Comparing Soil and Air Temperature

A lesson from the New Jersey Agricultural Society
Learning Through Gardening program

OVERVIEW: Do your students know that the temperature of the soil and the temperature of the air are not the same? Farmers and gardeners need to pay attention to soil temperature to know when to plant the first crops in the spring. Soil holds heat better than air and is usually warmer than the air. In this lesson, students learn the relationship between soil and air temperature, using their math skills to compare and graph the changes in both temperatures during a planting season.

OBJECTIVES: The student will be able to

- Measure the air and soil temperature over a period of weeks and chart and graph the results.
- Students calculate the differences between air and soil temperatures and show those differences as fractions, ratios, or percentages.
- Explain the differences between the air and soil temperatures.

GRADES: 3-5*, can be modified for younger grades as a whole class observation*

OBJECTIVES:

MATERIALS:

Soil and air thermometers for each small group or one if doing a whole-class observation
Rulers
Pencils
Copy of Soil Temperature Chart for each small group
Garden Temperature Chart for each student or one large chart for the whole class
Clipboards or notebooks
Graph paper

NOTE: Soil thermometers can be used for measuring air temperature. Just wipe off the soil and hold the thermometer up in the air for a minute or two. An oven thermometer that goes down to 32 degrees can also be used as soil thermometer.

INTRODUCTION:

Begin a class discussion about the temperature of the air and the temperature of the soil. What changes the temperature of the air? What might change the temperature of the soil? Share these soil temperature facts:

- Soil holds heat better than air does. The heat in soil is protected by the soil above it, vegetation over it, and snow. In fact, the deeper you go, the more insulation and the higher the average temperature, to a point. From about 30 to 200 feet below the surface, the soil temperature is relatively constant at about 55 degrees F. That's how worms and other creatures that live in the soil can survive winter by tunneling down deep in the soil.

- The amount of water in the soil will affect its temperature. Sandy, dry soil heats up very fast, and on hot summer days when the air temperature is in the 90s, the temperature near the surface of sandy, dry soil can spike up to over 100 degrees F. That's why the beach sand is so hot on your feet on a sunny summer day.

- Wetter soil tends to be cooler. That's why in February, when the soil is wet, soil temperatures near the surface can be lower than air temperatures. The soil warms up as the warmer air temperatures evaporate the water in it. From late March through the summer, soil temperatures are usually higher than air temperatures.

- Because the soil temperature is usually different from the air temperature, it is important for gardeners and farmers to know the temperature of the soil before they plant. The green dots on the Soil Temperature Chart tell you when it is okay to plant the seeds of cool-season and summer fruits and vegetables. Notice that the practical temperature for planting for cool-season vegetables such as lettuce, carrots, and spinach is much lower than the practical planting temperature for summer vegetables such as corn, tomatoes, and cucumbers.

PROCEDURE:

The best times to start this project are at the beginning of April or mid-September.

Explain to the students that once a week for the next seven weeks, you are going to check the temperature of the school garden's soil and compare it to the air temperature. Pass out the Garden Temperature charts. Each student will complete his own chart. Show students the air thermometer and soil thermometer (or just the soil thermometer if you are using it for air readings.)

First, in small groups, the student will measure the temperature of the air around the garden and record it on the chart. Next, the students will take the temperature of the soil in the garden where vegetables are or will be planted. The soil temperature will be taken at two different depths: two inches and six inches. To measure the soil, first the students should push the ruler into the soil until the two-inch mark is level with the ground. If the soil is hard, the students can use the point of a pencil to loosen the soil for the ruler. Once the two-inch mark is found, the students remove the ruler and put the soil thermometer in the two-inch hole, with the end at the bottom of the hole. The students record this temperature.

Next, the students choose another spot very close by and repeat this entire procedure, making a six-inch hole this time. Both soil temperatures should be recorded on the Garden Temperature Chart.

Next, each small group will take the soil temperature at a second location of their choosing. It can be a shaded spot near a building, under mulch or straw, or a very sunny spot near blacktop. The second location will show them how soil temperature can vary under different conditions. Once the second spot is chosen, the students take the soil temperature as in the garden bed, at a depth of two inches and again at six inches.

Each student records the temperatures on the Garden Temperature Chart. Inside the classroom, the small groups will set up and begin a graph showing how the temperatures of the air and soil at different depths vary over the course of the seven weeks.

MATH EXTENSIONS:

Younger students can calculate the difference between the soil and air temperatures and record this difference on a separate class graph.

Older students can use fractions, ratios, or percentages to show the difference between the soil and air temperatures.

Once they have recorded air and soil temperatures, students can make predictions for the air and soil temperatures before they go outside, based on the weather for the past week.

EVALUATIONS:

Completed individual Garden Temperature Charts and small group Temperature Comparison Graphs.

Once the seven-week project is completed, students can write a paragraph or several paragraphs, describing their observations of soil and air temperatures and explain how the relationship between the two temperatures changed over time.

TEACHER'S NOTE: This project is an excellent independent task for students to focus on while the teacher is working with small groups to plant or tend the garden. See Learning Through Gardening's Classroom Management in the Garden.

New Jersey Learning Standards

Science: 3: ESS2.D 4: ESS2.A 5: LS2.A, B

Math: 3.MD.B 4.MD.A,B 5.MD.B

Name_____

My Garden Temperature Chart

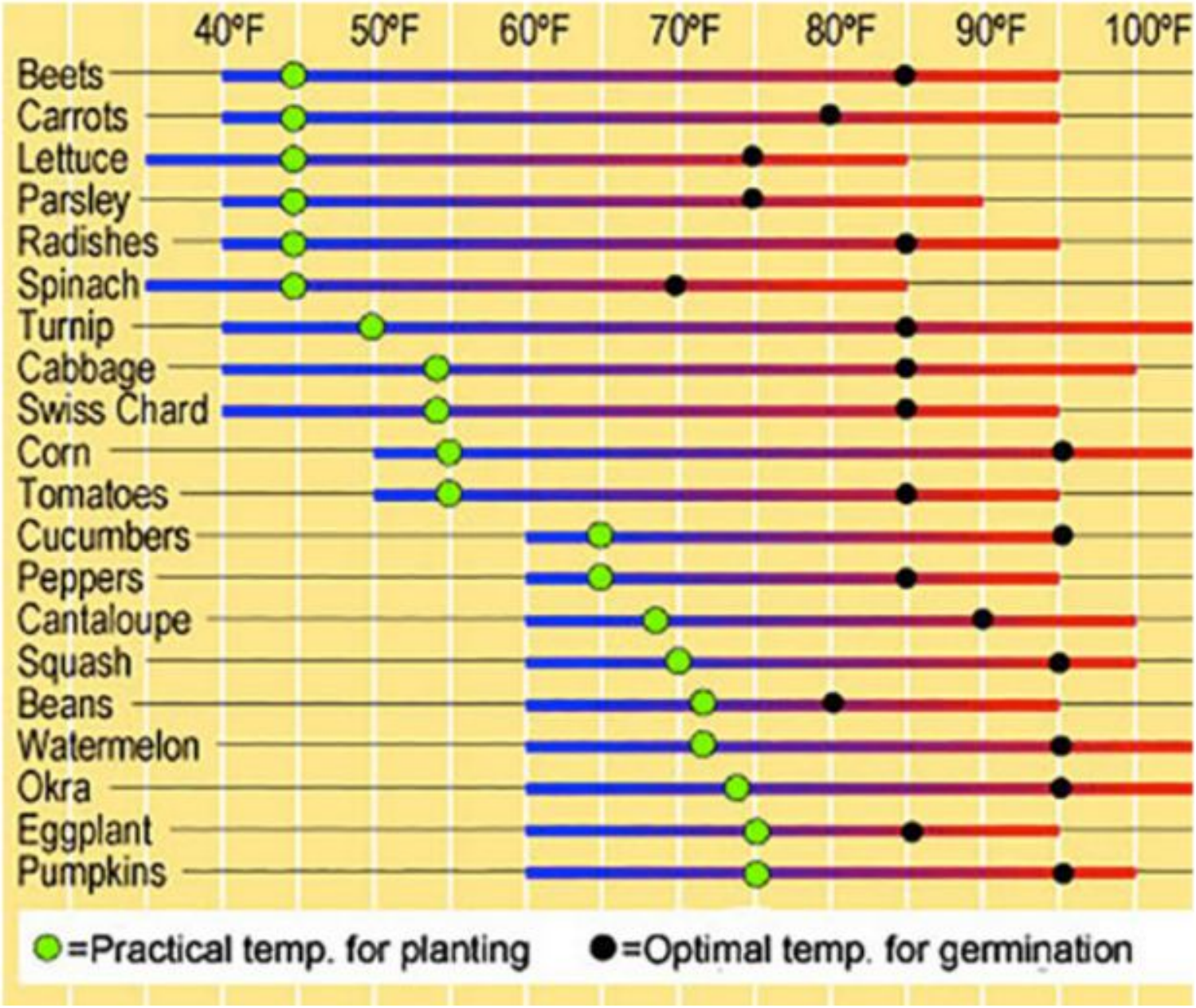
Date							
Air temperature							
Soil temperature garden bed 2" deep							
Soil temperature garden bed 6" deep							
Soil temperature 2nd location 2" deep							
Soil temperature 2nd location 6" deep							

*My second soil temperature location is*_____

*Garden observations:*_____

_____

SOIL TEMPERATURE CHART



The green dot shows how high the temperature of the soil must be before seeds can be planted in the spring.