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CHANGING CLIMATE

Observing Weather

Introduction

Thank you for using this Raising Educational Achievement through Cultural Heritage Up (REACH Up) unit in your classroom! The lessons are designed to address the Alaska Science Standards and Grade Level Expectations, Alaska Cultural Standards and the Bering Strait School District Scope and Sequence goals. All of the activities focus on how to observe and understand weather. Activities incorporate Alaska Native cultural, earth and life science perspectives. This supplemental unit addresses the place-based questions: How is local weather observed and monitored? What causes our local weather and how is it changing? Why is monitoring weather and understanding changes important to our community?

The REACH Up Observing Weather unit consists of five activities. Each activity will require a 45-minute class period; discussion and further data collection will extend into multiple class periods for one lesson. You may also want to repeat sections of an activity during subsequent class meetings, such as reviewing the *Observing Weather* video or asking students to practice the vocabulary card games multiple times. If you are utilizing the entire *Observing Weather* unit, please introduce the activities in the order they are presented. If time is short, any of the activities can be presented independently.

The accompanying student guide is intended for use with multiple groups of students. Do not allow students to write in the student guides. Ask students to record their work on a separate sheet of paper, or create copies of the corresponding worksheets that are included in this teacher's guide.

Whole Picture

Weather refers to the state of the atmosphere — warm, dry, cold, windy, sunny, cloudy, rainy, etc. — at a given time and place. According to oral tradition across the Arctic, weather events are attributed to *Ellam Yua*, the Person of the Universe. The elders and culture bearers interviewed by Ann Fienup-Riordan and Alice Rearden for their book *Ellavut: Our Yup'ik World and Weather* explained that people's actions could directly affect the weather. *Ellam Yua* looked to reward good behavior with calm, pleasant weather and punish bad behavior with disastrous storms. If people acted appropriately, they could expect weather that would lead to "a successful harvest and long life." Inappropriate behaviors were tied directly to atmospheric upset that might result in disaster.

From a scientific perspective, daily weather events are the result of a complex web of interactions involving albedo, air pressure and winds. In rural Alaska, where many people spend much of their time outdoors on the land, understanding what the weather conditions will be like throughout



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the day and in the days to come is a vital skill. Elders and cultural knowledge bearers report that weather patterns are changing and that weather indicators that could once be relied upon are no longer consistent.

Earth's albedo — the amount of light or energy reflected by a surface — varies because different types of surfaces absorb different amounts of energy. When the sun's energy reaches Earth, some of the energy bounces off objects such as clouds and ice, while some of it is absorbed by land and open water. For example, sea ice reflects approximately 50–70% of sunlight (absorbing 30–50%), while open water reflects only 5–10% (and absorbs 90–95%). This difference in energy absorption results in uneven heating of Earth's surface. In turn, this affects air temperature. As the surface warms, so too does the air above it. Warm air rises, and cool air sinks. On average, air over the land is warmer than air over water, because land absorbs energy more quickly than water.

Earth's atmosphere, the thin blanket of air surrounding the planet, is composed of five layers: the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere. Most of Earth's weather (clouds, wind, rain, snow, storms, etc.) occurs in the troposphere, the layer closest to the ground. The troposphere contains water, dust, 90% of the atmospheric gasses, and other tiny particles.

Gas molecules in the troposphere are constantly moving. As gravity pulls them toward Earth's surface, air near the surface is denser than air at higher elevations. Scientists call this air pressure — the weight of the atmosphere pressing down on Earth. Cool air is denser and has more pressure than warm air. As dense heavy air sinks, it pushes warmer, less dense, air up.

Because cool air has a higher pressure than warm air, wind blows from cooler places toward warmer places. Local winds, those that change from place to place, happen as a result of warmer and cooler air pockets. Local winds move short distances and can blow from any direction.

More constant prevailing winds, are global winds that always blow from the same direction. Like local winds, these winds are caused by uneven heating of Earth's surface. Because the air at the poles is colder than the air at the equator, cold air above the poles sinks and moves toward the equator, while at the same time, air at the equator moves up and goes toward the poles. As the air moves, Earth's rotation causes it to curve, resulting in winds that blow mainly from the east or the west. In Alaska, the prevailing winds are called polar easterlies. They come from the north pole and curve down toward the east.



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MIDDLE SCHOOL
TEACHER GUIDE



When warm winds meet with cool winds, storms can form. The sun warms the ground and the air close to it. Warm air rises, carrying water vapor with it. When water vapor gets high in the atmosphere, it cools, condenses, and creates clouds. Thunderclouds often form when this process intensifies.

The Alaska Native Tribal Health Consortium has established an online network, called Local Environmental Observers (LEO) Network, through which local observers can report unusual weather, animal and environmental events. The LEO Network links observers with topic experts and provides a variety of services to explore and study the unusual observations and alert communities to findings.

References

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

Alaska Native Tribal Health Consortium. (2012) About LEO Network. Accessed on 3/27/18 from: <https://www.leonetwork.org/en/docs/about/about>.



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Unit Vocabulary

Science Terms to Define	
atmosphere	a layer of gases that surrounds Earth
weather	the condition of the atmosphere at a particular place and time
pressure system	a body of warm or cold air in the atmosphere
precipitation	water, in liquid or solid form, that falls from the atmosphere
humidity	the amount of water vapor in a given volume of air
surface temperature	how hot or cold the air is near Earth's surface

Terms for Incorporating Local Indigenous Language				
English	Iñupiaq	Yup'ik	Siberian Yupik	Local Translation
atmosphere	silá	cella	aghtuneq	
cloud	qilaġluit	amirluq	qilawaq	
measure	urraun	cuqteq	puqlaghsusiq	
observe	qiniġluu	cumikeq	riirngi	
rain	ivġaniq	ivsuk	eslalluk	
snow	qannik	qanikcaq	anigu	
sun	masaq	ak'erta	siqineq	
weather	silagik	ella	esla	
wind	anuġi	anuqa	anuuqa	



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Observing Weather

Activity MS.1.1

TEACHER GUIDE



Activity MS.1.1: Ask an Expert

Overview

In this activity, students will interview an elder or cultural knowledge bearer.

Objectives

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

- demonstrate effective interviewing techniques,
- interpret qualitative data from interviews,
- describe and differentiate between qualitative and quantitative ways of monitoring local weather,
- explain how local weather and/or climate has changed, and
- describe how changes to the typical local weather or climate impact local lifestyles.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

SA1: The student demonstrates an understanding of the processes of science by

[6-8] **SA1.1** asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

SA3: The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by

[6] **SA3.1** gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion).

SD3: The student demonstrates an understanding that if cycles influenced by energy from the sun and by Earth's position and motion in our solar system by

[7] **SD3.1** describing weather using accepted meteorological terms (e.g. pressure systems, fronts, precipitation).

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.



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Activity MS.1.1

TEACHER GUIDE



[C] Culturally-knowledgeable students are able to actively participate in various cultural environments. Students who meet this standard are able to:

[C4] enter into and function effectively in a variety of cultural settings.

[D] Culturally-knowledgeable students are able to engage effectively in learning activities that are based on traditional ways of knowing and learning. Students who meet this cultural standard are able to:

[D.3] interact with Elders in a loving and respectful way that demonstrates an appreciation of their role as culture-bearers and educators in the community.

[D.4] gather oral and written history information from the local community and provide an appropriate interpretation of its cultural meaning and significance.

[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:

[E.2] understand the ecology and geography of the bioregion they inhabit.

[E.4] determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems.

Bering Strait School District Science Scope and Sequence

7.8A. Describe the weather using accepted meteorological terms: pressure systems, fronts, and precipitation. (SD3.1)

7.8D. Understand the difference between weather and climate.

7.8E. Use scientific processes and inquiry to directly support concepts on meteorology. (SA1.1, 1.2, 2.1, 3.1, SG)

Materials

- REACH Up Middle School Student Guide: *Observing Weather*
- Student Worksheet: *Ask an Expert about Weather Observations*
- Internet access and projector

Activity Preparation

1. Identify adults within your school or community who have lived year-round in the community for many years. People in the school might include teachers, administrators, secretaries, teacher aides, lunchroom/kitchen staff, recess duties, maintenance and custodial staff, etc. People in the community might include parents, grandparents, tribal administrators etc. Ask several of these local knowledge bearers if they would be willing to speak with a group of your students about how to observe and monitor weather, as well as share any knowledge they may have about changes to local weather over time. Make sure



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Activity MS.1.1

TEACHER GUIDE



that the volunteers you have identified will be available (in person or via telephone) during the time that your class will be completing this activity.

2. Ask the volunteers if they speak an Alaska Native Language, and if so, which language(s) and dialect(s) they are familiar with. If applicable, have them translate the written words on the student worksheet, so you have an answer key. Also, ask them to teach you the pronunciation of the terms.

Activity Procedure

1. Distribute the REACH Up Middle School Student Guide: *Observing Weather* and ask students to work with a partner to read Pages 1-3.
2. Show the video, *Observing Weather*, available at www.k12reach.org/videos.php. Videos are located under the Multimedia tab. Allow time for students to share comments and ask questions.
3. Ask students why people in their community might pay attention to the weather (students may note the need to be prepared for the weather when conducting outdoor subsistence activities, walking to school, traveling to other communities or by water, safely conducting commercial fishing, etc.). Explain that students will interview a few community members to learn about how and why weather is monitored in their community.
4. Separate students into small groups according to how many knowledge bearers are available to share weather observation information with your class. Explain if the appointed interviewees speak an Alaska Native Language, so students know whether or not they should pursue that portion of the interview.
5. Review expectations for student behavior while conducting the interview, including introductions, respectful listening and thanking the interviewee at the end of the interview. Discuss suggestions for effective interviewing techniques, such as allowing ample time for the interviewee to answer, and asking follow-up questions.
6. Distribute one Student Worksheet: *Ask an Expert about Weather Observations* to each group and assign each group one local knowledge bearer to interview. Provide 20-25 minutes for students to locate or call via telephone and interview the knowledge bearer.
7. Reconvene in the classroom and ask groups to share their findings. Discuss: What sort of weather can we expect during each season? How do people monitor the weather in our community? Why is it important to pay attention to the weather? Did the knowledge bearers note any changes to the typical weather in their lifetime? If so, what were the changes? How have the changes impacted lifestyles?



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Activity MS.1.1
WORKSHEET



Student Worksheet: *Ask an Expert about Weather Observations*

Names of Group Members: _____

Interview a long-term community member to learn more about observing weather in your area. Take notes about what you learn.

Who did you interview? _____

Ask:

What sort of weather can we expect during each season?

What observation strategies, methods, tools or resources do you use to monitor weather?

Why is it important to pay attention to the weather?

Have you noticed any changes in the typical weather for our area during your lifetime? If so, what has changed and how?

If there have been changes, how have the changes impacted your lifestyle or the lifestyles of others in our community?

Other notes:



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Observing Weather

Activity MS.1.1

WORKSHEET



For Alaska Native Language Speakers:

What language(s) do you speak? _____

What dialect(s)? _____

Could you please translate the following words?

atmosphere: _____

cloud: _____

measure: _____

observe: _____

rain: _____

snow: _____

sun: _____

weather: _____

wind: _____

Do you know any other words for weather that are not listed here?

Record the words and translations here:



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Activity MS1.2: Observing Weather Vocabulary

What terminology do we need to know to discuss weather?

Overview

In this activity, students will learn key weather terminology in English and their local Alaska Native language by playing vocabulary games with peers.

Background Information

Based on the Visual Iñupiaq Vocabulary Acquisition (VIVA) Program of the North Slope Borough School District, the vocabulary cards provided for this activity have Alaska Native Language and English terms and an associated image. The games suggested are meant to promote fluency through repeated practice. Other vocabulary cards can be easily integrated into the games. This will extend potential length of the games and add a greater challenge. By working with the words through different games, students can develop greater fluency with the vocabulary.

Objectives

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

- read and speak indigenous terms related to weather, and
- illustrate and define terms related to weather observation and the atmosphere.

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B.2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

[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:

[E.2] understand the ecology and geography of the bioregion they inhabit.

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Activity MS.1.2
TEACHER GUIDE



Bering Strait School District Science Scope and Sequence

- 7.8D. Understand the difference between weather and climate.
- 7.8E. Use scientific processes and inquiry to directly support concepts on meteorology.
(SA1.1, 1.2, 2.1, 3.1, SG)

Materials

- REACH Up Middle School Student Guide: *Observing Weather*
- Vocabulary card sets (1 per group of 4-6 students)
- Student Information Sheet: *Word Games Instructions* (1 per group of students)
- Student Worksheet: *Observing Weather Vocabulary*
- Dry Erase Marker (1 per group)
- Timers (optional)

Activity Preparations

1. If your students completed Activity MS.1.1 Ask an Expert, refer to their completed worksheets for the terms you will have them use for the vocabulary word card games.
2. If your students did not conduct interviews with Native language speakers, consult with a local knowledge bearer or language expert to determine which language/dialect translation provided on Page 4 of the Student Guide would be most appropriate for your students to practice. The following chart is provided for reference.





Alaska Native Languages in the Bering Strait Region				
Language	Dialect Group	Dialect	Subdialect	Community
Iñupiaq	Seward Peninsula Iñupiaq	Bering Strait		Brevig Mission
			Diomedede	Little Diomedede
				Shishmaref
			Wales (Kinikmiu)	Wales
		Teller	Teller	
			Unalakleet	
			Shaktolik	
	Fish River	Golovin*		
		White Mountain		
		Northern Alaskan Iñupiaq	Malimiut	
Siberian Yupik		St. Lawrence Island Yupik		Gambell
			Savoonga	
Yup'ik		Norton Sound (Unaliq-Pastuliq)	Unaliq	Elim
				Golovin*
				St. Michael
		General Central Yup'ik	Nelson Island and Stebbins	Stebbins

* It is very common for more than one language/dialect, or a combination of dialects, to be spoken in a community. It should also be noted that Inupiaq-Yup'ik bilingualism was common throughout the 1900s in the Norton Sound villages of White Mountain, Golovin, Elim, and Unalakleet. Golovin is listed twice on our chart because specific subdialects were cited in the research found on the Alaska Native Language Center website: <http://www.uaf.edu/anlc/languages/>.

- Keep in mind that different individuals may translate certain terms differently. It's fine to have different student groups working with various translations, or you can choose a set list of words for your whole class to practice. Highlight the diversity and do not attempt to offer an authoritative translation; the goal is to practice an Alaska Native language while discussing climate change topics.
- If using the Vocabulary Cards provided by REACH Up, label a sample set of cards with local indigenous words using a dry erase marker. If needed, create your own sets of the vocabulary cards from the template provided.
- Make copies of the Student Information Sheet: *Word Games Instructions* (one per group) and the Student Worksheet: *Observing Weather Vocabulary* (one per student).



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Observing Weather

Activity MS.1.2

TEACHER GUIDE



Activity Procedure

1. Distribute the REACH Up Middle School Student Guide: *Observing Weather* and review Pages 1-4.
2. Show students the vocabulary cards. Hold up each card. Discuss what each card depicts. How do these terms relate to weather observation in their region?
3. Say the English and local Alaska Native Language word for the illustration depicted on the card. Ask students to repeat the words. Repeat this once or twice, then ask students to call out the correct words as you hold up each card.
4. Divide the class into four groups.
5. Provide each group with the *Word Games Instruction* sheet, a set of Vocabulary Cards, and a timer (optional).
6. Students can commit to one game for a period of time or mix and match.
7. Encourage students to play the vocabulary games and practice the vocabulary words during free time throughout the duration of the Observing Weather unit. If possible, schedule 10-15 minutes twice per week to practice the vocabulary terms.
8. Write the following terms on the board: atmosphere, weather, pressure system, precipitation, humidity, and surface temperature. Ask students to share definitions for these terms. Refer back to REACH Up Middle School Student Guide: *Observing Weather* as necessary.
9. Distribute the Student Worksheet: *Observing Weather Vocabulary* and ask students to complete it. Provide review as needed.



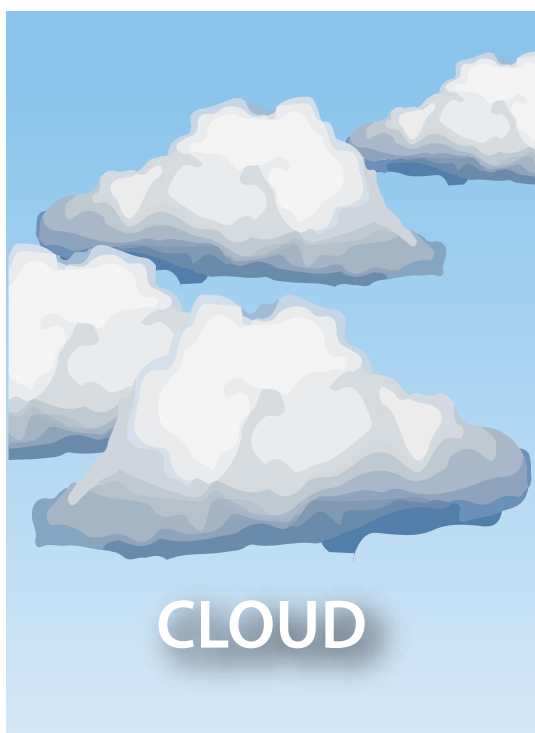
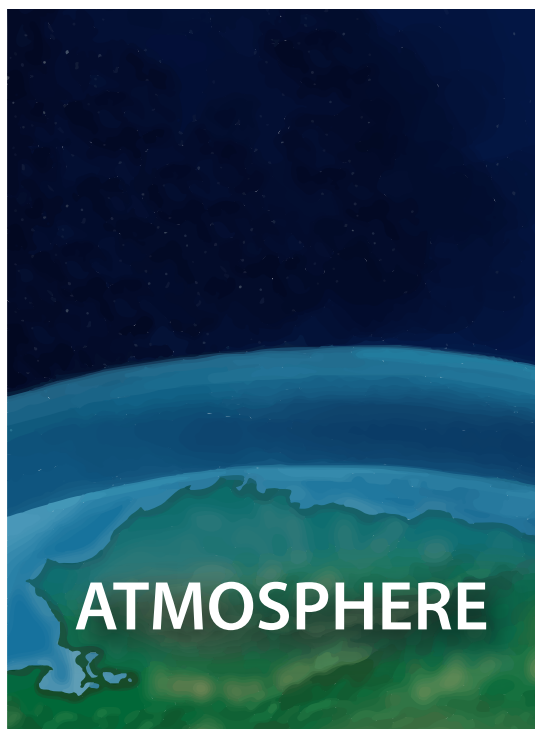
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Observing Weather

Activity MS.1.2
TEMPLATE



Vocabulary Cards



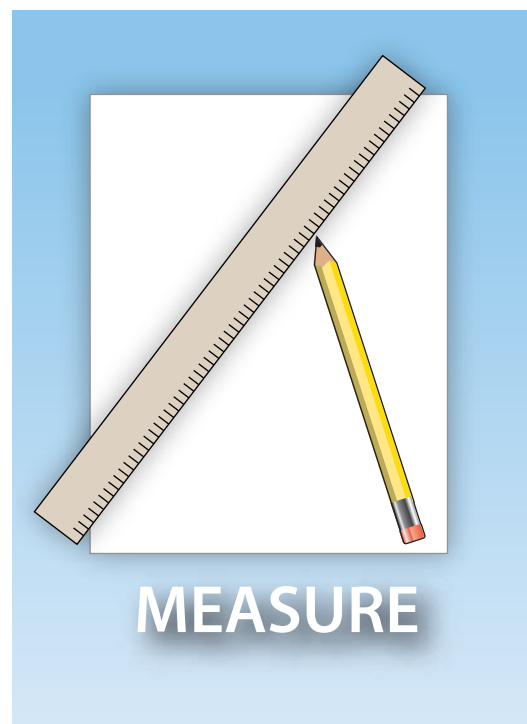
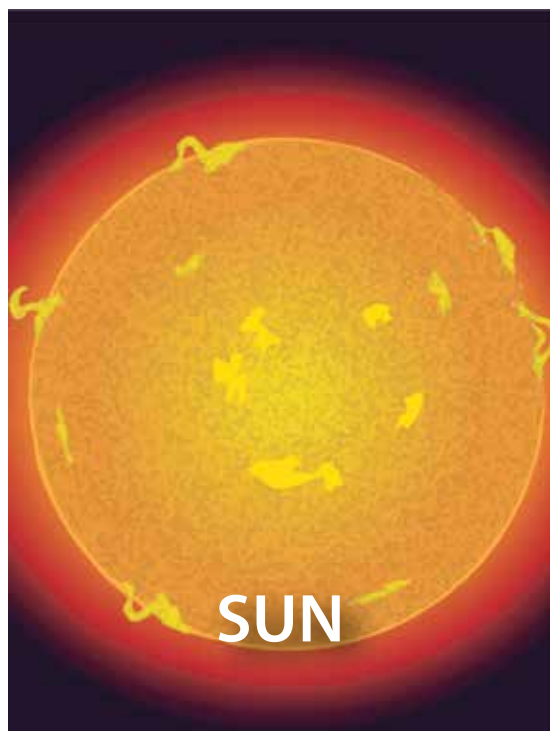
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Activity MS.1.2
TEMPLATE



Vocabulary Cards



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Vocabulary Cards



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Observing Weather

Vocabulary Cards

Local Indigenous Word

Local Indigenous Word

Local Indigenous Word

Local Indigenous Word

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STUDENT INFORMATION SHEET: *Word Games Instructions*

VOCABULARY SWAP

1. Distribute one card to each person.
2. Practice the word on your card, then find a classmate. Teach them the word on your card and learn the word on their card. Trade cards.
3. Find another classmate and repeat.

FIND THE CARD

1. Divide into small groups. Each group will need a set of vocabulary cards. Spread the cards in front of you so that everyone in your group can see the pictures.
2. Listen as your teacher says a word aloud from one of the cards.
3. Work with your group to find and hold up the correct card.

VOCABULARY SLAP

1. Select one student to serve as the “caller” for this game. That student should make a list of the vocabulary words on a separate sheet of paper. The words can be found on the back of the cards.
2. Place the cards in a circle, picture-side-up, in the middle of the playing area.
3. The caller should call out a word from their list. Everyone else should quickly place their hand on the picture that they believe represents that word.
4. Turn over the card or cards that students selected to see who chose correctly. Each student who placed his or her hand on the correct card earns a point.
5. Put the card(s) back in the circle and play again.
6. Play for a designated period of time. At the end of the time, the person with the most points wins.

TEAMWORK

1. Divide your group into two teams. Each team will need a pencil and paper.
2. Shuffle the vocabulary cards and stack them picture-side up in the middle of the table.
3. Work with your team to write down the local Alaska Native Language terms for the picture on the card.
4. After both teams have written answers for the top card, turn the card over to check. Teams get 1 point for the correct Alaska Native Language word.
5. Repeat until all cards are gone. The team with the most points wins.



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STUDENT WORKSHEET: *Observing Weather Vocabulary*

Name: _____

1. Draw a line connecting each definition to the term that it represents.

weather	a layer of gases that surrounds Earth
atmosphere	the condition of the atmosphere at a particular place and time
precipitation	water, in liquid or solid form, that falls from the atmosphere
humidity	a body of warm or cold air in the atmosphere
pressure system	how hot or cold the air is near Earth's surface
surface temperature	the amount of water vapor in a given volume of air



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Activity MS.1.2

WORKSHEET



- Complete the chart by writing the local Alaska Native Language terminology and illustrating the missing terms.

My Community: _____		
English Word	Local Alaska Native Language Word	Illustration
atmosphere		
cloud		
measure		
observe		
rain		
snow		
sun		
weather		
wind		







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STUDENT WORKSHEET: *Observing Weather Vocabulary* Answer Key

Name: _____

1. Draw a line connecting each definition to the term that it represents.

weather		a layer of gases that surrounds Earth
atmosphere		the condition of the atmosphere at a particular place and time
precipitation		water, in liquid or solid form, that falls from the atmosphere
humidity		a body of warm or cold air in the atmosphere
pressure system		how hot or cold the air is near Earth's surface
surface temperature		the amount of water vapor in a given volume of air

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Activity MS.1.2

ANSWER KEY



1. Complete the chart by writing the local Alaska Native Language terminology and illustrating the missing terms.

My Community: _____		
English Word	Local Alaska Native Language Word	Illustration
atmosphere	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
cloud	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
measure	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
observe	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
rain	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
snow	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
sun	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
weather	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.
wind	Answers will vary depending on language and dialect spoken in this community.	Sketch should illustrate word at left.



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Activity MS.1.3: Modeling Pressure Systems

Overview

In this lesson students will use the warm air within the school and the cold air outdoors to model pressure systems and observe what happens when a high pressure system and a low pressure system meet.

Objectives

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

- discuss heat retention and the role of the atmosphere in reducing temperature extremes between day and night;
- describe the relative density of warm air and cold bodies of air in the atmosphere;
- accurately use terms such as atmospheric pressure, high pressure system, low pressure system, cold front and warm front, when discussing weather; and
- describe the convection-driven movement of air in the atmosphere.

Alaska State Science Standards and Grade Level Expectations

SA1: The student demonstrates an understanding of the processes of science by

[6-8]SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating

[6]SA1.2 collaborating to design and conduct simple repeatable investigations

SD3: The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by

[7] SD3.1 describing the weather using accepted meteorological terms (e.g. pressure systems, fronts, precipitation).

[8] SD3.2 recognizing types of energy transfer (convection, conduction, radiation) and how they affect weather

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B1] acquire insights from other cultures without diminishing the integrity of their own.

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Observing Weather

Activity MS.1.3
TEACHER GUIDE



Bering Strait School District Science Scope and Sequence

- 7.8A. Describe the weather using accepted meteorological terms: pressure systems, fronts, and precipitation. (SD3.1)
- 7.8B. Recognize types of energy transfer (convection, conduction and radiation) and how they affect weather. (SD3.2)

Materials

- Thread
- Scissors
- Paper
- Tape
- REACH Up Middle School Student Guide: *Observing Weather*
- Student Worksheet: *Modeling Pressure Systems*

Activity Preparations

This activity must be completed on a day when it is much colder outside than it is indoors. Identify a door or window that opens easily to the outdoors to conduct this activity.

Activity Procedure

1. Distribute the REACH Up Middle School Student Guide: *Observing Weather* and ask students to work with a partner to read Pages 5-8.
2. Discuss the reading. Ask: What is the atmosphere? How does it help to keep the surface of Earth warm? How does the atmosphere affect daytime versus nighttime temperature? What is atmospheric pressure? What is the difference between a low pressure system and a high pressure system? What is a warm front? What is a cold front? What is convection and how does it apply to movement of the air in the atmosphere?
3. Explain that students will model and observe what happens when two pressure systems meet.
4. Divide students into pairs or small groups. Distribute paper, thread, scissors and tape to each group.
5. Ask each group to follow the instructions on Page 7 of their Student Guide to make four air movement detectors.
6. When all students have their air movement detectors ready, distribute the Student Worksheet: *Modeling Pressure Systems*.
7. Ask students to collect their air movement detectors, tape, worksheets and pencil and lead students to the door(s) that you will use for this activity.



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Observing Weather

Activity MS.1.3

TEACHER GUIDE



8. Demonstrate how to tape the air movement detectors so that they swing freely near the top and bottom of the door. Ask: What do you think will happen to these air movement detectors when we open the door? Will they move? If so, which direction will they move? Why? Will the detectors at the top of the door move differently than those at the bottom of the door?
9. Ask students to write their predictions on the “Hypothesis” section of their worksheet.
10. Ask a student to open the door(s) and hold it open for a few minutes. All students should observe what happens to the air movement detectors at the top and bottom of the door.
11. Ask students to sketch their observations in the space provided on the worksheet.
12. Repeat the modeling and observation process a couple times to ensure all students have an opportunity to observe the air movement detectors.
13. Return to the classroom and ask students to complete their worksheets.
14. Discuss: What happened when the warm front of your school’s low pressure system met the cold front of the high pressure system outside? How did the two bodies of air move relative to each other? How do you know? How might things be different if we did this exercise on a warm summer day? What if we used our air movement detectors near the door of a hot oven?



CHANGING CLIMATE

Observing Weather

Student Worksheet: *Modeling Pressure Systems*

Name: _____

Hypothesis

Make an educated guess: What do you think will happen to the air movement detectors when the door is opened? Why?

(For example, Will they move? If so, which direction will they move? Why? Will the detectors at the top of the door move differently than those at the bottom of the door?)

1. I predict that the air movement detectors near the top of the door will _____

because _____

_____.

2. I predict that the air movement detectors near the bottom of the door will _____

because _____

_____.

Model and Observe

Open the door and observe what happens to the air movement detectors. Sketch and label your observations in the spaces on the next page.





3.

Air Movement at the TOP of the door	
Before (=door is closed)	After (=door is open)

4.

Air Movement at the BOTTOM of the door	
Before (=door is closed)	After (=door is open)

Conclusions

What happened when the warm front of your school's low pressure system met the cold front of the high pressure system outside? How did the two bodies of air move relative to each other? How do you know?



Student Worksheet: Modeling Pressure Systems
Answer Key

Hypothesis

Make an educated guess: What do you think will happen to the air movement detectors when the door is opened? Why? (For example, Will they move? If so, which direction will they move? Why? Will the detectors at the top of the door move differently than those at the bottom of the door?)

1. I predict that the air movement detectors near the top of the door will _____
Answers will vary but should include a predicted action and the student's reasons for predicting this action.
2. I predict that the air movement detectors near the bottom of the door will _____
Answers will vary but should include a predicted action and the student's reasons for predicting this action.

Model and Observe

Open the door and observe what happens to the air movement detectors. Sketch and label your observations in the spaces below.

3.

Air Movement at the TOP of the door	
Before (=door is closed)	After (=door is open)
Sketch should show the air movement detectors near the top of the door hanging straight down on their strings.	Sketch should depict the movement of the detectors near the top of the door when students opened the door.

4.

Air Movement at the BOTTOM of the door	
Before (=door is closed)	After (=door is open)
Sketch should show the air movement detectors near the bottom of the door hanging straight down on their strings.	Sketch should depict the movement of the detectors near the bottom of the door when students opened the door.

Conclusions

Answers will vary but should demonstrate understanding that if it is cold outside and warm inside, the less dense warm air moves upward and out and that heavier cold air sinks down and in. Students should understand this from observing the movement of their air movement detectors.

CHANGING CLIMATE

Observing Weather

Activity MS.1.4: Build a Thermometer

Overview

In this lesson students will construct and calibrate a thermometer.

Objectives

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

- construct and use a weather instrument to measure temperature;
- discuss connections between the water cycle and weather phenomena;
- accurately use meteorological terms such as precipitation, humidity and temperature; and
- describe thermal expansion as it applies to a liquid bulb thermometer.

Alaska State Science Standards and Grade Level Expectations

SA1: The student demonstrates an understanding of the processes of science by

[6-8] **SA1.1** asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating

SD3: The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by

[6] **SD3.1** connecting the water cycle to weather phenomena

[7] **SD3.1** describing the weather using accepted meteorological terms (e.g. pressure systems, fronts, precipitation).

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B1] acquire insights from other cultures without diminishing the integrity of their own.

Bering Strait School District Science Scope and Sequence

7.8A. Describe the weather using accepted meteorological terms: pressure systems, fronts, and precipitation. (SD3.1)

7.8C. Able to use weather instruments in order to predict weather. (SE)

7.8E. Use scientific processes and inquiry to directly support concepts on meteorology. (SA1.1, 1.2, 2.1, 3.1 SG)



CHANGING CLIMATE

Observing Weather

Materials

- REACH Up Middle School Student Guide: *Observing Weather*
- Glass flask (recommended size: 250 ml)
- Hard plastic (or glass) tubing, about 12 inches long
- Rubber stoppers with a hole sized to fit tubing that fits the size of flask used
- Water (room temperature and warm water)
- Bowl
- Red food coloring
- Transparent tape
- Thermometer (or temperature sensor and data logger)
- Lined index card
- Student Worksheet: *Thermometer*

Activity Preparations

1. Prepare a thermos or pitcher of hot water. It does not need to be boiling, but should be significantly warmer than room temperature.
2. Place the thermometer materials in a location where students can easily collect them.

Activity Procedure

1. Ask students to work with a partner to read Pages 9-10 of the REACH Up Middle School Student Guide: *Observing Weather*.
2. Discuss the reading and extend ideas. Ask: What do you know about how the water cycle relates to weather? How do clouds form? What causes precipitation? What is humidity? What does surface temperature describe? Which temperature scale are you most familiar with? What is freezing on that scale? How about boiling? How are temperature scales helpful?
3. Explain that students will work in small groups to build and calibrate a thermometer by following the instructions on Pages 11-12 of the Student Guide.
4. Place students in groups of 4, distribute the Student Worksheet: *Thermometer* and ask students to collect the materials they need, and construct and calibrate their thermometers.
5. Circulate and assist as needed.
6. Discuss: What happened to the water in the tube when you poured warm water into the bowl? Why? What do you think would happen if you poured ice water into the bowl instead of warm water? How might you determine the temperature of the water in the bowl as it cools, using only the thermometer you built? Would your thermometers work at temperatures below freezing? Why or why not? What is thermal expansion? How does it apply to your thermometer?



CHANGING CLIMATE

Observing Weather

Activity MS.1.4

WORKSHEET

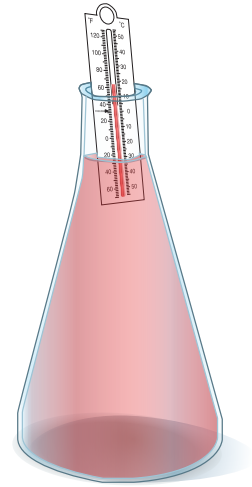


Student Worksheet: *Thermometer*

1. What is the temperature of the water before you put the stopper in the flask?

_____ °C / _____ °F

2. What happened to the water in the tube when you poured warm water into the bowl? Why?



3. What do you think would happen if you poured ice water into the bowl instead of warm water?

4. How might you determine the temperature of the water in the bowl as it cools, using only the thermometer you built?

5. What temperature reading do you think your thermometer will indicate tomorrow if you leave it set up in the classroom? Why?

_____ °C / _____ °F, because _____

6. Would your thermometer work at temperatures below freezing? Why or why not?



CHANGING CLIMATE

Observing Weather

Activity MS.1.4

ANSWER KEY



Student Worksheet: *Thermometer*

Answer Key

1. What is the temperature of the water before you put the stopper in the flask?
Answers will vary but should be around room temperature (18-35) °C / (65-78) °F.
2. What happened to the water in the tube when you poured warm water into the bowl?
Why?
Answers will vary but should indicate that the water level in the tube went up because of the thermal expansion of the water in the flask as it was warmed by the water in the bowl.
3. What do you think would happen if you poured ice water into the bowl instead of warm water?
Answers will vary but should indicate that the water level in the tube would drop.
4. How might you determine the temperature of the water in the bowl as it cools, using only the thermometer you built?
Answers will vary but should indicate understanding that students can measure the space between their room temperature mark on the card, and the high temperature mark on the card and make a scale between the two that will indicate the temperature as it drops.
5. What temperature reading do you think your thermometer will indicate tomorrow if you leave it set up in the classroom? Why?
Answers will vary, but should be somewhere around the initial room temperature reading °C/°F, because the water in the flask will cool back down to room temperature.
6. Would your thermometer work at temperatures below freezing? Why or why not?
Answers will vary but should indicate understanding that this thermometer would not work at temperatures below freezing because the water in the thermometer would freeze solid and no longer move within the tube.



CHANGING CLIMATE

Observing Weather

Activity MS.1.5: Collecting Weather Data

Overview

In this lesson students will use instruments to measure a variety of weather parameters in their community, then use the data they collected to help them predict weather for the following day.

Objectives

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

- use an instrument to quantitatively measure a weather parameter,
- record qualitative observations of weather conditions,
- communicate weather data, and
- predict weather based on data collected from observation and instrumentation.

Alaska State Science Standards and Grade Level Expectations

SA1: The student demonstrates an understanding of the processes of science by

[6-8] **SA1.1** asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating

[6] **SA1.2** collaborating to design and conduct simple repeatable investigations

[7] **SA1.2** collaborating to design and conduct simple repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.

[8] **SA1.2** collaborating to design and conduct repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.

SD3: The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by

[6] **SD3.1** connecting the water cycle to weather phenomena

[7] **SD3.1** describing the weather using accepted meteorological terms (e.g. pressure systems, fronts, precipitation)

Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B1] acquire insights from other cultures without diminishing the integrity of their own.

[B2] make effective use of the knowledge, skills, and ways of knowing from their own cultural traditions to learn about the larger world in which they live.

CHANGING CLIMATE

Observing Weather

Activity MS.1.5

TEACHER GUIDE



[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 and Sequence

- 7.7C. Knows that atmosphere is warmed through heat retention (greenhouse effect). (SD3.2)
- 7.8A. Describe the weather using accepted meteorological terms: pressure systems, fronts, and precipitation. (SD3.1)
- 7.8C. Able to use weather instruments in order to predict weather. (SE)
- 7.8E. Use scientific processes and inquiry to directly support concepts on meteorology. (SA1.1, 1.2, 2.1, 3.1 SG)

Materials

- REACH Up Middle School Student Guide: *Observing Weather*
- Anemometer
- Hygrometer (or other relative humidity gauge)
- Thermometer
- Barometer
- Cloud identification sheet (Students can use Pages 13-14 of the *Student Guide* or the NOAA cloud chart: <https://gewa.gsfc.nasa.gov/clubs/sailing/IMAGES/MISCELLANEOUS/CloudChart.pdf>)
- Clipboards
- Student Worksheets: *Collecting Weather Data* (Wind, Water, Temperature, Atmospheric Pressure)
- Computer or tablet with internet access

Activity Preparations

1. Make copies of the Student Worksheet: *Collecting Weather Data*.
2. Familiarize yourself with each of the weather instruments so that you will be able to instruct students in their use.
3. Identify which unit of measurement you would prefer for students to use for wind speed.



CHANGING CLIMATE

Observing Weather

Activity Procedure

1. Ask students to work with a partner to read Pages 13-17 in the REACH Up Middle School Student Guide: *Observing Weather*.
2. Ask students to reflect on what they learned from local community members about monitoring weather and what they have just read about observing and measuring weather. Discuss: What are some of the ways that we observe and measure clouds? What are some types of precipitation, and how can we measure it? What is one challenge when it comes to measuring precipitation? What is humidity? Which can hold more moisture: warm air or cold air? How do we measure wind? What are some ways of making qualitative observations of wind? How do we measure atmospheric pressure? If the weather is clear, what does that tell you about the atmospheric pressure? What do cloudy skies tell you about the atmospheric pressure?
3. Separate students into 4 groups. Explain that each group will measure and observe a different aspect of the weather. Discuss the process described on Pages 17 of the Student Guide. Emphasize the importance of recording units with their measurements and clear descriptions of observations.
4. Distribute a different weather instrument and the associated worksheet to each group and teach each group how to use their instrument (anemometer, hygrometer/relative humidity gauge, thermometer, barometer).
5. Ask students to gear up and go outside, taking the instrument, a pencil and worksheet with them to measure and record their weather parameter.
6. Return to the classroom and work with students to calculate their average measurement for the weather variable their group measured.
7. Ask each group to share their average measurement and their observations with the rest of the class.
8. Discuss: Based on class measurements and observations of today's weather conditions, what type of weather would you expect tomorrow? Why?



CHANGING CLIMATE

Observing Weather

Student Worksheet: *Collecting Weather Data*

Name: _____

WIND GROUP

Materials

- Anemometer
- This worksheet
- Clipboard
- Pencil

Measure

Go outdoors and follow the directions enclosed with the anemometer to measure wind speed and wind chill. Take three measurements of each and record your findings in the chart below.

	Trial 1	Trial 2	Trial 3	Average
Wind Speed				
Wind Chill				

Observe

1. Can you feel the wind?
2. Which direction is the wind coming from?
3. Wind can blow in different directions at different altitudes. If there are clouds today, which way are they moving? This indicates which direction the wind is blowing in that part of the atmosphere.
4. Describe your observations of today's wind conditions.

Share and Predict

Share your observations and average measurement with the rest of the class. Based on your class weather measurements and observations, what do you think tomorrow's weather will be?

CHANGING CLIMATE

Observing Weather

Student Worksheet: *Collecting Weather Data*

Name: _____

WATER GROUP

Materials

- Hygrometer
- Cloud identification sheet
- This worksheet
- Clipboard
- Pencil

Measure

Go outdoors and follow the directions enclosed with the hygrometer to measure relative humidity. Take three measurements and record your findings in the chart below.

	Trial 1	Trial 2	Trial 3	Average
Relative Humidity				

Observe

1. Look at the sky. Describe the cloud conditions (clear, partly cloudy, cloudy).
2. If there are clouds, use the cloud identification sheet to determine which types of clouds are visible. What kinds of clouds do you see?
3. Is precipitation falling? If so, what kind?

Share and Predict

Share your observations and average measurement with the rest of the class. Based on your class weather measurements and observations, what do you think tomorrow's weather will be?

CHANGING CLIMATE

Observing Weather



Student Worksheet: *Collecting Weather Data*

Name: _____

TEMPERATURE GROUP

Materials

- Thermometer
- This worksheet
- Clipboard
- Pencil

Measure

Go outdoors and follow the directions enclosed with the thermometer to measure temperature in degrees Celsius and degrees Fahrenheit. Take three measurements of each and record your findings in the chart below.

	Trial 1	Trial 2	Trial 3	Average
Temperature (Celsius)				
Temperature (Fahrenheit)				

Observe

1. Is there snow on the ground?
2. Describe the colors of any plants that you can see.
3. Can you feel the warmth of sunshine on your cheeks?
4. Can you see your breath?
5. What other indications of cold or warmth do you notice around you?

Share and Predict

Share your observations and average measurement with the rest of the class. Based on your class weather measurements and observations, what do you think tomorrow's weather will be?



CHANGING CLIMATE

Observing Weather

Student Worksheet: *Collecting Weather Data*

Name: _____

ATMOSPHERIC PRESSURE GROUP

Materials

- Barometer
- This worksheet
- Clipboard
- Pencil

Measure

Go outdoors and follow the directions enclosed with the barometer to measure atmospheric pressure. Take three measurements and record your findings in the chart below.

	Trial 1	Trial 2	Trial 3	Average
Atmospheric Pressure				

Observe

1. Study the sky. Describe the cloud conditions. If there are clouds, where in the sky are they located? Which direction are they moving?
2. Based on sky conditions, is there a high pressure system, or a low pressure system in your area?
3. Are any pressure fronts visible? If so, what kind?

Share and Predict

Share your observations and average measurement with the rest of the class. Based on your class weather measurements and observations, what do you think tomorrow's weather will be?

CHANGING CLIMATE

Observing Weather

Activity MS.1.5
ANSWER KEY



Student Worksheet: *Collecting Weather Data* **Answer key**

All answers will vary based upon today's weather, but should demonstrate an ability to accurately calculate averages and accurately measure and describe the weather parameter.

