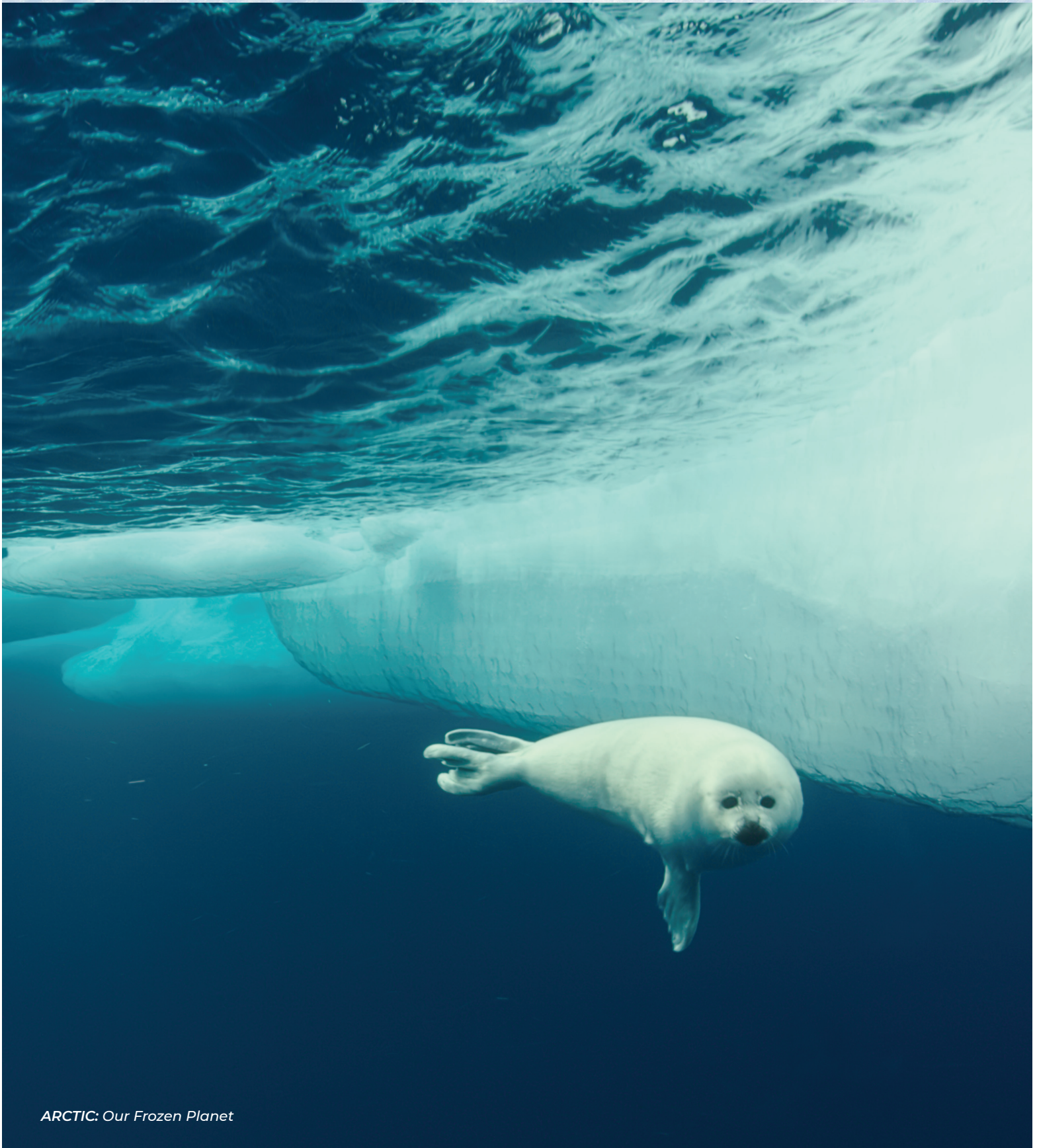


LESSON 1

# ARCTIC ANIMAL ADAPTATIONS

GRADE LEVEL K-2





*ARCTIC: Our Frozen Planet*

## LESSON 1

# ARCTIC ANIMAL ADAPTATIONS

GRADE LEVEL K-1

50 minute lesson

### STANDARDS (NGSS):

**K-ESS3-1** Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.

**2-LS4-1.** Make observations of plants and animals to compare the diversity of life in different habitats.

### FROM THE FILM:

Students will see animals in the film *ARCTIC: Our Frozen Planet* that may be similar to familiar wildlife they learn about every day but have different adaptations that allow them to survive in the Arctic.

### LESSON OVERVIEW:

In this activity, students will compare Arctic animals (like polar bears and wolves) to their counterparts living in warmer habitats to identify unique adaptations that enable animals to survive in freezing temperatures.

### MATERIALS LIST:

- **Arctic Animal Adaptations** activity pages  
( Bears and Wolves comparisons: 2 pages)  
( Polar Bear cut-out : 1 page )
- Art materials  
(White and colorful paper, pencils, markers)
- Paper glue
- Scissors
- Pads of sticky notes
- Chart paper or SMART board



LESSON 1

# ARCTIC ANIMAL ADAPTATIONS

## EDUCATOR PREP:

Prepare one comparison sheet and polar bear template per student. Precut polar bear template for camouflage demonstration. Collect other materials listed in the materials section for students.

## LESSON GUIDES:

1. As an icebreaker, ask students the following questions:

What animals did you see in the movie? Have you seen any of those animals before? If so, where?

Students may respond with various animals, but some animals featured in the movie include wolves, bison, bees, polar bears, seals, walruses, narwhals, and bowhead whales.

2. Have students pick their favorite animal from the movie and then get into groups based on their favorite animal. Ask each group to state one fact about their animal.

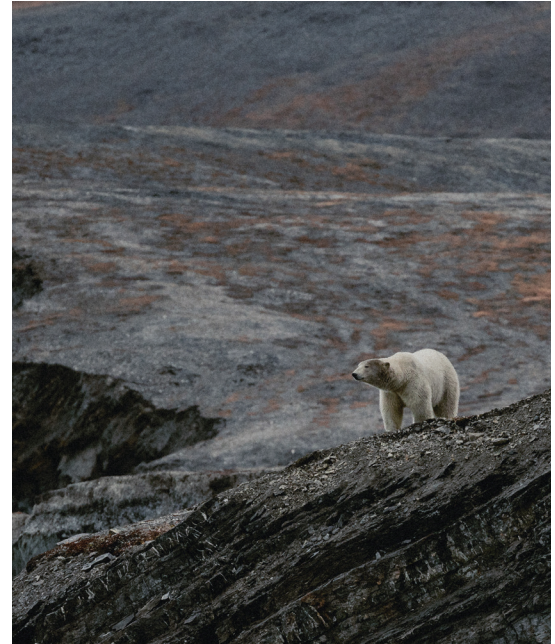
What color is it? Where does it live?

3. Have students consider why some animals can survive in the Arctic while others cannot.

Can you live in the Arctic? Why or Why not?

Animals that live in the Arctic can survive in cold temperatures, camouflage in the snow, and hibernate to survive the cold winters. These are called adaptations.

Humans can adapt to live in the Arctic. The Inuit people, who were featured in the movie, are the indigenous people of the Arctic. They have lived there for over 5,000 years.



*A polar bear is easy to spot against a darker background.*



4. Animals (and plants) are constantly working to survive by adapting to their habitat, the place an organism lives.

Ask students to reflect on their own place in their ecosystem through the following questions:

What is your habitat?

You can think of a habitat as a home. Students may list their school, their home, etc. A habitat must meet an organism's basic needs, or the organism cannot live there.

What are your basic needs to survive in your habitat?

We all need air, food, water, and shelter from extreme temperature, danger, weather, etc. to survive.

Do other animals have the same basic needs of air, food, water, and shelter? Do you think animals meet their basic needs the same ways in different habitats?

Animals develop distinct features that help them to survive better in their habitat. For example, humans developed two feet to help walk on land.

What is an adaptation?

Adaptation is a body part, feature, or behavior that helps a living thing survive and function better in its environment.

Can you think of any examples of animal adaptation?

There are many examples of animal adaptation, so students may answer with several different examples. One is camouflaging or a visual deception disguising or concealing an organism's presence by blending into or imitating surroundings.

Encourage students to explain why the adaptation gives the animal an advantage over another that does not have that adaptation.

## EDUCATOR NOTES:

Ask students to brainstorm in pairs at least three adaptations that would help animals survive in Arctic habitats. As they offer ideas, one person should record the ideas on sticky notes. After a few minutes, ask each pair to share one adaptation. Instruct the students to try not to repeat any adaptations.

5. Show photos of polar bears and then brown bears. Ask students what similarities and differences they notice between the polar bears and the brown bears.

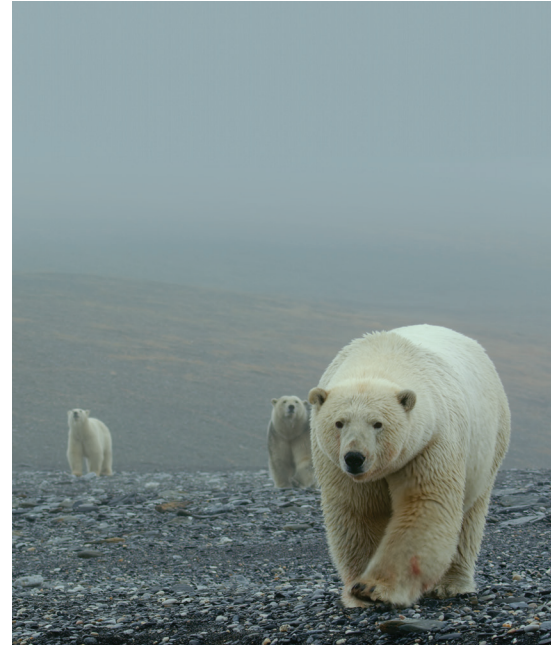
6. Draw a Venn Diagram on chart paper or a smart board and record students' answers. Add any characteristics from below that students do not suggest:

### Evolution

- Polar bears diverged from brown bears only 500,000 years ago, which is actually not a long time to adapt and change.
- After migrating to colder regions, polar bears' ancestors went through a series of evolutionary changes to survive in their new Arctic habitat.

### Similarities

- Both bears are large, furry, and have wide paws with sharp claws.
- Large with sharp claws because bears are powerful predators.
- Furry to provide bears warmth and protection.
- Polar bears are insulated by 2 layers of thick fur that prevent almost all heat loss. Despite below freezing Arctic temperatures, their fur keeps polar bears so warm that adult males can quickly overheat when they run.



*Despite below freezing Arctic temperatures, their fur keeps polar bears so warm that they can actually become overheated.*

## Differences

- Polar bears appear the color of snow, but brown bears are brown, the color of tree bark and earth.
- Polar bear fur is not actually white. Each hair shaft is pigment-free (without color) and transparent, with a hollow core that scatters and reflects visible light. Their fur reflects their snowy Arctic habitat, making polar bears appear white.
- Why would brown fur be better camouflage for a brown bear's habitat? Brown bears live in forests where their brown fur helps them hard to see from the trees and soil.
- Polar bears have longer snouts and shorter claws than brown bears.
- Polar bear paws are ideally adapted for movement in the Arctic.
- Their paws are extremely large, almost a foot across! This helps them walk on thin ice without falling through. Since polar bears are quite heavy, their paws help distribute their weight over a larger area, versus having a small paw, which would break through the ice.
- Their short and sharp claws help polar bears get more traction on the ice. Polar bear paws also help them swim. Their big paws help them paddle through the water. Have you ever used flippers to help you swim? Same idea.

7. Have students talk with their partner about how unique features help different bears live in the snow.

8. Separate students into groups to create an animal that can live in the Arctic. Ask them to consider the following questions about their animals:

What would the animal look like and why? For example, what would a butterfly that lived in the Arctic look like? Would it have fur?

Would it be colorful like the butterflies we see every day?

What would it need to survive in that cold habitat? Maybe fur, blubber, camouflage?

## EDUCATOR NOTES:

9. Give students about 15 minutes to draw and color their animals.
10. Once their animal is finished, ask students to turn to their neighbor and share two things about how their animal will survive in the Arctic.
11. Bring students back together as a whole group to debrief on all that they learned about Arctic animals today.

Can you name some adaptations of Arctic animals?

One very important feature of Arctic animals is that they use camouflage to blend seamlessly into their environment.

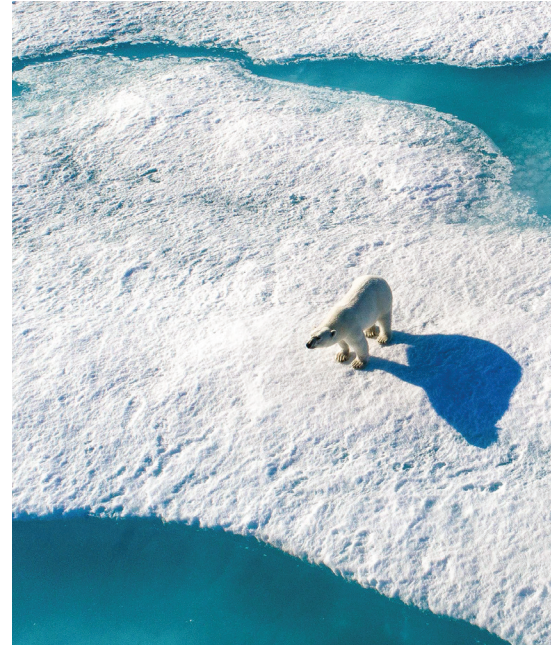
12. Inform students that as a final activity, they are going to create an environment for our friend the polar bear. Give each student a cutout polar bear and a piece of paper.

13. Show students the polar bear on colorful paper.

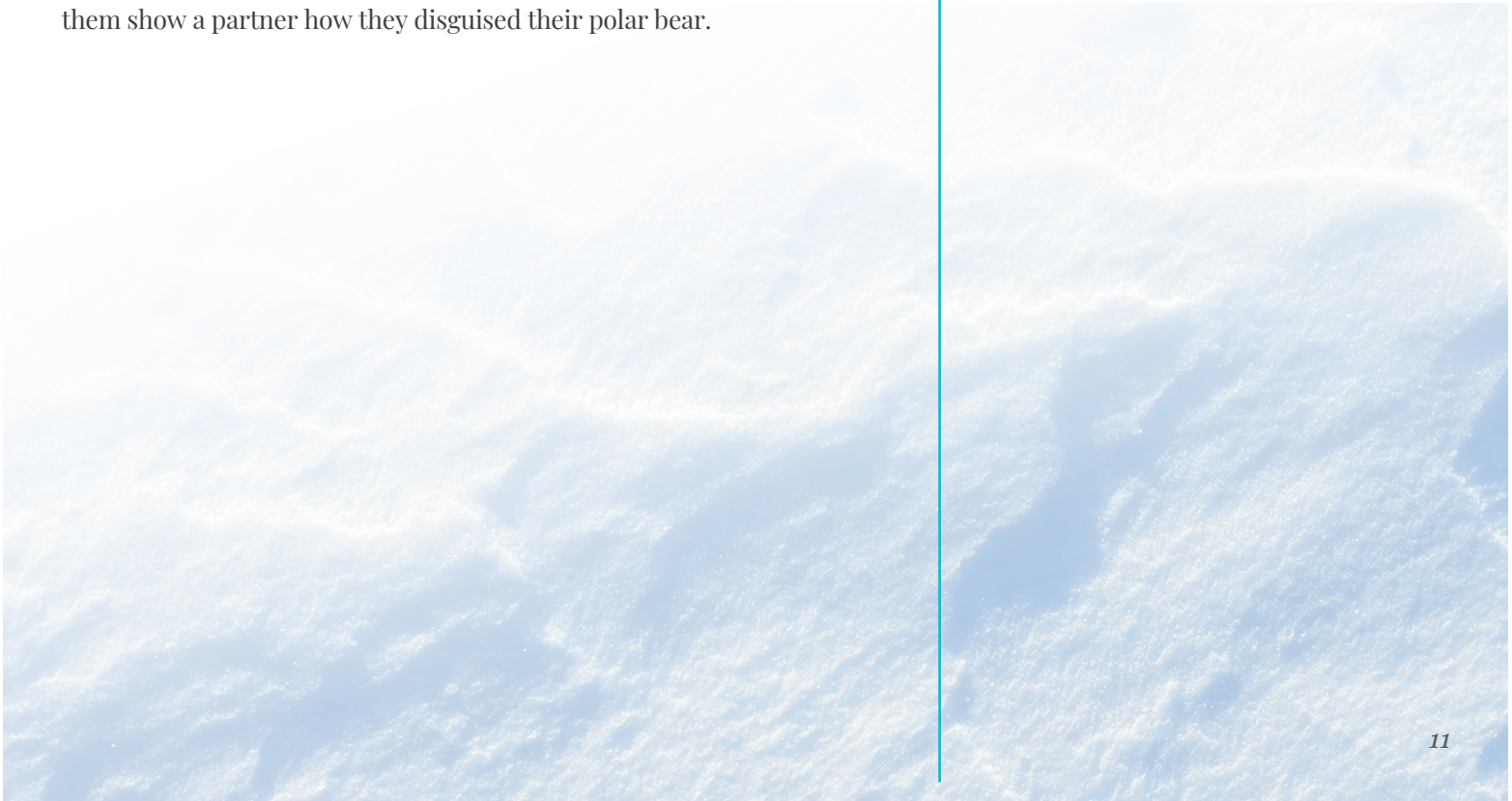
Does it blend in or stand out? What about the polar bear on the white paper?

14. Have students draw an Arctic environment in which the polar bear would survive on the blank piece of paper. Next, glue the polar bear into the environment so that it can survive for a long long time.

15. After students wrap up their polar bear demos, conclude by having them show a partner how they disguised their polar bear.



*Polar bears can detect the scent of seals miles away!*



# Arctic Animal Adaptations

## Activity Page

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Polar Bear



Brown Bear



Look at the photos of the two bears. What is similar?  
What is different? Write your ideas below.

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# Arctic Animal Adaptations

## Activity Page

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Arctic Wolf



Red Wolf



Look at the photos of the two wolves. What is similar?  
What is different? Write your ideas below.

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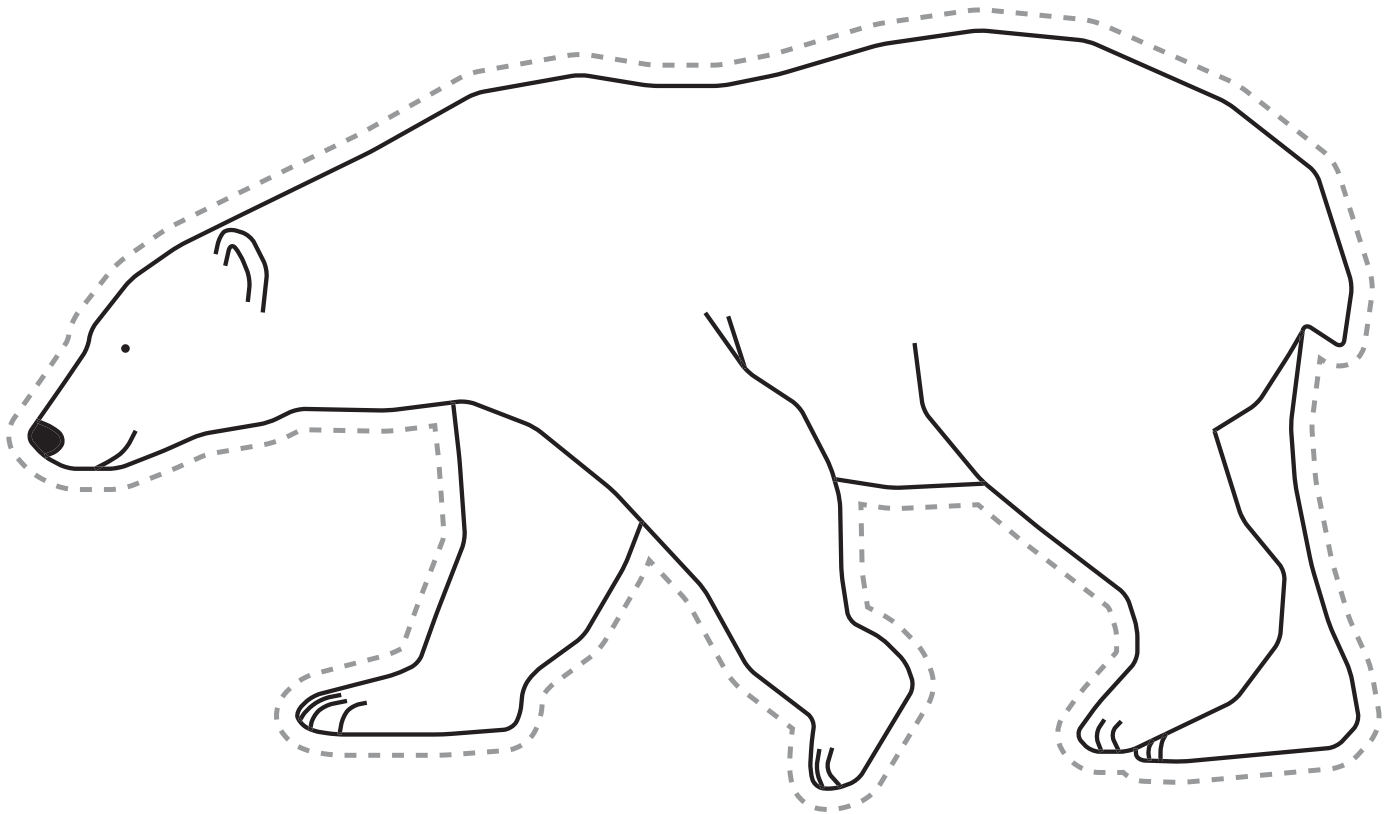
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# Arctic Animal Adaptations

## Activity Page

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Carefully use scissors to trim around the outline of the polar bear.

# Arctic Animal Adaptations

## ACTIVITY EDUCATOR KEY

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Polar Bear



Brown Bear



Look at the photos of the two bears. What is similar? What is different? Write your ideas below.

### Similarities

- Both bears are large, furry, and have wide paws with sharp claws.
- Both are large with sharp claws because bears are powerful predators.
- Heavy fur provide both bears warmth and protection.

### Differences

- Polar bears appear the color of snow, but brown bears are brown, the color of tree bark and earth.
- Unlike brown bear fur, polar bear fur appears white. Their fur reflects their snowy Arctic habitat.
- Brown bears live in forests where their brown fur makes them hard to see from the trees and soil.
- Polar bears have longer snouts and shorter claws than brown bears.
- Polar bear paws are larger than a brown bear's paw, ideally adapted for movement in the Arctic and also help them swim.

# Arctic Animal Adaptations

## ACTIVITY EDUCATOR KEY

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### Arctic Wolf



### Red Wolf



Look at the photos of the two wolves. What is similar? What is different? Write your ideas below.

#### Similarities

- Both wolves are important predators and keep rodent, deer or caribou populations in check.
- Both are a bit smaller than their cousin, the gray wolf.
- They live in small groups called packs.
- Both are threatened by habitat loss and human interactions.
- Both wolves mate for life.

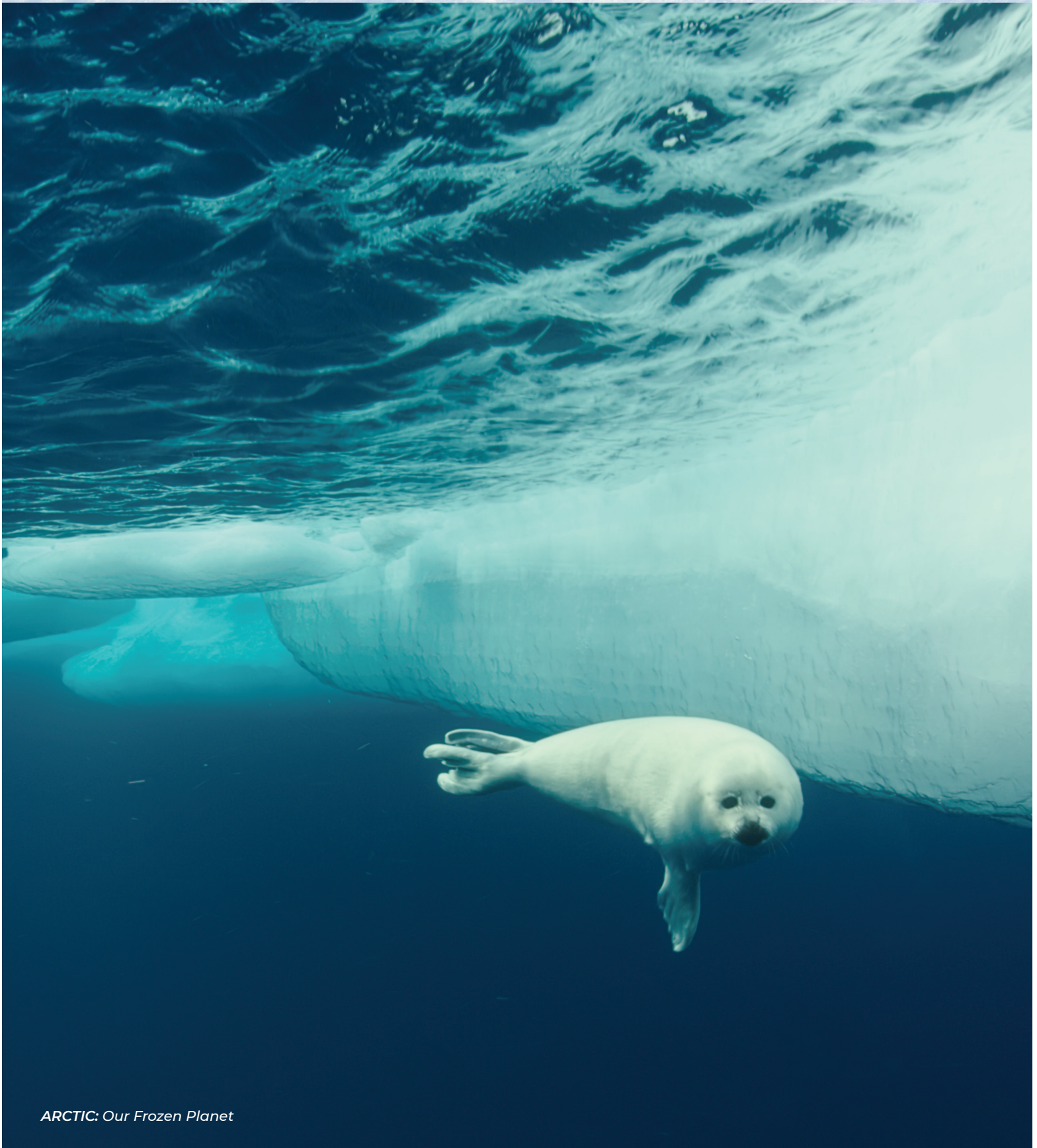
#### Differences

- Red wolves have black-tipped bushy tails, a coat mostly a brown or buff color.
- Arctic wolves have a thick white or cream-colored fur, although it can also be light grey or even brown.
- Historically the red wolf ranged from southeastern Texas to central Pennsylvania. Today the only place red wolves can be found in the wild is in eastern North Carolina's Albemarle Peninsula.
- Red Wolves are endangered, Arctic wolves are not yet, but they are declining.
- The Arctic wolf is native to the Arctic regions of North America and Europe.
- Arctic foxes, wolverines, and even polar bears have been known to prey on the Arctic wolf.

LESSON 2

# INUIT FOLKTALES FOR SURVIVAL

GRADE LEVEL K-2





*ARCTIC: Our Frozen Planet*

## LESSON 2

# INUIT FOLKTALES FOR SURVIVAL

GRADE LEVEL K-1

50 minute lesson

### STANDARDS (NGSS):

**K-ESS3-1** Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.

### FROM THE FILM:

As portrayed in *ARCTIC: Our Frozen Planet*, Inuit are a group of culturally similar indigenous peoples inhabiting the Arctic and subarctic regions of Greenland, Siberia, Canada, and Alaska (United States). This lesson expands on the film by further exploring the cultural beliefs and practices that have helped the Inuit survive in harsh Arctic environments.

### LESSON OVERVIEW:

Students will read a short story about Inuit folk lore and complete an activity to explore how their Arctic environment influences specific cultural practices and values. For example, Inuit spiritualism is animistic, characterized by belief that all things are inhabited by a spirit. Through this story and activity, students will investigate the relationship between humans and their environment through the cultural lens of Inuit peoples.

### MATERIALS LIST:

- *The Origin of Day and Night* by Paula Ikuutaq Rumbolt
- *Arctic animal* sorting board
- *Arctic animal* cards
- *Inuit photographs* (6)
- *Globe or World map*
- *Technology to screen Qalupalik* at Nunavut Animation Lab: *Qalupalik* by Ame Papatsie

[https://www.nfb.ca/film/nunavut\\_animation\\_lab\\_qalupalik/](https://www.nfb.ca/film/nunavut_animation_lab_qalupalik/)

LESSON 2

## INUIT FOLKTALES FOR SURVIVAL

### EDUCATOR PREP:

- Print Arctic Animal Activity materials for student groups. Each group will need:
  - Arctic Animal Sorting Board (1)
  - Arctic Animal Cards (12)
- Print or prepare to project Inuit photographs
- Review vocabulary and practice correct pronunciation for the following Inuktitut terms featured in the lesson story and film.
  - **Tiri** (TI-ri): Arctic fox name, short for “tiriganniaq” (ti-Ri-GAN-ni-aq) which means “fox”.
  - **Taaq** (TAAQ): darkness
  - **Ubluq**: day
  - **Ukaliq** (U-ka-liq): Arctic hare
  - **Siksik** (SIK-sik): Arctic squirrel
  - **Uumajurgautaviniit** (uu-ma-yurng-NGAU-ta- vi-NEET): ancient animals (“first animals”) who could speak and use powerful magic, including changing forms
  - **Iglu** (IG-loo): snow house
  - **Inuksuk** (e-NOOK-sook): rock cairn used to aid hunters and indicate direction
  - **Qalupalik** (QAL-lu-PIL-look): mythological sea creatures that steal disobedient children
  - **Amautik** (a-MOW-tick): pouch in back of a woman’s parka used to carry young children

### Note on emic versus etic perspectives on Inuit culture

To understand cultural beliefs and practices, it is important to center the emic perspective while recognizing our inability to view indigenous life through the eyes of indigenous people. As most perspectives on indigenous culture are etic, it’s important that we do not inadvertently practice ethnocentrism when learning about indigenous peoples.



*Sled dogs help humans get around on the ice and snow.*

## LESSON GUIDES:

1. Inform students that in this activity, they will learn about how Inuit people have adapted to survive in harsh Arctic environments through cultural practices. Ask them the following questions to activate their background knowledge and assess what they already know related to the topic.

What do you know about culture?

Culture is typically defined as shared beliefs, values, and norms in a community. While students may not necessarily know this definition, they may be able to give examples of cultures or things they associate with culture.

Can you think of specific examples of classroom values and norms?

Students may provide examples of specific classroom rules (raise hand to speak, walk in line, sit in assigned seat, etc.) or general social rules (respect and avoid harming others).

Can you explain why each classroom norm or rule exists?

Student explanations will vary according to specific norm or rule, but in general rules and expectations exist to guide social interactions and ensure group functioning. For example, classroom rules about who can speak when are necessary for teachers to communicate content and address questions for optimal learning. Rules like respecting others help group members get along and effectively work together. In other words, rules outline adaptive behaviors for a specific environment, in this case the classroom.

Do you follow the same classroom rules and norms at home?

Some rules like respecting others or safety concerns are the same across contexts, but other rules like raising your hand or walking in line may differ depending on where you are (e.g., home or school). Encourage students to share something about themselves that is influenced by culture or a tradition they follow and ask if they know where the traditions came from.

2. Explain that Inuit are a group of culturally similar indigenous peoples who live in Arctic and subarctic regions of Greenland, Siberia, Canada, and Alaska (United States). Show students these locations on a globe or world map.

## EDUCATOR NOTES:



3. Let students know that today, we will read a short story about Inuit folk lore and complete an activity to explore how their Arctic environment influences specific cultural practices and values. Share with them that for tens of thousands of years, oral storytelling has been a key way that parents teach children about values and behavioral norms to help them survive and thrive in their environment.

4. Tell students that many Inuit traditions and beliefs are based on animism.

What do you think animism means?

Although students may not know the definition, they should recognize the term is related to animals. Build on this familiarity by explaining that animism is the belief that all things are inhabited by a spirit.

Can you think of ways animism could influence traditional Inuit culture?

Traditional Inuit life was adapted to an extremely cold snow and icebound environment in which trees, fruit, and vegetable foods were almost nonexistent, so caribou, seals, whales, seabirds, and fish were the major food sources. Inuit observed various taboos to ensure that animal spirits were not offended.

When animals were killed for food, it was done according to certain rituals. Communal rites centered on preparation for the hunt, as this was the most important activity for survival in a hostile environment. Inuit highly valued and respected animals perhaps because their survival was closely linked with and in many ways dependent on Arctic animals.

5. Explain that they will explore animism in Inuit culture by reading a traditional folk tale. Show students the book **The Origin of Day and Night** by Paula Ikuutaq Rumbolt.

Ask the following questions as a pre-read check-in:

Has anyone read or heard the story before?

What do you think the book is about?

What do you know about book topic?

Student responses to these questions may reflect common misunderstandings of indigenous beliefs that are pervasive because the Inuit have been presented primarily from outsider (etic) rather than insider (emic) perspectives.



*Aerial view of the Arctic Ocean, which is a combination of water and sea ice.*

For instance, students may be familiar with and use the derogatory name Eskimo, meaning “eaters of raw flesh”, without realizing its culturally negative connotation as the term perpetuated a stereotype that denigrated the Inuit. Instead, use the name they call themselves, Inuit, or “the people.”

6. Tell students that this story is about Tiri and Ukaliq, an Arctic fox and hare, who control the setting and rising of the sun that create the cycle of day and night. Tiri the Arctic fox is best adapted to hunt at night and wants darkness to prevail, but Ukaliq the Arctic hare thrives in daylight.

Let's read to find out what happens!

7. Slowly and clearly read story and engage with students using active reading techniques. Use distinct character voices and alter your voice and behavior as tone of story changes.

Evaluate students' engagement through attention, body language, and participation, and adapt pacing and style accordingly.

8. As you read, check in with students about how they are receiving the story through the following active reading techniques:

- Encourage students to imagine themselves in the characters' positions.
- Ask questions as story events occur, including what students see happening in illustrations, how they think characters are feeling, and what they predict will happen. What is the story about? What happened in the beginning, middle, and end?
- To reinforce this knowledge and encourage active learning, probe the source of student knowledge with questions like, “How do we know that?”
- Encourage curiosity and skepticism, even if conclusions might seem inaccurate.

## EDUCATOR NOTES:

9. After you finish reading the story, explain the follow-up activity. Share with students that plants and animals, including humans, are constantly working to survive by adapting to their habitat, the place an organism lives.

What are your basic needs to survive in your habitat?

Student answers should include air, water, food, and shelter from elements, such as freezing temperatures and storms.

Can Arctic habitats support your basic needs to survive? Why or why not?

Survival is difficult because the Arctic is an extremely cold, snow and icebound environment in which trees, fruit, and vegetable foods are almost nonexistent. If students respond that humans cannot survive in harsh Arctic environments, remind them about the Inuit who live there and wrote the story. Like Arctic animals, Inuit have adapted to survive food scarcity and extreme elements that characterize Arctic habitats.

What is an adaptation?

Adaptation is a characteristic or behavior that helps a living thing survive and function better in its environment.

Can you think of examples of Arctic animal adaptations?

Student answers should reflect adaptations to provide Arctic animals warmth, including thick fur and high fat diet for insulation, as well as to provide camouflage, such as white fur.

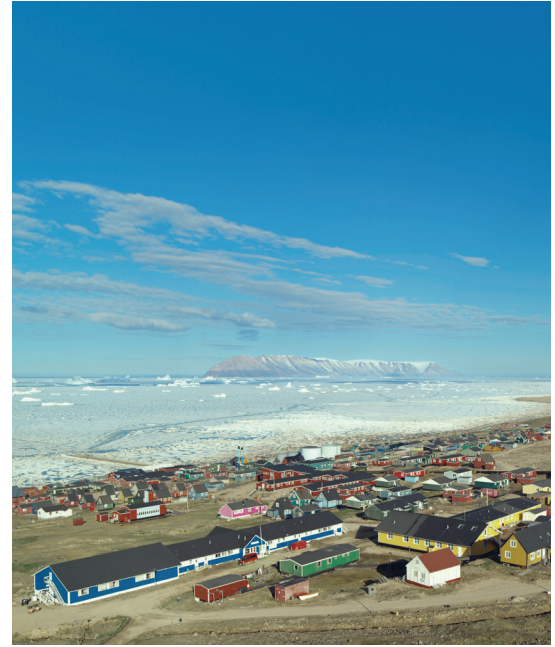
10. Tell students that *On the Origin of Night and Day* is about an important behavioral adaptation, when animals are active or resting.

Nocturnal animals like Tiri the Arctic fox are most active at night, while diurnal animals like the Arctic hare Uri are most active during daylight.

Show students Arctic Animal Cards for Arctic fox and hare and ask students to identify adaptations for nocturnal and diurnal life respectively.

Why are Arctic foxes well adapted to be active at night (nocturnal)?

Special adaptations for nocturnal living include large eyes for low-light vision and heightened senses of hearing and smell to help locate prey in the dark.



*Today, the Inuit people live in modern homes, and no longer in traditional igloos or tents.*

Why are Arctic hares well adapted to be active during the day (diurnal)?

Special adaptations for diurnal living include white fur coats for camouflage in bright, snowy environments and claws for digging burrows for protection from predators and the elements.

11. Have students work in groups to sort Arctic Animal Cards based on when they are most active (day or night) using the Arctic Animal Sorting Board. Once all animal cards have been sorted into day or night, call out the correct answers using the color coded dots as a guide.

Were any of the Arctic animal activity times surprising?

Student responses may focus on specific animals, but others likely will point out that a few animal cards (polar bear, snowy owl, and great white shark) indicate both day and night activity. Explain that some animals' activity schedule is dictated by their environment, particularly availability of prey, and depends on the time of year (breeding, migration, feeding season), location, temperature, and weather conditions.

12. Show the Inuit photographs and remind students that many Inuit adaptations are closely related to Arctic animal adaptations.

How have Inuit adapted to survive food scarcity in Arctic habitats?

If students are unsure, ask what Arctic animals eat. Like Arctic animals, Inuit adapted to frozen environment with scarce vegetation by adopting a fat rich diet in which caribou, seals, whales, seabirds, and fish were the major food sources.

How have Inuit adapted to stay warm and protected from extreme elements that characterize Arctic habitats?

Traditional cold-weather Inuit clothing like the parka were made from thick caribou furs to protect against extreme cold. Similarly, traditional Inuit pants, mittens, and footwear were made from caribou or sealskin in numerous layers, depending on the season. Over 5,000 years, Inuit have wintered either in temporary snowblock houses, generally referred to as igloos (iglus or igluvigaqs, depending on dialect), in tents made from animal skins, or in semisubterranean houses built of stone or sod over a whalebone framework. Today, they live in houses similar to the rest of the world.

## EDUCATOR NOTES:

13. To continue exploring Inuit mythology through folktales presented in a different medium, screen the short (5-minute) stop action animated film **Qalupalik** by Ame Papatsie, available at **Nunavut Animation Lab: Qalupalik** by Ame Papatsie - NFB.

Before starting the film, provide students with story context. Based on an Inuit legend told to prevent children from wandering alone to dangerous shores, Qalupalik are human-like sea creatures with green skin and long hair and fingernails. Qalupalik wear amautiit, in which they carry away disobedient children to live with them forever in the sea.

Such is the fate of Angutii, a young boy who plays by the shoreline instead of helping in his family's camp. Qalupalik seizes and drags him to the depths of the Arctic Ocean. Angutii's father, a great hunter, must then embark on a long kayak journey to rescue his son.

14. After watching the short film, discuss with students how the story reflects adaptive behaviors to survive in dangerous Arctic environments. In particular, emphasize the protective role of fear in Inuit folklore.



The Inuit refer to caribou, or reindeer, as **tuktu**.



# Inuit Folktales for Survival

## Activity Page



**Aiviq/Walrus**



**Tiriganniaq/Arctic Fox**



**Amaruq/Arctic Wolf**



**Nanuq/Polar Bear**



**Ukpik/Snowy Owl**



**Ermine/Tiriaq**

# Inuit Folktales for Survival

## Activity Page



**Ukaliq/Arctic Hare**



**Egalussuaq/Great White Shark**



**Siksik/Arctic Ground Squirrel**



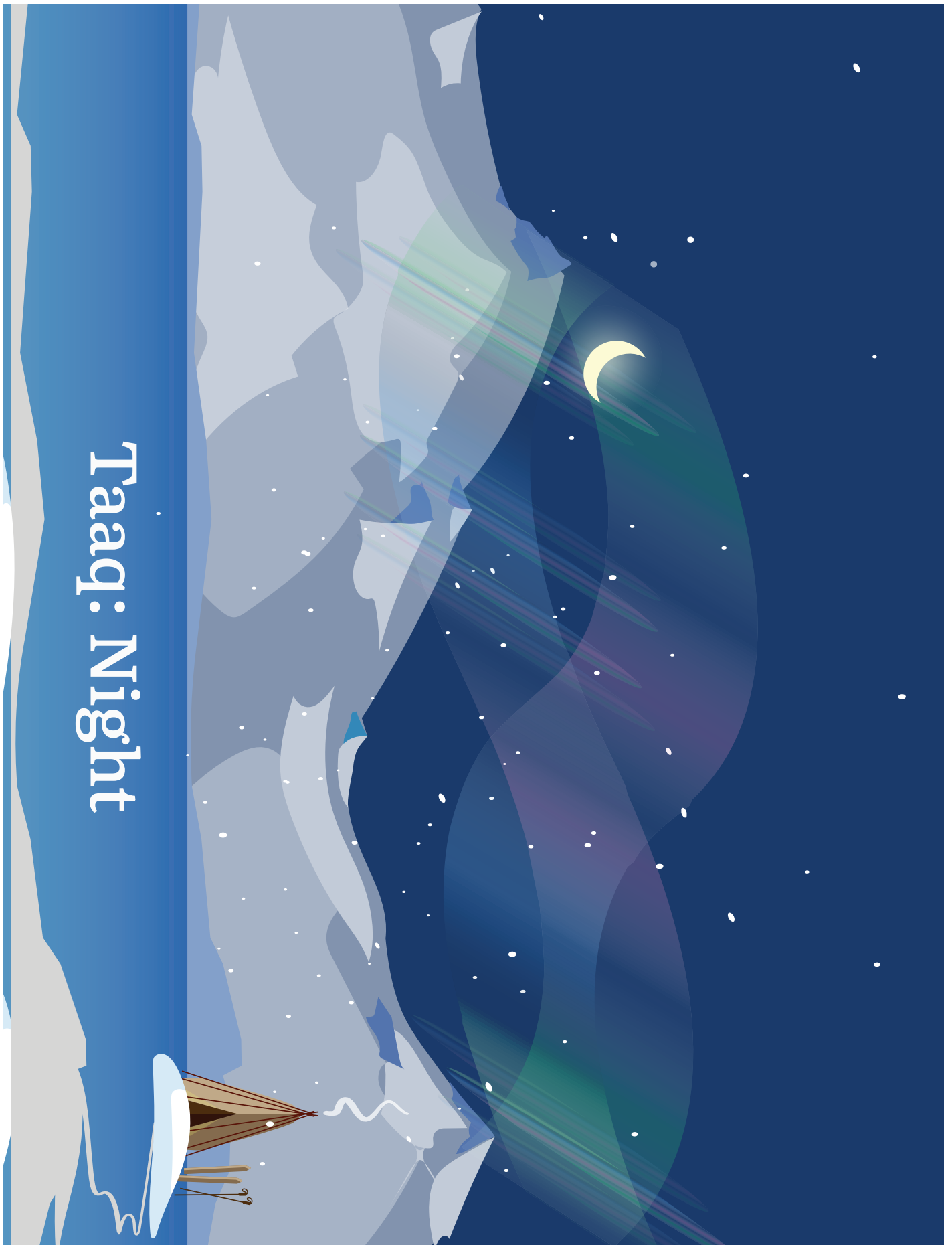
**Tuktu/Caribou/Reindeer**



**Tuugaalik/Narwhal**



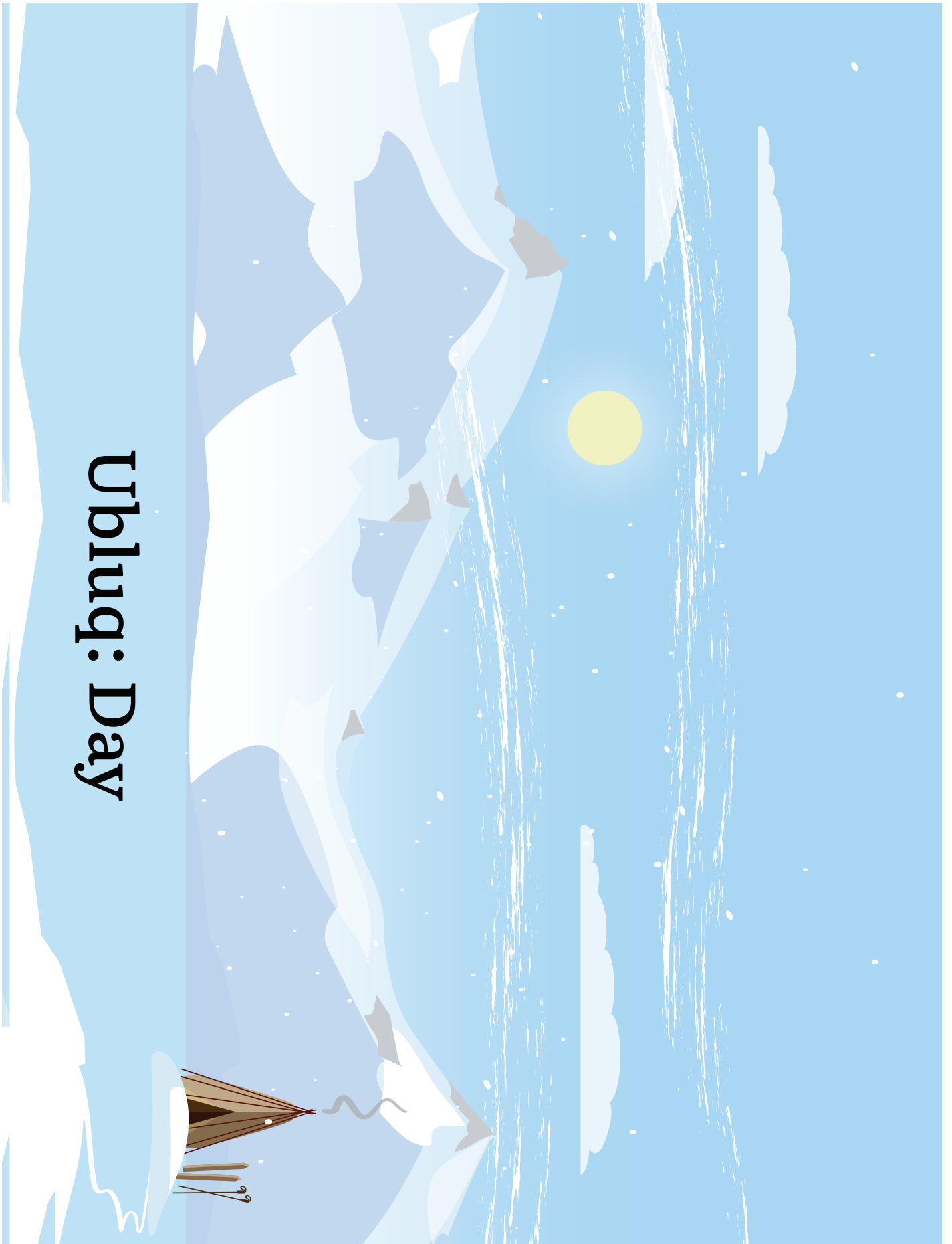
**Natsiq/Harp Seal**



# Taaq: Nignt



# Ubluq: Day



# Inuit Folktales for Survival

## ACTIVITY EDUCATOR KEY

Use the color dots to identify the correct answers.



# Inuit Folktales for Survival

## ACTIVITY EDUCATOR KEY

Use the color dots to identify the correct answers.



# Inuit Folktales for Survival

## Inuit Photographs



# Inuit Folktales for Survival

## Inuit Photographs



# Inuit Folktales for Survival

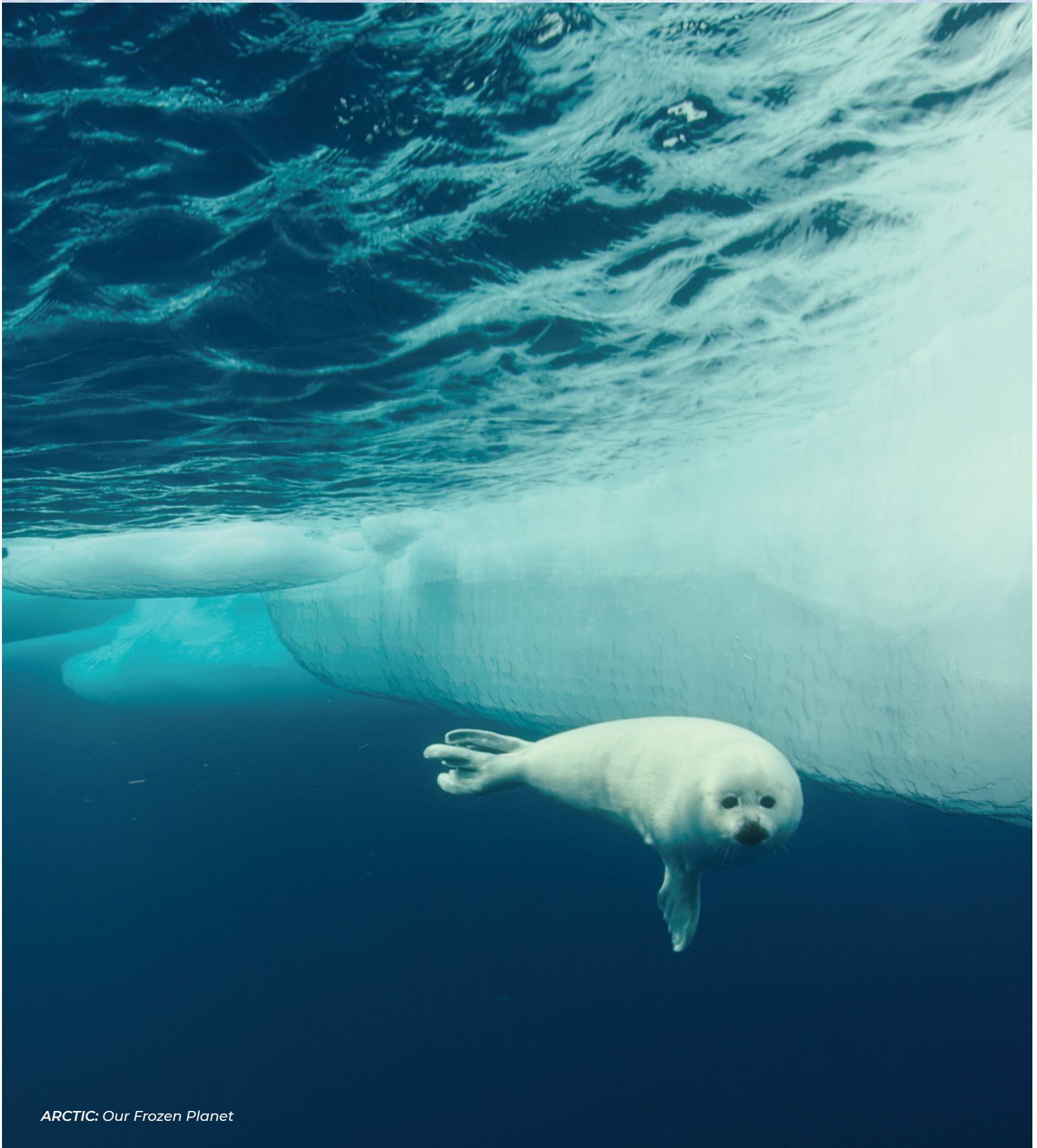
## Inuit Photographs



LESSON 3

# THE SHAPE OF ICE

GRADE LEVEL K-2





*ARCTIC: Our Frozen Planet*

### LESSON 3

## THE SHAPE OF ICE

GRADE LEVEL K-2

60 minute lesson

### STANDARDS (NGSS):

**2-ESS2-3:** Obtain information to identify where water is found on Earth and that it can be solid or liquid.

**2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

### FROM THE FILM:

In the film, *ARCTIC: Our Frozen Planet*, we learn about the critical role of water, in liquid and frozen forms, for humans and animals alike. Water provides everything from a frozen surface on which to travel for the Inuit to a place to live for narwhals and seals.

### LESSON OVERVIEW:

Students will experiment with water and ice while learning about states of matter and phase changes by observing ice melt into water. They will use salt to accelerate ice melting by lowering water's freezing point and food coloring to show melting process. Finally, students will explore extraordinary and unusual ice formations in different locations and geographical formations around the world.

### MATERIALS LIST:

- *Shape of Ice* activity page
- *Strange Ice* cards
- *Ice Map* cards
- Ice trays/molds
- Strings or yarn (precut)
- Salt
- Food coloring
- Trays
- Medium bowls
- Cups (assorted shapes and sizes)
- Towel



## LESSON 3

# THE SHAPE OF ICE

### EDUCATOR PREP:

Fill ice trays and molds with water and store in freezer for several hours until fully frozen.

Prepare trays with experiment materials (*one tray per group of 4 students*).

Fill a glass with water and add a drop or two of food coloring. Mix the food coloring into the water and then divide this diluted food coloring into small cups for student trays.

Each tray should include the following materials:

- 4 distinctly shaped and sized cups
- Bowl with large ice cubes (at least 2 ice cubes per student)
- Clear cup of water
- Salt
- String (1 per student)
- Cup of dilute food coloring
- Pipettes

### LESSON GUIDE:

#### Part One: States of Matter-Solid Ice and Liquid Water

1. Tell students they will be learning about Arctic ice and water. In the film, *ARCTIC: Our Frozen Planet*, we learned about the critical role of water, in liquid and frozen forms, for humans and animals alike.

Ask students:

Are ice and water the same thing? What (if anything) makes them different?

Student responses may include observations that ice is cold and hard, while water is warm and wet. Answers should reflect that water and ice are the same substance in different states of matter. These different states or phases of matter are caused by how the matter's molecules interact with each other.



*Sea ice is a central feature of the Arctic region, serving in some cases as a network of surfaces on which to travel.*



What are molecules?

Molecules are the building blocks of matter, a bit like Lego bricks.

What is the difference between molecules in solid versus liquid states of matter?

If students are unsure, direct them to the **States of Matter** handout for helpful hints. Solid molecules are tightly packed and have a defined structure, shape, and size. Liquid molecules are less closely packed and have movement space, so liquids have no definite shape of their own.

2. Explain to students that they will conduct experiments with ice cubes and water to explore different states or phases of matter (solids, liquids) and will draw their observations on their **States of Matter** handout.

3. Have each student take one of the four empty cups out of the tray. Explain that students will work in groups to transfer an ice cube from the bowl into each container before returning it to bowl. Ask students to draw the ice in each container on their **States of Matter** handout. Give students time to transfer their ice cubes and record their observations before asking the following questions:

What state of matter is ice?

The correct answer is solid because ice has a defined structure, shape, and size.

What happens when you transfer ice into different containers? Why?

Ice cubes maintain their own shape regardless of container. Solid molecules are tightly packed without room to move around, so solids hold their shape.

4. Next, students will investigate water. Explain that students will work in groups again to transfer the water into each container and draw their observations on their States of Matter handout.

Caution students to move and pour the water slowly and carefully to keep the water inside a container and minimize spills. Students need to keep all the water together, so there should only be water in one container at a time. Sometimes students will divide the water between the containers. Remind them that sharing is wonderful, but right now we should take turns pouring all the water into each container.

After a few minutes, ask students to share their observations.

## EDUCATOR NOTES:

What state of matter is water?

The correct answer is liquid. When water is a liquid it has no defined shape and can flow.

What happens when you transfer water into different containers?

Liquid molecules have some movement space, which allows them to pour and conform to shape of their container. Without a container, liquids have no defined shape (ex. spilled water). Students also may notice that some containers fill more than others (due to different shapes).

Is there more water in the containers that are filled to the top than the containers that are barely filled?

Student answers may vary depending on age, but the correct answer is no. Liquids have a set volume and will always take up the same amount of space.

## Part Two: Phase Change-Melting Fast

5. The film *ARCTIC: Our Frozen Planet* shows that Arctic ice is dramatically decreasing, endangering both land and marine animals. To explore this process, students will learn the science on how solid ice melts into liquid water, and about phase changes.

What is a phase change?

A phase change is a transition between states of matter. For example, when liquid water becomes solid ice, this phase change is called freezing. When solid ice transitions to liquid water, this phase change is called melting.

Can you think of other times you observed solids melting into liquids or liquids freezing into solids?

Student responses should provide contrasting examples between solids and liquids, as well as examples of the transition between the two. For example, many students are familiar with cold, solid ice cream melting into warm liquid.

6. Tell students to each take an ice block from the bowl. Students should have space to freely manipulate the ice and observe it melting. Instruct students to move their finger back and forth across ice block surface.

What do you notice and feel as you touch the ice?

Answers should note that ice is cold and begins to melt from solid to liquid from the heat of their touch.



*A baby harp seal, resting on sea ice.*



7. Instruct students that they are going ice fishing: **fishing for ice!**

Ask students to sprinkle salt on their ice blocks, encouraging them to experiment with the volume and pattern of salt. Then show students how to place the end of the string on top of an ice block and sprinkle salt over it. Ask them to observe how the surface of the ice melts and refreezes around the string.

Wait about 10 seconds, the string should freeze to the ice, allowing students to “fish” for ice.

8. After students have finished ice fishing, ask them to take turns using pipettes to drip diluted food coloring over the ice blocks coated with salt. The food coloring should fill the interstices of the melted ice, tracking the pattern of the salt. Point out wherever the formation of any ice crystals becomes visible.

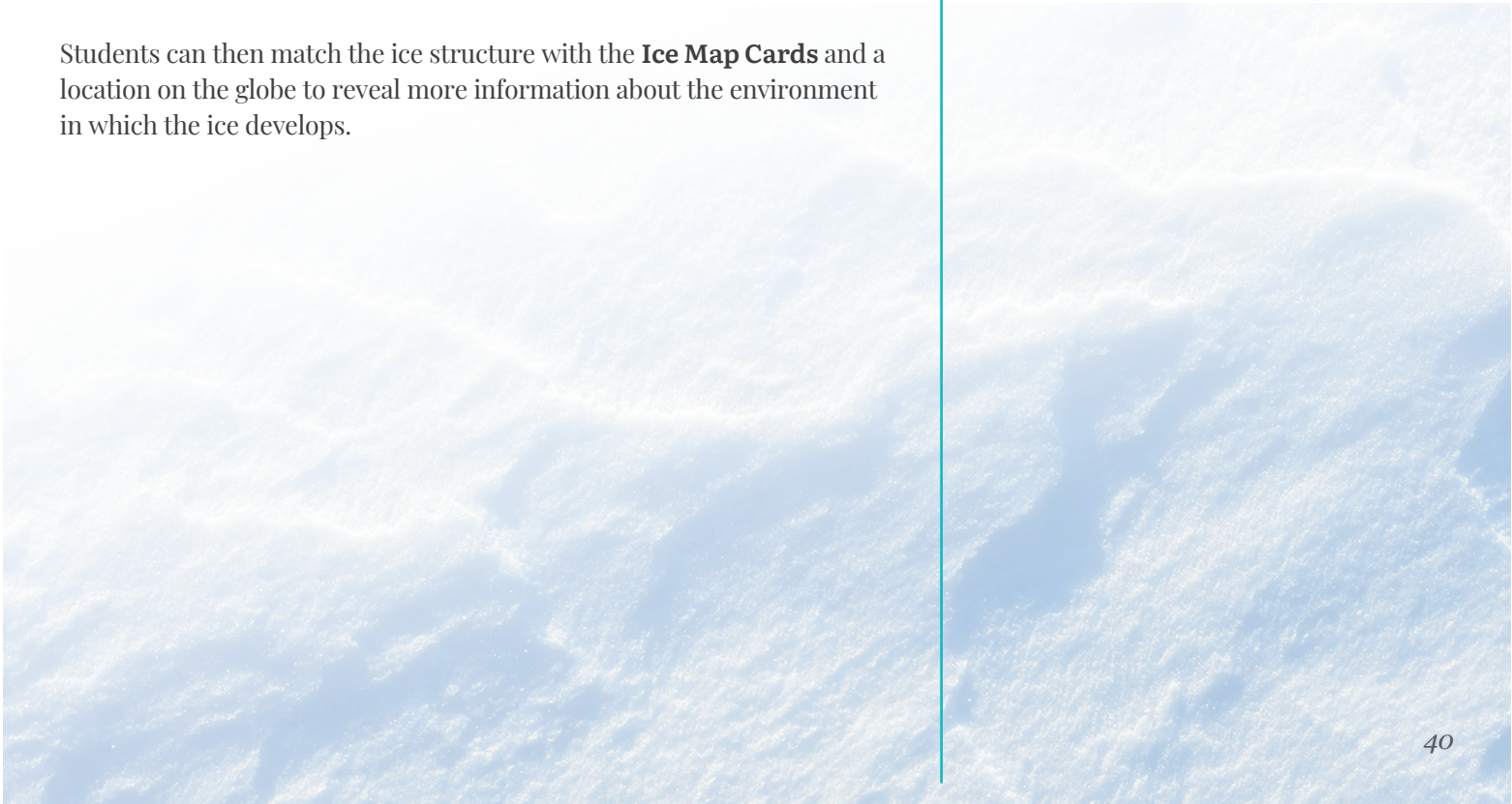
### Part Three: Strange Ice

9. Tell students that they are going on a trip around the world to find all the most unique ice formations on Earth. Students will explore extraordinary or unusual ice formations and match them to different geographical locations using the **Strange Ice Cards** and a globe or world map.

10. Ask students to select **Strange Ice Cards**, describe selected ice formation, and imagine how it might have formed.

Students can then match the ice structure with the **Ice Map Cards** and a location on the globe to reveal more information about the environment in which the ice develops.

### EDUCATOR NOTES:



11. Use this as a guide to match the ice formations with their locations:

Arctic Circle

Pancake Ice / Frost Flowers

Iceland

Diamond Ice / Needle Ice / Glacial Lagoon

Canada (Lake Abraham)

Ice Bubbles

Russia (Baikal Lake)

Ice Hummocks / Crystal Ice

Japan (Tokachi River)

Jewel Ice

United States (Maine)

Ice Circles

Chile, Argentina (Andes)

Penitentes

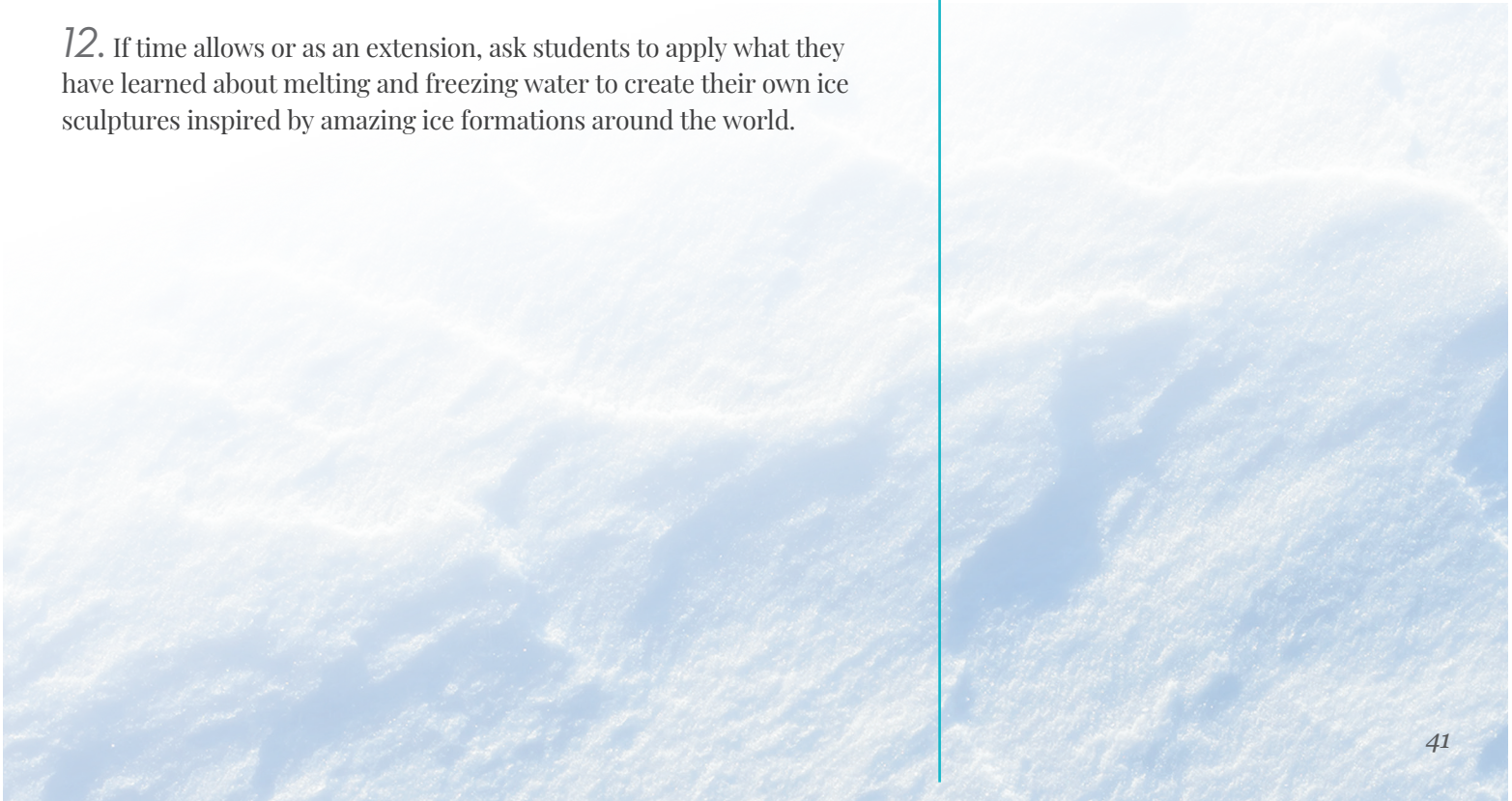
Antarctica

Striped Icebergs

12. If time allows or as an extension, ask students to apply what they have learned about melting and freezing water to create their own ice sculptures inspired by amazing ice formations around the world.



*Baby harp seal basking in the sunshine.*



# The Shape of Ice

Strange Ice Cards / Front



**Crystal Ice**  
Baikal Lake, Russia



**Pancake Ice**  
Arctic Circle



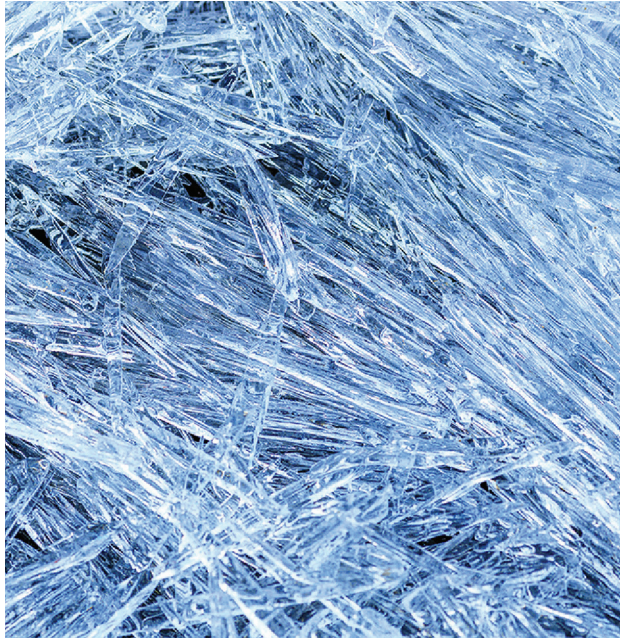
**Frost Flowers**  
Arctic Circle



**Diamond Ice**  
Diamond Beach, Iceland

# The Shape of Ice

Strange Ice Cards / Front



**Needle Ice**  
Iceland



**Glacial Lagoon**  
Iceland



**Ice Bubbles**  
Abraham Lake, Canada



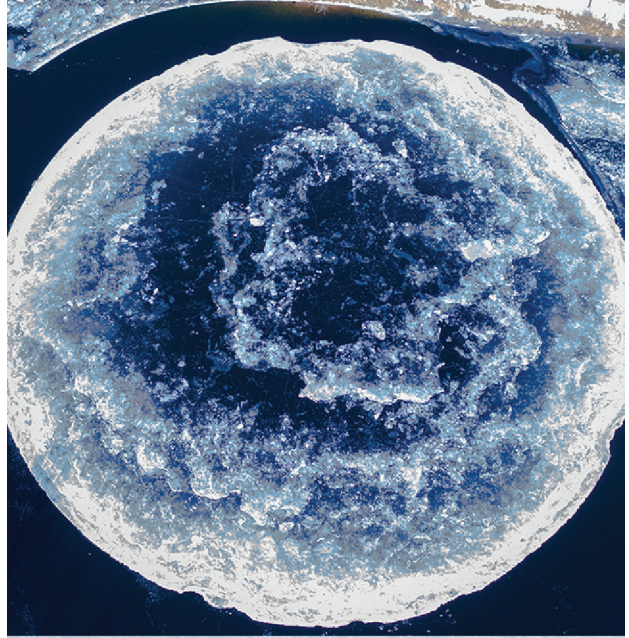
**Ice Hummocks**  
Baikal Lake, Russia

# The Shape of Ice

Strange Ice Cards / Front



**Jewel Ice**  
Tokachi River, Japan



**Ice Circles**  
Maine, United States



**Penitentes**  
Andes, Chile, and Argentina



**Striped Ice**  
Antarctica



# The Shape of Ice

## Strange Ice Cards / Back

### Pancake Ice

Arctic Circle

**Description:** Ice disks that range from a foot to nearly 10 feet across. Often the discs will gather slush, or frazil ice, and become a “hanging dam,” a circle of ice with high edges and a low center.

**Formation:** When the temperature is at freezing point but there is still moderate water movement, ice on water is broken up and spins in the eddy of a river, forming thin circles.

### Crystal Ice

Lake Baikal, Russia

**Description:** Large shards of transparent ice that form on the lake surface, making ice appear turquoise.

**Formation:** Lake Baikal contains high levels of oxygen, which helps microorganisms to filter the water and keep it pristine, so it freezes into crystal clear ice.

### Diamond Ice

Diamond Beach, Iceland

**Description:** Smooth, crystal clear blocks of ice that sparkle like diamonds against the black sand beach.

**Formation:** Glacial ice is formed slowly over hundreds of years by compression under a huge weight. During this process, air bubbles and impurities are pushed out of the ice, allowing light waves to travel very deep inside the ice undisturbed. The giant glacier pieces float out to the ocean where they end up breaking into polished ice blocks that wash up and sparkle on the shore.

### Frost Flowers

Arctic Circle

**Description:** Delicate, feathery tendrils that reach two to three inches high, floating on the surface of newly frozen sea ice or lake ice.

**Formation:** When air is extremely dry and colder than water surface, bits of ice vaporize and make the air humid and heavy with water vapor, until crystal by crystal the vapor turns back to ice, creating delicate, feathery ice tendrils.

# The Shape of Ice

## Strange Ice Cards / Back

### Glacial Lagoon

Iceland

**Description:** Glacial landscape of white, cyan-blue, and turquoise icebergs streaked with black volcanic ash and composed of ice that is over a thousand years old.

**Formation:** Glacial lagoons form where a melting glacier reaches sea level or a lowland plateau. As the glacier tongue slowly retreats year by year, it leaves behind a ground depression that then fills with meltwater to create a lake.

### Needle Ice

Iceland

**Description:** Needle ice has many names including ice castles, frost columns, ice fringes, or ice filaments.

**Formation:** When soil temperature is above freezing but air temperature is below freezing, water in the soil is drawn up through capillary action and freezes on air contact, creating a needle-like column of ice.

### Ice Hummocks

Lake Baikal, Russia

**Description:** Unique shard-like ice splinters as high as 32 to 39 feet above lake surface. Transparent and shining turquoise in sunlight, these masses of broken ice look like shards of glass piercing the sky.

**Formation:** When heavy winds push water above the lake's frozen surface, the water quickly freezes. The ice heats up during the day and cools at night. The huge swing in temperature causes the ice to crack and splinter.

### Ice Bubbles

Abraham Lake, Canada

**Description:** Unique circular bubble patterns stacked under the ice.

**Formation:** Plants on lakebed release methane gas. As the methane rises to the frozen surface, it freezes as bubbles that continue to stack below one another, trapped beneath the ice.

# The Shape of Ice

## Strange Ice Cards / Back

### Diamond Ice

Diamond Beach, Iceland

**Description:** Thin, round slabs of ice that rotate slowly in the water and vary in size but have been found as large as 300 feet diameter.

**Formation:** Ice circles, or ice discs, form in the bends of rivers. As a layer of ice is formed over the water, the current of accelerating water underneath creates a “rotational shear,” breaking off a chunk of ice and twisting it until it forms a circle. There it stays, a circle of ice slowly rotating in the river bend.

### Jewel Ice

Tokachi River, Japan

**Description:** Distinctly crystal-clear ice blocks that sparkle with orange or sapphire hue.

**Formation:** Created by unique combination of salt-free river water, sub-zero temperatures, and ocean saltwater tides. When the mouth of the Tokachi River freezes, blocks of ice break off and drift out into the ocean before washing up with the tide. Such crystal-clear ice requires water free of contaminants and a slow freezing process, so impurities and air bubbles have time to escape before ice solidifies.

### Striped Ice

Antarctica

**Description:** Enormous shards of ice striped in different shades of white, blue, and green.

**Formation:** Natural phenomenon caused by different types of water freezing together. The ice color depends on the type and amount of organic matter inside. The white color of the iceberg is caused by little snowflakes and air bubbles frozen inside the freshwater ice. When the iceberg cracks, it can fill with frozen seawater, also known as marine ice, containing algae and iron oxide that gets trapped inside the iceberg and creates beautiful jade colors.

### Penitentes

Andes, Chile, and Argentina

**Location:** Chile, Argentina in Andes Mountains

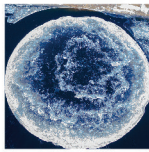
**Description:** Tall, jagged pinnacles of snow and ice that can range in size from an inch or two to over 16 feet tall.

**Formation:** Jagged structures form by sublimation, a process like melting, except that the sun turns the snow directly into water vapor without melting first. Essentially the ice goes from solid to gas and skips the liquid phase.

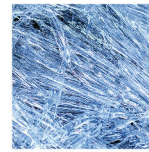
# The Shape of Ice

## Ice Map Cards

### UNITED STATES



### ICELAND



### RUSSIA



### ARCTIC CIRCLE



# The Shape of Ice

## Ice Map Cards

**ANTARCTICA**



**JAPAN**



**ARGENTINA**



**CANADA**

