Schoolyard Investigation

Soil Temperature

Third Grade

Schoolyard Investigation
Soil Temperature

Overview

These lessons will allow students to explore the *connection* between soil temperature and seed germination (sprouting). The lessons will help reinforce the concepts of the basic needs of plants and introduce students to *plant (seed) adaptations*. They explore seed differences as they read about different seeds and their germination temperatures. Students will review the skill of using a thermometer to record temperatures and will conduct a field investigation *comparing* soil temperatures at two locations and then apply this data to answer the focus question: "Why do seeds sprout at different times under different conditions?" Students also *construct arguments/explanations* using claim, evidence, reasoning when answering both the investigation and focus questions. (3-LS4-3)

Overview Statement

Students **collect data on soil temperature and make a claim** about **which location** a seed would **germinate earliest in the spring**.

Next Generation Science Standards

3-LS4-3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.	
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s)Analyze data from tests of an object or tool to determine if it works as intended. • Construct an argument with evidence.	**LS4.C: Adaptation** • For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change.

Common Core State Standards Connections:

ELA/Literacy —

RI.3.1	Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
RI.3.2	Determine the main idea of a text; recount the key details and explain how they support the main idea.
RI.3.3	Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
W.3.1	Write opinion pieces on topics or texts, supporting a point of view with reasons.
W.3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

Mathematics —

MP.2	Reason abstractly and quantitatively.
3.MD.B.3	Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

English Language Proficiency Standard

ELP.2-3.2 participate in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.

Background

It is highly recommended to implement this investigation in the spring; exploration of growing things is more fun when you can actually grow plants together as a classroom! Every plant has ideal zones in which they are ***more likely to thrive***, and specific temperatures they require to germinate. Germination is the process where a seed comes out of dormancy to become a plant. Typically, vegetables with large seeds (such as beans, peas, or squash) are used with young students to illustrate the process of germination. Maybe you have seen the exercise of planting a bean seed on a wet paper towel in a zip-top bag. This activity is a simple way to visually see how a seed germinates.

For this investigation, the goal is to encourage students to think about the factors that influence the process of germination. Students will be making ***observations*** about areas of their schoolyard, comparing these observations to quantitative data about temperature, and ***make a claim***, ***supported by their data*** about the best fit of a particular area of the schoolyard to a particular plant's needs. In the first section, students make connections between seed packets and seeds in their local environment and are encouraged to collect seeds outside to compare to seeds they are provided in the classroom. Seeds may be collected in a variety of ways, such as putting masking tape sticky side out on pants and/or sleeves, or by pulling wool socks over their shoes which allows students to collect seeds that are sticking in grassy or planted areas.

Since ***different seeds require different soil temperatures*** to sprout, it is important to know soil temperature when choosing a location to plant seeds. This investigation, comparing soil temperatures at two locations, will have the greatest soil temperature differences if you choose two contrasting sites. Taking soil temperatures on a sunny day increases the chances of having greater variations in soil temperatures between the two locations. And for an even greater impact, ask students to collect soil temperature data over multiple weeks, starting in winter and transitioning to spring. Students will see trends in temperature change and have more information to support their claim about the best location to plant.

In investigations there is not always a significant difference in the data. If there is little or no difference in the soil temperatures, it is still valid data even though it may be unexpected. Light energy from the sun is absorbed by the air and soil and changed (transformed) into heat (thermal) energy. Areas that receive more sunlight at a direct angle should change more sunlight into heat energy and have higher temperatures. Areas that are dark in color absorb more sunlight and may also have higher temperatures. Other factors such as the angle of the Earth, wind speed, cloud cover, and vegetation cover also affect temperature.

Objectives

Students:

- Review what plants need to grow, read information about different types of seeds and their ***specific germination needs***.
- Learn about fair tests and variables.
- Practice taking temperature with thermometers and recording data.
- Draw a bar graph to represent their data and contribute group data to a class number line to ***look at patterns.***
- Construct ***arguments/explanations*** for both the investigation question and focus question.

Materials: seed packets, **Seeds and Plants Information Sheet** (lamination recommended for durability), stopwatch or watch, soil thermometers, rulers, clipboards, student pages or student notebook, sticky pads, number line (Optional: oversized wool socks, masking tape, map of the area, talk-move sentence starters).

Timing: Plan for a minimum of five 45-minute sessions. If you choose to grow your own seedlings to compare in class plan for germination to take between 5 – 10 days, according to the seed packet.

Example seed packets for student observations.

Learning Experience

For this project students may work as individuals, in pairs or small teams. Each student should document their individual and group thinking throughout the investigation, utilizing either the generated student pages or in a science notebook.

Wonder Wall

A Wonder Wall is a great strategy to pair with inquiry lessons and promotes curiosity and wonder in student explorations. Simply, a Wonder Wall is a dedicated area of the classroom for student questions, which can be written on sticky notes. The point is, the educator is not to answer the questions through direct instruction, but that these questions invite students to investigate on their own. Some questions might be answered through the planned classroom investigations, while others might be learned during independent reading time or discussions around the dinner table. Students become the experts, answering questions of their peers!

For more ideas about the use of this strategy, check out Chapter 12 in Curriculum Essentials: A Journey (Linda J Button, Ed.D.)

Engage

Phenomenon: Why do seeds sprout at different times under different conditions?

1. Pass out seed packets (consider using the same varieties as listed on the student pages) and direct their attention to the back panel to show the varying zones of planting and have students ***notice and wonder*** about them.

2. Use the student page or notebooks to capture student's initial thinking with a Notice and Wonder[1] routine. Encourage students to look for and express ***patterns*** they may see: Elevation? Temperature? Soil type?
   a. Additionally, you may want to show a video showing Inconsistent Germination[2] where some seedlings of the same species are thriving in one spot and not another and it may be different for different species.

3. Read students a book about seeds such as Eric Carle's *The Tiny Seed*.

4. OPTIONAL: Take the students outside to collect seeds from the schoolyard and use those as one seed to draw and label in their notebooks. If you have a seed collection, or conditions aren't good, you can also just provide seeds for students to observe.

[1] A "Notice and Wonder" routine is a simple way to engage students in new phenomenon. At the very basic level, you ask students to write down or share what they notice, and what they wonder. You can find out a lot more about "Notice and Wonder" by visiting https://sadlerscience.com/notice-and-wonder/.
[2] RED Gardens. (2021, May 31). *Inconsistent Germination* [Video]. YouTube. https://www.youtube.com/watch?v=QoTlB7kyhQk&t=102s&ab_channel=REDGardens

Math Extension

Have students research the average temperature of different areas on the map at different times of the year, and plot or graph them to compare. They could focus on Washington, or they could choose cities of interest. Encourage comparison of different zones.

Reflection

Ask students to record everything they know about soil, plants, and growth in their journal or on a piece of paper. After a few minutes of independent thinking, have students find a partner and share their knowledge; students can add to their own list if they learn something new. Give students two minutes each to share their ideas. Encourage students to thank each other for the knowledge, move to find a new partner, and repeat the sharing process. After this activity, you could either have students put this in their science notebook or have a class discussion and create a class chart. This could be used a pre-assessment of your students' knowledge about plants and help identify possible misconceptions.

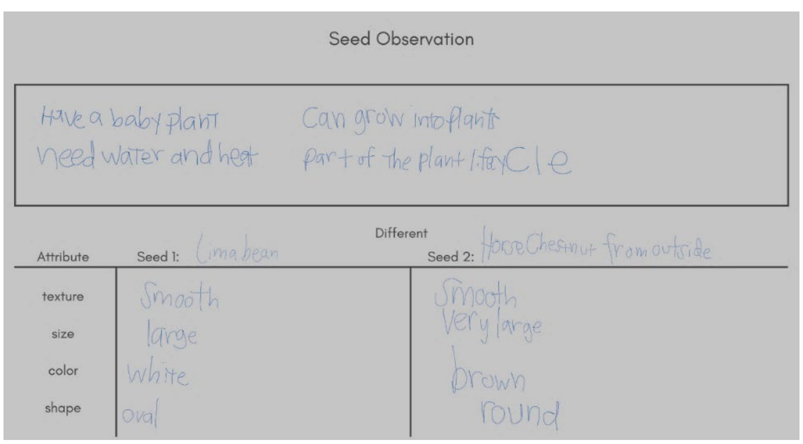
5. Have students examine two different seeds, cutting them open so they can see the tiny leaflet inside.
   a. Tip: a larger seed like a lima bean works well. Soak dry seeds in water overnight to facilitate opening.
   b. Have students draw the seeds and describe them in their notebooks or on the student page **Seed Observations**.

6. Introduce the idea that seeds are alive and will grow into plants, *given the right conditions*.

7. If you collected seeds from outside; Ask students *how these seeds are different* from the ones collected outside. Different seeds have different sizes, color, shape; different seeds have different dispersal mechanisms.

8. Have students discuss the seeds they observed. *What were the parts?* Tell them all seeds have the same parts even if they are too small for us to see without a microscope. All seeds have seed coats, cotyledons, and embryos to grow into plants. They all have *similar life cycles*, *but different plants have different types of seeds*.
   a. Teacher suggestion: Use a diagram or *model* of a seed/seedling[3] to be able to refer to with students, either an Internet resource or an anchor chart you build together.

9. **Science notebook option**: Ask students to *compare and contrast* two seeds using a Box and T-chart. By constructing a Box and T-chart, you can help them realize that even though seeds have many differences in appearance, they all have *the same parts inside*, which *enable them to grow into plants* Note the example Box and T-chart below.



Example student "Box and T - Chart"

[3] The Editors of Encyclopedia Britannica (Ed.). (2021, September). *Cotyledon* [Image]. Encyclopedia Britannica. https://www.britannica.com/science/cotyledon-plant-anatomy

Explore

Scout Investigation Locations. Look around the schoolyard and/or community with your students and encourage them to wonder and notice what they see. As much as feasibly possible, let the students determine the locations they want to take the temperatures of. If one group chooses two locations that are similar and one chooses two that are different, it opens an opportunity for *comparison between the groups*.

A few back pocket questions you may ask during the *survey/scouting*:
- Where are things currently growing?
- What types of things are going there?
- Why do you think certain things may be growing in different areas than others?
- Do certain plants come up and/or bloom at different times of year?
- What do you think may be affecting what grows where?

1. With your class, walk around the schoolyard and determine where they might find two good sites to *compare*. Bring markers such as flags or hula hoops with you to mark the spots determined by the class.
2. Have students make observations of the two locations, recording in their notebooks. Explain that scientists always describe their study sites first.
3. Have students predict which location will have the highest soil temperature. Discuss student predictions and ask students *why they predicted what they did*.

Scouting Locations

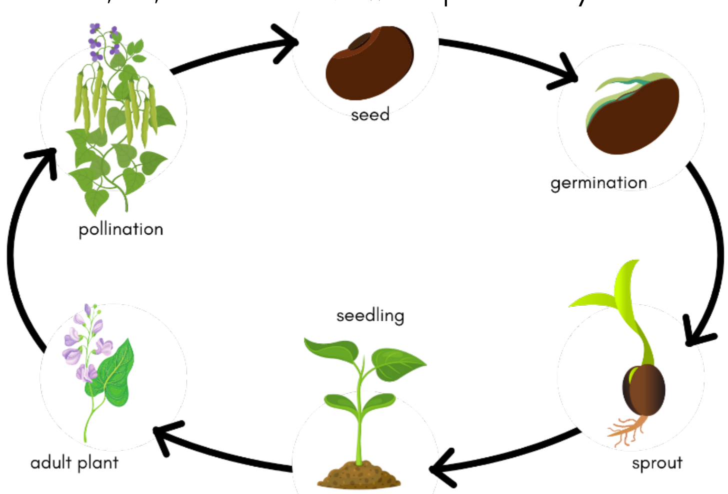
Look for:
- sunny versus shady parts of the school grounds
- north versus south sides of buildings
- protected area versus an open field

Make sure the thermometers are calibrated so they all show the same air temperature.

4. Back in the classroom ask students to write their prediction in their notebooks or on the **Soil Temperature Investigation** student sheet below the investigation question. Make sure to let students know it is fine to have predictions proven wrong – scientists do it all the time!

Investigating Soil Temperature. Students use this time to review the needs of plants and the plant life cycle to apply to the next part of the investigation, which is where they collect data on soil temperature.

6. Review with students (or refer to their notebooks, if already discussed in class) *plants' needs for growth*: light, water, mineral nutrients, air, and heat. Review the plant life cycle.



Example plant life cycle diagram

7. With the entire class, construct a consensus model of how the needs of plants are met (in the classroom and outdoors). The format of this scientific model is completely up to you! Scientific models can be diagrams, analogies, or physical replicas, and are based on evidence and used in sense-making (NGSS Appendix F[4]). At the minimum, this model should include:
    a. What plants need to sprout and grow (light, water, mineral nutrients, air).
    b. How these needs can be met in the classroom (grow lights, potting soil, watering cans).
    c. How these needs can be met outdoors (sun, soil, rain).

    The example chart below displays the types of thinking students may have during construction of the model.

Plants Need	How these needs are met in the classroom	How plants growing outdoors get their needs met
water	People watering the plants	Rain or people watering
air	Air in classroom	Air outside
mineral nutrients	Mineral nutrients in soil, water or fertilizer	Mineral nutrients in the soil and water
light	Light energy from light system	Light energy from the sun
heat	The room is heated that the plants are in	Light energy from the sun changes to heat in the air or ground/soil
space	Plants are thinned	Some plants die out to make room for others

8. Students can usually remember that plants ***require water and light***, but may need support for identifying mineral nutrients, air, heat, and space. Ask some of the following back pocket/probing questions to get to the idea of heat:
    - What allowed us to grow plants in the classroom in the fall or this early in the spring?
    - When do we usually plant seeds in a garden outside? Why?
    - When do we see flowers growing in our neighborhoods?
    - When do flowers develop their seeds?
    - What other factors besides light, air, water, and mineral nutrients might influence *where* a plant might grow?

9. Focus a conversation about how plants require heat energy to sprout, grow, flower, and fruit. Ask probing questions, such as "When do we see plants sprouting? What is the weather like at that time?" Just as all the ***seeds looked different***, so too do ***different types of seeds and plants have different temperature requirements***.

10. Give each pair of students the **Seeds and Plants Information Sheet**. Tell students each type of seed requires different minimum soil temperatures to sprout.

[4] NGSS Lead States. (2013). Appendix F – Science and engineering practices in the NGSS. In *Next generation science standards: For States, by States* (p. 6), National Academies Press. Retrieved from https://www.nextgenscience.org/sites/ngss/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf.

   a. Seeds do not actually need sun to sprout, as you can demonstrate by sprouting seeds in the dark. The plant, once sprouted, cannot grow without light.

11. Post the focus question and pose to students: **Which location in the schoolyard would allow seeds to sprout earliest in the spring?** Write the question on the board and have students record it in their notebook or on the **Plant Needs** student page.
    a. Discuss how they might go about deciding *which location would be best*.

12. Explain to students they are going to *investigate* which location in the schoolyard has the highest soil temperature. They will be collecting data to *compare two (2) locations* to begin with to perform a fair test to answer the investigative question. Post the following investigative question and have students write it in their notebooks:

Which location, ____________ or ____________, has the highest soil temperature 5cm below the surface?

Teacher Note: This investigation works best in the spring. If doing the investigation in in the fall explain to students that we are assuming that those soils that have the highest temperatures in the fall would also have the highest temperatures in the spring to answer the focus question "Which location would allow seeds to sprout earliest in the spring?" To verify this assumption, you could have students perform the investigation again in the spring and compare.

***Reminder: this investigation will have the greatest variation in soil temperature if the two chose locations are north vs. south sides of buildings, sunny vs. shady, protected vs. open areas.*

Practice with soil thermometers. If your students are not yet familiar with how to use a thermometer, you may want them to practice with the tool before collecting data. You can use this optional procedure to help students learn how to properly read soil temperatures. Feel free to skip this section if your students are ready to collect data!

13. Pre-mark or have student groups measure and **mark a line** (piece of tape or sharpie line) at **5cm from the bulb** of each thermometer.

14. Show students the graduations on the thermometer. Usually there will be a long line with a number indicating every 5 or 10 degrees, with shorter lines and no numbers indicating the temperatures in between. Many students may need support understanding how to read this. If needed, create an anchor chart for reading thermometers or a journal page they can take into the field with them during the investigation.

15. Go to a different location than where the soil temperature comparison will be made to practice using and reading the soil thermometers. Have students place their thermometer into the ground up to the 5cm mark, wait 1 minute, read the thermometer without taking it out of the ground, and record the temperature. Repeat until you feel students are reading the thermometers consistently.

16. Discuss why students are to read the temperature while the thermometer is in the ground.

Extension

Grow two or more varieties of seeds in the classroom and control for heat if possible. Then have students monitor the difference in plant growth over the course of the study. Use this as an opportunity to partner with other classrooms or common areas on different sides of the school building (such as classrooms with north-facing windows versus classrooms with south-facing windows, or interior rooms versus exterior rooms). Or create a mini green house in the same classroom and record the differences in temperatures. Use student ideas! Discuss controlling for light and water, etc.

- Ask: "*what is the thermometer measuring once it is out of the ground?*" Elicit that it is measuring the temperature of the air, which will be different than the temperature of the ground.
- Ask: "*What would the thermometer be measuring if you were holding on to the tip?*" Elicit that it would be measuring the temperature of their hand.

Soil Temperature Investigation. Student groups of 3-4 are ideal so that every student can actively participate.

Materials:

- A map of the area to show locations of sites would be useful, but not required.
- Soil thermometers marked at 5 cm (make sure they are calibrated)
- Something to mark student locations (Flags, cones, hula hoops, yarn circles)
- Rulers-one for every group of students
- Stopwatch or watch for teacher to time 1 minute.
- Clip boards or notebooks (cardboard with binder clips work well)
- Recording sheets for each student

17. Review previous work. What is the question we are investigating? What was your prediction? Why is it important to know about soil temperatures for plant growth and development? Where is our investigation taking place?

18. Put the investigative question on the board or in pocket chart:

Which location, ____________ or ____________, has the highest soil temperature 5cm below the surface?

19. Ask the following questions, underlining and then charting the variables.
    a. <u>Independent/Manipulated variable</u>: What are we comparing? (2 different locations in the schoolyard)
    b. <u>Dependent/Response Variable:</u> What are we measuring in the investigation? (temperature)
    c. <u>Controlled Variables:</u> What are we all doing the same in this investigation to make it a "fair" test? (Putting thermometer 5 cm into the ground, waiting 1 minute, taking all the temperatures on the same day)

20. Have students read through the procedure on their data sheets. Explain the importance of this procedure being the same for all measurements.

21. Bring students outside to follow the directions and conduct the investigation in the schoolyard at the two locations previously decided upon.

22. Have students briefly share their recorded temperatures by talking to another student from a different group. Identify a range of temperatures for each of the sites. **Note:** during Explain, students will go into greater depth about which site had the highest soil temperature. Students will be excited about the data collected so this discussion should capitalize on their excitement. Note: This can take place outside, walking back to the classroom, or inside the classroom.

Thinking About Data

It is okay if the data (temperature readings) for both sites are all the same. This happens in research all the time. The conclusion would be that both locations would have the same temperature.

If data is inconsistent, discuss with students how they may have taken temperatures differently each time. Students might have had difficulties with reading the thermometer, or different students read the thermometer differently.

Occasionally thermometers break. If readings are wildly inconsistent, you may want to redo the investigation and have students be more consistent about taking the soil temperature.

If one group has outliers, check that groups' thermometer as it may have become inaccurate. Twisting the thermometers in very hard soil can cause the thermometer to break.

23. Have students turn and talk to discuss questions about the procedure.
    a. Were there any problems taking the soil temperatures?
    b. Were the temperatures you recorded for trials 1, 2 and 3 the same or nearly the same? Does this data make sense?
    c. How does your data compare to your prediction? If your prediction turned out not to be correct, what does this mean? Elicit that it means they, as scientists, learned something new. Remind them that scientists never change their predictions.
    d. For ______, what was the highest temperature anyone recorded? What was the lowest temperature?
    e. Are these lowest and highest temperatures close or far apart? Does this make sense?
    f. For the other location, ______, what was the highest temperature anyone recorded? What was the lowest temperature?
    g. Which location was sunnier? (if the sun was out)
    h. Look at your data for both locations. Which location seems to have warmer soil temperatures?

Explain

Analyzing Class Data and Constructing Explanations and Arguments. Review the procedures to help students understand the main components of this comparative investigation. Tell students that detailed and accurate steps in a procedure help scientists repeat investigations showing that the investigation is a fair test (reliable and valid) to answer the investigative question. Students should follow along in their notebooks.

1. Post the investigative question:

Which location, ___________ or ___________, has the highest soil temperature 5cm below the surface?

2. Continue the discussion about the previous day's procedure with a turn and talk strategy.
    a. Why did we wait 1 minute each time after placing the thermometer in the ground? (In order to wait for the thermometer to read the temperature accurately)
    b. Why did we always place the thermometer 5 cm into the ground? (So, all temperatures were at the same depth to make the comparison a fair test)
    c. Why did we take 3 temperatures at each location? (Multiple trials make measurements more reliable-fairer test - *make sure our answer is right*)
    d. Why did we take all the temperatures on the same day? (To compare different locations, they needed to be on the same day to be a valid comparison; this is another variable kept the same)

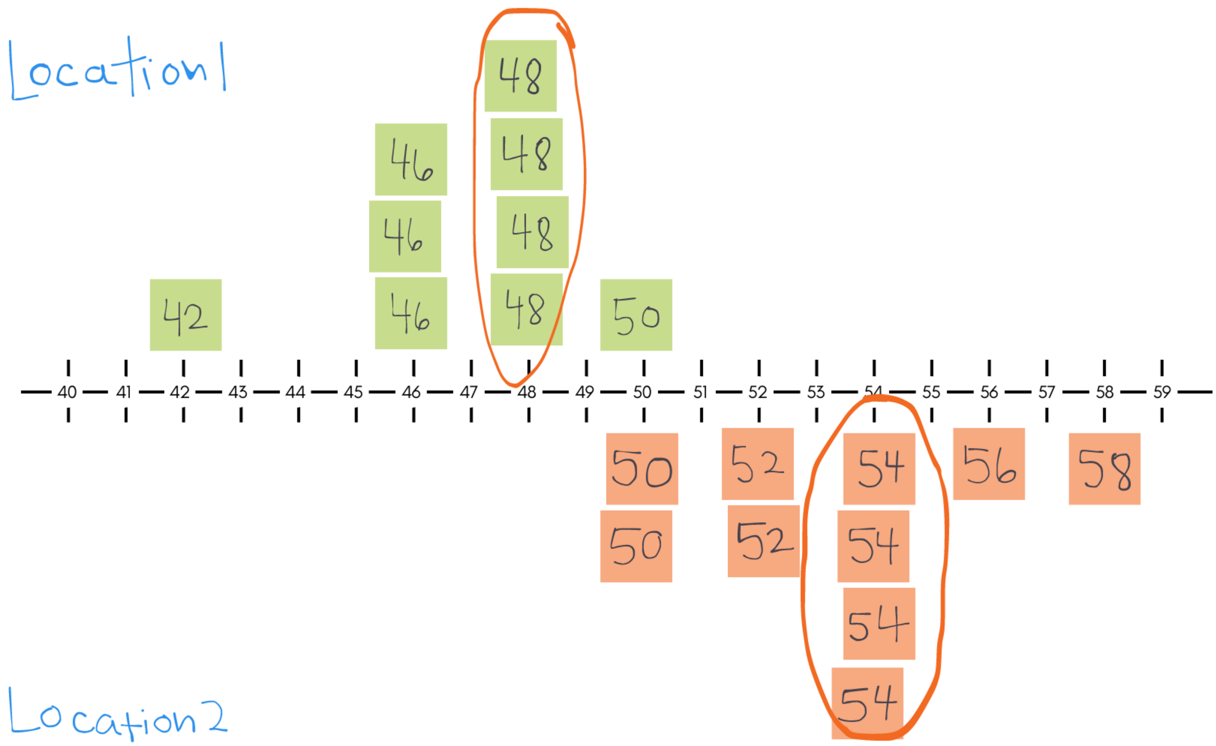
3. Ask students to think, pair, share about how they could be sure everyone in the class conducted a fair test. Have them first write their thoughts in their journals then write their neighbors thoughts, and lastly write down any new learnings from the class.

Math Extension

1. Create a class line plot on chart paper using a strip of masking tape for the number line. By doing a back-to-back line plot (note example below), students can compare the temperature data of the two locations easily. Use different colored post-it's for the different locations.

2. Tell students to write their recordings of soil temperature on a small post-it and place it on the number line.

3. Analyze the data on the line plot. Ask students what *patterns* they notice about the data. What are the *differences they see between the two sites*? Leave this data up on the board for students to reference for their argument/explanation.



Example back-to-back line plot

Teacher Note: *You could try the investigation again to see if you got similar results or try two new locations. If the locations do have the same soil temperature, then you would need more information (amount of sunlight, water, etc.) to decide where plants would sprout and grow the earliest or the largest.*

1. Return to the focus question: **Which location would allow seeds to sprout earliest in the spring?** Post the focus question on the board or in pocket chart. Consider passing out the laminated seed sheets again.

2. In groups of 4 have student discuss their *argument/explanations* using the sentence starters for claim, evidence, reasoning discussion.
    a. Each student in the group completes the top portion of the **Answering the Question** sheet. They may work together to complete the task.

3. Next, students will find a discussion partner in a different group. Each student of this new pair will have a chance to share his or her claim. The listening student should repeat what the speaking student says. After repeating, the listening student can then use the **Discussion Starter** to agree or disagree with the first student. Then they should switch roles.

4. Have students then help you *construct a class argument/explanation* for the focus question.

5. Record in their notebooks.

Example with different soil temperatures for the south side and north side: *On October 10, 2006, at 2:30 p.m., the south side of the school had the warmest soil temperature. The lowest temperature measured there was*

54°F, while the highest recorded temperature was 61°F. The north side had lower temperatures, with the lowest soil temperature at 48°F and the highest at 53°F. The soil on the south side of the school was 6°F to 8°F warmer than the north side. This temperature difference made me realize that seeds would probably like to grow better on the south side.

Example when soil temperatures are the same on the north side and south side: *On October 10, 2006, at 2:30 p.m., the soil temperatures on the north and south sides of the school were the same. Both locations had soil temperatures ranging between 48°F and 50°F. We thought they would be different, but they were the same. This could be because the south side receives more sunlight, while the north side is closer to the building. Based on this measurement, the seeds might like to grow on either side of the school.*

Elaborate

1. Reflection activity: Have students complete a **3,2,1 Reflection** found in the reflection and assessment section. Have students share out in small groups or class discussion about what they have learned, what they are still wondering and what questions they still have. These questions and wonderings might be used as further exploration or activities.

2. Have a discussion with students with one or more of these questions using think, pair, share or other strategy:
    a. Why is it important to know about soil temperatures? *(Know when to plant seeds, if a spot is a good place to grow a certain plant)*
    b. Would corn seeds that need at least 50° F to germinate, germinate at location _______________, at this time of year? Which seeds could germinate there now?
    c. What other factors might affect soil temperature? *(Sunlight, closeness to building, time of year, shadiness, whether or not soil is underneath plants, the number of leaves, beauty bark)*
    d. What might happen if soil temperature suddenly got colder in spring? *(Some plants that had sprouted might die; it would delay some seeds from sprouting)*
    e. What might happen to seeds if the soil got to 100 °F? *(The seeds might not be able to sprout and would die)*
    f. What happens to the type of life that lives in the soil if the soil temperature changes a lot? *(The types of life in the soil change depending on the specific needs of the plants and animals that live there)*
    g. Which area would be the best place to start a school garden?

3. Extend by doing the soil temperature investigation during different seasons, or by planting seeds in the spring in both locations and observe/measure their growth, or another question/wondering the students still have after their reflection activity.

Evaluate

1. Evaluate student journals looking for accurate recording of data both in their team and class.

2. Evaluate accurate drawing of graphs of the data.

3. Evaluate their argument/explanations for both the investigation question and the focus question.

4. Evaluate their 3,2,1 reflection activity.

Soil Temperature Investigation

Student Pages

Name: ______________________________

Seed Observations

1. Look at two DIFFERENT seeds. Draw the seeds and describe each seed in your notebook or on the paper below.

2. Ask your teacher to cut open the two seeds. Draw the seeds and describe them in your notebook or on the paper below.

Seed 1 Type of Seed:	
Draw and label seed unopened: Description of Seed:	Draw and label seed cut open: Description of Seed:

Seed 2 Type of Seed:	
Draw and label seed unopened: Description of Seed:	Draw and label seed cut open: Description of Seed:

Seed Comparisons

3. What is the same or similar about both of your seeds?

4. What is the difference between your two seeds? Record in the table below for each of the attributes listed.

Differences

Attribute	Seed 1:	Seed 2:
texture		
size		
color		
shape		

**Fun fact: Holly seeds must go through the digestive system of a bird to germinate!*

Plant Needs

Chart of Plant Needs for Growth

Plants Need	How these needs are met in the classroom	How plants growing outdoors get their needs met

Investigation Focus Question:

____

____

Which location ___________________________or__________________________________ has the highest soil temperature 5 cm below the surface?

Location 1:	Location 2:
Describe the Location	Describe the location

Prediction:

I think _____________________________ will have the highest temperature because

____

____

____

Seeds and Plants Information Sheet


Lima bean
minimum soil temperature: 65°F


Pea
minimum soil temperature: 40°F


Squash
minimum soil temperature: 60°F


Broccoli
minimum soil temperature: 40°F


Cucumber
minimum soil temperature: 60°F


Radish
minimum soil temperature: 40°F


Corn
minimum soil temperature: 50°F


Spinach
minimum soil temperature: 35°F

Soil Temperature Investigation

Which location ____________________ or ____________________
has the highest soil temperature 5 cm below the surface?

Prediction: ____

____

____

Soil Temperature Investigation Procedure:

1. Go to the first location (____________________) in the schoolyard and write the name on the first line next to the heading: Location 1.
2. Record the date, time, your school's name, air temperature and describe the weather.
3. Insert the soil thermometer into the soil to the 5cm mark.
4. Wait 1 minute (your teacher or designated person will be timing).
5. When the teacher says OK, take the temperature **keep the thermometer in the soil, while reading the temperature.** Record this first temperature reading (data) in the Trial 1 box on the table.
6. Use a ruler to locate a place 30 cm away from your first soil temperature reading. Insert the soil thermometer again to the 5cm mark and record the temperature again after 1 minute. Record as Trial 2.
7. Place the thermometer into the soil 30 cm away from your first temperature and second temperature readings. Read and record the temperature after 1 minute. Record as Trial 3.
8. As a class, go to the second location (____________________) and switch jobs with your partner. NOTE: The locations are what you are comparing in this investigation.
9. Follow steps 3 through 7 at the second location.

Data Table: Location and Soil Temperature at 5cm Below the Surface				
Date and Time:				
School:				
Weather:				
		Soil Temperature		
Location	**Trial 1**	**Trial 2**	**Trial 3**	**Median or Mode**

Answering the Question

Answer the Question

Which location in the schoolyard would allow seeds to sprout earliest in the spring?

Make a Claim:

Location ______________________ would allow seeds to sprout earliest in the spring.

Give Evidence:

Location ______________________ had a soil temperature of ______________ on

______________*(date)*, ______________*(time)*.

Reasoning:

Our seeds need water and (*warmer* / *cooler*) soil temperatures to germinate.
(circle one)

Discussion Starter

Find another student and read their claim. Next, complete the following in response to their claim.

I (*agree* / *disagree*) with your claim that location ______________________ would

allow seeds to sprout earliest in the spring. The evidence is that the temperature at that

location was ______________. Seeds need (*warmer* / *cooler*) temperatures, and

this means plants will sprout earliest in ______________________ location.

Reflection

Write three (3) ideas you have learned
Write two (2) ideas you are still wondering about
Write one (1) question you still have

Rubric: Claim and Evidence for Soil Temperature

3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

	Score of 4	**Score of 3**	**Score of 2**	**Score of 1**
Organizing Data	The student uses graphical displays (e.g., tables, pictographs, line plots) to organize the data from measuring soil temperature at two different locations.	With guidance, the student uses graphical displays to organize data from measuring soil temperature at two different locations.	With significant guidance, the student attempts to use graphical displays to organize data from measuring soil temperature at two different locations.	The student needs substantial support and guidance to use graphical displays to organize data from measuring soil temperature at two different locations.
Identifying Relationships	The student effectively uses their organization of the data to find patterns, accurately identifying how each of the locations relative to the other location would affect seed germination. They also demonstrate a clear understanding of how various needs for plant growth affect their ability to germinate and survive.	With guidance, the student mostly uses their organization of the data to find patterns, identifying how each of the locations relative to the other location would affect seed germination. They also demonstrate some understanding of how various needs for plant growth affect their ability to germinate and survive.	With significant guidance, the student attempts to use their organization of the data to find patterns but may struggle to accurately identify how each of the locations relative to the other location would affect seed germination. They also demonstrate limited understanding of how various needs for plant growth affect their ability to germinate and survive.	The student needs substantial support and guidance to identify patterns in the data, struggling to understand how each of the locations relative to the other location would affect seed germination. They also struggle to identify how various needs for plant growth affect their ability to germinate and survive.
Interpreting Data	The student effectively uses the patterns found in the temperature data to describe how the location would affect seed germination, and determine which location is better suited to have seeds germinate earliest in the spring.	With guidance, the student mostly uses the patterns found in the temperature data to describe how the location would affect seed germination, and determine which location is better suited to have seeds germinate earliest in the spring.	With significant guidance, the student attempts to use the patterns found in the temperature data to describe how the location would affect seed germination, and determine which location is better suited to have seeds germinate earliest in the spring.	The student needs substantial support and guidance to describe the way temperature variations between each location will affect seed germination, and determine which location is better suited to have seeds germinate earliest in the spring.