# Sea Ice Investigators



Sea ice covers the ocean for much of the year in the north and it is an integral part of Inuit culture and daily life. There are dynamic floe edges, which open and close at the whim of the winds and tides, and ridges forced up by immense pressure. The ability to correctly identify different types of sea ice and the skills required to safely navigate across them are traditionally passed down orally by elders. More recently, scientists and Inuit have collaborated to develop a catalogue of sea ice terms. In this lesson, students will become investigators and collaboratively piece together clue cards to learn about different types of sea ice and habitats.

## **FLOW**

- Pre-discussion questions
- Browse interactive sea ice profiles
- 3. Introduce and play Sea Ice Investigation game
- 4. Review answers to the game
- Post-discussion questions

90 minutes

### **LEARNING OUTCOMES**

- Students will be able to identify and describe, using both words and pictures, many different types of sea ice.
- Students will work collaboratively to solve problems.
- Students will understand sea ice from both traditional knowledge and scientific perspectives.

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## STUDENT OVERVIEW

## WHY?

Sea ice surrounds northern communities for much of the year and being able identify its type is a first step towards being able to safely hunt, fish and enjoy land-use activities.

## WHAT?

- Features of many different types of sea ice.
- The names of different types of sea ice in Inuktitut dialects and English.
- Safety precautions.

## HOW?



Review what you already know about sea ice



Explore a presentation that shows many different types of sea ice



As a team, piece together clues to solve questions about sea ice



Talk about your findings



**IMAGE 1** A Snowy owl perches atop piled up sea ice forming Ivuniit ( $\triangle > \sigma^b$ ) / Ivunik / Ridges

## BACKGROUND

The following is a modified passage from Siku Atlas 1.

Sea ice is an integral part of life for Inuit in northern communities. Even though lifestyles have changed a lot over the past 50 years, Inuit families still rely on sea ice to facilitate travel and enable acces to food resources, as well as for recreation. Livelihood, health and cultural values are also tied to sea ice. From fall freeze-up to spring melt, sea ice is dynamic, providing afe passage on solid land-fast ice as well as dangerous obstacles near the floe edge. The different types of sea ice influence patterns of land and ocean use for both people and animals.

Much of the detailed Inuit knowledge about sea ice is not written down. It has been passed down orally over generations through the long term use of sea ice and experience in this environment. Inuit have their own science or classification system for telling apart different kinds of ice that is critical to safety, observing changes, catching animals, etc. Today, elders and hunters recognize that youth are not traveling on the land or ice as much as they used to. Young Inuit are busy attending school, and are involved in many other aspects of community life. This doesn't mean that youth do not use the ice. However, it does mean that when they do travel on the ice, they may be less experienced, travel faster with snowmobiles, and rely more on technology for navigation.

While language is strong in some areas, the terminology used about the land, like sea ice terminology, is most at risk of being lost because it isn't used as much as it used to be. The ability to understand this terminology



**IMAGE 2** A hunter uses a harpoon to check for dangerous ice conditions such as apputainaq  $\checkmark$   $\sim$   $\triangle \circ$  where snow falls or has been blown onto open water, near polynyas or at the floe edge, which is deceptive because there is no ice underneath. (P. Kattuk et al. 2)



## **VOCABULARY**

Qinu (Pa) / Frazil Ice: slushy ice in the water, often from snow falling in the water, ice is soft and of slushy consistency.

Sikuaq ( 'd ') / Young Ice: first thin and continuous layer of ice, formed when it is calm and cold weather, but can break up easily.

Tuvaq / Fast Ice / Tuva (⊃<): ice that snow has accumulated on top of, is good for travel - not dangerous anymore. Also called Landfast ice.

Kanijjuk (bσ゚∀゚) / Qanguti: frost crystals forming on thin ice (sikuliak) that is new/fresh and which doesn't have snow on top of it already.

**Qavvaq / Multi-year Ice:** old ice, which has survived at least two summers' melt and is often over 3 metres thick.

**Ivuniit** ( $\Delta \mathcal{P} \sigma^b$ ) / **Ivunik** / **Ridges:** where the ice picks up, along the floe edge or along the shore.

**Ikirasaq / Saqvaq (\DeltaPS\56) / Polynya:** An area of open water surrounded by sea ice that remains open all winter due to strong currents, but can freeze over at times.

## Tukilik (⊃P⊂<sup>b</sup>) / Tidal crack:

forms in tuvaq, often happens at points of land, it can open with warmer weather or high tides, and then refreezes after opening, a good place for hunting (where you look for seal holes), these used to occur in expected locations every year, but now they are not always in the same place, more cracks in new areas.

Sinaaq (''a sb) / Aulaniq ( \Cos sb) / Floe edge: the edge of the ice. Both terms refer to the general area of the floe edge with sinaaq specifically referring to the edge of the land fast ice (tuvaq) and aulaniq referring to the moving ice in the open water at the ice edge.



IMAGE 3 Sinaaq / Aulaniq / Floe edge (J.Heath)

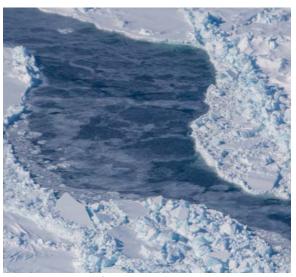


IMAGE 4 Sikuaq / Young ice. (J.Heath)



IMAGE 5 Tukilik (⊃P⊂b) / Tidal crack (J.Heath)

## **PREPARATION**



IMAGE 6 (J.Heath)

## **MATERIALS**

- Scissors or paper trimmer
- Clue cards (from Teacher Guide)
- Laminator (optional)

## **SETUP**

For each group of 4 students:

- 1. Cut out 1 set of Clue Cards (pg. 9) or have students do this.
- 2. Cards should be laminated if you want to keep them for multiple classes/years.

### **RESOURCES**

## Extra Clue Cards

The teacher booklet contains 1 set of clue cards that accommodates 4 students. These extra clue cards can be printed for larger groups. Cards should be laminated if you want to keep them for multiple classes/years.

https://arcticeider.com/links/sii2

## Sea Ice Terminology Video

A short video showcasing many different types of sea ice. https://arcticeider.com/links/sii4

## SIKU Interactive Presentation

An interactive presentation which provides information and examples about many different types of sea ice. This is used in Part I - Hook. Requires a free SIKU account. https://arcticeider.com/links/sii5

## SIKU Offline Presentation

This powerpoint presentation can be used in place of the interactive presentation where internet connectivity is limited.

https://arcticeider.com/links/sii6

## PROCEDURE

## PART I - HOOK

- 1. Brainstorm answers to Pre-discussion Questions (pg. 7) as a class. For question 1, have students come up with and write their answers on the board all at once or hand out sticky notes and have students write their answers individually before sticking them on them board.
- 2. Explore the SIKU Interactive Presentation (pg. 5) on the SmartBoard.
- 3. Read Background (pg. 3) together.

## PART II - COLLABORATIVE GAME

- 4. Explain that students will now become investigators to uncover the secrets of sea ice. However, they will need the expertise of each other to solve the challenge.
- 5. Split up the class into groups of 4 (groups of 2, 3 or 5 will work, but with uneven distribution of clue cards).
- 6. As a class, review the Rules (pg. 7) for the collaborative game.
  - A Hand out materials
  - B Each person in the group receives all the clue cards of a single suit (Ice, Walrus, Eider, Hunter)
  - © Explain how students must piece together 2 or 3 individual clue cards and one photo card to collectively answer all the questions correctly.
  - All clues must be used.
- 7. Groups complete game.
- 8. Review the Answer Key (pg. 15) as a class.
- 9. Complete the Post-discussion Questions (pg. 18) as a class.



## PRE-DISCUSSION QUESTIONS

- What are some things you know about sea ice? How is it different than freshwater ice? How cold does it need to be to form?
  - It contains varying concentrations of salt
  - Saltwater in Hudson Bay freezes around -1.5°C (depending on how much salt is in the water the freezing temperature varies)
  - It takes longer to freeze than freshwater ice
  - It is more flexible than freshwater ice
- 2. Name or describe as many different types of sea ice as you can.

Encourage students to describe ice they have seen or heard about even if they don't know what it is called.

- 3. In what ways do people in your community use sea ice?
  - Hunting
  - Travel
  - Camping
  - Cultural values

## **RULES**

### **SETUP**

- Divide up into groups of four according to your teacher's directions.
- Your group will receive one set of Clue Cards (pg. 9).
- 3. Organize the clues by suit (Ice, Walrus, Hunter, Eider) and distribute one suit to each member of your group.

### **HOW TO PLAY**

- The goal of the game is to collectively answer 8 questions by piecing together the information contained on 29 clues (including 8 photo cards).
- Together as a group, read through the Game Questions (pg. 8).
- Take turns reading your clues aloud to the group.
- Only the holder of each clue may read it aloud to the rest of group.
- In the space provided on the question sheet, answer the questions and note which clues helped you reach your answer.
- You are finished when all questions have been answered and all clues have been used.



# GAME QUESTIONS

A	What is the Inuktitut term for the early stage of ice formation?
	Answer:
	Clue numbers:
B	What are the English and Inuktitut words for a type of sea ice that is almost salt free?
	Answer:
	Clue numbers:
G	What causes polynyas to form? Where are they often found and what are they called in Inuktitut?
	Answer:
	Clue numbers:
D	Sinaaq forms at the intersection of what two things?
	Answer:
	Clue numbers:
E	What is the Inuktitut word for new, thin, continuous ice that breaks up easily?
	Answer:
	Clue numbers:
F	What two forces of nature cause ivuniit?
	Answer:
	Clue numbers:
G	What is the common Inuktitut term for a tidal crack?
	Answer:
	Clue numbers:
H	What are "frost flowers" called in Inuktitut?
	Answer:
	Clue numbers:









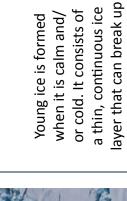








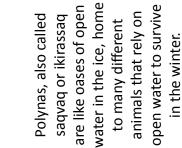




easily.



**1** 



pushed out. The longer it is frozen the less salt

salt molecules are

there is and ice that has been frozen for

When sea ice freezes,

more than one winter

is nearly salt free.



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formed from brine Frost flowers are

(landfast ice), opens

with warm weather or high tides and

refreezes after opening.

Tukiliit (or nagguti),

forms in tuvad

extraction.

































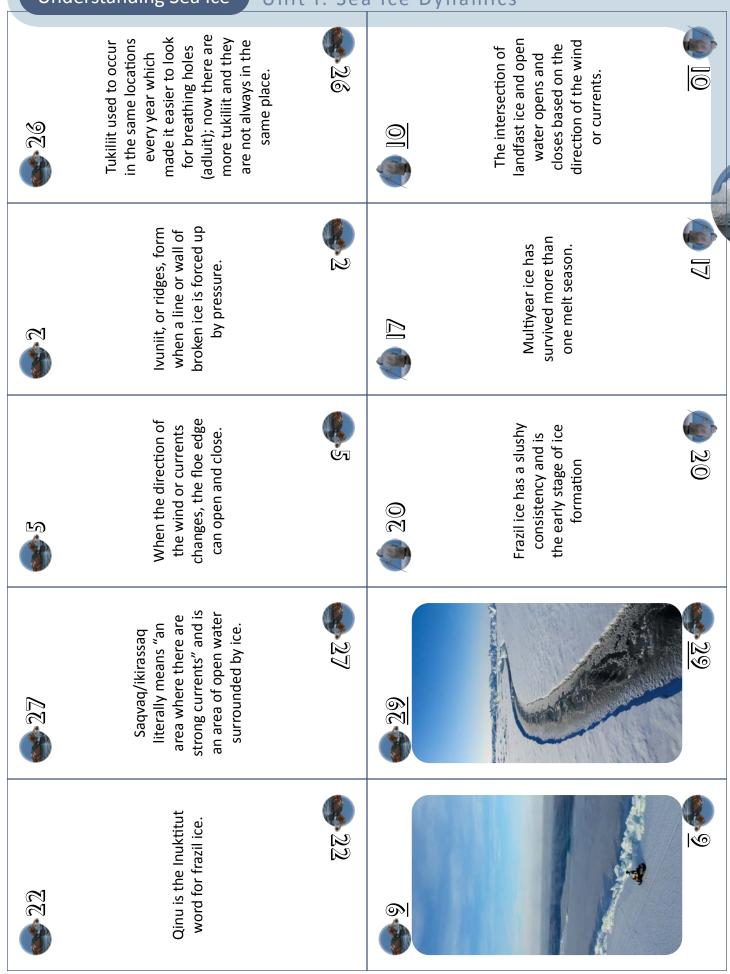






















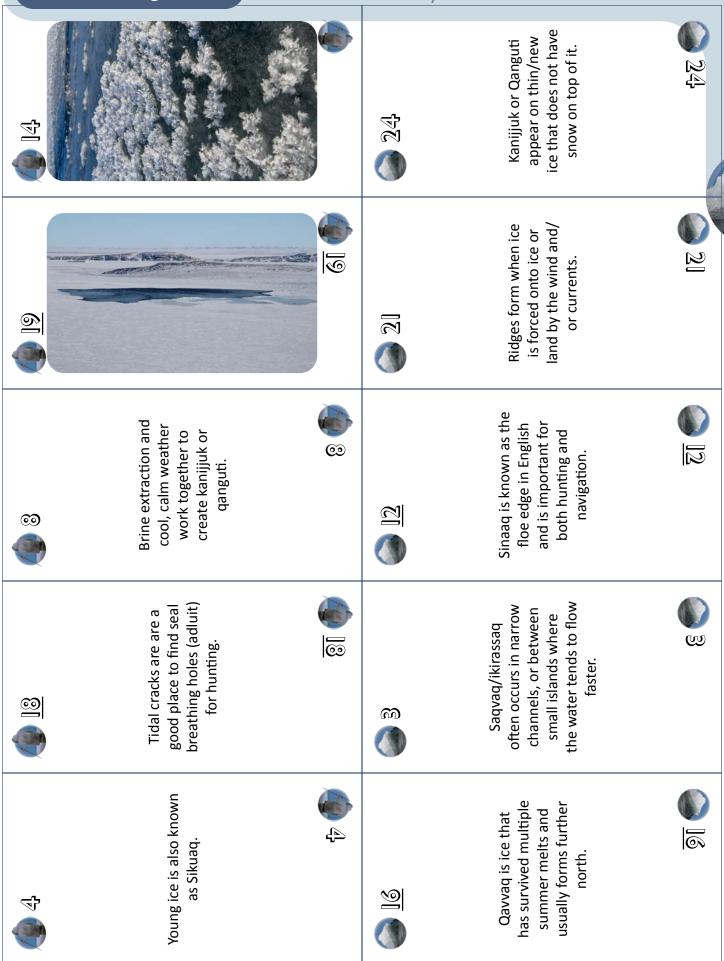


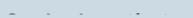
































## ANSWER KEY

What is the Inuktitut term for the early stage of ice formation?

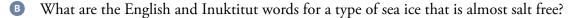


#### Answer:

Qinu

## Clues:

- 20. Frazil ice has a slushy consistency and is the early stage of ice formation
- 22. Qinu is the Inuktitut word for frazil ice.
- 28. Qinu/Frazil ice photo





**Answer**: *Multiyear ice and Qavvaq* 

### Clues:

- 1. When sea ice freezes, salt molecules are pushed out. The longer it is frozen the less salt there is and ice that has been frozen for more than one winter is nearly salt free.
- 16. Qavvaq is ice that has survived multiple summer melts and usually forms further north.
- 17. Multiyear ice has survived more than one melt season.
- 25. Multiyear/Qavvaq photo

## What causes polynyas to form? Where are they often found and what are they called in Inuktitut?



### Answer:

Polynya are caused by strong currents, occur in narrow channels or between small islands and are called saqvaq or ikirassaq in inuktitut.

## Clues:

- 3. Saqvaqlikirassaq often occurs in narrow channels, or between small islands where the water tends to flow faster.
- 7. Polynas, also called saqvaq or ikirassaq are like oases of open water in the ice, home to many different animals that rely on open water to survive in the
- 25. Polynya/saqvaq/ikirassaq photo



- 27. Saqvaq/ikirassaq literally means "an area where there are strong currents" and is an area of open water surrounded by ice.
- D Sinaaq forms at the intersection of what two things?



### Answer:

Landfast ice and open water

### Clues:

- 5. When the direction of the wind or currents changes, the floe edge can open and close.
- 9. Floe edge/Sinaag photo
- 10. The intersection of landfast ice and open water opens and closes based on the direction of the wind or currents.
- 12. Sinaaq is known as the floe edge in English and is important for both hunting and navigation.
- (E) What is the Inuktitut word for new, thin and continuous ice that breaks up easily?



### Answer:

Sikuaq

## Clues:

- 4. Young ice is also known as Sikuaq.
- 6. Young ice/Sikuaq photo
- 15. Young ice is formed when it is calm and/or cold. It consists of a thin, continuous ice layer that can break up easily.
- What two forces of nature cause ivuniit?



### Answer:

Wind and currents

## Clues:

- 2. Ivuniit, or ridges, form when a line or wall of broken ice is forced up by pressure.
- 13. Ivuniit/Ridges photo
- 21. Ridges form when ice is forced onto ice or land by the wind and/or currents.

What is the common Inuktitut term for a tidal crack?



**Answer**: Tukiliit/nagguti

### Clues:

- 18. Tidal cracks are are a good place to find seal breathing holes (adluit) for
- 23. Tukiliit (or nagguti), forms in tuvaq (landfast ice), opens with warm weather or high tides and refreezes after opening.
- 26. Tukiliit used to occur in the same locations every year which made it easier to look for breathing holes (adluit); now there are more tukiliit and they are not always in the same place.
- 29. Tidal crack/Tukiliit/Nagguti photo
- What are "frost flowers" called in Inuktitut?



**Answer**: *Kanijjuk/Qanguti* 

### Clues:

- 8. Brine extraction and cool, calm weather work together to create kanijjuk or qanguti.
- 11. Frost flowers are formed from brine extraction.
- 14. Frost flowers/Kanijjuk/Qanguti photo
- 24. Kanijjuk or Qanguti appear on thin/new ice that does not have snow on top of it.



## POST-DISCUSSION QUESTIONS

- 1. What are some factors that you should consider in order to travel on the ice safely?
  - Tides during full and new moons, the tides are higher and currents are stronger which means travel on sea ice is more risky.
  - Geography narrow openings between land often create faster currents which lead to more dangerous ice conditions. Areas close to freshwater streams and rivers may also melt sooner than other areas.
  - Winds the strength and direction of the wind can cause ice to break off from the floe edge or polynya, which can leave people stranded.
  - Temperature the temperature can have a great influence on ice conditions.
  - Bring a harpoon to test ice before you walk on it.
  - Talk to elders and hunters who have been out before and follow well known travel routes.
  - Visually inspect the ice for qualities such as color, reflectivity and texture.
- 2. Why are polynyas and floe edges important hunting grounds in the winter?

They provide open water habitat for animals that need to breathe, like seals, whales and ducks. Because these animals congregate at polynyas and floe edges, they are good spots for hunters to catch the animals.

3. Do you think people your age know more or less about sea ice than your parents and elders did when they were your age? Why?

Many parents and grandparents grew up on the land and were exposed to sea ice at a very young age. It was critical that they observed how their parents checked the ice in order to stay safe. People now live in houses in towns and it is not necessary to travel onto the sea ice to survive. Students also spend more time at school land less time on the ice.



**IMAGE 7** Sikuliaq / Nilas is a thin elastic crust of ice, easily bending on waves and swelling and under pressure, thrusting in a pattern of interlocking "fingers." (J.Heath)

## LINKS

## Siku Atlas Sea Ice Terminology

A collection of some of the most common Inuktitut sea ice terms that tend to be shared or understood in a number of Baffin Island communities with only minor spelling or dialectical differences. Also included is English terminology from the World Meteorological Organization. https://arcticeider.com/links/sii1

## **MANICE**

Scientific sea ice definitions as used by the authoritative document from Environment and Climate Change Change Canada for observing all forms of ice: Sea Ice, Lake and River Ice, and Ice of Land Origin.

https://arcticeider.com/links/sii3

## **EXTENSIONS**

## **SEA ICE ICONS**

Using what students have learned about ice types from the game, have students design or draw an icon for a type of ice. The icon should:

- Not contain text
- Should visually represent the concept.
- Should include a brief description explaining why the the symbol represents the concept
- Be drawn on paper or designed on a computer.

Using a large map of the community and surrounding area, have students post their icons onto the areas where they know certain ice conditions occur or where they think they might occur based on what they now know about the ice type.

### INVITE AN ELDER INTO YOUR CLASS

If community resources are available, invite a local knowledge holder to visit the class to discuss the specific ice conditions discussed in the lesson and to give feedback on students' icons:

- Where are they found in the local area?
- How do conditions change in various locations over the seasons?
- How have the ice conditions changed over time?



## SOURCES

- Siku Atlas. (n.d.). Retrieved August 19, 2016, from http://sikuatlas.ca/sea\_ice\_terminology. html.
- 2 Kattuk, P., Iqaluq, J., Novalinga, C., Iqaluk, J., Arragutainaq, L., Ippak, L., & Ippak, P. (2017). Sanikiluaq siku terminology workshop (Rep.) (J. Cookie, Trans.). Sanikiluaq, NU.

Cover photo and clue card photos by J.Heath

Clue card text modified from Siku Atlas and Voices from the Bay. See full citations below.

McDonald, M. A., Arragutainaq, L., & Novalinga, Z. (1997). Voices from the Bay: Traditional ecological knowledge of Inuit and Cree in the Hudson Bay bioregion. Ottawa, Ont.: Canadian Arctic Resources Committee.

MacKinnon, G. R. (1996). Biographical Science: Cooperative Investigations into Scientists' Lives. Science Teacher, 63(2), 43-45.

MacKinnon, G.R. (1996). The life & times of Louis Pasteur: A cooperative activity. Chem 13 News Feb 1996

MANICE. (n.d.). Retrieved August 19, 2016, from https://ec.gc.ca/glaces-ice/default.asp?lang=En&n=2CE448E2-1

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