WHAT IS WEATHER?

UNIT 2: Weather
Lesson 3 — Grades 4 -5
INSTRUCTIONS

Overview

In this lesson, students will investigate temperature changes for different materials, and create a model to demonstrate erosion.

NOTE: There are two parts to this lesson; one class period to learn about uneven heating of the earth, and another class period to learn about severe flooding. It is possible to do only one of the projects, though students will have a better understanding of the processes if both parts are completed.

Objectives

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

- describe how different types of surfaces absorb different amounts of energy; and
- demonstrate and explain changes that might occur on the landscape as the result of extreme weather.

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] 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).

[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).

[5] SD3.2 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 comparing heat absorption and loss by land and water.

[5] SG2.1 The student demonstrates an understanding of the bases of the advancement of scientific knowledge by reviewing and recording results of investigations into the natural world.

Alaska Cultural Standards

[A] Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community.
[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.
[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.

Bering Strait School District Scope & Sequence

4th Grade Sequence #8: Water cycle
5th Grade Sequence #7: Water cycle

Materials

Part 1

- 2 aluminum cans for each student or group + an additional set for your own demonstration
- Water
- 2 thermometers for each student or group + an additional one for your own demonstration
- Stopwatch for each student or group + an additional one for your own demonstration
- Dark soil or sand
- A light source with a 100 watt bulb or greater for each student or group + an additional one for your own demonstration (NOTE: do not use a fluorescent bulb for this activity)
- Student Worksheet "Uneven Heating of Earth's Surface"

Part 2

- Aluminum baking pan for each student or group + an additional one for your own demonstration
- A plastic bag for each student or group + an additional one for your own demonstration
- Plastic gloves for each student or group
- Soil
- Water
- Toothpicks
- Beaker for each student or group + an additional one for your own demonstration
- Student Worksheet "Modeling a Flood"

Additional Resources

Harcourt School Publishers Science IV: Ch. 9, Lessons 1, 2, 4
Harcourt School Publishers Science V: Ch. 11, Lessons 1, 2, 4

Activity Preparation

1. Read through the entire lesson, including the "Whole Picture" section for teacher background informatiom.
2. Gather all materials and make copies of student worksheets.
3. Practice conducting the experiments.

Whole Picture

What is Weather?

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. According to the elders and culture bearers interviewed by Ann Fienup-Riordan and Alice Rearden for their book *Ellavut: Our Yup'ik World and Weather,* 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. Depending on where a person lives, s/he may be more or less concerned about daily weather events. A person living in a warm climate, where temperature and weather vary little from day to day may not be as concerned about changes in the weather as a person who lives in a climate where weather can change drastically from day to day. In rural Alaska, where many people spend much of their time outdoors on the land, understanding what the weather conditions will be like throughout the day and in the days to come is a vital skill.

What Causes Weather?

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 heats, so too does the air above it. Warm air rises, and cool air sinks. Typically, 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 four layers: the troposphere, the stratosphere, the mesosphere, and the thermosphere. 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 becomes more dense and weighty. 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. This rising and sinking of air causes wind.

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.

Other, more constant winds, **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.

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.

Vocabulary

atmosphere	the blanket of air surrounding Earth
troposphere	the layer of air closest to Earth's surface
air pressure	the weight of the atmosphere pressing down on Earth
local winds	movements of air that result form local changes in temperature
prevailing winds	global winds that blow constantly from the same direction

Activity Procedure

Part1

1. Explain to students that like traditional practitioners, western scientists also have ways of observing and predicting the weather. One way is by monitoring air temperature and wind speeds. Explain that winds and air temperature vary because Earth's surface heats unevenly. Today, students will conduct their own investigation to learn about the uneven heating of Earth.
2. Assign students to partners or groups. Give each group the following materials:
    a. 2 aluminum cans
    b. 2 thermometers
    c. stopwatch
    d. A lamp with a 100 watt bulb or greater (do not use a fluorescent bulb)
    e. STUDENT WORKSHEET: Uneven Heating of Earth's Surface (one per student)
3. Ask one student from each group to bring a can and fill it ¾ full with water.
4. Ask another student from each group to bring a can and fill it ¾ full with soil.
5. Demonstrate how students will conduct the experiment:
    a. Place a thermometer in your own water and soil cans.
    b. Time 1 minute, using the stopwatch.
    c. Then, measure and record the temperatures of the two cans.
6. Allow students to continue independently. Assist where needed.

Part 2

1. Explain that severe weather can bring damage to people's property.
    a. It takes only 60 cm (2 feet) of moving floodwater to sweep away a car.
    b. Higher waters can move trees, bridges, even houses.
    c. In this activity, students will learn how heavy rain and flooding can damage the landscape.
2. Start by asking students the following questions (do not correct them if they are wrong; allow them to discover the correct answer as they move through the experiment.)
    a. What is severe weather?
    b. What kinds of damage can severe weather, like flooding, bring?
    c. What would happen to plants and animals during a flood?
3. Pass out the STUDENT WORKSHEET: "Modeling a Flood".
4. Assign students to partners or groups and distribute materials.
5. Assist students as needed as they model a flood.

Extension Activities

- For homework, have students talk to cultural knowledge bearers to learn about extreme weather events in their area. Instruct students to ask their parents, aunties, uncles, and grandparents about changes in local weather and weather patterns. These might include stories about extreme weather events, changes in how weather behaves, or ways to "read the weather."
- Give students a list of cloud types and ask them to investigate traditional knowledge about what those cloud types might indicate. Encourage students to learn local terminology regarding weather. Students should share their findings with the class on a specified day.

Answers "Uneven Heating of Earth's Surface"

1. Student answers will depend on the heat of the bulb and their precision in reading the thermometer. However, all students should have similar answers.
2. Students should notice that the soil heats more quickly than the water.
3. Students should notice that the soil cools more quickly than the water.

Answers "Modeling a Flood"

Student answers will vary. However, students should notice more erosion happening with the increase in water.

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.

Student Worksheet "Uneven Heating of Earth" Page 1

Name _____

Procedure

1. Make a prediction.

   Which do you think will heat up more quickly, soil or water? _____

   Which do you think will cool off more quickly, soil or water? _____

When you predict, you combine what you already know with what you expect to observe in the investigation. A prediction may turn out to be incorrect, but it can still guide your investigation. Even if the results show that your prediction was not correct, you have learned something new.

2. Fill one can with dark soil or sand.
3. Fill the second can with water.
4. Place a thermometer upright in each can.
5. Time 1 minute, using the stopwatch.
6. Measure and record the temperatures of the two cans. Remove the thermometers.
7. Place both cans under the light. Make sure that both cans get an equal amount of light.
8. Time 5 minutes on the stopwatch.
9. Measure and record the temperatures. Remove the thermometers.
10. Repeat steps 7–9 three times.
11. Turn off the lamp.
12. Time 5 minutes on the stopwatch.
13. Measure and record the temperatures. Remove the thermometers.
14. Repeat steps 12–13 two times.
15. In the space provided, describe how the soil and water heated differently.
16. In the space provided, describe how the soil and water cooled differently.
17. **Inquiry Skill** Scientists use what they observe to form a **hypothesis**. Use your observations from this investigation to hypothesize how the weather on earth would be different if Earth's surface were mostly land instead of mostly water.

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Student Worksheet "Uneven Heating of Earth" Page 2

Name _____

Contents	Lamp On Time (in minutes)					Lamp Off Time (in minutes)		
	0	5	10	15	20	5	10	15
Soil Temperature								
Water Temperature								

Describe how the soil and water heated differently: _____

_____

_____

_____

_____

_____

Describe how the soil and water cooled differently: _____

_____

_____

_____

_____

_____

Student Worksheet "Modeling a Flood"

Name _____

Procedure

1. Put on gloves and half-fill an aluminum baking pan with soil.
2. Make a path in the soil to form a "river channel" that runs through the center of the pan.
3. Build up some small hills around the river channel.
4. Press the soil into place.
5. Use a toothpick to poke several holes in the bottom of a plastic bag.
6. Measure 150 mL of water in a beaker.
7. One partner should hold the plastic bag over the pan while the other partner slowly pours the water into the bag.
8. Let the water drip over the pan to model a "rainy day."
9. Record what you observe.
10. Repeat steps 6–10 several times until the pan becomes ¾ full of water.
11. Answer the questions in the space provided.

Rainy Day	Observations
1	
2	
3	
4	

Explain what happened to the soil in the pan after the first "rainy day":_____

_____

_____

Student Worksheet "Modeling a Flood"

Name _____

Explain what happened to the soil in the pan after the last "rainy day": _____

_____

_____

Critical Thinking: What do you think causes floods? Think about the rivers in your area, too!

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