

HOW DO WE OBSERVE AND MEASURE WEATHER?

UNIT 2: Weather Lesson 5 — Grades 4 -5 INSTRUCTIONS



Overview

In this two-part activity, students learn and practice traditional methods of weather observation, then build an anemometer and measure wind speed.

Objectives

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

- describe traditional methods of predicting weather; and
- explain how an anemometer works and why scientists use them.

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] SA 2.1 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] SE2.2 The student demonstrates an understanding that solving problems involves different ways of thinking, perspectives, and curiosity by identifying multiple explanations (e.g., oral traditions, folklore, scientific theory) of everyday events (e.g., weather, seasonal changes)

Alaska Cultural Standards

[E] Culturally-knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E2] understand the ecology and geography of the bioregion they inhabit

Bering Strait School District Scope & Sequence

4th Grade Sequence #8: Water Cycle

5th Grade Sequence #7: Water Cycle

Additional Resources

Harcourt School Publishers Science IV: Ch. 9, Lessons 1-4

Harcourt School Publishers Science V: Ch. 11, Lessons 1-3



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Materials

Part 1 — Traditional Methods of Observing Weather

- Student Worksheet: “Don’t forget to Observe the Sky Out There”
- Pens / Pencils

Part 2 — Building an Anemometer

- Flexible straws (4 per student)
- Condiment cups (4 per student)
- Balsa wood or mat board, very thin, cut to 1½” square (2 per student)
- Pencils with flat erasers (1 per student)
- Washers (1 per student)
- T-pins, large (1 per student)
- Sticker (1 per student)
- Scotch tape
- Variable speed fan
- Stopwatches (1 per pair of students)
- Computer with internet access
- STUDENT INSTRUCTION SHEET: “Build an Anemometer”
- STUDENT WORKSHEET: “Wind Speed”
- Access to computers with internet connectivity (for sharing activity)

Activity Preparation

Part 1 — Traditional Methods of Observing Weather

1. Read through the entire lesson, including the Whole Picture section for teacher background information.
2. Consult with a cultural knowledge bearer to familiarize yourself with your community’s understanding of the Yup’ik concept of Ella. (Known as Eslaghllak in Siberian Yupik and Sila in Inupiaq.) These terms are variously translated to English as weather, climate, world, sky, outdoors, universe, or even as sense or awareness. If possible, ask a Native speaker to teach you the Native language terms for weather related vocabulary words.
3. Identify an outdoor location where students can make their observations.
 - a. Determine whether the vegetation is safe for tasting.
4. Make copies of the STUDENT WORKSHEET.
5. Optional: On day 5, arrange for an elder to come in and speak with your class about their observations.



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Part 2 — Building an Anemometer

1. Build your own anemometer to use as an example in class.
 - a. Set it and the fan in your demonstration area, ready for demonstration.
2. Lay out the materials for the anemometers — students will collect the materials at your instruction.
3. Make copies of the STUDENT WORKSHEET and STUDENT INSTRUCTION SHEET.
4. Identify an outdoor location where students can use their anemometers. Orient yourself so that you know the directions of North, South, East, and West when outside.

Whole Picture

The term wind is used to describe the movement of air. Wind is caused by changes in temperature in combination with air movement from high to low pressure. High pressure pushes cold air down, and tends to create clear skies. Low pressure allows warm air to move upward, thereby encouraging cloud formation. Often, low pressure brings rain or snow.

Wind direction and speed are monitored by meteorologists, elders, pilots, sailors, scientists, architects, and others who need to know Earth's weather activity. Wind speed and direction are significant in a variety of applications, including (but not limited to): planning hunting, fishing, and whaling trips, building solid structures, managing landfills, and predicting weather.

Long before TV, radio, and internet weather forecasts, Alaska Native people predicted the weather and other landscape events like seasonal changes and animal migration through close observation of their surroundings. Many elders have explained that one crucial element to observe is wind. Depending on the time of year and direction from which it comes, wind can be the harbinger of many things, from good or bad weather, to the arrival of salmon, or the changing of seasons. John Phillip, from Kongiganak, was taught that along the coast strong, dangerous winds typically come from the north and south. In winter, when the winds come from the south, he explains that people might expect a snowstorm or flooding:

“Negeqvaq [north wind] and ungalaq [south wind] are the only strong winds. When it's windy from the south, there is a strong snowstorm. They say that it floods because the strong wind pushes [the water] and fills the Kuskokwim River. Places down coast from us flood because the wind is strong.” (Fienup-Riordan and Rearden, 2012, p. 83)

Particular types of wind might indicate different things in different regions. People throughout southwest Alaska use wind indicators to predict when certain salmon will arrive, where they might find sea mammals, and what kind of weather might be expected in the coming days. Based on past experience in Hooper Bay, the people there expect to catch more salmon if it is windy, stormy, or cloudy.

Minute changes in the wind could mean an improvement or deterioration of the weather. David Jimmie of Chefornek has explained:

“When a wet south wind turns toward the ocean [i.e., begins to blow from the west], they



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say that the wind has turned in a good direction and [the weather] will improve. But when it turns from behind our village [i.e., it begins to blow from the east], [the weather] won't improve right away. They say that the wind has turned in the wrong direction." (Fienup-Riordan and Rearden, 2012, p. 89)

For those who depend on the land, being able to predict what the weather and landscape will do is very important. Similarly, scientists depend on wind knowledge to predict weather events and understand the changing climate. One instrument scientists use to monitor the wind is an anemometer, which measures the force or speed of the wind. A common anemometer uses four cups mounted at equal distance from each other on horizontal arms, which are then mounted on a vertical shaft. The air flow turns the cups in proportion to the speed of the wind. Many anemometers convert the revolutions per minute into wind speed. Wind speed is measured in several different ways: MPH (miles per hour), knots (nautical miles per hour), M/S (meters per second), F/S (feet per second), or KM/H (kilometers per hour).

Experts worldwide use information about wind speed. Crane operators, air traffic controllers, fishermen, weathermen, and others use their understanding of wind to help them efficiently do their job. Just think how unhappy you would be if you lived near a landfill whose operator did not understand the behavior of wind and the odors were constantly wafting into your house!

Vocabulary

anemometer an instrument for measuring the speed of wind

Activity Procedure

Part 1 — Traditional Methods of Observing Weather

1. Write the following on the board: "How do we predict the weather?"
 - a. Give students 1 minute to think about the question, then ask for students to come to the board and write their brainstorming ideas.
 - a. After all students have had a chance to participate, review their answers. Ask for some students to defend their reasoning. Do not correct wrong answers (yet). Allow students to discover the answers throughout the activity. You will come back to these at the end of the lesson.
2. Explain that one traditional method of predicting the weather is to become keenly aware of minute changes in *ella / eslaghllak / sila* — the sky, the clouds, the sun, the stars, the outdoor smells, etc. Traditional practitioners have relied on this method for thousands of years. Keen observers always know when it is a good time to hunt, and when to stay indoors because of an approaching storm.
3. Share the following story with students: Paul John, from Toksook Bay, spoke about how his elders often said, "Don't forget to observe the sky out there." Frequently, he was unsure what he should notice, but heeding their admonitions, he observed the sun, the clouds, the horizon. "And if he noticed something in the morning and watched all day, he would begin to understand what the weather would do before the day ended. Also



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as the sun gradually went down, if he saw some sign beneath the sun toward the south, he would begin to understand the changes it would make before daybreak.” (Fienup-Riordan and Rearden, 2012, p. 61).

4. Explain that today, students will be going outside, to begin building their own awareness and observations. For the next 5 days, we will spend 5 minutes at the beginning of class to continue the observations. Encourage them to share their observations with a family member, community elder, or other culture bearer, who might help them interpret their observations.
 - a. Students may also wish to make their own observations in the traditional manner — by making an observation first thing in the morning when they wake up, and then again in the evening before the sun sets.
5. Before going outside, pass out the Student Worksheet: “Don’t Forget to Observe the Sky Out There.” Tell students to also bring a notebook and something to write with.
 - a. While outside, students should sit in a quiet location, they are not to communicate with others.
 - b. During the time (5–10 minutes), students should make notes of what they observe. They should use four senses (possibly five if edible vegetation exists)—sight, hearing, feeling, smelling, (tasting)
 - c. Instruct students to tune-in carefully to their surroundings and to pay close attention to the sky and horizon.

Teacher Note

You should take notes of your own observations. This will help you offer feedback to your students.

6. Back in the classroom, discuss student observations — what did everyone observe?
 - a. Discuss what those observations might mean — ask if anyone knows an elder who has taught them about what weather signs mean.
 - b. Have students predict tomorrow’s weather based on their observations today.
 - c. Explain that each day for the next five days, you will go outside and record observations. For homework, encourage students to talk with their family members and elders to understand what certain observations mean.



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Teacher Note

Each day, for the next 5 days, spend 5 minutes at the beginning of class outside. Allow students to quietly observe ella / eslaghllak / sila.

- a. Did they notice a particular weather event when the sky looked a particular way (rain, wind, sunshine, snow, dryness, etc.)?
- b. Did their elders, aunties, or family members have any insight to share regarding what the weather might do if the sky looked a particular way?
- c. Did anyone make additional observations (first thing in the morning or before the sun set)?
 - i. How were these similar to or different from the observations they took during class?
 - ii. Can those students make more accurate predictions?
- d. How will they continue to build their knowledge?

Part 2 — Build an Anemometer

1. Show students the anemometer you created.
 - a. Hold it in front of the fan, with the fan turned off. Ask students what they observe (the anemometer is not spinning).
 - b. Turn the fan on the lowest setting, while holding your anemometer in front of it. Ask students what they observe (the anemometer is spinning slowly).
 - c. While holding your anemometer in front of the fan, turn it to the highest setting. Ask students what they observe (the anemometer is spinning quickly).
 - d. Ask students to predict what scientists use anemometers for (to measure wind speed).
2. Explain that students will be creating their own anemometer and will use it to measure wind speed.
3. Pass out the STUDENT INSTRUCTION SHEET “Building an Anemometer,” and instruct students to gather the appropriate materials.
4. Assist students as they collect materials and build their anemometers.
5. When students are ready, pass out the STUDENT WORKSHEET “Wind Speed.”
 - a. As a class, look up the wind speed forecast at: <http://climate.gi.alaska.edu/Wx/forecast.html>.
 - i. Explain that students will measure the wind themselves and compare it to this forecast.
 - a. Instruct students to complete the “Hypothesis” section of their worksheet.
 - b. As a class, complete questions 1-2 on the worksheet. Share the Teacher



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Information Sheet “Wind Speed and Direction” to show them how to draw the symbol for wind speed.

6. Take students outside, where they will measure the wind speed using their anemometers.
 - a. They should follow the instructions on their worksheet. Assist students as necessary.
7. Back inside, instruct students to complete the remainder of the worksheet.
8. Critical Thinking: Discuss how this data could be used to predict weather.

Answers: “Don’t Forget to Observe the Sky Out There”

Student observations will vary depending on the weather in your location. Their observations, however, should be similar to your own.

Answers: “Wind Speed”

Hypothesis

Answers will vary.

Data

1. Answers will vary based on the information at: <http://climate.gi.alaska.edu/Wx/forecast.html>
2. Answers will vary based on today’s wind speed (refer to the Teacher Information Sheet “Wind Speed and Direction”)

Analysis of Data

Answers will vary based on student data.

Conclusion

1. Answers will vary.
2. Answers will vary.

Further Questions

1. C — anemometer
2. Answers will vary depending on information at: <http://climate.gi.alaska.edu/Wx/forecast.html>
3. Answers will vary but might include: more precise data, more precise instruments, different location for gathering data.



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References

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- Kawagley, Angayuqaq Oscar. (2006). *A Yupiaq Worldview: A Pathway to Ecology and Spirit*. Long Grove: Waveland Press.
- NOAA. "Wind Speed and Direction." <http://www.hpc.ncep.noaa.gov/dailywxmap/plottedwx.html>
- Stuckenberger, Nicole (Ed). 2007. *Thin Ice: Inuit Traditions within a Changing Environment*. Hanover and London: University Press of New England.
- Yukon River Drainage Fisheries Association. 2011. *When Will the Salmon Come? Advice from Elders: Knowledge from lower and middle Yukon River elders and fishers*. Anchorage: Northern Printing.



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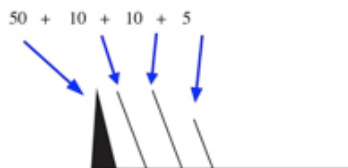


Teacher Information Sheet: “Wind Speed and Direction”

To depict wind direction, scientists use an imaginary arrow, which points toward the direction the wind is blowing. Wind speed is depicted as “feathers” (each representing 10 knots) and “half feathers” (each representing 5 knots), at the tail of the arrow. The large triangle feathers represent 50 knots. Note that all wind in the table below is blowing from the west toward the east.

Wind Speed Symbols		
Symbol	Knots	Miles Per Hour (MPH)
	Calm	Calm
	1-2	1-2
	3-7	3-8
	8-12	9-14
	13-17	15-20
	18-22	21-25
	23-27	26-31
	28-32	32-37
	33-37	38-43
	38-42	44-49
	43-47	50-54
	48-52	55-60
	53-57	61-66
	58-62	67-71
	63-67	72-77
	68-72	78-83
	73-77	84-89
	103-107	119-123

The image below shows the meaning of each “feather” and “half feather.” In this example, the wind is blowing from the west at 75 knots.



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Student Worksheet: “Don’t Forget to Observe the Sky Out There”

Name _____

Directions: Each day, observe and record your observations of ella / eslaghllak / sila (the sky, the clouds, the horizon, outdoors, etc.). You should make at least one observation in class each day this week. If you wish, you may practice the more traditional method, also noting your observation first thing in the morning and when the sun is setting in the evening. If you run out of space, make your own data sheet in your notebook, or on the back of this sheet. As the week goes on, you may wish to consult your elders, aunties, and parents to help you find meaning in your observations. At the end of the week, analyze your observations and discuss your hypotheses with your teacher and classmates.

Date	Time	Observation Details Optional: Information from elders, aunties, parents
Example: 3/10/13	Example: 8:02am	Example: Partly cloudy (amirlu). A light breeze blows from the north. Anuqsa’artuq. Negeqvaq. There are ducks flying north.



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STUDENT WORK



Student Worksheet: “Wind Speed” (page 1 of 2)

Name _____

Testable Question

What is the wind speed today?

Hypothesis

The wind speed today is _____.

Experiment

Materials

- Anemometer
- Stopwatch
- Pencil
- Worksheet

Procedure: Read all directions before beginning.

Work in pairs. One student will serve as the timer, the other as the counter.

Counter

1. Hold your anemometer so that the wind is blowing directly at it, causing it to spin around.
2. Watch the cups, looking for the one with the sticker. When it rotates around to be visible, say “start.”
3. Begin counting the number of times the anemometer rotates. Count the number of times the sticker appears. After the timer says “stop,” record the number of rotations in the data section.
4. Repeat steps 1–3 two more times, then switch roles.

Timer

1. When the counter says “start,” start the stopwatch. Watch the stopwatch for 60 seconds. When it reaches 60 seconds, say “stop.”
2. Stop the stopwatch.
3. Reset the stopwatch.
4. Repeat steps 1–3 two more times, then switch roles.



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Student Worksheet: "Wind Speed" (page 2 of 2)

Data

1. The National Weather Service daily wind speed forecast today is _____ mph.
2. Draw the symbol that represents today's wind speed.

3. In the chart below, record the number of times the anemometer rotated in each 60-second period.

Test	Number of Rotations
1	
2	
3	

Analysis of Data

1. Take an average of the three measurements.
$$\left(\quad + \quad + \quad \right) \div 3 = \text{rotations per minute}$$
$$\left(\text{test 1} + \text{test 2} + \text{test 3} \right)$$

Conclusion

1. The wind speed today is _____.
2. Was your hypothesis proved or disproved? _____

Further Questions

1. Scientists use a(n) _____ to measure wind speed.
 - a. rain guage
 - a. barometer
 - a. anemometer
2. Was the National Weather Service wind speed forecast the same or different than your measurement? _____
3. Why might the National Weather Service measurement be different?

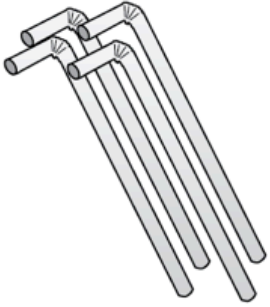
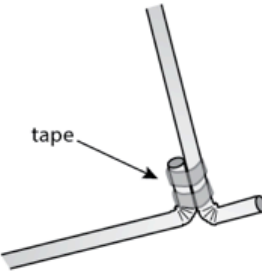
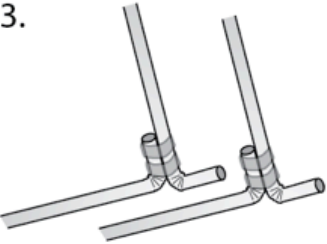
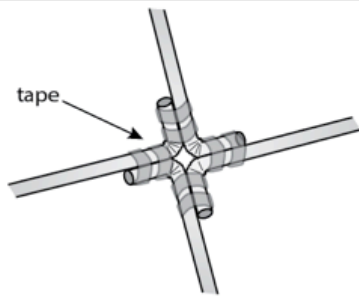
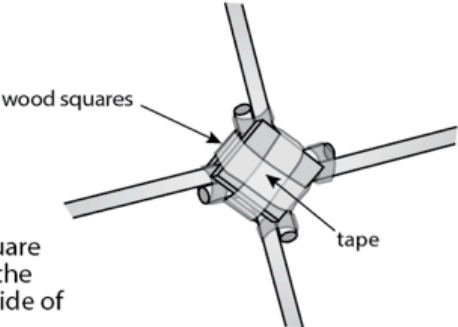

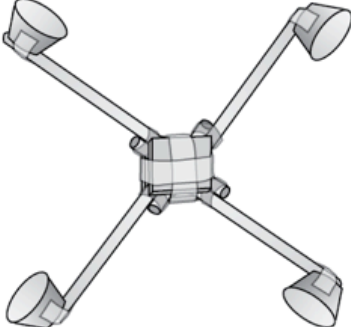
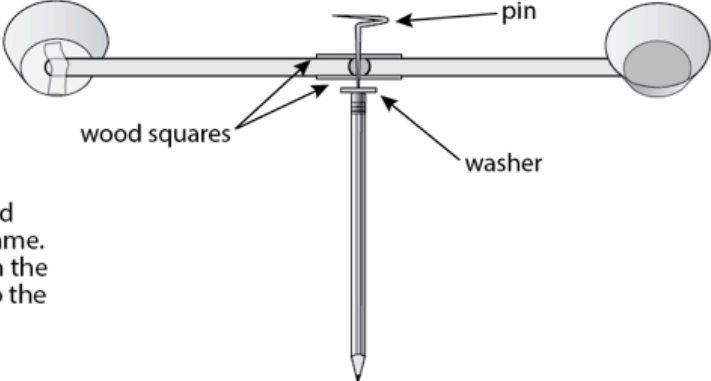


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Student Instruction Sheet: Build an Anemometer

Directions: Follow the instructions below to build your anemometer. Ask if you have questions.

<p>1.</p>  <p>Bend each straw.</p>	<p>2.</p>  <p>tape</p> <p>Tape two of the straws together as shown.</p>	<p>3.</p>  <p>Tape the other two straws together so you have two sets that look the same.</p>
<p>4.</p>  <p>tape</p> <p>Tape the two sets of straws together to make the frame.</p>	<p>5.</p>  <p>wood squares</p> <p>tape</p> <p>Tape a wood square to the center of the straws on each side of the frame.</p>	
<p>6.</p>  <p>Put a sticker in the bottom of one cup.</p>	<p>7.</p>  <p>Attach one cup to the end of each straw. Make sure each cup is pointing in the right direction!</p>	
<p>8.</p>  <p>pin</p> <p>wood squares</p> <p>washer</p> <p>Poke the pin through the wood squares in the center of the frame. Put the end of the pin through the washer, then push the pin into the pencil eraser.</p>		

