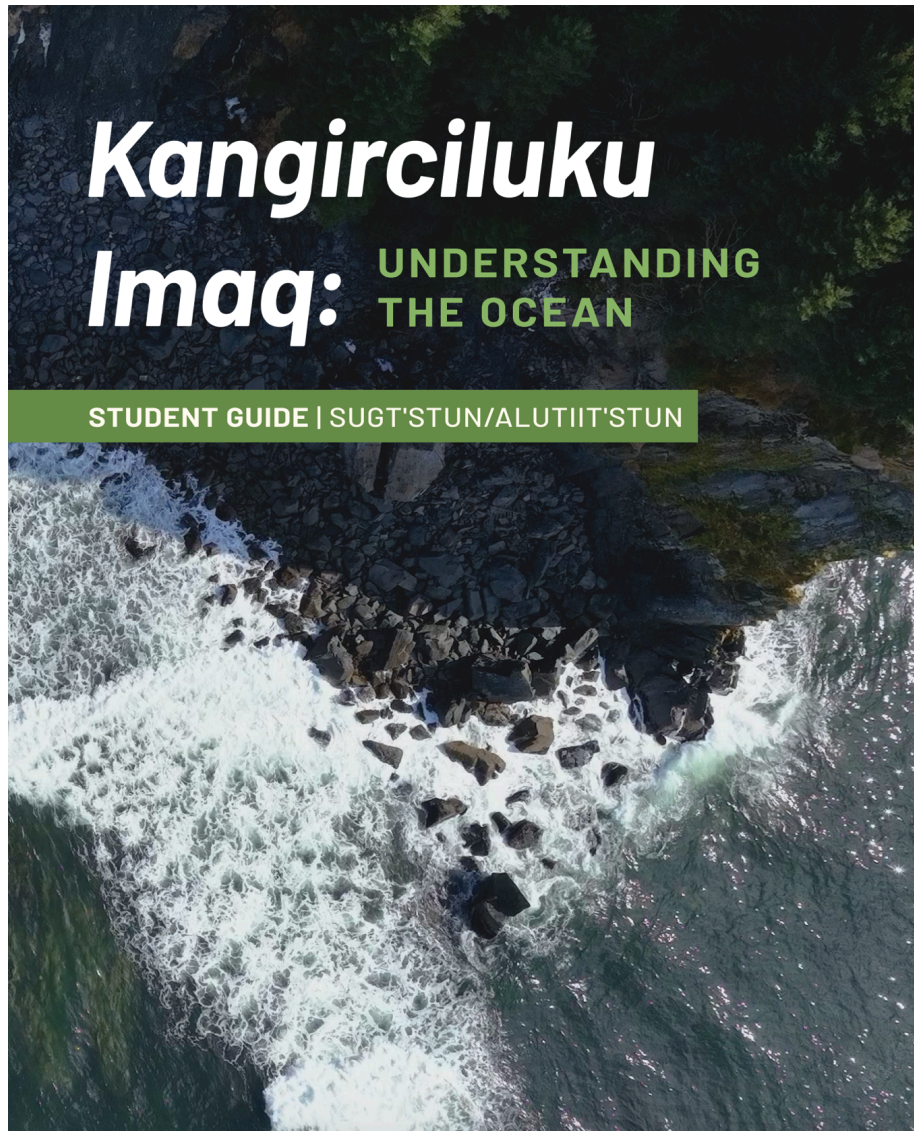


Kangirciluku Imaq: Understanding the Ocean Teacher's Manual for:



Quyanaa (thank you):

Special thanks to the Alutiiq Museum, Kodiak Archipelago Leadership Institute, and Kodiak Island Borough School District. Kodiak Sugpiaq/Alutiiq community members Dehrich Isuwiq Chya, Spiridon Gguitka Ash, Yvonne Mullan, Meagan Mickelson, and Teri Uutu Mahle guided content development for this publication. Quyanaa to this team and the many additional local knowledge bearers, educators and scientists who contributed their expertise, interviews, data and pictures to the project. The information provided in this publication is for educational purposes and not for commercial use.

Credits:

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Thanks also to the Teacher who pilot tested and advised revision of these materials:
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Cultural Connections to Alaska Science – Kangirciluku Imaq: Understanding the Ocean

Dear High School Teacher,

Thank you for using the Cultural Connections to Alaska Science activity kit in your classroom! The kit is designed to address Kodiak Sugpiaq/Alutiiq Values and Alaska Native Values for the Curriculum as well as Science Standards for Alaska, and Alaska Cultural Standards. Teaching this kit in full will provide 9-12th grade students with an understanding of cultural and operational perspectives on how tides and currents behave in the ocean, traditional practices of travel and subsistence, and navigational practices from experienced knowledge bearers. This Teacher's Manual includes key ocean and tide vocabulary in Koniag style of Alutiiq from the Kodiak Archipelago. Activity-based assessments are provided for your convenience. We recommend teaching the kit while there is no snow on the ground so that students will be able to participate in the field trip in Activity 3: Traditional Tidal Knowledge. We encourage you to work collaboratively with the bilingual educator in your school to teach these lessons, as all include Alaska Native language.

Established Goals:

- Students develop understanding of tide, currents, and how they are formed.
- Students will understand the impact of weather on ocean conditions.
- Students will measure wave height, frequency, and manipulate a tidal environment with a modeled ocean shore.
- Students hear traditional stories from around their community involving the tides.
- Students become knowledgeable about safety practices for ocean travel and navigation.

Targeted Frameworks, Values and Standards:

Kodiak Sugpiaq/Alutiiq Values:

- Ties to our Homeland “our lands”
- Stewardship of animals, land, sky & waters “taking care of our lands”
- A subsistence lifestyle respectful & sustained by the natural world “our way of being alive”
- Our heritage language “our ways of speaking like a Sugpiaq”
- Learning by doing, observing & listening “our way of learning”
- Traditional arts, skills, & ingenuity “our ways are wise”
- Faith and spiritual life from ancestral beliefs to the diverse faiths of today “we are prayerful”
- Humor “we like to laugh”
- Our people: we are responsible for each other & ourselves “our people (community)”
- Our Elders
- Our family and kinship of ancestors & living relatives “our family”
- Sharing: we welcome everyone “we favor sharing”
- Trust: “we trust”
- Respect for self, others, & the environment is inherent in all values “we respect them”

Alaska Native Values for the Curriculum:

1. Show Respect to Others - Each Person Has a Special Gift

2. Share what you have - Giving Makes You Richer
3. Know Who You Are - You Are a Reflection on Your Family
5. Have Patience - Some Things Cannot Be Rushed
8. Honor Your Elders - They Show You the Way in Life
10. See Connections - All Things Are Related

Science Standards for Alaska:

MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle.]

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.]

HS-ESS2-2. Analyze geoscience data to evaluate claims that one change to Earth's surface creates feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperature that melts glacial and sea ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as feedbacks due to the effects of permafrost thawing; how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge and decrease sediment transport, and how the loss of wetlands causes a decrease in local humidity that further reduces wetland extent.]

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals, wildlife, fish, trees, and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting, and soil erosion), and severe weather (such as hurricanes, floods, storm surge, lightning strike fires, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, changes in stream or ocean water temperatures and/or chemistry,

and the types of food that can be raised, hunted, fished, harvested, or gathered.]

HS-ESS3-3. Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.]

Cultural Standards for Alaska Students:

- A) Culturally-knowledgeable students are well grounded in the cultural heritage and traditions of their community. Students who meet this cultural standard are able to:
- 5: reflect through their own actions the critical role that the local heritage language plays in fostering a sense of who they are and how they understand the world around them; 6: live a life in accordance with the cultural values and traditions of the local community and integrate them into their everyday behavior
- 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:
- 1: acquire insights from other cultures without diminishing the integrity of their own; 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;
 - 4: identify appropriate forms of technology and anticipate the consequences of their use for improving the quality of life in the community
- 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:
- 1: acquire in-depth cultural knowledge through active participation and meaningful interaction with Elders;
 - 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;
 - 5: identify and utilize appropriate sources of cultural knowledge to find solutions to everyday problems
- 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:
- 2: understand the ecology and geography of the bioregion they inhabit;
 - 3: demonstrate an understanding of the relationship between world view and the way knowledge is formed and used.
 - 4: determine how ideas and concepts from one knowledge system relate to those derived from other knowledge systems;

Next Generation Science Standards:

MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle.]

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.]

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Activity 1: Kangirciluku Imaq Vocabulary

Overview:

In this activity, students will learn **imaq** (ocean) and tide terminology translated into the Alaska Native language and dialect of their region.

Time: 1 class period (45 minutes – 1 hour)

Materials:

- Vocabulary card set (1 per group)
- Timers (optional)
- Sugt'stun/Alutiit'stun pronunciation guide (available at:
 - <https://culturalconnections.gi.alaska.edu/vocab/ccas/understanding-the-ocean/index.html>
- iPads or computers
- Markers or colored pencils
- Scissors
- Instruction Sheet: Word Games (1 per group)
- Student Worksheet: Kangirciluku Imaq Vocabulary
- Kangirciluku Imaq Vocabulary Cards Template

Standards Addressed:

Alaska Native Values for Curriculum: See Connections, Know Who You Are

Kodiak Sugpiaq/Alutiiq Values: Our heritage language “our ways of speaking like a Sugpiaq”, Learning by doing, observing & listening “our way of learning”

Alaska Cultural Standards: A.5, B.2, E.2

Objectives:

The student will:

- recognize, read, and say Sugt'stun/Alutiiq vocabulary terms related to **imaq** and tides;
- use local Indigenous language words to describe the world around them;
- follow instructions to play vocabulary learning games;
- work cooperatively, responsibly and respectfully with peers when playing vocabulary games; and
- use a computer to achieve competency in pronouncing Alutiiq vocabulary terms.

Background Information:

Based on the Visual Inupiaq Vocabulary Acquisition (VIVA) Program of the North Slope Borough School District, these vocabulary cards have both the Alutiiq and English terms. The games suggested are meant to promote fluency through repeated practice. Other vocabulary cards can be easily integrated into the games. This will extend the 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 Alutiiq vocabulary. Sugt'stun/Alutiiq is the heritage language of the Sugpiaq/Alutiiq people.

Assessments:

Vocabulary fluency game observations and the student worksheet responses provide a means of assessing student ability to:

- use local heritage language to help them understand tide cycles and the **imaq**;

- make effective use of the knowledge, skills and ways of knowing embedded in the local heritage language to learn about the larger world in which they live by associating Alaska Native words with their English counterparts;
- hear, read and speak Sugt'stun/Alutiiq language terms and sentences;
- follow instructions;
- share and cooperate with peer group members.

Student use of online pronunciation guide provides a means of assessing student ability to:

- find and use information from media sources.

Student engagement with families provides a mean of assessing student ability to:

- apply their local heritage language in learning about the **imaq** and the tides in their communities.

Activity Preparation:

1. Pronunciation and spelling of Alaska Native terms can vary depending upon the dialect spoken within a community. Ask your local Alaska Native language teacher to check the vocabulary cards and multimedia to ensure they are accurate for your community. If possible, collaborate with the Alaska Native language teacher in your school to teach this activity.
2. Familiarize yourself with the Sugt'stun/Alutiiq vocabulary in the Kangirciluku Imaq: Understanding the Ocean Student Guide so that you can support student pronunciation. Visit the following site for an online pronunciation guide:
<https://sites.google.com/alaska.edu/ccas>

Activity Instructions:

1. Read pages 2 & 3 of the Kangirciluku Imaq: Understanding the Ocean Student Guide as a class. Ask students to share their own experiences of the **imaq** (ocean). Discuss the importance of the **imaq**, **tung'iq** (high tide), and **ken'aq** (low tide).
2. Ask students to try the online Alaska Native Vocabulary Pronunciation Guide at <https://culturalconnections.gi.alaska.edu/vocab/ccas/understanding-the-ocean/index.html> to learn how to pronounce Alaska Native words related to the **imaq**.
3. Show students the vocabulary cards templates. Hold up each card. Discuss what each card depicts.
4. Say the Alaska Native word shown on the card. Ask students to repeat the word. Repeat, then ask students to call out the word as you hold up each card.
5. Divide the class into groups of four.
6. Provide each group with a Vocabulary Card Template set and colored pencils. Ask students to cut the cards to separate them and then work as a group to illustrate the word on the back of each card.
7. After students have illustrated the cards, provide each group with a printout of the Word Games Instruction sheet, a stack of vocabulary cards, and a timer (optional).
8. Students can commit to one game for a period of time or mix and match.
9. Provide time for each group to play through the games.
10. Discuss as a class: Which games were hard to do with only a few Sugt'stun/Alutiiq words in your vocabulary? What games did you enjoy most? What words were difficult to guess, no matter what game you played?
11. Distribute the Student Worksheet: Kangirciluku Imaq Vocabulary and ask students to complete it. Please note: If the local dialect is different than that provided on the cards, please revise the worksheet answer key accordingly. Provide review as needed.

12. Ask students to share the words they learned with their families/parents, and find out if families have other ocean words to share.
13. Consider asking students to practice the vocabulary words or play a vocabulary game for 10-15 minutes each day while teaching the Kangirciluku Imaq: Understanding the Ocean unit.

Connections and Extensions:

- Ask students to create their own word games to help each other learn new Sugt'stun/Alutiiq words.
- Using whiteboards and markers, ask students to write a Sugt'stun/Alutiiq word on their slate after prompting with the word's associated image or English term. Have students show what they wrote to see who is retaining the vocabulary and who might need more practice.
- Create a Focus Wall in your classroom by printing the vocabulary terms and posting them on the wall, along with ocean images and other key concepts and ideas from the activity kit.
- Use Kahoot to help students learn and practice vocabulary words.

Answer Key:

1. Imaq □ ocean, qayaq □ kayak, ken'aq □ low tide, Qik'rtaq □ Kodiak island
2. Drawing should be of waves
3. The ending of the word change

Vocabulary List:

Sugt'stun/Alutiiq term or phrase (Koniag)	English term or phrase
Kangirciluku Imaq	Understanding the Ocean
imaq	ocean
Qik'rtaq	Kodiak Island
macaq	sun
iraluq	moon
tung'iq	high tide
ken'aq	low tide
carwaq	current
carwat	currents
aqlaq	wind
aqlat	winds
qangyuk	wave
lla	weather
qayaq	kayak

angyaq	open skin boat
kiakeq	North wind
waasarnaq	Northeast wind
ungaleq	East wind
kanakeq	Southeast wind
waakeq	South wind
waakelayak	Southwest wind
ikakeq	West wind
puyuleksek	Northwest wind
nasquluk	bull kelp

Kayanguq.	The wind is blowing hard.
Sapuraakut	We are weathered in.
Cestun lla et'a?	How is the weather?
Pinartuq.	It is calm out.
Parag'uutaq kangiyarmen iluwartuq.	The boat is going into the bay.
Quyanaa.	Thank you.

Kangirciluku Imaq Vocabulary Cards Template

imaq ocean	tung'iq high tide
qangyuk wave	ken'aq low tide
lla weather	carwaq current

Qik'rtaq Kodiak Island	qayaq kayak
angyaq open skin boat	aqllat winds

Instruction Sheet: Word Games

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 drawings.
2. Listen as your teacher says a Sugt'stun/Alutiiq 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 Alutiiq vocabulary words on a separate sheet of paper. The words can be found on 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 place the stack picture-side-up in the middle of the table.
3. Work with your team to write down the Sugt'stun/Alutiiq word for the card.
4. After both teams have written answers, turn the card over to check. Teams get 1 point for the correct Sugt'stun/Alutiiq word.
5. Repeat until all cards are gone. The team with the most points wins.

ACT IT OUT

1. Shuffle the vocabulary cards and deal them out to each player. Keep your cards a secret!
2. Take turns acting out your cards using motions and sound effects, but no words.
3. Whoever guesses the Sugt'stun/Alutiiq word first takes the card as a point.
4. The game is over after all cards have been acted out.
5. Optional: Add a timer to the mix! See if you can get your classmates to guess the word in 30 or 60 seconds.

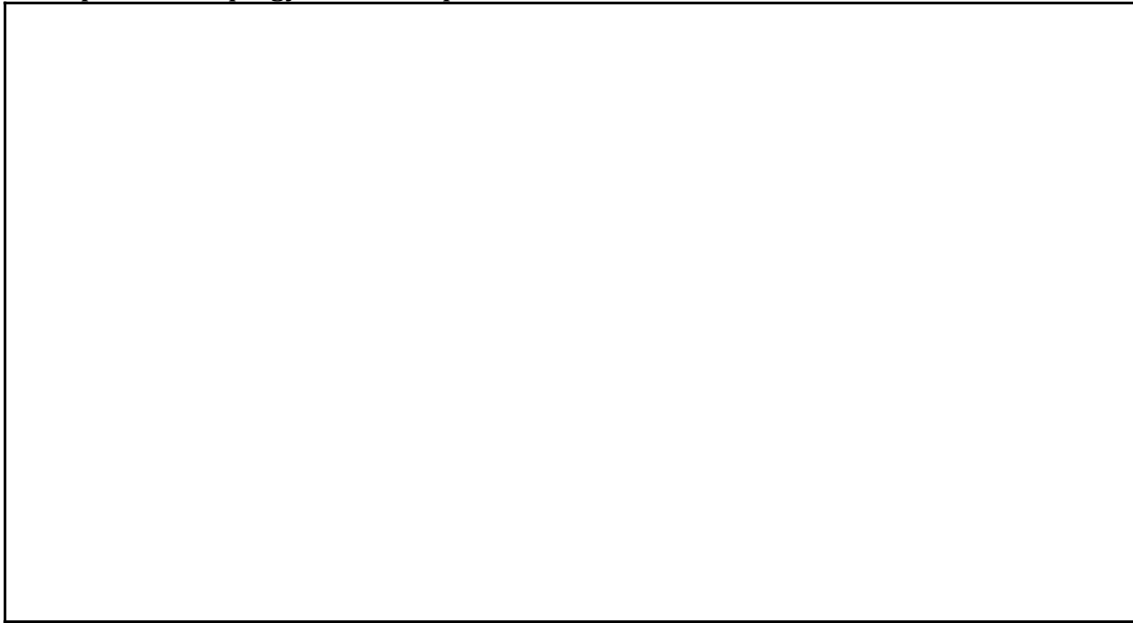
Student Worksheet: Kangirciluku Imaq Vocabulary

NAME _____

1. Draw a line to connect each Sugt'stun/Alutiiq word to the correct English word:

imaq	Kodiak Island
ken'aq	kayak
qayaq	low tide
Qik'rtaq	ocean

2. Draw a picture of qangyuk in the space below.



3. Study the words below. What part of the word changes to make the word plural?

carwaq = an ocean current (singular)

carwat = ocean currents (plural)

angyaq = open skin boat (singular)

angyat = open skin boats (plural)

Activity 2: Reading Qangyut

Overview:

In this activity, students will create a wave tank, manipulate the water and model how waves affect a shoreline.

Time: 2 class periods (90 min)

Materials:

- Plastic tub (29"x18")
- Acrylic sheet (4"x6")
- Water
- Sand & gravel
- Ruler
- Stopwatch
- Dry erase marker
- Pitcher or bucket
- Notebook & pencil
- Student Worksheet: Reading Qangyut
- Kangirciluku Imaq: Understanding the Ocean video available here:
 - <https://sites.google.com/alaska.edu/ccas>

Standards Addressed:

Alaska Native Values for Curriculum: Show Respect to Others, See Connections, Have Patience

Kodiak Sugpiaq/Alutiiq Values: *Nunapet* (Ties to our Homeland "our lands"), *Sugt'stun niuwacipet* (Our heritage language "our ways of speaking like a Sugpiaq"), *Liicirpet* (Learning by doing, observing, & listening "our way of learning"), *Ling'aklluki* (Respect for self, others, & the environment is inherent in all values)

Science Standards for Alaska (2019): MS-ESS2-4, HS-ESS1-4, HS-ESS2-2, HS-ESS2-5

Alaska Cultural Standards: A.5, B.2, B.4, E.2

Next Generation Science Standards: MS-ESS2-4, HS-ESS1-4, HS-ESS2-2, HS-ESS2-5

Lesson Objectives:

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

- use vocabulary terms appropriately;
- understand and measure wave height, and frequency of a wave;
- model and observe how tidal energy impacts sediment movement or changes in water;
- explain the effect of gravity's force on tides and differentiate between tides and currents;
- analyze data and explain results in repeated experiments;
- model how energy flow affects tidal behavior and its influence on Earth's systems;
- work with peers.

Background Information:

Tides are the periodic rising and falling of ocean waters caused by the gravitational forces of the sun and moon as well as Earth's rotation. Ocean waters on the side of Earth closest to the moon will experience a greater gravitational pull from the moon than waters on the opposite side of

Earth (tide generating forces vary inversely as the cube of the distance from the tide generating object). This causes a "bulge" in the waters closest to the moon, and creates a high tide. At the same time, forces on the opposite side of Earth cause a similar "bulge" creating another high tide. These movements create two high tides and two low tides each day in most coastal areas. The vertical motion of tides is accompanied by a horizontal movement of ocean waters called tidal currents. Oceanographers say that tides rise and fall, while tidal currents ebb during a falling tide and flood during a rising tide.

Local wind and weather patterns often affect tides. Strong offshore wind can move water away from coastlines, exaggerating low tide exposures. Onshore wind may act to pile up water onto the shoreline, virtually eliminating low tide exposures. High-pressure systems can depress sea levels, leading to clear sunny days with exceptionally low tides. Conversely, low-pressure systems that contribute to cloudy, rainy conditions typically are associated with tides that are much higher than predicted.

Ocean waves are surface movements of water primarily caused by wind blowing across the sea's surface. The energy transferred from the wind creates oscillations that propagate through the water. Wave height refers to the vertical distance between a wave's crest (the highest point) and its trough (the lowest point). Wave frequency measures how many wave crests pass a fixed point per unit of time, often expressed in waves per second. Together, wave height and frequency are key indicators of a wave's energy and impact, affecting everything from coastal erosion to ocean navigation.

Assessment:

Classroom discussion provides a means of assessing student ability to:

- explain what a tide is and what a current is;
- listen respectfully and follow directions from instructor;
- discuss ways of knowing from cultural traditions to learn about the larger world;
- engage in a collaborative discussion while reading an informational text;
- discuss the gravitational force from the earth and moon on movement of water.

Wave tank modeling provides a means of assessing student ability to:

- comprehend the relationship between changes to ocean waves and beach erosion;
- illustrate transfer of energy from motion of waves to a stationary object;
- mimic ocean environment by simulating wave motion through model;
- investigate the movement of simulated ocean waves to understand how water's properties influence Earth's surface processes.

Student worksheet responses provide a means of assessing student ability to:

- explain energy flow and sediment transport by tides;
- demonstrate an understanding of motions, forces, their characteristics, relationships, and effects by describing the characteristics of a wave (i.e., wave height and frequency);
- hypothesize what impacts tidal erosion has on coast lines and the people who reside there;
- collect data and calculate frequency of waves;
- analyze data in relation to waves and effects on Earth's surface.

Activity Preparation:

1. Pronunciation and spelling of Alaska Native terms can vary depending upon the dialect

spoken within a community. If possible, collaborate with the Alaska Native language teacher in your school to teach this activity.

2. Make copies of the Student Worksheet: Reading Qangyut for the class.
3. Set up a model tank using the information on the Student Worksheet.

Activity Instructions:

1. Distribute student guides. Read pages 4-9 as a class. Watch the Kangirciluku Imaq: Understanding the Ocean video as a class. Ask students to think about the video, what they learned from the student guide, and their own experiences. Discuss:
 - a. What have you learned about the **imaq** (ocean)?
 - b. Why is it important to pay attention to the tides and **carwat** (currents)?
 - c. What tips have you learned about boating and **imaq** travel? How are **qangyut** (waves) and tides related?
 - d. What causes tides?
 - e. What does wave energy have to do with tidal motion?
2. Break the class into groups of 4-5. Distribute Student Worksheet: "Reading Qangyut." Review the background information and the process for conducting this investigation.
3. Quickly walk through the instructions the students will follow to create their own wave tank in their groups.
 - a. Use a clear plastic container that is long and shallow. Ensure it is clean and watertight. Place the tank on a flat, stable surface, such as a table or countertop, to prevent spills or uneven waves.
 - b. On one end of the tank, create a sloping sandy shore by piling sand into a wedge shape. The highest point of the slope should be above the waterline when the tank is filled. Use your hand or a small flat object to smooth the slope for uniformity.
 - c. Carefully pour water into the other side of the tank, away from the sand, to avoid disturbing your shoreline. Fill the tank until the water level covers about three quarters of the sand slope's height.
 - d. Hold the plastic card vertically near the water's surface at the side opposite the sandy shore. Push the card gently forward to create small waves. Experiment with speed and angle to observe different wave patterns.
4. Ask students to work through the worksheet in their groups. NOTE: this may take more than one class period depending on length of class meetings. After all groups are finished with their experiments and have completed the worksheet, call everyone back together to share.
5. As a class, compare the results each group found and discuss: How did one wave tank compare to other groups? What relationships were noticed between wave height and frequency? How did more frequent waves transfer energy to the beach?

Connections & Extensions:

- Explore QUIKSCAT data, showing current satellite-derived ocean surface winds. QUIKSCAT images are derived from an instrument called a scatterometer, mounted on polar orbiting satellites that calculate wind speed and directions based on ocean surface roughness algorithms. You can use an archived image such as follows: https://alaskawaters.org/wp-content/uploads/2023/04/72marchived_image.jpg. Do the winds from the QuikScat image match well with the ocean currents the students sketched in their science notebooks? If so, why? If not, why not?
- In assembling the beach shore portion of the wave tank, experiment with different "beach materials" (e.g., small pebbles or gravel) and observe how they respond to wave action.

- Discuss the impact of climate change on tidal patterns and coastal ecosystems.
- Ask students to navigate to <https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=9457261&legacy=1> or pull up on smartboard in classroom. Note the tidal charts and graphs. Explore the date feature on the second half of the page. Ask students to explore the date feature on the Tides & Currents webpage. Explore how changing the range of dates and time of day impacts the tides and currents.

Student Worksheet: Reading Qangyut

NAMES _____

Materials:

- Plastic Tub
- Acrylic Sheet
- Aquarium Sand/Gravel
- Ruler
- Stopwatch
- Water
- Dry Erase Markers

Instructions:

1. Use a clear plastic container that is long and shallow. Ensure it is clean and watertight. Place the tank on a flat, stable surface, such as a table or countertop, to prevent spills or uneven waves.
2. On one end of the tank, create a sloping sandy shore by piling sand into a wedge shape. The highest point of the slope should be above the waterline when the tank is filled. Use your hand or a small flat object to smooth the slope for uniformity.
3. Carefully pour water into the other side of the tank, away from the sand, to avoid disturbing your shoreline. Fill the tank until the water level covers about three-quarters of the sand slope's height.
4. Draw a picture below of the original shoreline created. In the image describe the shape and slope of the sandy shore before creating waves. You will use this drawing later on in the worksheet to answer question 13.



5. Hold the plastic card vertically near the water's surface at the side opposite the sandy shore. Push the card gently forward to create small waves. Experiment with speed and angle to observe different wave patterns.
6. Practice being consistent with the waves. Try to generate waves of similar size for accurate measurements in the questions below.

7. Place the ruler vertically into the water near the center of the tank, where waves are most consistent. Observe the highest point (peak) of each wave relative to the water's calm level. Use the dry erase marker to create a mark on the side of the plastic tank for recording measurements.
8. Record the height of five consecutive waves in centimeters.

Wave Number	Height (cm)

a. **Average Wave Height:** _____ cm

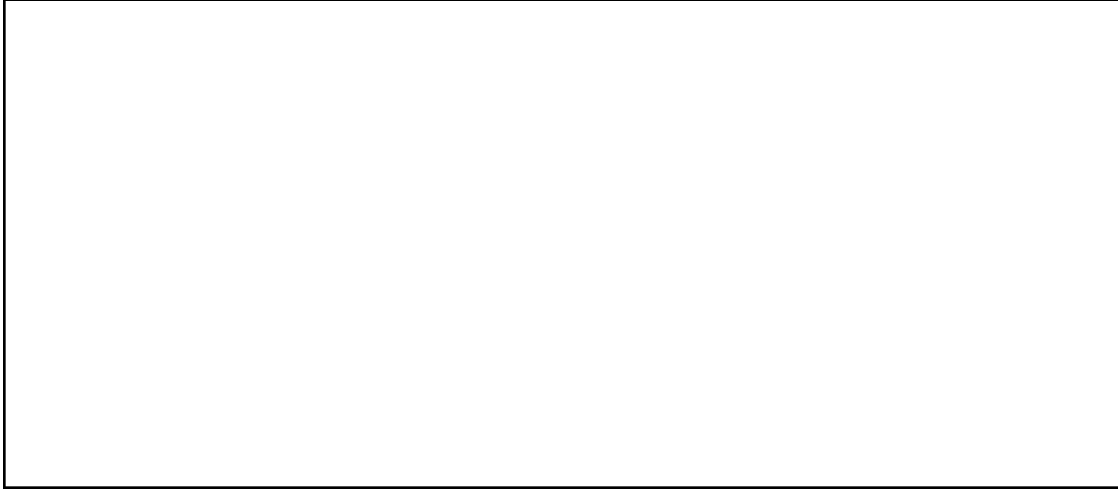
9. Use a stopwatch or timer to measure how many waves pass a fixed point in 10 seconds.
10. Choose a point on the side of the tank and make a small mark with the dry erase marker. Count how many wave peaks pass this point in 10 seconds.
11. Perform three trials, then calculate the average wave frequency (waves per second).

Trial Number	Waves in 10 sec	Frequency (waves/second)

a. **Average Frequency:** _____ waves/second

12. Set the stopwatch for 2 minutes. Begin creating continuous waves for the 2 min. Watch how the waves interact with the sand. Record any movement, erosion, or changes to the slope. How did the waves affect the shore? Did the sand move?

13. Set the timer for another 3 min. Create continuous waves for the 3 min. Draw of the shoreline as it is now.



- a. Compare the changes to the current shore with the sketch of the initial shore.

Conclusion:

14. How do you think the wave height and frequency would change if you moved the plastic card faster?

15. What patterns did you notice in how the waves eroded or deposited sand?

16. How might these observations apply to real-world coastal environments?

Activity 3: Traditional Tidal Knowledge

Overview:

In this activity, students will visit a local beach to record observations of a tidal environment, speak to an Elder/Knowledge Bearer from the community about local stories/experiences concerning ocean navigation and the tides and investigate what resources are harvested from the beach in the area at various levels of tide.

Time: 2 class periods (1 class period + outdoor field trip)

Materials:

- Stopwatch
- Measuring tape
- Notebook & Pencil
- **Kangirciluku Imaq: Understanding the Ocean** video available here:
<https://sites.google.com/alaska.edu/ccas>

Standards Addressed:

Alaska Native Values for Curriculum: Show Respect to Others, See Connections, Have Patience

Kodiak Sugpiaq/Alutiiq Values:

Nunapet (Ties to our Homeland “our lands”), *Unguwacirpet* (A subsistence lifestyle respectful & sustained by the natural world “our way of being alive”), *Sugt’stun niuwacipet* (Our heritage language “our ways of speaking like a Sugpiaq”), *Ling’aklluki* (Respect for self, others, & the environment is inherent in all values), *Cuqllipet* (“Our Elders”)

Science Standards for Alaska (2019): HS-ESS2-2, HS-ESS3-1, HS-ESS3-3

Next Generation Science Standards: HS-ESS2-2, HS-ESS3-1, HS-ESS3-3

Alaska Cultural Standards: A.3, A.4, A.5, B.2, D.1, D.3, E.2,

Objectives:

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

- use vocabulary terms appropriately;
- read and speak Alaska Native terms related to tides, ocean, and subsistence;
- explore the relationship between tides, moon phases, and natural rhythms using Indigenous knowledge and scientific principles;
- listen to traditional stories told by local knowledge bearers;
- compare and contrast modern and traditional tools of navigation;
- understand the cultural significance of tides for Sugpiaq/Alutiiq people;
- observe tidal zones and identify the ecological and cultural importance of marine resources;
- discuss sustainable practices and Indigenous stewardship principles related to tidal ecosystems;
- work closely with peers.

Background Information:

The Kodiak Archipelago is located in the Gulf of Alaska. Sugpiaq/Alutiiq people have inhabited the group of islands for over 7,500 years. The coastline of the largest island, **Qik’rtaq** (Kodiak) was scoured by glaciers thousands of years ago into many fjord-like bays. Skilled Sugpiaq/Alutiiq seafarers have fished, hunted and traveled the **imaq** (ocean) since time immemorial. Long before boats had motors, they traveled long distances to trade and socialize with mainland

neighbors.

The **imaq** continues to be integral to life for the people of **Qik'rtaq**. Households rely on the **imaq** for food, income, travel and transporting supplies. Some hunt marine mammals such as sea lions, otters and porpoises for subsistence purposes. Many people fish for crab, cod, and salmon both commercially and to feed their families and communities. There is a deep and spiritual connection to the **imaq** in this place. Knowledge of tides is important for knowing when to travel, where and when to gather foods, potential hazards associated with tides, and finally, knowing when the local conditions are out of the ordinary.

Predicting tides has always been important to people who look to the sea for navigation, subsistence and livelihood. The Sugpiaq/Alutiiq people have long been coastal people who traditionally harvested much of their food from the **imaq**. New generations learn from old how to recognize and make use of the bounty of the **imaq**. Additionally, commercial and subsistence fishers use their knowledge of the tides and **carwat** (currents) to help them improve their catches.

Sugpiaq/Alutiiq people hold extensive traditional knowledge of the **imaq** (ocean). This knowledge informs when and where to travel as well as how to travel across the water. Historically, Sugpiaq/Alutiiq people crafted swift, seaworthy boats from wood and animal skins. Sugpiaq/Alutiiq **qayat** were long and slender, built for flexibility in the rough, windy waters of the Pacific Ocean. The impact of waves on watercraft and the need for speed when hunting influenced **qayaq** design.

Up to 32 feet long, **angyat** had sturdy driftwood frames covered with sea mammal skins sewn with special leak-proof stitches. They were expertly designed for navigating **Qik'rtaq**'s rough waters and landing in the surf. People used **angyat** for travel and trade. Villagers used to **angyat** to transport bird-hunting crews to the Alaska Peninsula in summer, and carry goods to **Qik'rtaq** in the fall. The boat carried between twenty and thirty people, as well as their gear.

Assessments:

Field trip discussion provides a means of assessing student ability to:

- differentiate between and explain tides and currents;
- listen respectfully to Elder and follow directions from instructor;
- engage in a collaborative discussion with peers;
- reflect on stewardship practices of the region as a group;
- understand the importance of safety for themselves and others during ocean navigation.

Beach exploration provides a means of assessing student ability to:

- observe ocean behavior in comparison with classroom model;
- draw comparisons between previous modeling experiences and real world environments;
- collect data of ocean waves and calculate wave frequency;
- infer connections between coastal processes, human impact, and feedback mechanisms at.
- connect to surrounding landscapes through storytelling.

Student worksheet provides a means of assessing student ability to:

- compare traditional ecological knowledge to western science concepts of ocean and tides;
- analyze geoscience data to identify and explain feedback loops within Earth's systems;
- connect the traditional stories about ocean travel to modern uses.

Activity Preparation:

1. Pronunciation and spelling of Alaska Native terms can vary depending upon the dialect spoken within a community. If possible, collaborate with the Alaska Native language teacher in your school to teach this activity.
2. The activity below involves a field trip to a local beach location. Plan ahead for arranging bus transportation, parental permission and appropriate outdoor gear. Research the area and choose a local beach with clear tidal zones and diverse marine life. Examples for Kodiak include Fossil Beach or White Sands Beach. Check the tide tables for your region and plan to arrive at the beach during a low tide.
3. Arrange to pick up a few marine plant and animal identification books from the local library or school to bring along for students to ID species.

Activity Instructions:

1. **Day 1:** Invite a local Elder/Knowledge Bearer to visit a community beach with your class. Brainstorm questions ahead of your visit with the Elder/Knowledge Bearer related to traditional stories about the ocean, subsistence and resources i.e. How do the tides impact when we can harvest? What type of resources do you harvest based on the tide level? Does this vary by season? What resources are harvested on the beach or out in the water? etc.
2. Ask students to work in pairs to read pages 12-17 of the student guide. Review the relationship between the moon, Earth, and sun in creating tidal patterns. Show to the class the portion of the Kangirciluku Imaq video that highlights subsistence (starting at 7:22). Reflect on what themes arose in the interviews from the videos. Ask: Did students hear similarities between conversations with different knowledge bearers? Have they heard any of the information from the video shared personally from family or friends? What else have they learned from local Elders and knowledge bearers about ocean subsistence?
3. Teach students how to read a tide chart and predict when the lowest and highest tides will occur during the trip. As a class, review the weekly tide chart for Kodiak Island located at <https://tides.net/alaska/1399/>.
4. **Day 2:** Ask students to gather their notebooks, a writing implement and outdoor gear and prepare for their trip to the beach. Travel to the beach location most convenient for the class. Upon arrival, open the visit with a land acknowledgment to honor Indigenous ties to the land and water. Before allowing groups to go explore, gather to welcome the Elder/Knowledge Bearer and allow them the space to share about the **imaq** (ocean). Leave this fairly open and unstructured for whatever may arise (i.e. storytelling, personal anecdotes, history, plant ID). Prompt students to practice respectful listening and when it is a suitable time be open to asking some of the questions the class prepared.
5. Divide students into groups, each led by a teacher or knowledge bearer. Pass out student worksheets, one for each student within their groups, and one stopwatch per group. Ask the class to focus their attention on exploring tidal zones (high, mid, and low), identify marine plants and animals, observing water movement and sharing/discussing with the visiting Elder(s).
6. Before students are released to explore, ask students to take time to notice what organisms appear and what they do. Use prompt questions inspired from the worksheet such as: Can you spot any of the resources people in your community harvest? Consider what tide level the **imaq** is at and what organisms may be exposed or covered due to high/low tide. In notebooks or on worksheet, jot down a few ideas of subsistence

- practices at both high and low tides and how they differ. How do you know?
7. Give student groups 30-45 min to explore the beach and fill out the worksheet. Make sure adult chaperones keep eyes on all student groups during this exploration activity. Give students a 10 min warning before the class is called back together to share what they have observed.
 8. Regroup with the visiting Elder or Knowledge Bearer and ask groups to share what has been observed or written down. Discuss sustainable harvesting practices and the concept of reciprocity. Relate any observations students made of the beach or the ocean to traditional uses (e.g., harvesting kelp, clams, or mussels). Leave time for the Elder to reflect on what has been shared by the students and any remaining questions.
 9. Thank the Elder for their time and sharing their knowledge and experiences. NOTE: Option to return back to the school and complete the remaining discussion there or remain on the beach to discuss.
 10. Discuss: What did you learn about the **imaq** from your visit with the Elder/Knowledge Bearer? Has the tidal subsistence or the relationship with the **imaq** changed for Sugpiaq/Alutiiq people over time? How?
 11. On the back of the worksheets, ask students to reflect on what knowledge was shared within the group and data that was gathered by creating a dual-perspective tide journal. Have students draw a line down the page splitting it into two columns that reflect on the following questions:
 - a. How can traditional Sugpiaq/Alutiiq understanding of the ocean and subsistence contribute to Western science? (qualitative oral records of resource availability and how that has changed, stories of past weather and extreme tidal events, local systems-based understanding of how changes in one area/species/weather/event impact others)
 - b. How can traditional Western science support or contribute to Sugpiaq/Alutiiq subsistence and understanding of the ocean? (tide tables, weather and current modeling, etc)
 12. Discuss as a class.

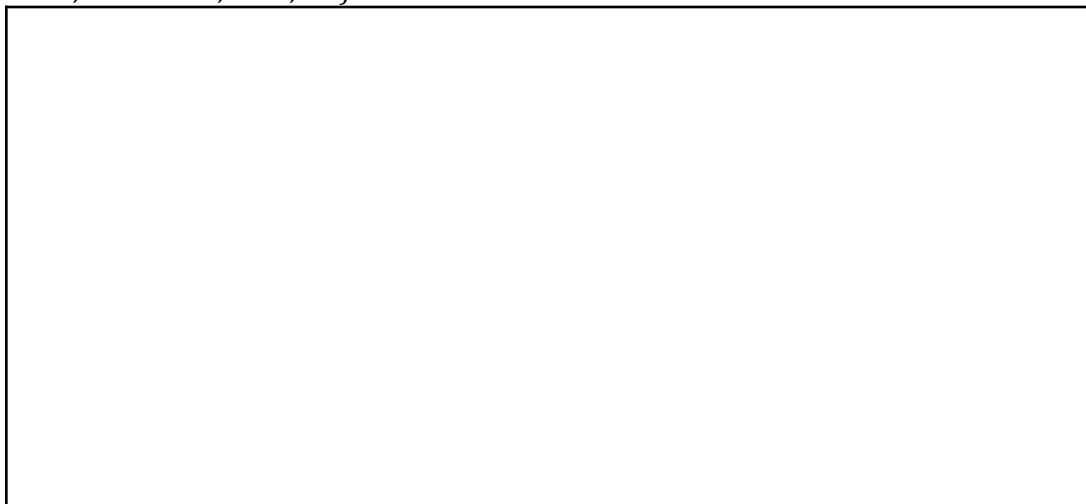
Connections & Extensions:

- Research and construct a model **qayaq** using traditional knowledge from the area. Reference pages 13-15 in the student guide as a refresher on **qayat** and **angyat**. Follow the link below to Chugachmiut's Traditional Transportation: Building a Model Qayaq lesson plan:
https://chugachheritageak.org/pdf/TT_6-121-2_Building_a_Model_Qayaq.pdf
- Engage in a citizen science project by researching and participating in a local intertidal monitoring project.
- Develop a proposal to protect a tidal ecosystem on Kodiak Island.

Student Worksheet: Traditional Tidal Knowledge

NAMES _____

1. In the box below, draw a picture of the physical features of the beach (etc. sand, rocks, driftwood, cliffs, etc)



2. How does the **lla** (weather) affect the beach today? (e.g., wind, temperature, cloud cover)
3. Circle what tide level the ocean was at during your visit (Low/Mid/High). What time was this at? _____
4. What organisms (plants, animals, etc.) did you notice on and around the beach? _____

Include a few sketches below:



5. Observe the high water mark. Circle: Is the tide is **coming in** or **going out**? Pick a point on the shore and using your stopwatch, measure the frequency of **qangyut** (waves) over 1 minute. _____ waves/min
6. Where do the **qangyut** seem to break on the beach? Is it horizontal, steep, or very steep?

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