

# HOW ARE LOCAL TEMPERATURES CHANGING?



## Overview

In this lesson, students investigate temperature variability in several locations within a small, local area. Students interview an elder or culture bearer to learn how climate change is affecting normal temperatures in their region. NOTE: This is a two-day lesson.

## Objectives

On successful completion of this lesson, students will be able to:

- identify conditions that could make temperatures vary within a small area;
- explain how repeating experiments improves the likelihood of accurate results; and
- describe how the local environment is changing, according to an elder or culture bearer.

## Alaska Standards

### Alaska Science Standards / Grade Level Expectations

- [4, 5] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.
- [4, 5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations: observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate.
- [4, 5] SA2.1 The student will demonstrate an understanding of the attitudes and approaches to scientific inquiry by supporting their ideas with observations and peer review.
- [4, 5] SE1.1 The student demonstrates an understanding of how to integrate scientific knowledge and technology to address problems by recognizing that tools (e.g., spear, hammer, hand lens, thermometer) and processes (e.g., drying fish, sewing, photography) are an important part of human cultures.
- [4, 5] SF1.1-SF3.1 The student demonstrates an understanding of the dynamic relationships among scientific, cultural, social, and personal perspectives by connecting observations of nature to a local or traditional story that explains a natural event (e.g., animal adaptation, weather, rapid changes to Earth's surface)
- [4, 5] SG2.1 The student demonstrates an understanding of the bases of advancement of scientific knowledge by recognizing the need for repeated measurements.

## Alaska Cultural Standards

- [A] Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community.
- [D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning.
- [E] Culturally-knowledgeable students demonstrate an appreciation of the relationships and processes of interaction of all elements in the world around them.



# HOW ARE LOCAL TEMPERATURES CHANGING?

## UNIT 2: Energy & Heat Lesson 2 — Grades 4 -5 INSTRUCTIONS



### Bering Strait School District Scope & Sequence

4th Grade Sequence #1: Energy, Heat, Light, & Sound

5th Grade Sequence #2: Energy, Heat, Light, & Sound

### Materials

- Copy of Native Values poster from the Alaska Native Knowledge Network
- Thermometers (five)
- Clipboards (one per group)
- Timer or stopwatch (one per group)
- Calculators (one per group)
- Student Lab “Temperature Investigation”

### Additional Resources

Harcourt School Publishers Science IV: Ch. 14, Lesson 2

Harcourt School Publishers Science V: Ch. 15, Lessons 2, 3

### Activity Preparation

#### Day 1

1. Arrange to have an elder or culture bearer visit your classroom to discuss local temperatures and how they are changing as a result of climate change.
  - a. Ask if they would prefer to visit your classroom or if they would prefer to be outside in a location of their choosing.\* If you plan to go outside, be sure to obtain whatever permissions are necessary from your site administrator.  
\*NOTE: Research shows that outdoor locations tend to spark elders’ interest and memories.

#### Day 2

2. Identify five locations outside for students to take temperature readings. If possible, choose at least one near a building and one away from a building, one in the shade and one in the sun. Try to select locations that vary in wind exposure and elevation.
3. Look up National Weather Service Data at [www.weather.gov/](http://www.weather.gov/). Enter your village or town to see the forecast for the day as well as current weather conditions. Write the temperature on the board, or in a prominent location where all students can see it.

### Whole Picture

Alaska Native people have had an intimate connection with the land for thousands of years. Long before the introduction of tools like thermometers, people used signs from the land to determine how cold it might be. Though people could not know the exact temperature on a Fahrenheit or Celsius scale, they could describe the varying degrees of “cold.” One way to know that the temperatures outside were deeply cold was to listen carefully. Bob Aloysius, an elder



## HOW ARE LOCAL TEMPERATURES CHANGING?



from Kalskag, explained that in very cold temperatures, sounds could be heard across a great distance :

“When it used to get cold, you could hear everything, especially animals around trees ... when people walked on top of the snow, we could be heard for maybe two miles.”

In another example, John Phillip, an elder from Kongiganak explained that:

“One could not only see and hear cold snow, but use one’s nose to sense it; “If it was going to be very cold out, a person’s nostrils would immediately begin to sting when they walked outdoors. People also looked for clues — like those they might observe in the sun (macaq). When the weather was going to be cold, the sun would put on its mittens and parka: “There would be two red things alongside it, and they said that those were its mittens. When those mittens were visible, they’d say it was going to be cold. They say that the sun is putting on its mittens” (64).

While some people might use these same indicators today, elders report that they are less reliable because temperatures are changing. The whole Arctic seems to be warming. “The most noteworthy signs of warming temperatures are changes in sea and river ice.” Many people have reported later freeze-up in the fall and earlier break-up in the spring. Other changes people report have to do with the type and timing of ice formation on the rivers and changes to the landscape — including the apparent sinking of hills due to permafrost thaw.

It is not just elders who have noticed changes in the temperature and climate; scientists who study the Arctic also report dramatic changes in climate norms — the pattern of weather an area experiences over a long period of time. One such example is the unpredictability of sea ice. Scientists involved in the Study of Environmental Arctic Change (SEARCH) are currently studying the loss of summer sea ice and in recent years have reported dramatic declines and extreme unpredictability. These scientists have reported that “the Arctic is undergoing rapid transformation,” and understanding and adapting to these changes will be a complicated process.

Temperature may be affected by the amount of a location’s exposure to the sun or wind. Topography is also a factor. Under normal conditions, temperature decreases as elevation increases.

In the winter time, the sun is at a lower angle in the sky and therefore supplies less warmth to Earth’s surface. The climate in the Bering Strait School District is mainly “maritime polar.” This means that coastal regions experience wet, windy, cold conditions through most of the year. Winter temperatures can be especially cold due to the wind chill factor. Though the air temperature on the Seward Peninsula averages about  $-11^{\circ}\text{F}$  in winter, the winds can make it feel much colder. For example, it is not uncommon for coastal areas to experience winds of 20mph or more. If the air temperature is  $-11^{\circ}\text{F}$  and there is a wind of 20mph, the result are conditions that mimic an air temperature of  $-36^{\circ}\text{F}$ .

This lesson addresses temperature variability through the scientific process. More specifically, students learn to recognize the value of repeating experiments to ensure accuracy.



# HOW ARE LOCAL TEMPERATURES CHANGING?

## UNIT 2: Energy & Heat Lesson 2 — Grades 4 -5 INSTRUCTIONS



### Vocabulary

<b>climate</b>	the pattern of weather and temperature an area experiences over a long period of time
<b>elevation</b>	the height above sea level
<b>heat</b>	a form of energy produced by the motion of molecules
<b>mean</b>	the mathematical term for average, obtained by adding all the values together and then dividing the sum by the number of value
<b>range</b>	a measurement span obtained by subtracting the lowest value from the highest value
<b>temperature</b>	the degree of heat present in a substance or object
<b>thermometer</b>	an instrument for measuring temperature
<b>topography</b>	an arrangement of features on a landscape (mountains, hills, lakes, etc.)
<b>weather</b>	a description of the state of the atmosphere at a certain time

### Activity Procedure

#### Day 1 — Elder Visit / Culture Bearer Visit

1. Before the elder or culture bearer arrives, review the “Native Values” poster with students. Ask students to think about how they might apply these values not only during the guest visit, but also in their daily life and throughout their school day.
2. Students should be prepared to listen attentively and politely, appropriately ask questions about local temperatures, take notes (optional, depending on learner style), and participate in any activity that the guest asks of them.
3. The goal of this day is for students to learn about local temperatures, weather indicators, and how the temperatures in the region are changing due to climate change.  
**Note:** If you are unable to arrange for a guest visit, complete step 1 with students. Then, as homework, instruct students to talk with their parents, grandparents, aunties, and uncles to learn about local temperatures and how they may be changing. Students should share their findings with the class on a predetermined day.

#### Day 2

1. Explain that students will look at different factors that influence air temperatures.
2. Distribute and briefly review the packet for the STUDENT LAB: “Temperature Investigation.”
  - a. Explain the class will go outside and measure the temperature in various places around the school.
  - b. Briefly describe the five locations where students will take measurements.
  - c. As a class, brainstorm the variables in these environments (sun, wind, elevation) and decide on clear names for each (Step 1 in the STUDENT LAB).
3. Read the “Testable Question” in the STUDENT LAB packet, and ask students to determine



## HOW ARE LOCAL TEMPERATURES CHANGING?

### UNIT 2: Energy & Heat Lesson 2 — Grades 4 -5 INSTRUCTIONS



- their hypothesis (temperatures will be the same or temperatures will be different).
- a. Students should record their hypothesis in the appropriate area in their Student Lab packet.
4. Divide students into five groups and direct them to the five predetermined locations.
- a. Remind students it takes a thermometer several minutes to take an accurate reading.
  - b. Explain that in order to take an accurate measurement, the thermometer should rest on a clipboard or sheet of paper — students should not hold the thermometer. Holding the thermometer will take the temperature of one's hand, not the air.

#### Teacher Note

If students have never used a thermometer before, you may need to take extra time to teach this.

5. Instruct students to fill in the data chart as they take their measurements. They will use the data table to list each location and associated temperatures.
  - a. Students will take three measurements at each location.
6. After all students have recorded temperatures at each of the five locations, return to the classroom.
  - a. Instruct the class to complete the remainder of their worksheets. Assist as necessary.
  - b. Discuss the results. Include a discussion of why it is important to take more than one measurement (to ensure accuracy).

#### Extension Activity

- For homework, have students talk to cultural knowledge bearers to learn about heat and cold. Instruct students to ask their parents, aunties, and grandparents about local stories and terms related to temperature. These might include stories about the sun, weather, or safety as related to the cold. Alternatively, give students a list of words (cold, heat, sun, warm, weather, etc.) and encourage them to learn how to say them in their local language. Ask students to share what they learn during the next class period.



# HOW ARE LOCAL TEMPERATURES CHANGING?



## Answers — Student Lab Packet: Temperature Investigation

**Note:** You may wish to take your own temperature readings at each of the 5 stations, to ensure student accuracy, and assist you in the discussion portion back in the classroom.

### Hypothesis

Answers will vary.

### Data

1. Answers will vary.
2. Answers will vary.
3. Answers will vary but must show student work (calculating the mean of all 15 temperature readings).

### Analysis of Data

1. Answers will vary.

### Conclusion

1. Answers will vary.
2. Answers will vary.
3. E, A, B, and C.

### Further Questions

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.
4. (A) to increase the likelihood of accurate experiment results.
5. (C) repeating the experiment three times.

### Critical Thinking

1. The shade.
2. High wind.

### References

Fienup-Riordan, Ann and Rearden, Alice. (2012). *Ellavut Our Yup'ik World and Weather: Continuity and Change on the Bering Sea Coast*. Seattle and London: University of Washington Press.

SEARCH. (2010). "Recommendations for Understanding Arctic System Change: Report from a Workshop." Fairbanks: Arctic Research Consortium of the United States. Accessed from: <http://www.arcus.org/search/understanding>.



# HOW ARE LOCAL TEMPERATURES CHANGING?



## Student Lab: Temperature Investigation

Name: \_\_\_\_\_

### Testable Question

Will temperatures taken at the same time in various outdoor locations of a small area be the same or different?

### Hypothesis (circle either A or B)

Temperatures recorded in various outdoor locations of a small area will mostly be:

- a. the same
- b. different

### Materials

- thermometer
- watch or stopwatch
- clipboard
- calculator
- pencil

### Procedure

1. Before going outside, discuss the variables (wind, sun, elevation) of the various locations where you will make temperature recordings, with your teacher and fellow students.
  - a. In the space below, record the names for each location.

- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
- D. \_\_\_\_\_
- E. \_\_\_\_\_

2. You will record temperatures at five locations.
  - a. On your data sheet, record the name and a brief description of the location.
  - b. Choose one person to be the timer. The other members of your group will take turns reading the thermometer.
3. Start the stopwatch. When it reaches 2:00 minutes, push stop and instruct the first member of your group to read the temperature.
  - a. Record the temperature on the data chart.
  - b. You can calculate the average when you are back in the classroom.



# HOW ARE LOCAL TEMPERATURES CHANGING?



4. Take two additional temperature readings at this location. Be sure to allow two minutes for each reading. Record the data in the table.
5. Repeat steps 2–4 for each of the remaining stations.

### Data

To calculate the average temperature, add the three temperature trials together and divide by three.

Location	Temperature Readings			Average Temperature
	#1	#2	#3	

1. What is the range of all 15 temperature readings? (range = highest value – lowest value)  
\_\_\_\_\_
2. What is the average, or mean, of all 15 temperature readings? \_\_\_\_\_  
Show your work here:

### Analysis of Data

1. The temperatures recorded in the chart above are mostly:
  - a. the same
  - b. different
2. Which location was the coldest? \_\_\_\_\_
3. What do you think made it the coldest? \_\_\_\_\_
4. Which location was the warmest? \_\_\_\_\_
5. What factor made this location the warmest? \_\_\_\_\_
6. Were any individual recorded temperatures unusually low or unusually high? \_\_\_\_\_

If yes, why do you think so? \_\_\_\_\_  
\_\_\_\_\_





# HOW ARE LOCAL TEMPERATURES CHANGING?



## Conclusion

1. Temperatures recorded in various places outside the school were mostly:  
a. the same                      b. different
2. Was your hypothesis proved or disproved? \_\_\_\_\_
3. Circle the reason why temperatures measured in different places within a small area might be different?
  - a. The sun is shining on some, but not all, of the thermometers.
  - b. The wind is blowing on some, but not all, of the thermometers.
  - c. The temperature is different at different elevations, or heights.
  - d. a and b only.
  - e. a, b, and c.

## Further Questions

1. Write the temperature forecasted for your area by the National Weather Service.  
\_\_\_\_\_  
(NOTE: You may need to ask your teacher for assistance).
2. Compare the National Weather Service forecast with the mean temperature from your own investigation.
  - a. Are the two temperatures the same or different? \_\_\_\_\_
3. What would make them different? \_\_\_\_\_  
\_\_\_\_\_
4. Why do scientists perform multiple trials of the same experiment? Circle the best answer.
  - a. Scientists perform multiple trials of the same experiment to increase the likelihood of accurate experiment results.
  - b. Scientists perform multiple trials of the same experiment to complete the steps of the experiment in less time.
  - c. Scientists perform multiple trials of the same experiment to include additional variables.
  - d. Scientists perform multiple trials of the same experiment to find a less expensive way to conduct the experiment.



## HOW ARE LOCAL TEMPERATURES CHANGING?



5. A scientist is performing an experiment to determine the freezing point of a new substance. Which action could increase the likelihood of obtaining accurate results? Circle the best answer.
- a. Writing out the procedure after the experiment would increase the likelihood of obtaining accurate results.
  - b. Experimenting with multiple substances would increase the likelihood of obtaining accurate results.
  - c. Repeating the experiment three times would increase the likelihood of obtaining accurate results.
  - d. Using three types of thermometers in the experiment would increase the likelihood of obtaining accurate results.

### Critical Thinking

In the following two questions, circle the best answer.

1. A house built in \_\_\_\_\_ would experience a fuel increase during a cold winter.
- a. the sun
  - b. the shade
2. A house built in an area of \_\_\_\_\_ would experience a fuel increase during a cold winter.
- a. high wind
  - b. calm wind

