Soil Temperature

In this lesson, students will be able to:

- Read and record the current air temperature from a weather application
- Measure and record the temperature at a variety of sites in the growing environment
- Average the temperatures
- Discuss the variances in temperature and the impact of growing plants
- Optional – convert temperatures to Celsius

Materials Needed:

Outdoor area with concrete, turf, and mulch in sun and shade
Infrared temperature guns (laser guns)
Access to a weather app
Calculator

Time to Complete

Activity = 45 minutes

Introduction

Soil temperature affects all biological organisms in the soil environment, including microbes, invertebrates, vertebrates, plants, and fungi. The focus of this lesson will be on how soil temperature affects plant growth.

The roots of plants and seeds are more sensitive to changes in soil temperatures than the above-ground portions of plants are to ambient or air temperatures. Roots and seeds can be greatly impacted by soil temperatures, both hot and cold. Additionally, soil temperatures can be impacted by soil moisture as water in the soil will result in soil taking longer to warm up and longer to cool down.

This material is based upon work supported by the National Science Foundation under Grant No. 2202151.
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

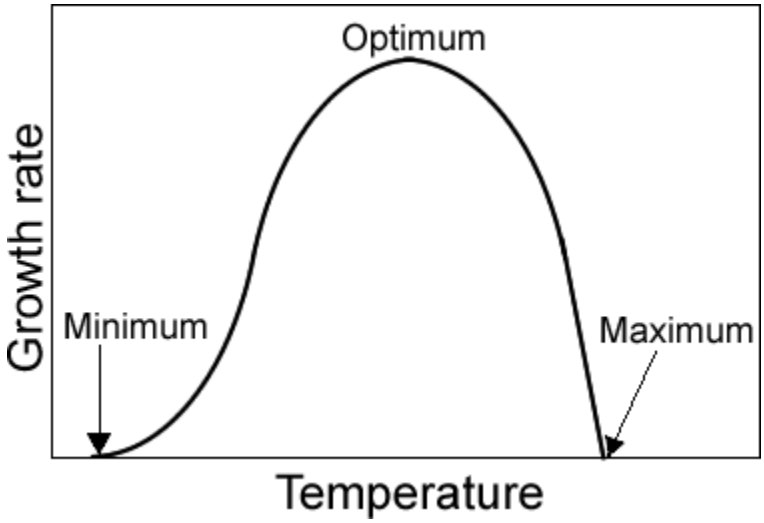
Soil Temperature and Plant Growth

Plants have a **range of temperatures** that are considered key to understanding how they affect plant growth. Some plants can function outside of this range in extreme cold or extreme hot environments. However, this lesson will focus on the temperatures that are generally considered the "normal" range.

Minimum temperatures are at the low end of what a plant can tolerate. Most plants struggle to survive below 40°F. At 32°F, most plants will suffer from ice crystals forming in their cells and causing irreparable damage. A killing freeze is marked at 28°F and very few herbaceous plants can survive below this temperature.

Optimal temperatures are the range of temperatures at which a plant is actively growing. Most plants grow actively between 50°F and 85°F. Plants grow best when daytime temperatures exceed nighttime temperatures.

Maximum temperatures are the upper limit of what a plant can tolerate. Most plants will slow their growth above 85°F. Upon reaching 112°F many plants will suffer damage to their structures or experience extreme stress. By 120°F, most plants will not survive, especially if the temperature persists for long periods of time.



https://www.uwyo.edu/virtual_edge/

Soil temperatures do not flex as quickly or as easily as the air temperatures do. This is because the soil has a natural buffering effect. In addition, mulch and turf can help insulate the soil. On the other hand, concrete and buildings can heat up the soil due to reflection and the transfer of heat from absorption.

This material is based upon work supported by the National Science Foundation under Grant No. 2202151.
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Activity

This activity will explore temperatures of the air and different surfaces in the growing environment.

Record the date, time, and temperature of the ambient environment (air) using a weather app on your phone in degrees Fahrenheit.

Date: Time: Temp:

Using your infrared thermal gun measure the temperature (°F) each listed site a total of four times.

Concrete in the sun

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

Concrete in the shade

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

Bare soil in the sun

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

This material is based upon work supported by the National Science Foundation under Grant No. 2202151.
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Bare soil in the shade

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

Mulch in the sun

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

Mulch in the shade

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

Turf in the sun

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

Turf in the shade

Temp 1: Temp 2: Temp 3: Temp 4:

Average:

This material is based upon work supported by the National Science Foundation under Grant No. 2202151.
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Discussion:

Are these temperatures different from what you expected? Why or why not?

What is the minimum, optimum, and maximum growing temperatures for most plants?

Which of the environments we explored today would be most ideal for plant growth and development? Why?

What do the temperature readings today tell us?

Use the following link: https://cropwatch.unl.edu/soiltemperature

How do your one-day surface temperature readings compare with the 7-day average UNL CropWatch temperature readings taken at 4 inches for the location closest to you?

What does this information tell us?

Should we rely on one one-day averages or on 7-day averages for the best data?

Activity Add-ons

Have the students convert the temperatures to Celsius.

Observe measurements from the same locations over the course of a week.
Did any of the sites buffer their temperatures better than others? Why or why not?

Reflection

What did you already know when we started this activity?

What did you learn from this activity?

How will this activity help you grow plants?

This material is based upon work supported by the National Science Foundation under Grant No. 2202151.
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.