Soil Temperature Investigation
Third Grade

Developed by: Pacific Education Institute and Seattle School District 2009

Patricia Otto, Pacific Education Institute
Kathryn Show, Science Coach Seattle Public Schools

Revised by Pacific Education Institute and Puyallup School District 2019

Soil Temperature and Seed Sprouting Investigation

Supports Plant Growth and Development Standards

Overview

These lessons will allow students to explore the connection between soil temperature and seed germination (sprouting). This is part of the plant life cycle studied during *How Plants Grow and Change Unit.* (LS1.B). The lessons will help reinforce the concepts of the basic needs of plants and introduce students to plant (seed) adaptations. There is an optional pre-day lesson where students go outdoors to collect and observe seeds and their differences. They explore seed differences as they read about different seeds and their germination temperatures. (LS3.A) (LS3.B) Students will review the skill of using a thermometer to record temperatures. Students will conduct a field investigation comparing soil temperatures at two locations and then applying this data to answer the focus question, "which location would allow seeds to sprout earliest in the spring?". Students also construct arguments/explanations using claim, evidence, reasoning when answering both the investigation and focus questions. (3-LS4-3) Students practice the skills needed for testing a solution to a problem. (3-5 ETS1-3) There are 3 lessons taking 4-5 days. Lesson 1 takes two classroom periods or an extended period. Other lessons take about an hour to accomplish. When students think about seeds it is difficult to think about them as living. This is the phenomena this unit is exploring.

"*A SEED KNOWS how to wait. Most seeds wait for at least a year before starting to grow; a cherry seed can wait for a hundred years with no problem. What exactly each seed is waiting for is known only to that seed. Some unique trigger-combination of temperature-moisture-light and many other things is required to convince a seed to jump off the deep end and take its chance-to take its one and only chance to grow…A coconut seed is a seed that's as big as your head. It can float from the coast of Africa across the entire Atlantic Ocean and then take root and grow on a Caribbean island. In contrast, orchid seeds are tiny: one million of them put together add up to the weight of single paper clip. Big or small, most every seed is actually just food to sustain a waiting embryo. The embryo is a collection of only a few hundred cells, but it is a working blueprint for a real plant with root and shoot already formed."*-Hope Jahren**,** Lab Girl

Comparative Field Investigation-Soil Temperature and Seed Sprouting
Next Generation Science Standards-3-Dimensions

Dimensions from the Framework	What Students are Doing
Science and Engineering Practices • Asking questions • Planning and carrying out investigations • Analyzing and interpreting data • Constructing explanations • Engaging in argument from evidence • Using mathematics and computational thinking • Obtaining, evaluating, and communicating information	Students ask questions and carry out investigations answering the question, "which location has the highest soil temperature?" and relate that data to the focus question, "which location will seeds germinate the earliest?". Students analyze soil temperature data using mathematical thinking of medians and modes. Students use this data as evidence when they construct arguments/explanations to answer both their questions. Students obtain information by reading informational charts about when certain seeds germinate and communicate their findings through discussions and journal entries.
Disciplinary Core Ideas **LS1.B: Growth and Development of Organisms** Reproduction is essential to the continued existence of every kind of organism. Plant and animals have unique and diverse life cycles (3-LS1-1) **LS3.A: Inheritance of Traits** Mancy characteristics of organisms are inherited from their parents. (3-LS3-1) **LS3.B Variation of Traits** Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) **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 **3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled.	**LS1.B:** Students are examining the seed part of plant lifecycle to learn about heat needed for seeds to germinate (sprout). **LS3.A; LS3.B**: Students collect seeds and read an information sheet to discover that different types of plants have seeds that look very different and that each of those seeds has different germination requirements. **3-LS4-3:** Students construct an argument about which location (habitat) seeds would germinate earlier in the spring (and thus where those plants would survive well) with soil temperature evidence from their comparative investigation. **3-5-ETS1-3:** Students plan and carry out a fair test of which location has the highest temperature. They all measure soil temperature at the same depth and for the same number of minutes controlling those variables. (Though this isn't testing as solution, it is practicing planning and carrying out fair tests.)
Cross Cutting Concepts • Patterns • Cause and effect • Systems and system models • Structure and function	• Students look for patterns in the data they collect. • Students consider cause and effect with a minimum temperature determining germination in seeds. • Students look at the system of a seed and the energy (heat) that goes into a seed for germination. • Students learn about the structure and function of seeds in plants' lifecycles.

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.

Third Grade Math Standards

CCSS.Math.Content.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. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*

CCSS.Math.Content.3.MD.B.4

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.

Pre-day Engagement

Teacher Background
To engage students and make a connection between lima bean seeds and seeds in their local environment, students collect seeds outside to compare those seeds to the lima bean seeds they describe in the classroom. Seeds may be collected in a variety of ways. Putting masking tape sticky side out on pants and/or sleeves allows students to get smaller seeds as they walk or swing arms among plants. Putting wool socks over shoes allows students to collect seeds that are sticky in grassy or planted areas.

Materials: Lima bean seeds – per 2 students; Optional- socks or masking tape

Pre-day Engagement

1. Read students a book about seeds such as Eric Carle's *The Tiny Seed.*
2. Have students examine a lima bean seed cutting it open so they can see the tiny leaflet inside.
3. Have students draw it and describe the lima bean in their notebooks. *Optional-Use box and T chart.*
4. Introduce the idea of seeds; they are alive and will grow into plants, given the right conditions.
5. Students collect seeds outdoors and draw and label one seed in their notebooks. If you have a seed collection, you can also provide seeds for students to observe.
6. Ask students how these seeds are different from the lima bean seed. Different seeds have different size, color, shape; different seeds have different dispersal mechanisms.
7. Have students discuss the lima bean seed 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 in order to grow into plants. They all have similar life cycles, but different plants have different types of seeds.
8. **Science notebook option**: Ask students to compare and contrast two seeds using a box and T-chart. If students are unable to collect seeds outdoors, bring in seeds you collected. 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. If your students have not made a box and T-chart, you could construct one as a whole class activity. Note the example box and T-chart below.
9. **Reflection activity:** Ask students to record everything they know about soil, plants, and growth thin 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. Students should each share for two minutes. Students should then thank each other for the knowledge and 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 (example: plants need dirt in order to grow.)

Seeds

Same

- Contain a baby plant (embryo)
- Can grow into plants
- Needs water and heat to sprout (plant needs light and soil to grow)
- Part of a plant life cycle

Different

	Seed #1 (Lima Bean)	Seed #2 (Collected from outdoors-Horse Chestnut)
(texture)	smooth	smooth
(size)	large	very large
(color)	white	brown
(shape)	oval	round

*Fun fact: Holly seeds have to go through the digestive system of a bird in order to germinate.

Lesson 1: Preparing for Comparative Soil Temperature Investigation

Teacher Background and Preparation

- Lesson 1 takes an extended period or 2 periods
- Underlined words in the lessons should be added to the word list for students to reinforce their use and understanding.

Since different seeds require different soil temperatures in order to sprout it is important to know soil temperature when choosing a location to plant seeds. This investigation, comparing soil temperatures at 2 locations, will have the greatest soil temperature differences if you choose 2 contrasting sites. Taking soil temperatures on a sunny day increase the chances of having greater variations in soil temperatures between the two 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*

Objectives:
Students will: 1) review what plants need to grow; 2) read information about different types of seeds needing different sprouting temperatures; 3) introduced to fair tests and the focus and investigation questions; 4) practice with thermometers.

Materials: Laminated seed sheets, soil thermometers, stopwatch or watch

Engage

1. Discuss what students learned during their *How Plants Grow and Change* Unit(or in previous grades) in the classroom. Review with students (or refer to their notebooks) plants' needs for growth.; light, water, mineral nutrients, air, and heat. Review the plant life cycle.

2. Chart or draw how plants needs are met in the classroom and outside.

   In the first column list what plants need to sprout and grow (light, water, mineral nutrients, air). Ask: "*How are these needs met by plants we grow in the classroom?".* In the second column write down how these needs are met in the classroom. Students could also be asked to draw what they know about what plants need to grow. Ask some of the following questions:

   - 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 coming up 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?

Add **heat** to the list of needs for a seed to sprout, if not listed. Finally ask: *"How are plants' needs to sprout and grow met outdoors?".* In a third column write down how these needs are met when plants grow outdoors.

(Example)
Chart of Plant Needs for Growth

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

3. Focus in on how plants require heat energy to sprout, grow, flower, and fruit. Just as all the seeds looked different so do different types of seeds and types of plants have different temperature requirements.
4. Give each pair of students the laminated sheet of seeds; lima beans, squash, cucumber, corn, pea, broccoli, radish, and spinach seeds. Tell students each type of seed requires different minimum soil temperatures in order to sprout. Seeds do not actually need sun to sprout as you can show by sprouting seeds in the dark. The plant, once sprouted, however cannot grow without light.
    - Lima beans: 70° F
    - Squash and cucumbers: 60° F
    - Corn: 50° F
    - Pea, broccoli, radish: 40° F
    - Spinach: 32° F

    Post the focus question and pose to students: **Which location would allow seeds to sprout earliest in the spring?** Discuss how they might go about deciding which location would be best?

    5. Explain to students they are going to investigate which location on the schoolyard has the highest soil temperature? They will be comparing 2 locations to begin with to perform a fair test to answer the investigative question. Post the investigative question:

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

6. Have students open their science notebooks to a blank page. On the left side have students write the date and the investigative question.

Teacher Note: If doing the investigation in October explain to students that we are assuming that those soils that have the highest temperatures in October would also have the highest temperatures in May in order 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 May and compare.

Explore

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.

1. 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 at 5cm, wait at least 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.
2. Discuss why students are to read the temperature while the thermometer is in the ground. 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.
3. Go outside and have students make observations of the two locations, recording in their notebooks. Explain that scientists always describe their study sites first.

Teacher Background Information:

- 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.

Explain

1. Have students predict which location will have the highest soil temperature. Discuss student predictions and ask students why they predicted what they did.
2. Back in the classroom have students write their prediction in their notebooks below the investigation question. Make sure to let students know it is fine to predict incorrectly-scientists do it all the time.
3. Share temperature readings students recorded. If readings are different, ask why. Discuss why scientists take more than one reading. This is called multiple trials.

Lesson 2: Soil Temperature Investigation

Focus question: Which location would allow seeds to sprout earliest in the spring?

Investigative Question:

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

Note: Student groups of 3-4 are ideal so every student can actively participate.

Objectives: Students 1) conduct an investigation to answer the focus and investigative questions and 2) discuss the initial findings of the investigation.

Materials:

- Map of 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

Engage

1. Review previous work. What was 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?
2. Reflection activity: Have students complete a **3,2,1 Reflection** found in the reflection and assessment section.

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

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

4. Ask the following questions, underlining and then charting the variables. Note sample chart below.

- What are we comparing? (2 different locations in the schoolyard)
- What are we measuring in the investigation? (temperature)
- 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)

5. Have students read through the procedure on their data sheets.

Explore

Students follow the directions and conduct the investigation outside at the two locations previously decided upon.

1. Each group will go to a flag/hula hoop/yarn circle in the first location.
2. All students will record the date, time, and place, and describe the location and weather on their data sheets.
3. Have students write their predictions, which location will have the highest temperature, on their data sheets before starting the investigation.
4. Students will take turns taking the soil temperature.
5. Have students place the thermometer into the ground to the 5 cm mark –explain the importance of this procedure being the same for all measurements.
6. Instruct students to **keep the thermometer in the soil, while reading the temperature.**
7. Inform students that you will let them know when to take the reading (after you have timed for one minute). First temperature reading (data) should be recorded as Trial 1.
8. Next have students use the ruler to locate a place 30 cm away from their first soil temperature reading. Have them read and record the temperature again after 1 minute. Record as Trial 2.
9. Students place the thermometer into the soil 30 cm away from their first temperature and second temperature reading. Have them read and record the temperature after 1 minute. Record as Trial 3.
10. Have students go to the second location and switch jobs. NOTE: The locations are what they are comparing in this investigation. Follow steps 4 through 9 at the second location.

Soil Temperature Investigation

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

Soil Temperature Investigation Procedure:

1. Hand out the **Soil Temperature Investigation** page(located at the end of this investigation, sample below.)
2. Go to the first location_____ in the schoolyard and write the name on the first line next to the heading: Location 1.
3. Record the date, time, your school name, and the description of location 1.
4. Describe the weather and record the air temperature.
5. Insert the soil thermometer into the soil to the 5cm mark.
6. Wait 1 minute.
7. When the teacher says OK, take the temperature and record in the Trial 1 box.
8. Take the temperature of the soil at 2 more sample sites in the first location as instructed by your teacher, and record as Trial 2 and Trial 3.
9. Go to the second location_____ and write the name on the 2nd line next to the heading: Location 2 and follow steps 4 through 7.

Date_____ Time_____

School _____

Location 1 description_____

Location 2 description_____

Weather_____Air Temperature_____

Predict which location will have the highest soil temperature.

Prediction: _____

Location vs. Soil temperature °F at 5 cm				
	Soil Temperature °F at 5 cm			
Location	Trial 1 °F	Trial 2 °F	Trial 3 °F	Median or Mode °F

Explain

1. 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 lesson 3 students 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.
2. Have students turn and talk to discuss questions about the day's procedure.
    - Were there any problems taking the soil temperatures?
    - Were the temperatures you recorded for trials 1, 2 and 3 the same or nearly the same? Does this data make sense?
    - 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.
    - For _____ what was the highest temperature anyone recorded? What was the lowest temperature?
    - Are these lowest and highest temperatures close or far apart? Does this make sense?
    - For the other location_____what was the highest temperature anyone recorded? What was the lowest temperature?
    - Which location was sunnier? (if sun was out)
    - Look at your data for both locations. Which location seems to have warmer soil temperatures?

Note to Teacher:

- If data is inconsistent, discuss with students how they may have taken temperatures differently each time. Were there difficulties with reading the thermometer? Did you always want to get the same number as your neighbor? Explain occasionally thermometers break so don't compare your temperature readings until back in the classroom. You may want to redo the investigation and have students be more consistent about taking the soil temperature.
- It is okay if the data (temperature readings) are all the same. This happens in research all the time. The conclusion would be that both locations would have the same 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 become un-calibrated.*

Lesson 3: Finding the Mode and Median and Constructing Explanations and Arguments

Objectives: Students will: 1) determine median or mode for their group data; 2) contribute group data to a class number line to determine class median or mode; 3) construct arguments/explanations for both the investigation question and focus question.
Materials: Sticky pads; number line on board or on paper; talk-move sentence starters for both the investigative question and focus question- on thick paper and cut into individual sentence starters

Engage

Review the procedures in order to help students understand the main components of a 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.

2. Continue the discussion about the previous day's procedure with a turn and talk strategy.
    - 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)
    - 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)
    - Why did we take 3 temperatures at each location? (multiple trials make measurements more reliable-fairer test - *make sure our answer is right*)
    - 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.

4. Have students look at the data they collected and find either the median or the mode. Explain <u>mode</u> as any number they have recorded more than once on their data table. Tell students that if they do not have the same number recorded more than once, then they will need to find the <u>median</u>, or the number in the middle of the 3 numbers on their data table. If students need support finding the median have them cross out the lowest and the highest number and circle the number that is left. Once students have found the median or the mode, have them record that number in the space provided. See example 1 below, if students are more familiar with T charts, use example 2.

Example 1:
Median

	Soil Temperature ° F			
Location	Trial 1	Trial 2	Trial 3	Median
North	48° F	44° F	46° F	46° F

OR Mode

	Soil Temperature ° F			
Location	Trial 1	Trial 2	Trial 3	Mode
South	50° F	50° F	48° F	50° F

Example 2:

North Location

Trials	° F
1	48
2	44
3	46 Median

South Location

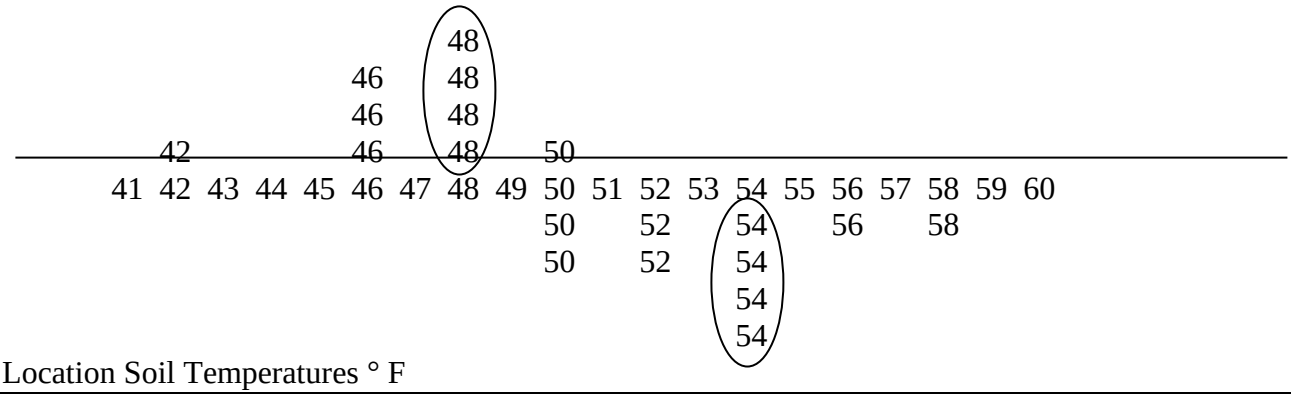
Trials	° F
1	50
2	50 Mode
3	48

Explore

1. Tell students that finding the median and the mode for the class data will make it easier to construct an argument/explanation, making a claim with evidence and reasoning.
2. Create a 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 two different colored post-its for the two different locations.
3. Tell students to write their median or mode soil temperature, whichever they recorded on their data table, on a small post-it and place it on the number line.
4. Analyze the data on the line plot. Ask the students to identify the class mode. The mode will be obvious as the soil temperature with the most data points.
5. Model finding the median for the students by pointing to each end of the range and moving towards the middle of the data set, one post-it at a time, until you arrive at the post-it in the middle. Sometimes the mode and median are the same number, as in the example data below. But sometimes the mode and median are different.
6. If the class modes and medians are different, discuss with the students which one seems to be the "best or most representative middle number" for the class data.
7. Have students record the class median or mode in their journals.

Example 3.

North Location Soil Temperatures ° F



South Location Soil Temperatures ° F

Teacher Note: You could try the investigation again to see if you got similar results. Or try two other 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.

Explain

1. 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 gets one of the 4 cards and fills it out. It may be helpful for all students to have all cards to fill out or record what the other students say.
    b. Next, starting with # 1 card students go around in their group and share their information. If reasoning is too difficult have # 3 and #4 student share a summary of what they did and the data they measured.
2. Have students then help you construct a class argument/explanation for the investigation question.
3. Record in their notebooks.

Example with different soil temperatures for the south side and north side: *The south side of the school had the highest soil temperature on October 10, 2006 at 2:30 p.m. The median soil temperature in the south location was 54℉. In contrast, the median soil temperature at the north location was 48℉. The south side of the school soil was about 6° F warmer than the north side. I now realize that the sun shines longer each day on the soil on the south side of the school making it warmer.*

Example when soil temperatures are the same on the north side and south side: *The soil temperatures were the same on the north and south sides of the school on October 10, 2006 at 2:30 p.m.*

Both locations had a median soil temperature of 48 ° F. The south side is sunnier, but the north side is closer to the building.

4. 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.
5. Have students discuss in new groups of 3 using the discussion sentence starters for the focus question.
6. Have students write their own claim, evidence, reasoning argument/explanation in their journals.
7. Make a class argument/explanation answering the question: **Which location would allow seeds to sprout earliest in the spring?** Write it on the board.

Elaborate

1. Have a discussion with students with one or more of these questions using 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 amount 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 to100 °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 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?

2. Extend by doing the soil temperature investigation during different seasons.
3. Plant seeds in the spring in both locations and observe/measure their growth.

Evaluate

1. Evaluate student journals looking for accurate recording of data both in their team and class.
2. Evaluate accurate calculation of the median or mode of the data.
3. Evaluate their argument/explanations for both the investigation question and the focus question.

Soil Temperature Investigation

Student Pages

Name: _____

Pre-lesson

Seeds

Same

- Contain a baby plant embryo
- Can grow into plants
- Need water, soil, and heat to grow
- Part of a plant lifecycle

Different

	Seed #1	Seed #2
Texture	Rough	Smooth
Size	Large	Big
Color	Black	Brown
Shape	Oval	Round

Seeds and Plants


Lima Bean Plant and Seeds
Minimum soil temperature 70° F


Pea Plants and Pea Seeds
Minimum soil temperature 40° F


Squash and Squash Seeds
Minimum soil temperature 60° F


Broccoli and Broccoli Seeds
Minimum soil temperature 40° F


Cucumber and Cucumber Seeds
Minimum soil temperature 60° F


Radishes and Radish Seeds
Minimum soil temperature 40°F


Corn Plants and Corn Seeds
Minimum soil temperature 50° F


Spinach Plants and Spinach Seeds
Minimum soil temperature 32 ° F

____ = 1 cm

____ = 1 cm

Name_____

Date_____ **Time**_____

School _____

Location 1 description_____

Location 2 description_____

Weather_____

Air Temperature_____

Predict which location will have the highest soil temperature.

Prediction: _____

Location vs. Soil temperature °F at 5 cm				
	Soil Temperature °F at 5 cm			
Location	Trial 1 °F	Trial 2 °F	Trial 3 °F	Median or Mode °F

Answer the Question:

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

Make a Claim:

1. **Claim:** Today, _____, we compared the soil temperature at _____(location 1) to the soil temperature at_____(location 2)and we found _____

Give Evidence:

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

2. **Evidence:** I agree/disagree with your claim that_____ and the evidence is that _____ (give median or mode data)

Give Reasoning:

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

3. One reason the surface temperatures were _____ is probably because_____. What do you think #4?

Give Reasoning:

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

4. I agree/disagree with that reason and think another reason for _____might be _____

Answer the Question:

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

Make a Claim:

I think the _____location would allow seeds to sprout earliest in the spring.

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

Give Evidence:

I agree/disagree with your claim that_____ and the evidence is that _____ (give median or mode data) and this means plants will sprout earliest in _____ location.

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

Give Reasoning:

Seeds need heat and water to germinate. Use the evidence above with one of these reasons in the following sentence.

One reason plants would sprout earliest in _____ location is because _____ and our data showed this location was _____.

Reflection and Assessment

3, 2, 1 Reflection

- Write three ideas you have learned
- Write two ideas you are still wondering about
- Write one question you still have