect the circles with a solid line and the squares with a dashed line to show the trend over time. Label each line as either "Bare Soil" or "Soil Covered With Leaves."

Effect of Leaf Cover on Soil Temperature



9. Practice with subtraction: Determine the total change in temperature of the soil in each of the two pie pans by subtracting the final temperature from the starting temperature:

$$\text{Temperature change} = \text{Starting temperature} - \text{Final temperature}$$

10. Practice with division: Determine the rate of change in temperature by dividing the temperature change by the total time of the experiment:

$$\text{Rate of temperature change} = \text{Temperature change} / \text{Total time}$$

11. More advanced students use the rate of change to predict the temperature of the soil in the future. Students can also compare the effect of different depths of leaves on top of the soil to determine the ability of the leaves to insulate the soil.
12. Related topics include the use of mulches such as wood chips or ground bark to protect the soil in gardens around students' homes.



Soil and Thermometer



Soil and Ice



Soil Covered with Leaves



Soil Covered with Leaves and Ice



Soil Science Society of America
www.soils.org

Don't Lose Your Cool: Fallen Leaves Insulate the Soil

Discussion Questions

- What is insulation and how does it work? Give some examples of things you use every day that insulate you from cold temperature.
- What is the temperature change of the bare soil and the soil covered with leaves? Does the temperature change faster in the bare soil or in the soil covered with leaves?
- Based on your observations, are leaves on the surface of the soil a good insulator?
- What do you think would happen to the temperature of the two soils if the bag of ice were left on the soil for a longer period of time? What would the soil temperature be in the two pie pans after 1 hour? Would the bare soil continue to get colder and colder? Would the temperature of the soil covered with leaves ever be the same as the temperature of the bare soil?
- Why is insulating the soil important? The soil is home to many creatures such as moles, salamanders, worms, ants, protozoa, fungi, and bacteria. What happens to the organisms living in the soil if the temperature gets too cold and the soil freezes? What happens to them if the soil gets too hot?
- Climate change is a serious concern among scientists. Think about how this experiment relates to climate change.

Additional Resources

www.soils4teachers.org
www.soils4teachers.org/soil-and-environment
en.wikipedia.org/wiki/Thermal_insulation
www.nrri.umn.edu/worms/forest/soil.html



Soil Science Society of America
www.soils.org