

# Inquiry Based Science Investigation in the Schoolyard

## Investigation of Soil Temperature in Two Locations

Adapted from **Olympic Park Institute's** field science curriculum in the Old Growth Forest of the Olympic National Park

Overview and Objectives This is a **guided inquiry** in which students will conduct a comparative field investigation focused on soil temperatures (**responding/dependent variable**) in two locations, (**manipulated/independent variable**) in the schoolyard. (At Olympic Park Institute we use guided inquiries to prepare students for more complex open inquiries where *they* determine the investigative question.) Students will use simple equipment to gather data; develop descriptions, explanations and predictions related to a real world situation; think critically and logically to relate evidence and explanations; and communicate scientific procedures and explanations.

Based on the **National Science Education Standards**, all students in grades K – 12 should develop abilities necessary to do scientific inquiry and understandings about scientific inquiry. This investigation complements the following curriculum topics: measurement, statistics, graphing, soil composition, microclimates, microbes, and stewardship.

The Story behind the Soil Temperature Investigation A middle school population fills several large dumpsters with garbage including food waste from the cafeteria every week. School staff wants to answer the **essential question**: Can some of the school's food waste be composted on site? A green cone is a simple small-scale composting system with a covered 1.5 foot deep "pit" that creates compost in 3 to 5 months. Optimum location of the green cone includes close proximity to source of waste, and maximum distance from windows and walkways. Because higher soil temperature promotes more rapid decomposition, students are asked to consider the **investigative question**, is the soil temperature higher on the south side or west side of the schoolyard?

### Materials

- 1 soil thermometer for every small group
- 1 timer for whole class
- 1 science notebook and pencil for each student
- (may include a still or video camera)

### Safety and Management

All students will be going outdoors together and collecting data in two locations in the schoolyard near the school building. They will:

- Work respectfully within their assigned groups (3 or 4 students per group)
- Stay within the boundaries described by their teacher
- Refrain from engaging the attention of students in any other class
- Use science equipment only as instructed
- Wear appropriate clothing for an outdoor investigation
- Avoid horse play (pushing shoving, climbing, etc.)
- Follow all rules previously outlined for classroom behavior by the teacher

### Procedure for Data Collection

1. In the classroom introduce the story and **focus question**. Ask students how they would answer the **investigative question**. Each group can develop its own procedure or use the one provided by the teacher. Students should record the questions, their **hypothesis** and the **procedure** in their notebook. Gather input from students to determine **variables** that should be held **constant**, e.g. thermometers in sun or shade, distance of thermometers from buildings or sidewalks.
2. Introduce the chaperone.
3. Describe safe behavior for the investigation including how to carry and use the soil thermometers. Students should write at least three **safety rules** in their notebook.
4. Students will record **field notes** about the site (date, time, temperature, weather, location, nearby vegetation, animal activity) in their notebooks while waiting for the thermometer to equilibrate, approximately 4 minutes. Ask students to create their own **data table** or use the one provided.
5. Prepare to leave the classroom. Students wear appropriate clothing and bring materials.
6. Lead students to the first location and form a class circle. Identify boundaries for the data collection.
7. Groups select their test site. Give a signal for beginning the measurement. After 4 minutes, signal for students to read their thermometers and record data. Students repeat this measurement two more times in a different site in the first location.
8. Move to the second location and repeat steps 6 and 7.
9. After the final measurement is completed, students form a class circle to share observations.
10. Return to the classroom.
11. Students meet with their groups and determine a **mean** temperature for both locations.
12. Use **mean** temperatures from each group to create a class data bank for each location.
13. Students record class data and determine the **mean** temperatures for the class.

### Data Analysis Students will:

1. Identify factors that could have influenced the data. Consider whether outliers should be included. Explain whether **mean**, **median**, or **mode** best represents the class data.
2. Create a line plot representing the data and highlight the data point or derived number they will use to represent the temperature at each location.

### Comparative Investigation Students will identify:

1. Manipulated/independent variable
2. Responding/dependent variable
3. Controlled variable(s)
4. Number of trials completed

### Conclusion Students will:

1. Write a conclusive statement which answers the **investigative question**.
2. Include supporting data, **evidence**, for lowest and highest temperatures.
3. Describe the difference in these two numbers.
4. Use explanatory language (explain how these data support your conclusion).
5. Include error analysis:
  - Identify two possible sources of error in the investigation.
  - Describe how each source of error could have affected the investigation results.
  - Explain how the investigation results could be made more reliable.
  - Discuss whether additional data collection is necessary to satisfactorily answer the **investigative question**. Describe a plan to complete further work if needed.
6. Identify new questions and plan a new investigation that would provide more evidence to answer the **essential question**.



Communication Students will:

1. Prepare a presentation of final results for the school staff interested in placing green cones in the schoolyard in the form of a letter, oral presentation, poster, or video.
2. Practice presentation to group or class. Use feedback from peers to improve presentation.
3. Deliver presentation to school staff.

## Data Table for Investigation of Soil Temperature in Two Locations

| Student Name | Group Member | Group Member | Group Member |
|--------------|--------------|--------------|--------------|
|              |              |              |              |

| Date    |  | Time     |  |
|---------|--|----------|--|
| Weather |  | Location |  |
|         |  |          |  |
|         |  |          |  |

### Location 1 Temperatures

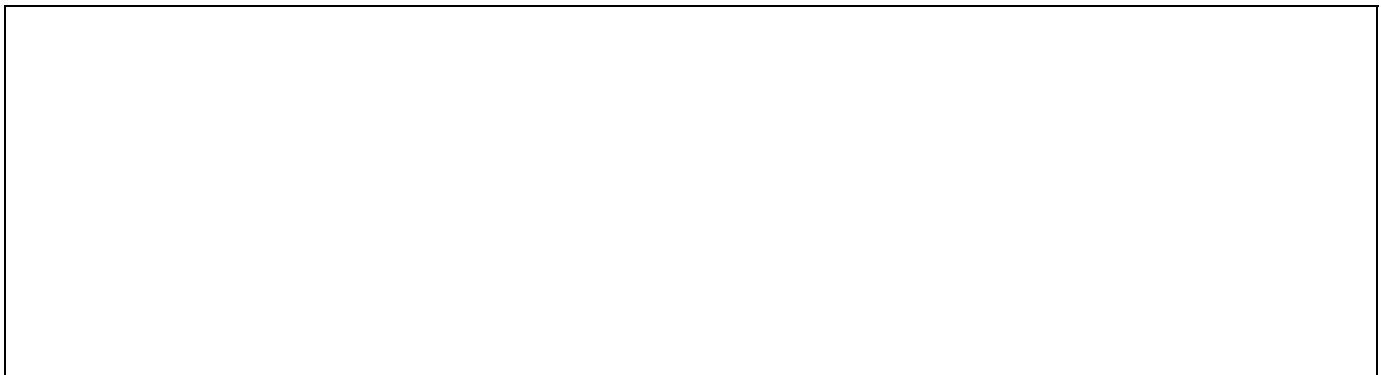
| Trial 1 | Trial 2 | Trial 3 |
|---------|---------|---------|
|         |         |         |



Map of measurement positions in location 1

### Location 2 Temperatures

| Trial 1 | Trial 2 | Trial 3 |
|---------|---------|---------|
|         |         |         |



Map of measurement positions in location 2