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# COASTAL EROSION

## TEACHER GUIDE

### Theme 2: Changing Landscapes

#### UNIT 6: Coastal Erosion

##### Middle School



### 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 coastal erosion and related landscape changes from Alaska Native cultural, physical and earth science perspectives. This supplemental unit addresses the place-based question: How is coastal erosion changing the landscape in our area and why are these changes important to our community?

The REACH Up Coastal Erosion unit consists of three activities. Each activity will require a 45-minute class period; discussion could easily be extended into multiple class periods. You may also want to repeat sections of an activity during subsequent class meetings, such as reviewing the Coastal Erosion video or having your students practice the vocabulary card games multiple times. If you are utilizing the entire Coastal Erosion unit, you should introduce the activities in the order they are presented. However, if time is short, any of the activities could be presented independently.

The accompanying student guide is intended for use with multiple groups of students and you should not allow students to write in them. You can either have students 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

Scientists and cultural knowledge bearers alike know that Earth's surface changes slowly over time and have different "stories" to explain how things came to be the way they are. One such story shared by cultural knowledge bearers in Alaska provides history for the rock outcroppings near Togiak. Elders explain that these rock outcroppings are people who were frozen in stone after experiencing some frightening ordeal; because of their history, they remain "animate and responsive to those who seek their help" (Fienup- Riordan and Rearden, 2012, p.48). Other stories about landforms feature Raven as the creator. Michael John, from Newtok, told how Raven created Nelson Island to save his daughter who was lost on an ice floe. "And they said Raven's daughter, when it was time, was fishing for tomcod along a small piece of ice that had stuck to the land. They told Raven that the ice detached and his daughter floated away ... He filled the bottom of his garment with land from the surrounding ground, and he splashed it along these evunret [piled ice]. And when he splashed it, this area here became land" (Fienup- Riordan and Rearden, 2012, p.46).

Scientists, too, have stories and explanations for how certain land features came to be; these typically rely on a deep understanding of geological forces, like weathering and erosion, which help shape the Earth slowly over time.

Weathering takes two forms: physical weathering and chemical weathering. Physical weathering causes rocks to fracture and crumble. In the Arctic, a common form of physical weathering is



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frost wedging. During the spring and summer, water drips into existing cracks; when winter comes, the water freezes and expands, and eventually cracks or breaks the stone. Other forms of physical weathering come from water (think of a beach or river bank slowly changing form over time), wind (imagine the changing shape of dunes), and plants (hearty shrubs and trees have been known to fracture nearby rocks over time). Chemical weathering, on the other hand, dissolves rock and soil. Chemical weathering can result in the creation of underground caves or the discoloration of rocks above ground.

Typically, weathering occurs in concert with erosion —the process by which Earth’s surface (soil and weathered rock particles) are moved from one place to another. Agents of erosion include gravity, wind, water, glaciers, and waves, which shape Earth’s surface. Erosion is a natural process that typically happens slowly, over thousands of years. In coastal areas, for example, the constant crashing of waves weathers large stones into small pebbles and fine sand, eventually shaping the land and beach. Inland, rivers and glaciers carve out valleys, and wind wears down mountains.

Recently, however, the rate of erosion in many parts of the Arctic has rapidly increased as a result of climate change. In Alaska, the impacts include infrastructure failure on such a grand scale that some villages must consider relocation. In other parts of the world, calamitous consequences of excessive erosion include: desertification, agricultural infertility, water contamination, land degradation, and ecological collapse.

One such village experiencing devastating erosion is Shishmaref — a coastal village on Sarichef Island in the Chuckchi Sea. In the past, sea ice and permafrost protected Shishmaref’s shores from major storms and heavy waves. Climate change, however, has had a drastic impact, causing sea ice and permafrost erosion. Ben Kokeok of Shishmaref weighs in on the changing ice conditions, “Usually we are butchering seals on the ice, but this year it is too rotten. Travel on the ice has changed, too. It is dangerous.” (Brubaker et. al. 2015). The loss of sea ice and permafrost has made the Shishmaref shoreline vulnerable to heavy, crashing waves, which erode the shoreline at such a rate that buildings have crashed into the sea and village residents are scrambling to find solutions. Other Bering Strait communities, such as St. Michael, Stebbins, Teller, Unalakleet and Golovin also face erosion and inundation concerns. Tom Punguk of Golovin explains, “In my own lifetime, I have seen the coast erode 30-50 feet. I remember the village had a street all the way down to the beach. Now the buildings want to collapse”(Brubaker et. al. 2015).

Many elders believe that the earth is changing following its people. “According to Paul Tunuchuk [from Chefornek], ‘Ella is worsening since we are no longer treating it with care and respect.’” Similarly, Paul Kiunya from Kipnuk, noted that his elders told him “if people get bad, the weather will get bad following its people” (Fienup-Riordan and Rearden, 2012, p. 316).

Similarly, scientists agree that climate change is the result of human activity. It is clear, they agree, that though weathering and erosion are both natural processes, the erosion we see in the near future will be much more dramatic, and will happen on a faster timescale, as a result of climate change.





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**Unit Vocabulary**

<b>Science Terms to Define</b>	
<b>erosion</b>	the removal of weathered materials from one location to another
<b>sea ice</b>	ice that forms when sea water freezes
<b>shore ice</b>	sea ice that is frozen to the shore
<b>permafrost</b>	soil that has remained frozen year-round for at least two years

<b>Terms for Incorporating Local Indigenous Language</b>				
<b>English</b>	<b>Iñupiaq</b>	<b>Yup'ik</b>	<b>Siberian Yupik</b>	<b>Local Translation</b>
ice	siku	ciku	siku	
sea ice	siku	imarpik ciku	qelughtaaq	
shore ice	sinaasiku	cena ciku	uughhun	
coast	tagium sinaa	cena	tapghaa	
storm	piqsiq	pircir	eslalluuk	
waves	qailiq	qaiq	nengulghat	

<sup>1</sup> 2012 Glencoe McGraw Hill Earth Science Textbook, Chapter 6, page 179.



### **Activity MS.6.1: 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 changes in sea ice in their region
- describe changes in coastlines in their region

#### **Alaska Standards**

##### **Alaska Science Standards / Grade Level Expectations**

[6-8] **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.

[6] **SA3.1** The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by 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).

[8]**SD1.2** The student demonstrates an understanding of geochemical cycles by applying knowledge of the water cycle to explain changes in the Earth's surface.

[7]**SD2.1** The student demonstrates an understanding of the forces that shape Earth by identifying strategies (e.g. reforestation, dikes, wind breaks, off road activity guidelines) for minimizing erosion.

[6]**SD2.3** The student demonstrates an understanding of the forces that shape Earth by describing how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches).

#### **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.





[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.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.

### **Bering Strait School District Scope & Sequence**

- 6.9G** Understand how ecosystems change over time. (SF)
- 7.3B** Understand that wind, water (in different states) and gravity change the surface of the earth. (SD1.2, SD2.3)
- 7.3C** Explain erosion and deposition.
- 7.3F** Use scientific processes and inquiry to directly support concepts of erosion and deposition. (SA1.1, 1.2, 2.1, 3.1)
- 7.9B** Apply knowledge of the water cycle to explain changes on the earth's surface. (SD1.2)

### **Materials**

- REACH Up *Coastal Erosion Middle School Student Guide*
- Student Worksheet: *Ask an Expert about Coastal Erosion*
- Internet access and projector

### **Activity Preparations**

1. Identify adults within your school who have lived year-round in the community for many years. This might include teachers, administrators, secretaries, teacher aides, lunchroom/kitchen staff, recess duties, maintenance and custodial staff, etc. Ask these local knowledge bearers if they would be willing to speak with a group of your students about how the nearby coastline is used by themselves or the community, as well as any changes they have noticed to the coast as a result of erosion. Make sure that the volunteers you have identified will be available 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 Coastal Erosion student guide and ask students to work with a partner to read pages 1-6.
2. Show the video, Coastal Erosion, available at [www.k12reach.org/videos.php](http://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 how the community uses the nearby coast (subsistence, shipping, economic, recreation, and transportation themes may arise). Explain that students will interview a few community members about this topic.
4. Separate students into small groups according to how many local knowledge bearers are available to share coastal erosion information with your class. Identify which 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 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 Coastal Erosion to each group and assign each group one local knowledge bearer to interview. Provide 15-20 minutes for students to locate and interview the knowledge bearer.
7. Reconvene in the classroom and ask groups to share their findings. How do the people in our community use local coastlines? How are the coastlines changing? How is the sea ice changing? What impacts might current or future changes have on local lifestyles?





# COASTAL EROSION STUDENT WORKSHEET

Theme 2: Changing Landscapes  
UNIT 6: Coastal Erosion  
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## Student Worksheet: Ask an Expert about Coastal Erosion

Names of Group Members \_\_\_\_\_

---

**Interview a long-term community member to learn more about coastal erosion and sea ice changes in your area. Take notes about what you learn.**

Who did you interview? \_\_\_\_\_

### Ask:

**How do people in our community make use of the nearby coastlines and beaches?**

**Are the coastline or beaches changing? If so, how?**

**How are current changes to coast and ice conditions impacting our community? If the coast and ice conditions have not changed, how might future coastal erosion or decreased ice impact our community?**



**COASTAL EROSION  
STUDENT WORKSHEET**

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**For Alaska Native Language Speakers**

**What language(s) do you speak?** \_\_\_\_\_

**What dialect(s)?** \_\_\_\_\_

**Could you please translate the following words?**

**Ice** \_\_\_\_\_

**Sea Ice** \_\_\_\_\_

**Shore Ice** \_\_\_\_\_

**Coast** \_\_\_\_\_

**Storm** \_\_\_\_\_

**Waves** \_\_\_\_\_





### **Activity MS.6.2: Coastal Erosion Vocabulary**

#### **What terminology do we need to know to discuss permafrost-related lake loss?**

#### **Overview**

In this activity, students will learn key coastal erosion 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 climate, landscape and ecosystems
- illustrate and define terms related to coastal erosion in their region

#### **Alaska Standards**

##### **Alaska Science Standards/Grade Level Expectations:**

[8]SD1.2 The student demonstrates an understanding of geochemical cycles by applying knowledge of the water cycle to explain changes in the Earth's surface.

[6]SD2.3 The student demonstrates an understanding of the forces that shape Earth by describing how the surface can change rapidly as a result of geological activities (i.e., earthquakes, tsunamis, volcanoes, floods, landslides, avalanches).

#### **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.





[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**

- 7.3B** Understand that wind, water (in different states) and gravity change the surface of the earth. (SD1.2, SD2.3)
- 7.3C** Explain erosion and deposition.
- 7.9B** Apply knowledge of the water cycle to explain changes on the earth's surface. (SD1.2)
- 7.9G** Understands how currents and waves have distinct characteristics and impacts. (SD1.2)

### **Materials**

- REACH Up *Coastal Erosion Middle School Student Guide*
- Vocabulary card sets (1 set per group of 4-6 students)
- Dry erase markers (1 per group)
- Student Information Sheet: *Word Games Instructions* (1 per group)
- Student Worksheet: *Coastal Erosion Vocabulary* (1 per student)
- Timers (optional)

### **Additional Resources**

2012 Glencoe / McGraw Hill Earth Science textbook, Chapter 14

### **Activity Preparations**

1. If your students completed Activity MS.6.1 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 Alaska Native language speakers, consult with a local knowledge bearer or language expert to determine which language/dialect translation provided on Page 6 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 Inupiaq	Bering Strait		Brevig Mission	
			Diomedede	Little Diomedede	
				Shishmaref	
			Wales (Kinikmiu)	Wales	
		Qawariaq	Teller	Teller	
				Unalakleet	
				Shaktoolik	
	Fish River		Golovin*		
			White Mountain		
		Northern Alaskan Iñupiaq	Malimiut		Koyuk
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. For example, "frozen ground" and "ground that is frozen" will both work when communicating about "permafrost". Also, some words do not have one-to-one translations. In Yup'ik, there is not necessarily a word for "erosion", but a speaker may describe the action of something eroding away; *ustuq* means "to erode". Another example is that many indigenous languages have multiple words for "storm". In Yup'ik, storm is *anuqa*, rain storm is *cellalliq*, and snow storm is *pircirtuq*. 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.

4. 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.
5. Make copies of the Word Games Instruction Sheet (one per group) and the Coastal Erosion Vocabulary worksheet (one per student).

### **Activity Procedure**

1. Distribute the *Coastal Erosion* Student Guide and review pages 1-6.
2. Show students the vocabulary cards. Hold up each card. Discuss what each card depicts. How do these terms relate to coastal erosion 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, dry erase marker, and a timer (optional).
6. Instruct students to label their cards with the local indigenous words. Groups can select one student from the group for this task, or take turns.
7. Direct students' attention to the Word Games Instruction sheet. Students can commit to one game for a period of time or mix and match.
8. Encourage students to play the vocabulary games and practice the vocabulary words during free time throughout the duration of the Coastal Erosion unit. If possible, schedule 10-15 minutes twice per week to practice the vocabulary terms.
9. Write the following terms on the board: erosion, sea ice, shore ice, and permafrost. Ask students to share definitions for terms. Refer back to the Coastal Erosion Student Guide as necessary.
10. Distribute the Coastal Erosion Vocabulary Worksheet and ask students to complete it.

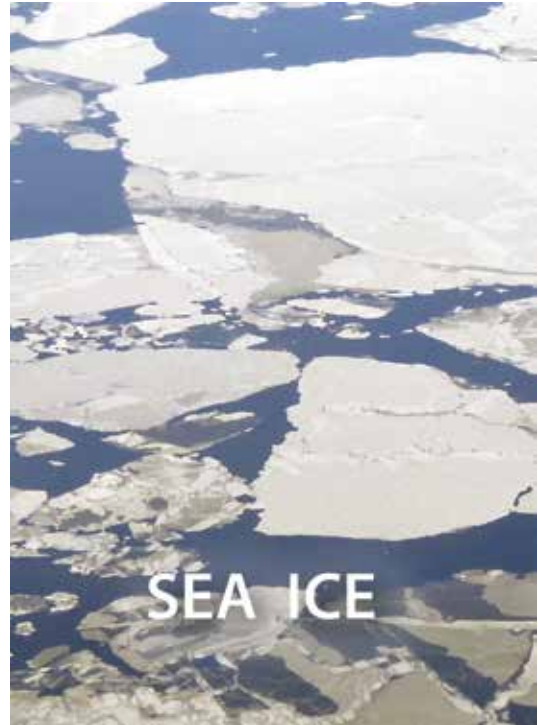
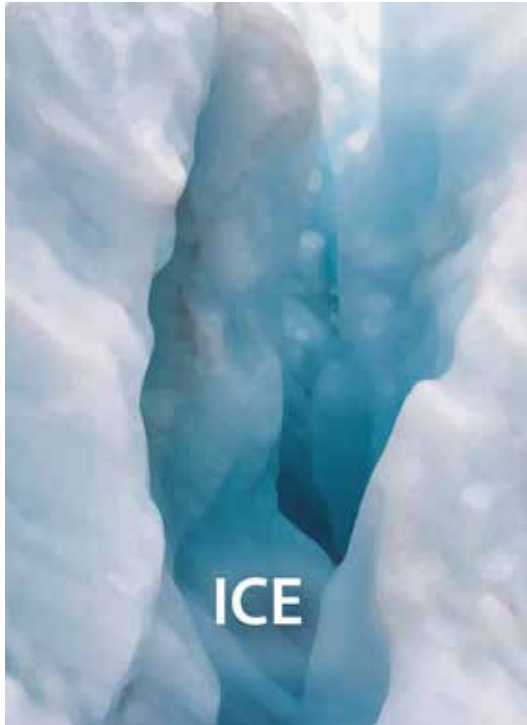


# COASTAL EROSION

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### Vocabulary Cards





**Vocabulary Cards**

\_\_\_\_\_

Local indigenous word

\_\_\_\_\_

Local indigenous word

\_\_\_\_\_

Local indigenous word

\_\_\_\_\_

Local indigenous word



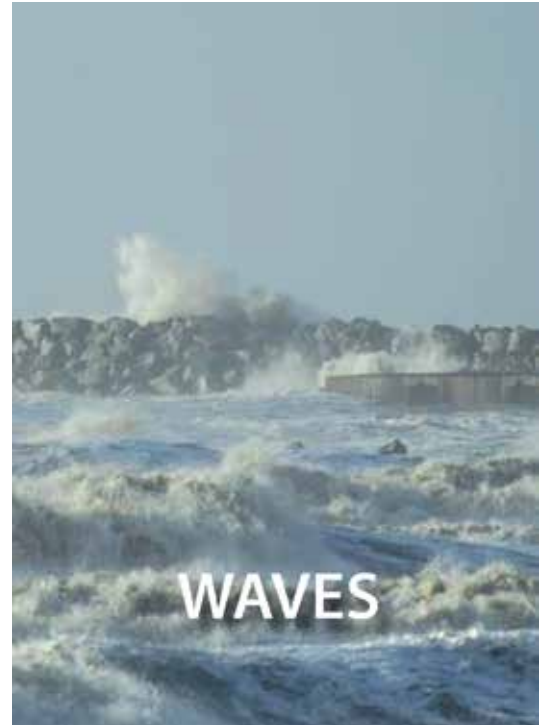
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### Vocabulary Cards



**COASTAL EROSION**  
**TEACHER GUIDE**



**Vocabulary Cards**

\_\_\_\_\_

Local indigenous word

\_\_\_\_\_

Local indigenous word



**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 term and English words 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 each correct Alaska Native Language word.
5. Repeat until all cards are gone. The team with the most points wins.



# COASTAL EROSION STUDENT WORKSHEET



## Student Worksheet: Coastal Erosion Vocabulary

Name \_\_\_\_\_

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

Erosion
Sea Ice
Shore Ice
Permafrost

Soil that has remained frozen year-round for at least two years
The movement of sand, soil and rock by forces of nature such as wind, water, ice and gravity.
Sea ice that is frozen to the shore.
Ice that forms when sea water freezes.

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

My Community: _____		
<i>English Word</i>	<i>Local Alaska Native Language Word</i>	<i>Illustration</i>
Ice		
Sea Ice		
Shore Ice		
Coast		
Storm		
Waves		



**Answer Key: Permafrost Thaw Vocabulary**

1)

<b>Erosion</b>		Soil that has remained frozen year-round for at least two years
<b>Sea Ice</b>		The movement of sand, soil and rock by forces of nature such as wind, water, ice and gravity.
<b>Shore Ice</b>		Sea ice that is frozen to the shore.
<b>Permafrost</b>		Ice that forms when sea water freezes.

2)

<b>My Community:</b> _____		
<b>English Word</b>	<b>Local Alaska Native Lanuage Word</b>	<b>Illustration</b>
<b>Ground</b>	Answers will vary depending on language and dialect spoken in this community	Sketch should illustrate word at left
<b>Ice</b>	Answers will vary depending on language and dialect spoken in this community	Sketch should illustrate word at left
<b>Lake</b>	Answers will vary depending on language and dialect spoken in this community	Sketch should illustrate word at left
<b>Permafrost</b>	Answers will vary depending on language and dialect spoken in this community	Sketch should illustrate word at left
<b>Coast</b>	Answers will vary depending on language and dialect spoken in this community	Sketch should illustrate word at left
<b>Storm</b>	Answers will vary depending on language and dialect spoken in this community	Sketch should illustrate word at left
<b>Waves</b>	Answers will vary depending on language and dialect spoken in this community	Sketch should illustrate word at left



### **Activity 6.3: Community Shorelines**

#### **Overview**

In this lesson, students will compare historic, current, and predicted shorelines for communities in their region to determine the rate of shoreline change in each community and the potential impacts of these changes.

#### **Objectives**

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

- measure distance using a map scale
- calculate the rate of shoreline change
- analyze and describe the risk coastal erosion poses to local structures based on historic and predicted shorelines for a community

#### **Next Generation Science Standards**

**Standards by Disciplinary Core Ideas:** Earth and Human Activity

**Standards by Topic:** Human Impacts

#### **Performance Expectations**

The activity is just one step toward reaching the performance expectations listed below:

MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

#### **Dimension:**

##### ***Science & Engineering Practices***

Analyzing and Interpreting Data

##### ***Disciplinary Core Ideas***

ESS3.B: Natural Hazards

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)

##### ***Crosscutting Concepts***

Patterns





### **Alaska Standards**

#### **Alaska Science Standards / Grade Level Expectations**

- [6-8] **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.
- [6] **SA1.2** The student demonstrates an understanding of the processes of science by collaborating to design and conduct simple repeatable investigations.
- [7] **SA1.2** The student demonstrates an understanding of the processes of science by 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** The student demonstrates an understanding of the processes of science by collaborating to design and conduct repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings.
- [6] **SA3.1** The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by 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).
- [7] **SD2.1** The student demonstrates an understanding of the forces that shape Earth by identifying strategies (e.g., reforestation, dikes, wind breaks, off road activity guidelines) for minimizing erosion.

### **Alaska Math Standards**

- 6.RP** Understand ratio concepts and use ratio reasoning to solve problems.
- 6.RP.2d** Use ratio reasoning to convert measurement units between given measurement systems (e.g. convert kilometers to miles); manipulate and transform units appropriately when multiplying and dividing quantities.

### **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:

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

### **Bering Strait School District Scope & Sequence**

- 6.9G** Understand how ecosystems change over time. (SF)





# COASTAL EROSION

## TEACHER GUIDE

## Theme 2: Changing Landscapes

### UNIT 6: Coastal Erosion

#### Middle School



- 7.1B Understand the scale, legend, symbols, and contour lines (show same elevation) of a topographic map. (SD 2.1)
- 7.3B Understand that wind, water (in different states) and gravity change the surface of the earth. (SD1.2, SD2.3)
- 7.9B Apply knowledge of the water cycle to explain changes on the earth's surface. (SD1.2)
- 7.3C Explain erosion and deposition.
- 7.3F Use scientific processes and inquiry to directly support concepts of erosion and deposition. (SA1.1, 1.2, 2.1, 3.1)

### Materials

- *Coastal Erosion* Middle School Student Guide
- Sample Map: Port Heiden
- Student Worksheet: *Community Shorelines*
- Document projector
- Metric rulers (one per student)

### Activity Preparations

1. Run through the sample questions on the Port Heiden Sample Map so that you are prepared to demonstrate and discuss these questions with students.
2. Prior to this lesson, review using a map scale to measure distance with students, as needed.

### Activity Procedure

1. Distribute the REACH Up Coastal Erosion middle school student guide. Review the information on pages 1-6. Then ask students to work with a partner to read page 7. Discuss the information on page 7 as a class.
2. Place the Sample Map: Port Heiden on the document projector. Direct student attention to the map key and discuss: What color represents the 1957 shoreline? What color represents the 2002 shoreline? What color represents where scientists expect the shoreline to be in 2035?
3. Direct student attention to the scale. How many meters are represented by each centimeter on this map? Place a ruler next to the scale to assist.
4. Demonstrate how to find the answer to each question on the Sample Map, then distribute the Student Worksheet: Community Coastlines and rulers to each student. Ask students to use the maps in their Coastal Erosion student guides and work in pairs to complete the worksheet.

# COASTAL EROSION

## TEACHER GUIDE

### Theme 2: Changing Landscapes

#### UNIT 6: Coastal Erosion

##### Middle School

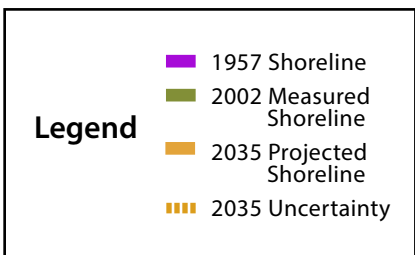
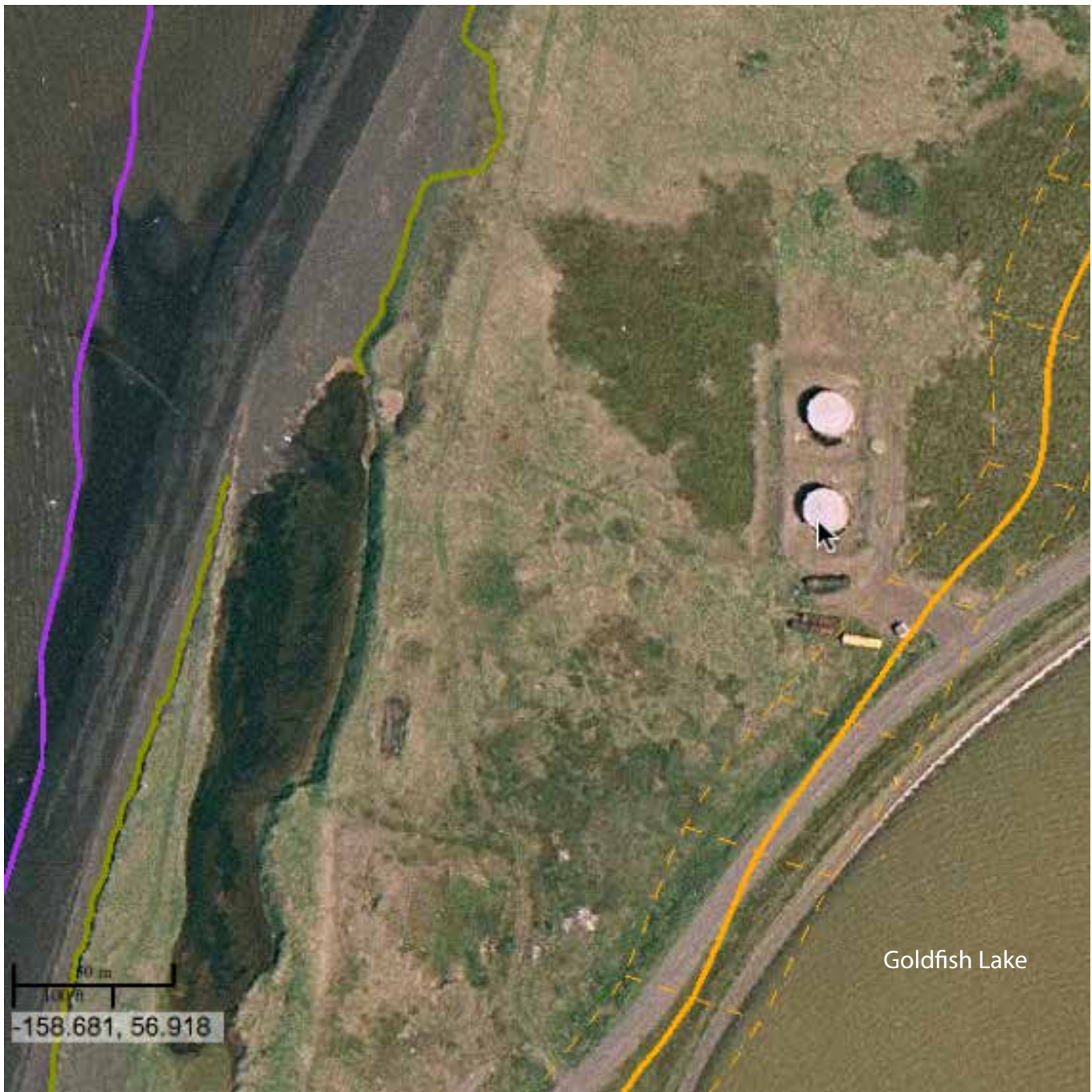


5. When students are finished with the worksheet, review the conclusion questions as a group. If your community is not one of the three provided, discuss how the shoreline in your community is changing. Are any of the structures in your community at risk from coastal erosion? If your community is on a river rather than the coast, discuss how riverbank erosion can similarly impact communities. drained lakebed older or younger than lakes with shallow water? *(Students can assume a drained lakebed is older than a lake that still has water. The shallow lake will likely drain too, but is not as far along as the dry bed.)*





Sample Map: Port Heiden





**Student Worksheet: Community Shorelines**

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

**Unalakleet:**

1. What is the average annual rate of shoreline change from 1951 – 2012?
2. Is the shoreline getting closer to the school, or farther away?
3. What will be the closest distance between the school and the projected shoreline in 2030?

**Wales:**

4. What is the closest distance from the water tank to the 2011 shoreline?
5. What is the annual rate of shoreline change from 1950 to 2011 near the water storage tanks?
6. Is the shoreline getting closer to town, or farther away?
7. Is the water storage tank in a safe place from coastal erosion? Why or why not?
8. How far will teacher housing be from the projected shoreline in 2035?

**Shishmaref:**

9. Is the shoreline getting close to the village, or farther away?
10. What is the closest distance from the school to the 2003 shoreline?
11. a. What is the annual rate of shoreline erosion from 1950 to 2003?  
b. Based on this rate, about how many more years will it be before the shoreline is at the edge of the school?  
c. Do you think the school is in a safe location from coastal erosion? Why or why not?



# COASTAL EROSION

## STUDENT WORKSHEET

Theme 2: Changing Landscapes  
UNIT 6: Coastal Erosion  
Middle School



### Conclusion:

12. Is the rate of shoreline change in all villages the same?
13. What village has the greatest rate of shoreline change?
14. Why is monitoring shoreline change important to Alaska's coastal villages?





**Answer Key: Community Shorelines**

NOTE: This answer key is a guide. Student answers may vary according to exactly where they measure on the map. Answers should be very close, however.

**Unalakleet**

1. What is the average annual rate of shoreline change from 1951 – 2012? *50 meters / 61 years = .82 meters per year*
2. Is the shoreline getting closer to the school, or farther away? *Farther*
3. What will be the closest distance between the school and the projected shoreline in 2030? *Approximately 60 meters*

**Wales**

4. What is the closest distance from the water tank to the 2011 shoreline? *Approximately 30 meters*
5. What is the annual rate of shoreline change from 1950 to 2011 near the water storage tanks? *20 meters / 61 years = .33 meters/years*
6. Is the shoreline getting closer to town, or farther away? *Farther*
7. Is the water storage tank in a safe place from coastal erosion? Yes Why or why not? *The shoreline is increasing in distance from the water tanks*
8. How far will teacher housing be from the projected shoreline in 2035? *Approximately 15 meters*

**Shismaref**

9. Is the shoreline getting close to the village, or farther away? *Closer*
10. What is the closest distance from the school to the 2003 shoreline? *50 meters*
11. a. Based on the rate of coastal erosion, about how many more years will it be before the shoreline is at the edge of the school? *50 meters / 1.3 meters per year = 38.4 years.*  
b. Do you think the school is in a safe location from coastal erosion? *No*  
c. Why or why not? *Since the shoreline is getting closer to the school it will eventually need to be moved.*

**Conclusion**

12. Is the rate of shoreline change in all villages the same? *No*
13. What village has the greatest rate of shoreline change? *Shishmaref*
14. Why is monitoring shoreline change important to Alaska's coastal villages? *In some villages the ocean is threatening to destroy homes and other buildings.*

