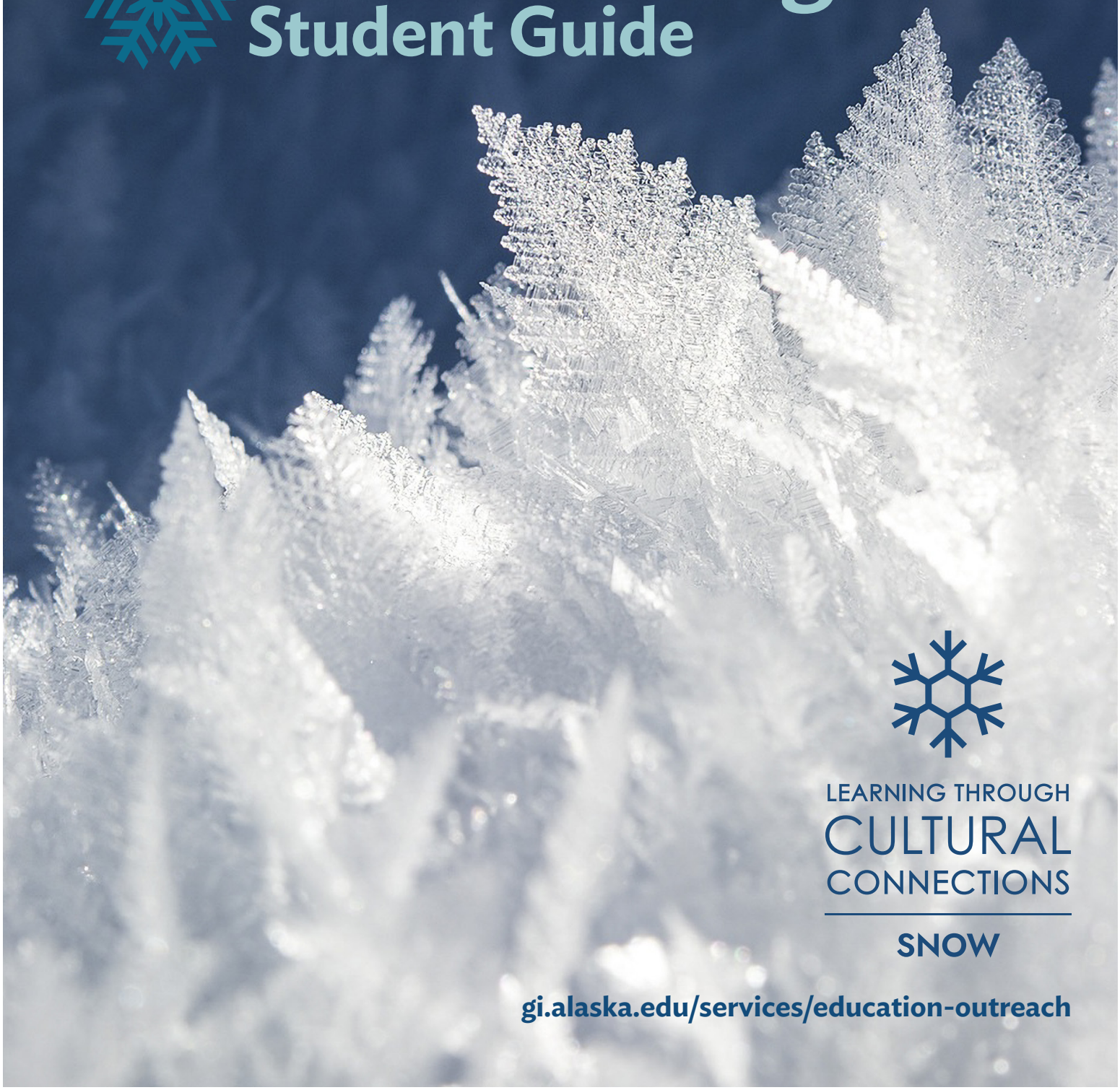
Qanniksuq

It is Snowing

Student Guide



LEARNING THROUGH
CULTURAL
CONNECTIONS

SNOW

gi.alaska.edu/services/education-outreach

Apun
Snow

NASA photo

Why is snow important?

The Iñupiaq word for snow cover is apun. In the Arctic, apun blankets the landscape for many months each winter. It is an important factor in weather and climate. Apun insulates the ground and sea ice from cold winter temperatures. It also helps cool Earth by reflecting the sun's energy back into space.

People, animals and plants in the Arctic rely on apun. It provides water to hydrate Arctic ecosystems and communities. Apun insulates plants and protects them from the wind. Many animals burrow into apun for warmth and refuge from predators. People travel across apun to hunt and fish, to visit nearby communities that are not connected by road, and for recreation. How is apun important to you?

"Snow is important for us in the Arctic for safety... for our food, berries, and out on the ocean, if you think you're going to get lost or something, it's very important."

Pearl Goodwin
Kotzebue, Alaska

ON TRACK FOR SAFETY

This student guide provides many safety tips, but it does not tell you all that you need to know to be safe in the snow. Talk to your parents, Elders and others to learn more about snow safety.

ACTIVITY 1

Snow vocabulary

Iñupiat Iḷitqusiat *(Iñupiaq values):* ***Iḷisimaŀiq Uqapiaŀiġmik*** *(Knowledge of Language),* ***Savaqatigiiyuŀiq*** *(Cooperation)*

Would you like to learn Iñupiaq words related to snow? Work with classmates or your teacher to practice the vocabulary words in this booklet. Use the cards provided in the snow kit, or print them at https://sites.google.com/alaska.edu/snow/.

Visit: https://sites.google.com/alaska.edu/snow/ to hear and practice the vocabulary words.

snow art courtesy Vecteezy

ACTIVITY 2

Understanding Arctic Snow

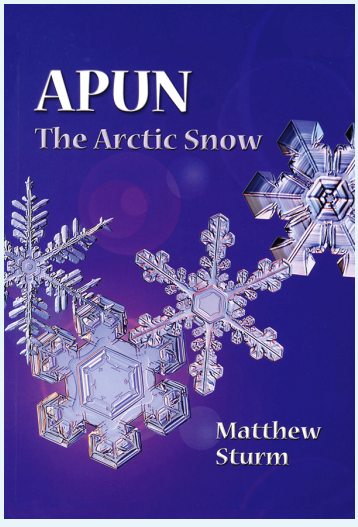
Iñupiat Iḷitqusiat: ***Iḷisimaŀiq Uqapiaŀiġmik*** *(Knowledge of Language),* ***Aatchuqtuutiŀiq Avatmun*** *(Sharing),* ***Kamakkutiŀiq*** *(Respect for Others),* ***Savaqatigiiyuŀiq*** *(Cooperation),* ***Kamaksriḷiq Utuqqanaanik*** *(Respect for Elders),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature)*

How is **apun** important to your community and beyond? How is it important to the animals and plants around you? Watch and read about how Iñupiaq Elders and university scientists answer these questions.

Procedure:

1. Look at the snow outside your classroom window. What do you notice about the snow? Share your thoughts with a classmate.
2. Watch the TRACK Talk: Different Types of Snow. Read *Apun: The Arctic Snow* as a class.
3. Think about what you learned from the film and the book as well as your own snow experience. Work with your class to make four lists:
   - How is snow important to our community?
   - What Iñupiaq words relate to snow?
   - How are Arctic animals adapted to snow?
   - Why do Arctic plants need snow?
4. The snow is constantly changing. Observe today's snowpack and weather. What processes do you think are changing the snowpack today (i.e. wind, temperature differences, heat)? How do you know?
5. Think about snow from a different point of view (hunter, snowshoe hare, snowmachine traveler, ground squirrel, lemming, fox, blueberry bush, seal, etc). Describe snow from that point of view. What questions do you have from that viewpoint? What new ideas about snow does this point of view give you?

Elmer Kappaisuk Goodwin shares snow knowledge.



Qanniksuq
It is snowing

Matthew Sturm photo

Where does apun come from?

Apun is part of the water cycle. Water molecules behave differently at different temperatures and can exist in three forms: solid, liquid and gas. Water vapor is water in the gas phase. The water you drink is in the liquid phase. Ice and snow are water in the solid phase.

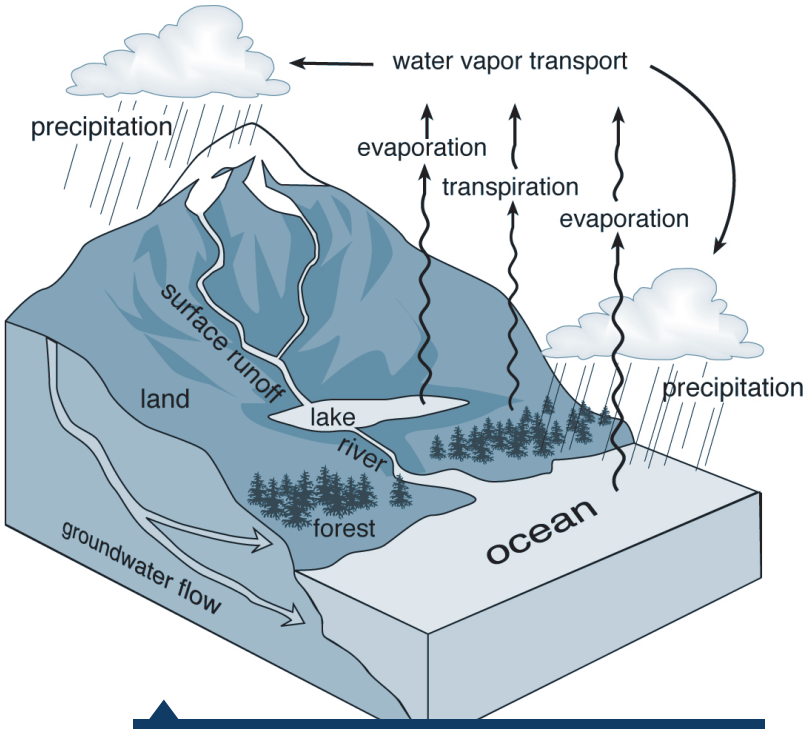
Snow forms when water vapor freezes on tiny particles of dust or salt floating in the atmosphere. This occurs within clouds. The tiny particle tumbles about in the atmosphere bonding with more water molecules as they freeze. The molecules bond together in specific positions, growing crystal shapes as the snow falls.

> **For winter travel, you know it's always safety first. Prepare what to do, what you got planned for going where you're heading. Let someone know. Always have your survival gear with you wherever you're going — to and from.**
>
> *Cyrus Naunġaq Harris*
> *Kotzebue, Alaska*

ON TRACK FOR SAFETY

Always wear warm clothes and bring emergency supplies when traveling on the snow.

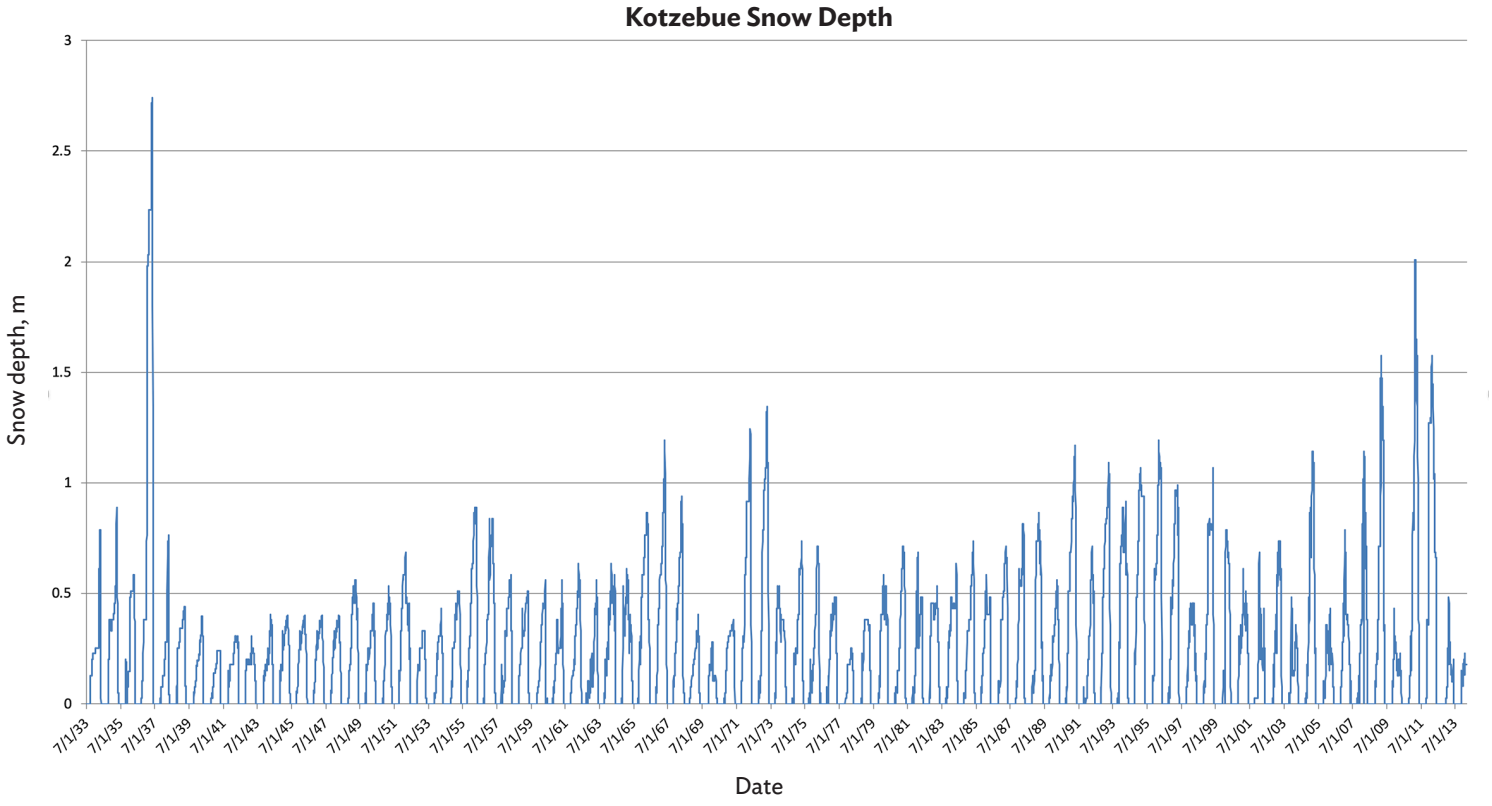
When you see snow falling from the sky, you can say, **"Qanniksuq"** or, "It is snowing." Dark clouds that bring snow are **nuviya** in Iñupiaq. Have you noticed **nuviya**? How do you know when it is likely to snow in your community? How do you prepare for snow?



Falling snow is a type of precipitation. When the snowpack melts each spring, it becomes runoff and groundwater.

courtesy of the Alaska Tsunami Education Program, UAF Geophysical Institute

The graph below shows daily snow depth in Kotzebue, Alaska from 1933 to 2013. The peaks on the graph indicate maximum snow depth each winter, and the valleys indicate days with no snow on the ground.



Credit: Data from Kotzebue met station, graph provided by Vladimir Romanovsky

ACTIVITY 3

Moving Molecules

Iñupiat Iḷitqusiat: ***Iḷisimaŧiq Uqapiaŧiġmik*** *(Knowledge of Language),* ***Savaqatigiiyuŧiq*** *(Cooperation),* ***Kamaksriḷiq Utuqqanaanik*** *(Respect for Elders),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature)*

Apun is made up of water molecules. Each snow crystal is many frozen water molecules bonded together. Cold water molecules and warm water molecules behave differently. Have you ever made a cup of tea for an Elder? If you have, you probably used hot water. What would happen if you used cold water instead? Making tea in hot and cold water can help you see how temperature changes the behavior of water molecules. Try it!

Materials:

- 2 heat-safe cups that are clear glass or white on the inside
- 2 teabags containing black or dark tea
- hot water
- cold water

photo by Zach Locklear, UAF

Procedure:

1. Work with a small group. Fill one cup with hot water and another with cold water.
2. At the same time, place one teabag in each cup. Do not stir or move the cup.
3. Watch as the color from the tea moves with the water molecules in each cup.
4. Record your observations.
5. After you have observed and recorded for three to five minutes, and if local health conditions allow, deliver the hot tea to an Elder or another nearby adult whom you appreciate.

Discuss:

- What differences did you notice between the two cups of tea?
- Which cup of tea brewed faster? How could you tell?
- Which water molecules move faster — hot water molecules or cold water molecules? How do you know?
- Have you ever caught a qannik (snowflake) on the sleeve of your coat? Are the water molecules in the qannik moving fast or slow? How do you know?
- What do you think would happen if you placed a teabag in a cup of snow? Why?

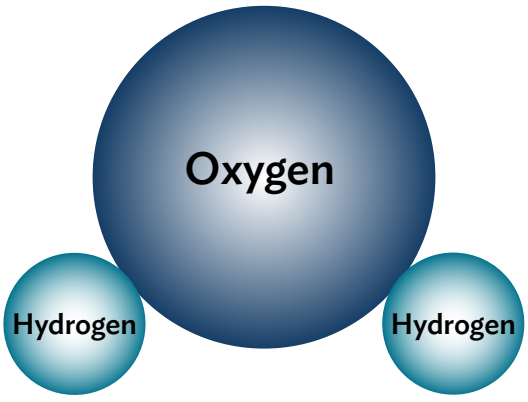
Qannik
Snowflake

Matthew Sturm photo

Sunlight refracting through tiny snow crystals known as diamond dust causes sundogs/halos around the sun.

What shape is a snow crystal?

Snow crystals come in many sizes and patterns, but all are naturally hexagonal. This is due to the structure of a water molecule. A water molecule (H_2O) is made up of two hydrogen atoms strongly bonded to one oxygen atom. A snow crystal is many frozen water molecules bonded together in an intricate matrix. The tiny, sparkling snow crystals that form in clear skies are called diamond dust. Some snow crystals that bond together in clouds become picturesque snowflakes. The Iñupiaq name for a snowflake is qannik. A qannik can also take a simpler form, such as a six sided plate, column, or thin needle. What qannik shapes have you noticed? How does snow crystal shape impact the way you interact with snow?



A water molecule is made up of two hydrogen atoms and one oxygen atom.

Is snow clean?

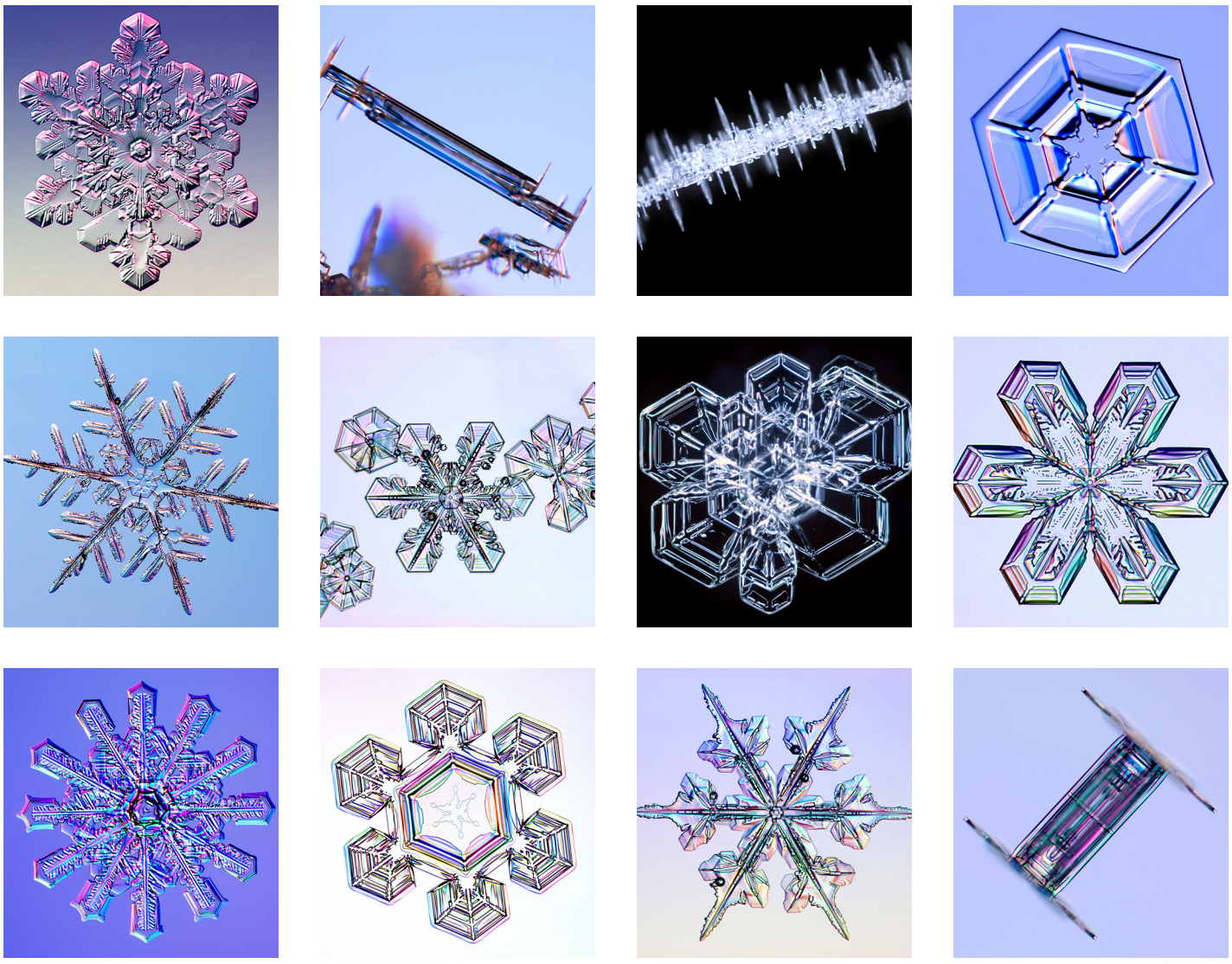
As snow tumbles about in the atmosphere, it can collect airborne pollutants. These include exhaust from vehicles and factories, ash from volcanic eruptions and more. Sometimes the pollutants are produced near where the snow is falling. Other times they have traveled on the wind from far away. The tiny pollutants stick to the snow crystals and can be found in the runoff from melted snow. Pollutants such as litter and liquid waste can be added to snow after it falls.

You can detect pollutants in the snow near you by lining a strainer with a white coffee filter, placing snow in the coffee filter and allowing it to melt. Small pollutants will discolor the filter. Larger pollutants will remain on the surface of the filter. What actions can you take to reduce snow pollution in your community?

ON TRACK FOR SAFETY

If you are gathering snow for drinking water, select clean snow and, if possible, boil it before drinking. Ask an Elder about how to gather and prepare snow for drinking.

microscopic images by Kenneth G. Libbrecht, Caltech



ACTIVITY 4

Modeling Snow

Iñupiat Iḷitqusiat: ***Savaqatigiiyuḷiq*** *(Cooperation),* ***Aatchuqtuutiḷiq Avatmun*** *(Sharing),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature)*

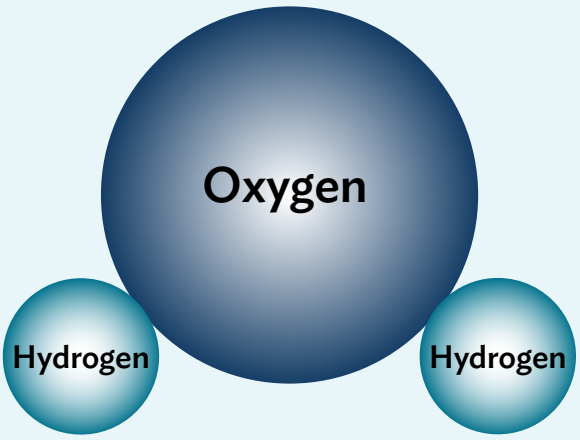
Have you ever looked at a **qannik** (snowflake) with a magnifying glass? Try it. What if you could keep magnifying the snow crystal until you could see each frozen water molecule? What might it look like then? Create your own model of a water molecule and work with classmates to model a snow crystal.

Materials:

- TED Ed Film — The Science of Snowflakes by Marusa Bradac
- Magnifying glass
- 2 colors of paper (red and white)
- Scissors
- Tape or glue
- Water model kit

Procedure:

1. Watch the TED Ed Film — The Science of Snowflakes by Marusa Bradac. Think about the film. Pair up with a partner. Share your thoughts.
2. Use paper, scissors and tape to make two water molecule (H_2O) models.



A water molecule is made up of two hydrogen atoms and one oxygen atom.

3. In an open space, play a modeling game. Hold one water molecule in each hand. When your teacher calls out: gas, liquid or solid, take these actions:

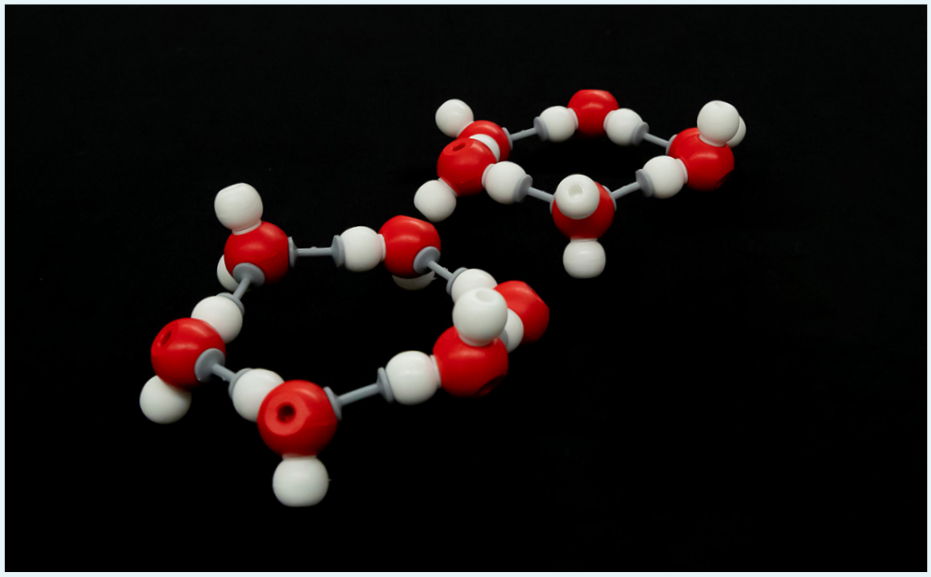
    - **Gas:** (molecules are far apart, move fast and sometimes collide). Stretch your arms out and jog around. Occasionally "high five" another water molecule.
    - **Liquid:** (molecules are closer together and move freely past each other at a medium speed). Press your elbows against your sides. Move close to your classmates and walk around, brushing your water molecules past others.
    - **Solid:** (molecules bond together and move slowly). Move close to your classmates and stand in place. Touch your water molecules to one or two others. Move your hands slowly back and forth. Do not break contact with other water molecules.

4. Work with a small group. Use the water model kit of red and white beads and connectors to make a hexagonal snow crystal as shown. Your group will need 12 white beads (hydrogen atoms), 6 red beads (oxygen atoms), 12 short connectors (strong bonds) and 6 long connectors (weaker bonds).

    Discuss:

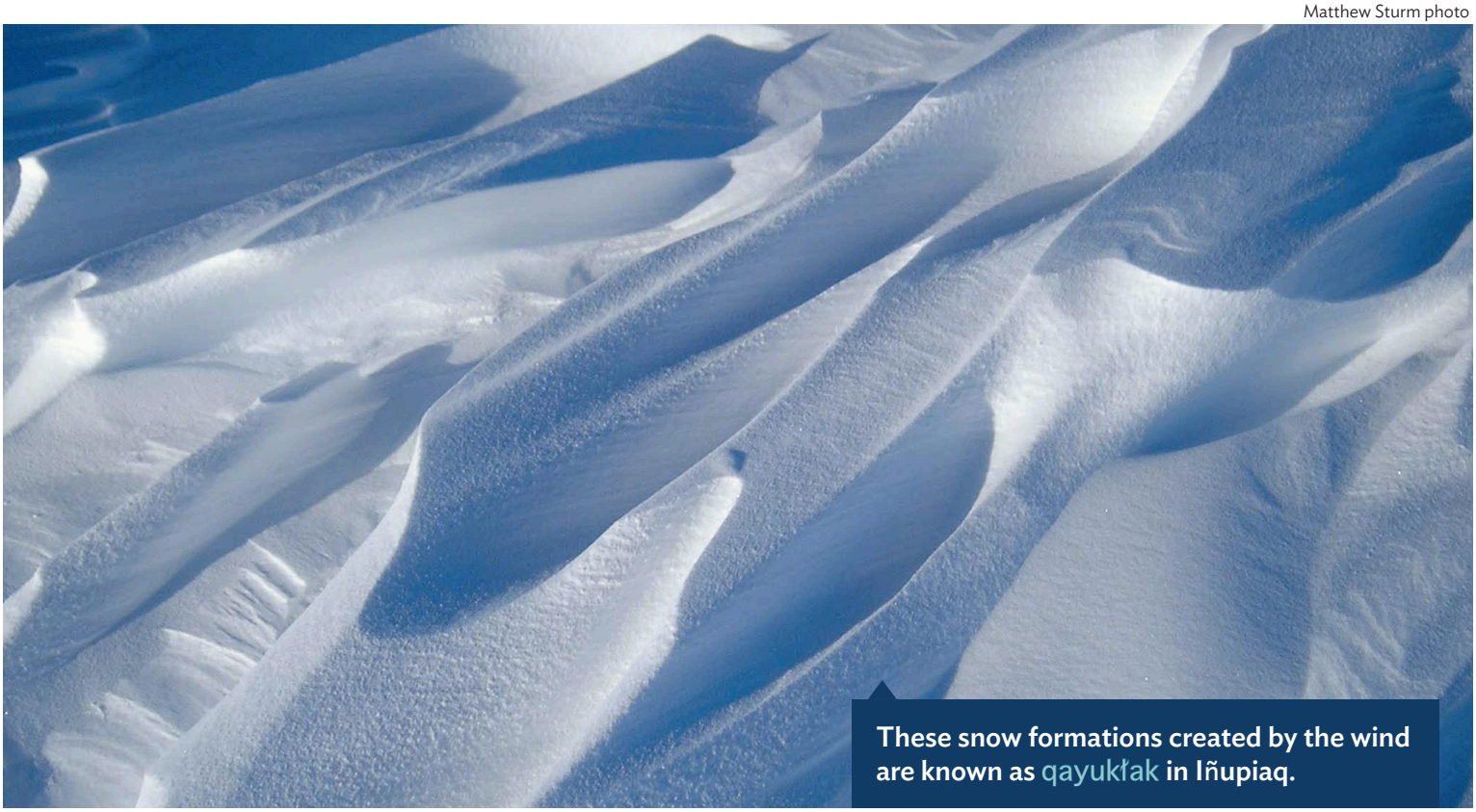
    - How do the frozen water molecules in snow move compared to the molecules in a glass of water? How about compared to steam?
    - Why are snow crystals able to hold their shape, whereas liquid water does not?

photo by Zach Locklear, UAF



Apun Simmiġuuruq
Snow Changes

Matthew Sturm photo



These snow formations created by the wind are known as qayukłak in Iñupiaq.

How does snow change after it lands on the ground?

Once snow lands on the ground, it begins to change. Anuġi (wind) can move the snow about, battering and breaking it into smaller pieces. When the anuġi stops blowing, the battered snow crystals bond together in a process known as sintering. This creates a hard crust of snow that can be sturdy enough to walk on or ride a snow machine across. This hard snow can be cut into blocks to create an anigutyaq (snow house) or a windbreak. Anuġi also shapes the snow. Snowdrift shape can indicate predominant wind direction. Have you ever ridden a snow machine over bumpy drifted snow? Iñupiaq wisdom teaches how to use the shape of snowdrifts to navigate when landmarks are not visible. Ask an Elder how to use snowdrifts for navigation.

> **Snow that has been drifted in by the wind, it makes it hard. It's solid.**
>
> *John Igauqpak Goodwin*
> *Kotzebue, Alaska*

Matthew Sturm photo

Pukak (depth hoar) crystals

Anuġi (wind) breaks snow into tiny pieces that sinter together into a hard crust.

The sun's heat melts snow crystals. Melt water bonds the crystals together to refreeze in a cluster.

The temperature difference between the ground and the air causes pukak to form.

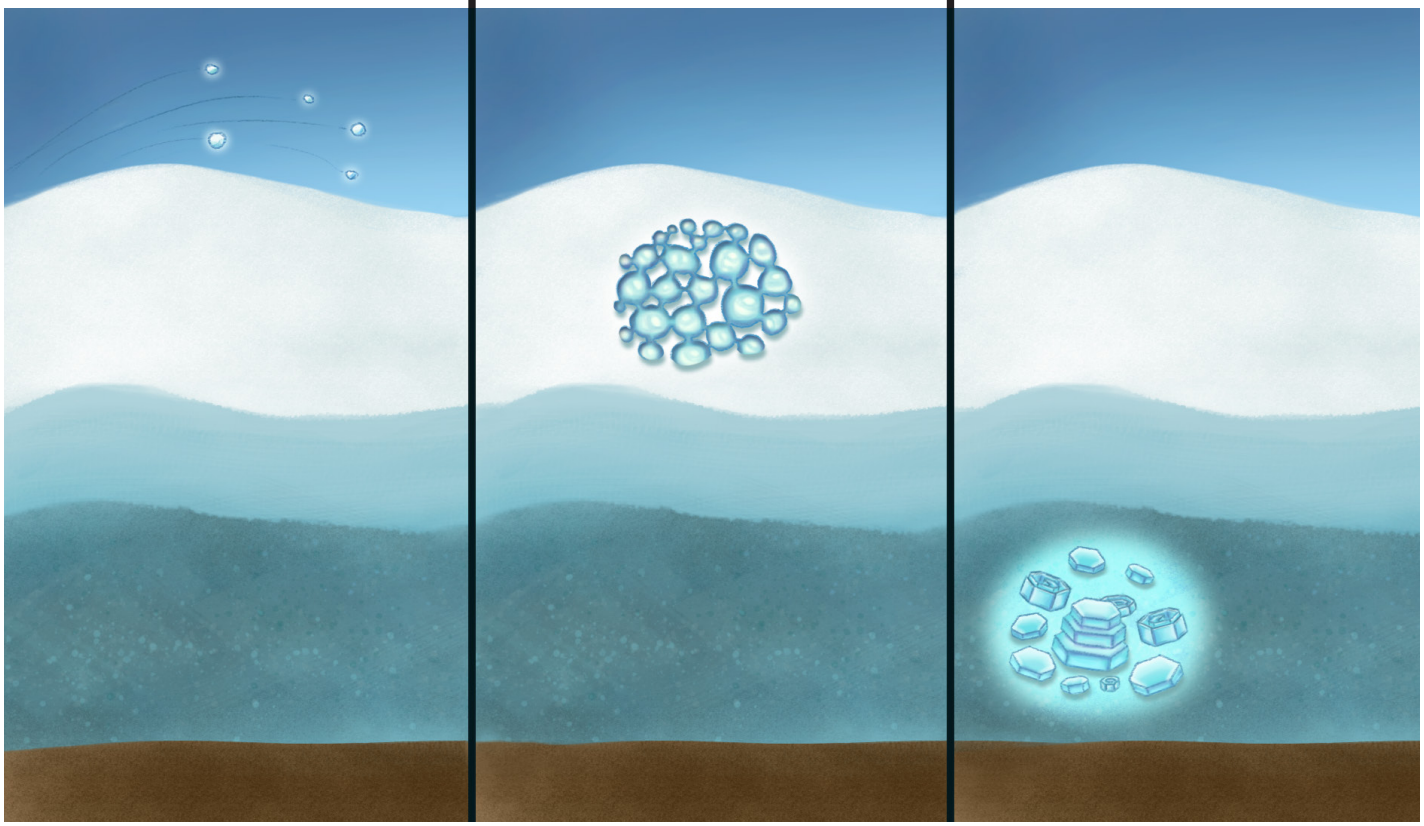


illustration by Hannah Foss, UAF

Heat also changes the snow. It can cause snow crystals to melt, rounding the edges until the hexagonal crystals become spheres. The water on the outside of the sphere gathers to form neck-like bonds of meltwater anywhere that it touches another sphere. These liquid bonds can refreeze if cold weather returns, creating a strong, hard network of rounded snow grains. They can be very slippery to walk on. Melting and refreezing is especially common in early spring. When you see slushy melting snow, you can say "Aukkaa!" which is Iñupiaq for "It melted!"

Temperature gradient (the difference between the warm air near the bottom of the snowpack and the cold air near the surface) can cause the water molecules within apun to become water vapor and move from the bottom of the snowpack upward. This causes the formation of pukak, or depth hoar. Pukak is made up of large, loosely packed snow crystals that start out as chunky hexagons but can grow into fancy six-sided cups and spirals.

> **"In May...during the middle part of the day, the sun is shining warm and it makes the snow slushy... If you step on a trail, it's okay, but if you step off the trail you could get your feet into the snow, and there's water under. And it makes it difficult to travel with snow machines."**
>
> *Hannah Paniyavluk Loon*
> *Kotzebue, Alaska*

ACTIVITY 5

Studying Arctic Snow

Iñupiat Iḷitqusiat: ***Iḷisimaŕiq Uqapiaŕiġmik*** *(Knowledge of Language),* ***Aatchuqtuutiŕiq Avatmun*** *(Sharing),* ***Savaqatigiiyuŕiq*** *(Cooperation),* ***Savvaqtuŕiq*** *(Hard Work),* ***Kamaksriḷiq Utuqqanaanik*** *(Respect for Elders),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature)*

Most experienced Iñupiaq hunters and travelers are careful observers of apun. So are the scientists who study snow as their livelihood. How and why do people observe, measure and study apun? One way to learn more about apun in your area involves digging a snow pit. Try it!

Materials:

- Shovel
- Temperature probe
- Snow viewing surface (such as black fabric)
- Hand lens
- Meter stick
- Pencil
- TRACK Talk: Studying Snow

Procedure:

1. Watch the TRACK Talk: Studying Snow.
2. Find an area of undisturbed snow near your school. Work with classmates to dig a snow pit all the way to the ground.
3. Use a temperature probe to find the temperature of the snow at the top of the snow pack, in the middle, and at the ground. Record your findings.
4. Sketch the layers of snow in your pit. Can you find the pukak layer Elders described in the videos? Place some of the pukak on your snow viewer and look at it using a magnifying glass. Draw it. Now look at and draw some of the snow crystals from the top of the snowpack. What differences do you notice?
5. Conduct a hardness test of each layer of snow you can identify. Press gently first with a pencil,

Matthew Sturm photo

then your finger, and finally your closed fist. Record the largest tool that easily poked into each layer. Which layer was softest? Which layer was hardest? Why might some layers be harder than others?

6. Use a meter stick to measure the depth of the snow. How deep is the snow in your pit? Record your findings.

7. Return to the classroom and share your snow data with your peers.

Discuss:

- What do you know about apun in your community based on the data that your class collected?
- What types of snow did you find in the pit? (Use Iñupiaq or English terms)
- How is snow observed, measured and predicted in your community?
- Can you think of a snow study that would be helpful to your community? How would it be helpful?

Uqquutaq
Insulation

Image by Jarkko Mänty | Pixabay

What is insulation?

Uqquutaq is the Iñupiaq word for insulation. Insulation is material that slows heat transfer. People all over the world rely on uqquutaq, but in the Arctic, it is especially important. During winter, you rely on the uqquutaq in your coat or parka to keep your body heat close to you. When you drink hot tea out of a thermos, you can hold the thermos in your bare hand because it is well insulated. It slows the transfer of heat from the tea to your hand. What other ways do you rely on uqquutaq?

> **"It's comfortable to have snow cover your sauligauraq (ivrulik/sod house), because inside you know you'll be warm. Even though there are higher winds, you will still be warm under the snow... it is the same for animals too, like rabbits and ptarmigan, weasels—non-hibernating animals, small game that we eat. They live under the snow too."**
>
> *Hannah Paniyavluk Loon*
> *Kotzebue, Alaska*

How is heat transferred?

There are three ways to transfer heat: **conduction**, **convection** and **radiation**.

Conduction occurs through touch. When a warm atom comes into contact with a colder atom, the warm atom transfers some of its heat energy to the cold atom. If you grab a hot dish from the oven with your bare hand, the heat from the dish will burn you by transferring quickly to your hand. Ouch! This is conduction.

Convection is heat transfer through the movement of gases and liquids. It occurs when warmer, less dense material rises above cooler, denser material in a cyclical pattern. Wind is an example of convection. When someone opens the door to your warm house on a cold winter day, and you feel cold air wash over your feet but not your face, you are observing heat transfer through convection. The cold outdoor air is sinking below the warm indoor air.

Radiation occurs when heat is transferred by electromagnetic waves. When you feel the warmth of the sun on your face, you are experiencing heat transfer through radiation. Think of more examples of heat transfer. Which method/s of transfer does each example use?

What makes something a good insulator?

A good insulator slows one or more methods of heat transfer. Most insulators slow heat conduction. Think about the differences between the two cups pictured here. Have you ever used cups like these? If so, you might have noticed that when you wrap your hand around a mug instead of holding it by the handle, the heat from the drink is conducted to your hand much more quickly than when you hold a disposable cup. Ceramic is the better conductor because it is denser. Its atoms are packed closer together, allowing energy to move quickly through the material. Disposable cups made of polystyrene foam, like this one, are good insulators because they are less dense. There is air trapped in the foam. Conduction of heat takes longer when the atoms in a material are separated by air or space.

Can you think of other examples of good insulators? What type of heat transfer do your examples impact? Do you think snow is a good insulator? Why or why not?

illustration by Vicki Daniels, UAF

ACTIVITY 6

Snow as Insulation

Iñupiat Iḷitqusiat: ***Savaqatigiiyuḷiq*** *(Cooperation),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature),* ***Kamaksriḷiq Utuqqanaanik*** *(Respect for Elders)*

If you found yourself stranded for a night on the tundra in winter, would it be warmer to sleep on top of the snow, or under the snow? Why? Test a mini snow cave to find out.

Materials:

- Two microwavable heat packs
- Microwave
- Thermometer

photo by Molly Putman, UAF

Procedure:

1. Work with a partner. Place two heat packs in the microwave so that they are the same distance from the center and heat for 25 seconds on high. Use a thermometer to find the temperature of each heat pack by gently folding the heat pack around the thermometer probe. Record your results.

ON TRACK FOR SAFETY

The thermometer probe is sharp. Use care to avoid puncturing the heat pack, yourself or others.

2. Go outside. Find an area of undisturbed snow and make a small snow cave, just large enough for one heat pack with a little space around it. Place one heat pack in the cave and the other on top of the snow nearby. Cover the entrance to the tiny cave with a bit of snow. Leave a small air hole. **Please note:** The heat packs are different colors so you can remember which was in the snow cave and which was on top of the snow.
3. Predict: Which heat pack will stay the warmest? Why?
4. Wait 7 minutes, then remove the heat packs from the snow and check the temperature of each heat pack. Record your results and compare with others in your class. What did you find? Which heat pack stayed warmer? Which was colder? Why do you think this happened?
5. Watch and listen to the TRACK Talk about snow as insulation. Discuss with your class what you learned from the Elders and other experts in the video.
6. If you were caught out in the wilderness during winter, how could you use snow to help you stay warm? Create a class sketch of a snow shelter.

Discuss:

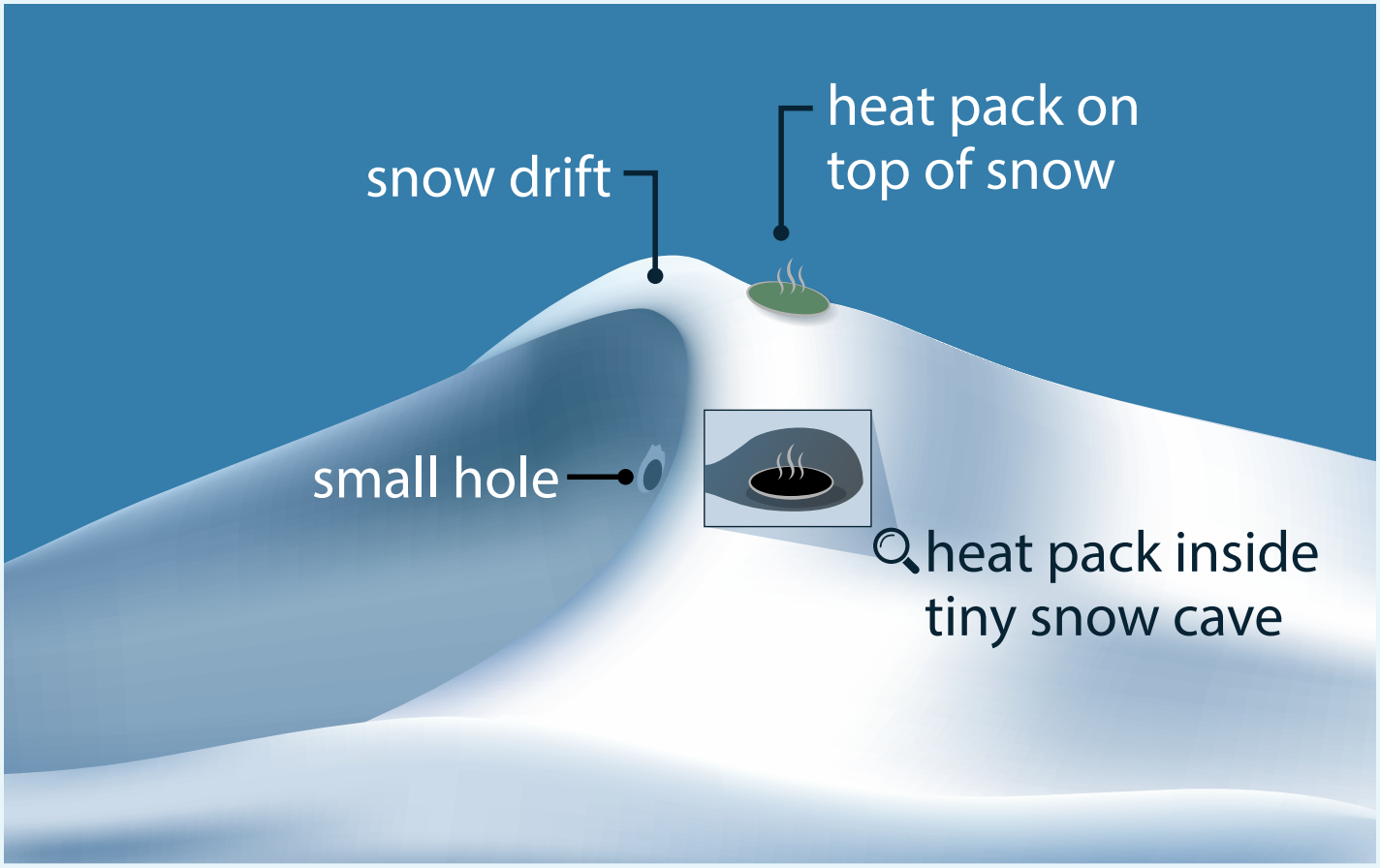
- What makes something a good insulator?
- What animals in your area live beneath the snow during winter? Why?
- How do you think a thick snow pack might affect the sea ice or permafrost beneath it?

> **In fall time, they told us to watch the weather. If it snows first before it freezes, the ice is going to be dangerous to get on.**
>
> *Polly Aġnik Schaeffer*
> *Kotzebue, Alaska*

ON TRACK FOR SAFETY

- **The Elders in the video talked about how snow can cover areas of open water. How can you detect these areas? Why is it important to be aware of this?**
- **Always keep a second small hole in your snow shelter (in addition to the entrance) so that you will have safe air to breathe. How can you maintain the hole from inside?**

illustration by Vicki Daniels, UAF



Aputim Utiqtitkaa Sayaktuutit

Snow Reflects Energy

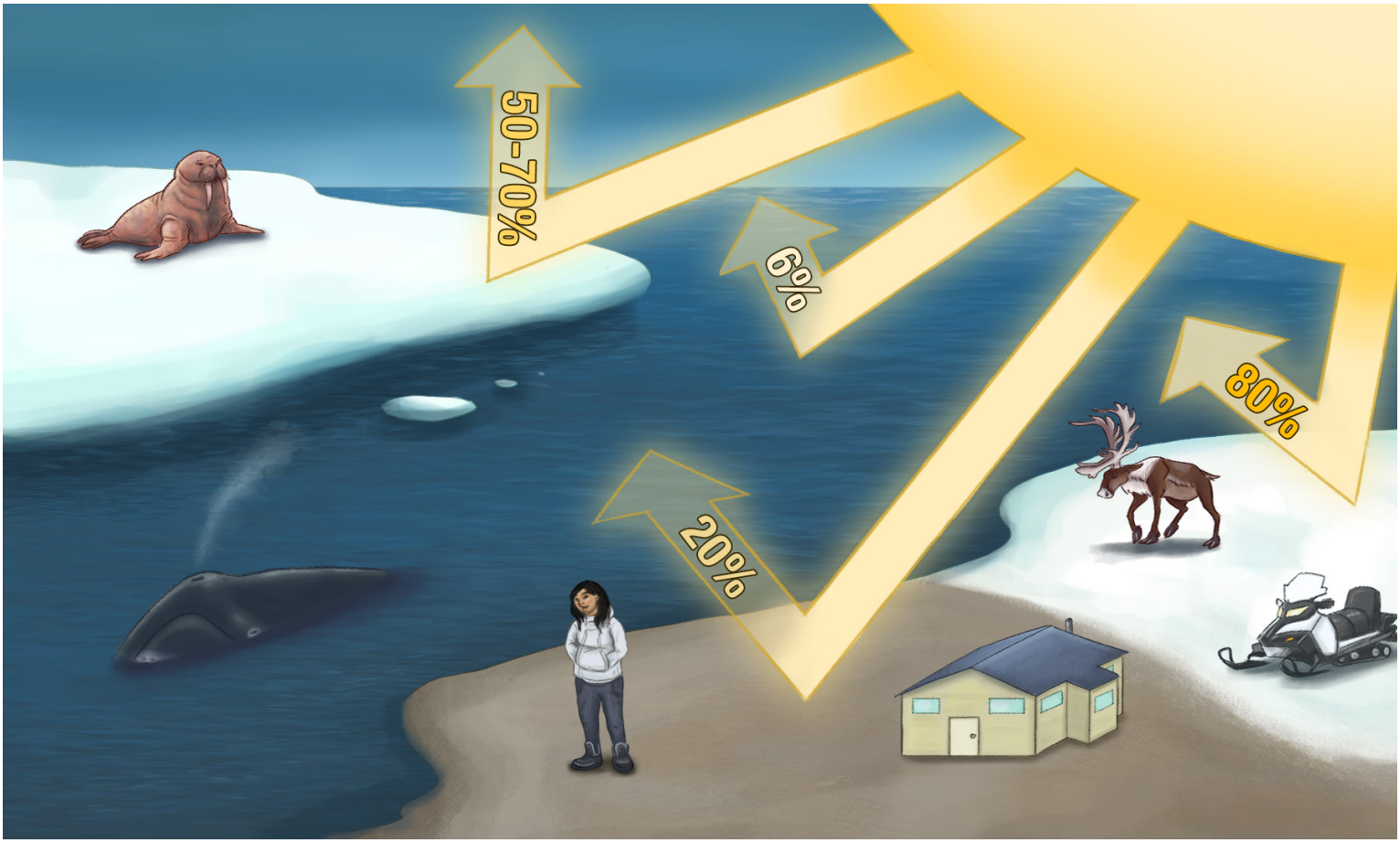


illustration by Hannah Foss, UAF

What is albedo?

The sun constantly radiates energy toward Earth. When the energy reaches Earth it can be reflected or absorbed. The reflected energy radiates back into space. The absorbed energy warms up Earth, and the atmosphere near Earth's surface. Albedo describes the amount of radiation reflected by a surface. Some surfaces are more reflective than others. Light colored surfaces reflect more energy than dark surfaces. This is important when it comes to apun (snow cover) because snow is much lighter in color than most of the surfaces it covers. Apun is so bright that it has an average albedo of about 0.8. This means that about 80% of the solar energy that strikes apun is reflected back to space. This has a cooling affect on the atmosphere, prompting some to refer to apun as Earth's atmospheric air conditioner. If there were no snow, Earth's climate would be warmer. Tundra reflects only about 20% of solar energy and ocean water reflects less than 10%. Even sea ice has a lower albedo than snow, reflecting about 60% of the sun's energy back to space. Reflection of solar radiation is another way that apun insulates Earth.

Are snow seasons changing?

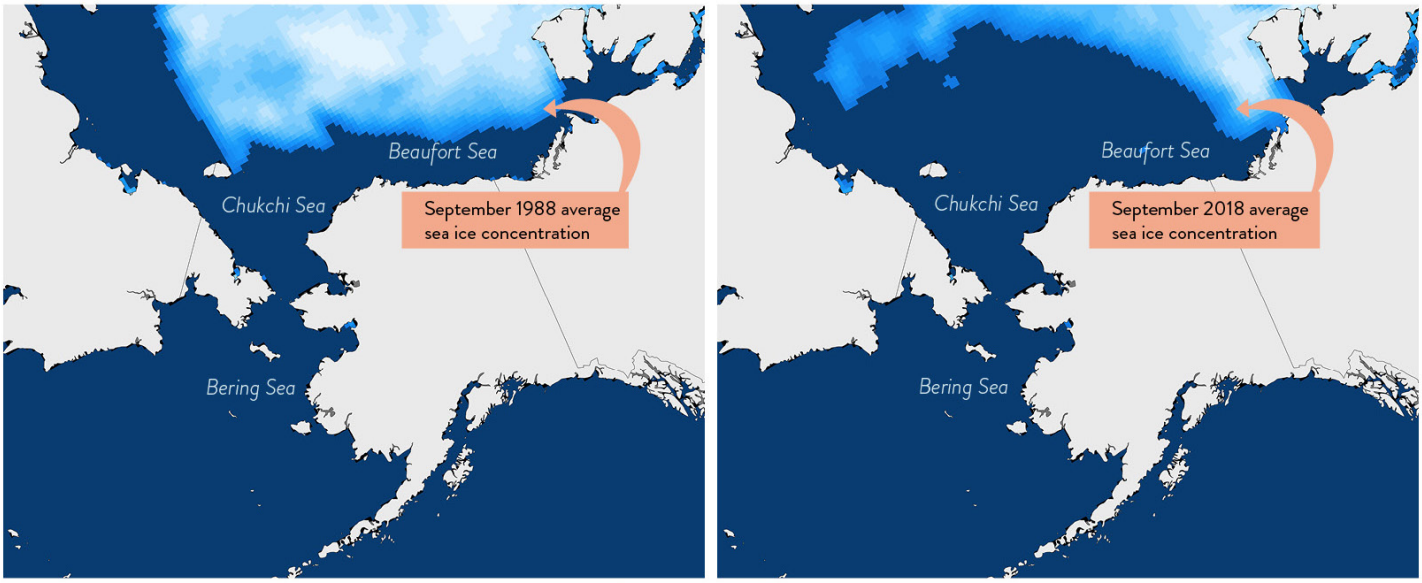
In most of the Arctic, snow is arriving later in the fall and melting earlier in the spring. This means that it covers the ground for less time than it used to in many places. How do you think this could affect the climate?

> **Our spring thaw is happening 30 days sooner. Our freeze up is happening at least 30 days+ later. Boats we should have put away in the middle of October are out in the bay in November. Growing up, I used to be able to dog team across from Sisualik to Kotzebue just at the very end of October. But today I am unable to do it until the first part of December. You know those are the big changes we're seeing.**
>
> *Cyrus Naungaq Harris*
> *Kotzebue, Alaska*

How does snow's reflectivity impact daily life?

When you step outside on a sunny winter day, you might find yourself squinting. This is because direct sunlight and sunlight reflected off the snow are entering your eyes at the same time. That is nearly twice as much light as you encounter on a sunny summer day! If you are out walking or riding a snowmachine across the snow, you must wear eye protection to prevent snow blindness. Snow blindness occurs when your eye is exposed to too much solar radiation. It is painful, but usually temporary. Snow blindness is a sunburn on the cornea of your eyeball. Iñupiaq people invented **illuksiutik** (snow goggles) to protect people from snow blindness. If someone you know lost his **illuksiutik** or sunglasses and came home with snow blindness, you could say "**Illuktuq**" which is the Iñupiaq way of saying "He developed snow blindness."

Sea ice concentration off Alaska, 1988 vs. 2018



Rick Thoman, Alaska Center for Climate Assessment and Policy
Data source: NSIDC

IARC International Arctic Research Center
University of Alaska Fairbanks

ACTIVITY 7

Energy Reflection Calls for Eye Protection

Iñupiat Iḷitqusiat: ***Savaqatigiiyuŕiq*** *(Cooperation),* ***Kamaksriḷiq Utuqqanaanik*** *(Respect for Elders),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature),* ***Aatchuqtuutiŕiq Avatmun*** *(Sharing),* ***Aŋunialguŕiq*** *(Hunter Success)*

Which reflects more energy — a light surface or a dark surface? Test it! How can we protect our eyes from snow blindness if we lose our sunglasses on the trail? Design a solution!

Materials:

- Black felt pocket
- White felt pocket
- Small desk lamp with incandescent bulb
- 2 thermometers or temperature probes
- traditional snow goggles
- contemporary sunglasses
- paper and pencil or art supplies

ON TRACK FOR SAFETY
Always wear eye protection when you are out on the snow during daylight hours.

Procedure:

1. Watch the Snow as a Reflector TRACK Talk. Discuss: What safety concerns are related to snow's reflectivity? How does the reflectivity of snow influence climate? What is albedo? Which reflects more energy — a light or dark surface?
2. Test it! Put a thermometer inside each felt pocket and record the reading. Place the pockets under the lamp and turn it on. Wait 10 minutes. Check the new temperatures inside each pocket. Which heated up most? Least? Why? How does this model what happens with snow covered ground versus bare ground? How might this relate to wearing a light vs. a dark colored jacket?
3. Look at **illuksiutik** (traditional snow goggles) and contemporary sunglasses.

Discuss:

- Why are these tools important?
- How do they protect your eyes from snow blindness?
- What do you notice about the materials or methods used to make each of these tools?
- What are some advantages and disadvantages of each material?
- What are some strengths and weaknesses of each device?

4. Work with a partner. Imagine you are traveling across the snowpack and lose your sunglasses or **illuksiutik**. You must use materials you have with you to create a new device to protect your eyes from snow blindness. Sketch or create a model of your device. Show your design to the class. Explain how your device works and what materials you used to create it. How did you come up with your idea? Were you inspired by traditional and/or contemporary devices?

5. After seeing other groups present their designs, identify a way you and your partner could improve your design.

photos courtesy University of Alaska Museum of the North, catalog numbers 0378-0013, UA2006-009-0005, and UA90-001-0017

photo by Zach Locklear, UAF

At left are Iñupiaq illuksiutik (traditional snow goggles) made from carved wood and rawhide. These illuksiutik are from the Nome area (top), Point Hope (middle), and Kotzebue (bottom). Above is a pair of contemporary sunglasses for comparison.

> **"When the sun is shining you know, and all white, if you're playing out or going somewhere and you don't have sunglasses on, then you get snowblind. So you've got to have protection on your eyes."**
>
> *Lena Suuyuk Hanna*
> *Kotzebue, Alaska*

Apun Iñuutchiqaqtuq
Snow and Arctic Life

photo by K. Joly, NPS

Caribou huddle together on a snowbank in summer to reduce harassment by biting insects.

How are Arctic animals adapted to apun?

The birds, land and sea mammals that live in the Arctic are adapted to apun. Physical adaptations are features of an animal that help it to survive in its environment. The creature might have fur or feathers that turn white in winter for camouflage in the snow, or keen hearing that allows it to detect the skitter of prey beneath the snowpack. Behavioral adaptations are things the animal does that help it to survive. This includes behaviors such as creating snow dens for warmth and safety from predators, migrating before the snow arrives, or eating snow for hydration. Think about the animals near your community. How are they adapted to apun? Which of their adaptations are physical? Which are behavioral?

Elders and snow scientists have observed that as the climate warms, the snow season is growing shorter. How do you think a shorter snow season might impact different animals in your region? How might it impact your family and community?

> **Caribou is our most important food in this area or this region. We need these multi-year snowbanks in the mountains for snow for caribou to take refuge from insects.**
>
> *Lance Qaluraq Kramer*
> *Kotzebue, Alaska*

photo by Tim Rains, NPS

An ukalliq (snowshoe hare) has large hind feet that distribute its weight over a broad area. This helps it stay on top of the snow. In the late fall, the ukalliq turns from grayish brown to white. White fur blends in with the snow.

NSF photo

A natchiq (ringed seal) has a thick layer of blubber that insulates it from the cold environment. When it is time to birth pups, the female natchiq builds a snow cave known as a lair on top of the sea ice. Pups are raised in the cave, where they are warmer and safer from predators.

How are Arctic plants adapted to the snow?

Arctic plants also have physical and behavioral adaptations to the snow. Tundra plants rely on the melt-water from winter snow for much of their moisture. Their small leaves prevent the limited moisture from escaping. They also tend to grow close together and near the ground. This allows the snow to blanket them during the bitterly cold winter, insulating them and protecting them from the wind. Taiga plants such as spruce trees have a cone-like shape that prevents snow from piling up and breaking the branches. What are some of the important plants that grow around your community? How do you or others in your community rely on these plants? How the plants around you adapted to the snow?

photo by Denali Whiting

Asiat (berries) such as the ones shown here are an important subsistence fruit. The plants are buried beneath snow for much of the year, so they must flower and fruit quickly during the short growing season. These berries are locally known as blackberries. Their official name is crowberry.

ACTIVITY 8

Adapted to Survive

Iñupiat Iḷitqusiat: ***Savaqatigiiyuŀiq*** *(Cooperation),* ***Kamaksriḷiq Utuqqanaanik*** *(Respect for Elders),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature),* ***Aatchuqtuutiŀiq Avatmun*** *(Sharing),* ***Aŋunialguŀiq*** *(Hunter Success),* ***Piqpaksriḷiq Iḷiḷgaanik*** *(Love for Children),* ***Iḷisimaŀiq Uqapiaŀiġmik*** *(Knowledge of Language)*

Many people in the Arctic harvest local plants and animals for subsistence. Does your family? Even animals and plants that are not harvested by people can be an important part of our food chain. Animal and plant adaptations to snow are essential to survival. Which animal and plant adaptations would you like to know more about?

Procedure:

1. Invite Elders to the classroom or speak to them on the phone and ask them to tell you about how local plants and animals are adapted to apun.
2. Watch the TRACK Talk: Snow and Arctic Life.
3. Discuss the different animals and plants in your region and how they are adapted to the snow. How do they rely on the snow? How does it help or hinder them? How do they fit into the subsistence food chain for your community? What could happen to these plants and animals if there were less or more snow? What if the snow arrived later or melted earlier?
4. Work with one or two partners. Identify a local animal or plant that is important to your community and use what you learned from the Elders and the film, along with your school library, and the internet to research how the plant or animal is adapted to snow.
5. Create a poster or flier all about the animal or plant that includes:
    - Photos or drawings of the animal or plant
    - Iñupiaq and English name of the animal or plant
    - List of physical adaptations to snow
    - List of behavioral adaptations to snow
    - Description, drawing or photos of how the animal or plant is important to your community.
    - Answer to the question: How might a change in snow impact this plant or animal?
6. Work with your group to share your poster or flier and findings with the rest of your class. Hang your poster or flier where younger students can learn from it. Invite a young child in your community to see it and share what you learned.

Arctic Plants & Animals

Note: *Some local English names deviate from official English names. The "salmonberry" shown here is officially a cloudberry. The "cranberry" shown here is officially a lingonberry.*

ukalliq
snowshoe hare

tuttu
caribou

asiavik
blueberry

qusrkhaaq
arctic fox

ugruk
bearded seal

aviŋŋaq
lemming

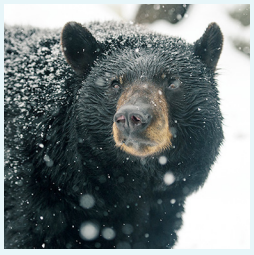
aqpik
salmonberry

ugruŋaq
shrew

sisuaq
beluga whale

tiniikaq
moose

umiŋmak
muskox



iyyaġriq
black bear

quaġaq
sourdock

qapvik
wolverine

pamiuqtuuq
river otter

aqargiq
ptarmigan

tiġiaq
ermine

paʟuqtaq
beaver

aiviq
walrus

tulugaq
raven

kipmiŋñaq
cranberry

amaġuq
wolf

niutuiyiq
lynx

ukpik
snowy owl

uqpiich
willow

Photos courtesy:
DeaShoot | flickr (hare); peupleloup | flickr (caribou); Kevin Phillips | Pixabay (blueberry); pexels (fox); Alastair Rae | flickr (seal); Karen Kohn (lemming); Denali Whiting (salmonberry); Mike Taras | ADF&G (shrew); pxhere (beluga); Skeeze | Pixabay (moose); David Mark | Pixabay (muskox); Eric Kilby | flickr (bear); Denali Whiting (sourdock); Andrea Bohl | Pixabay (wolverine); Sara Germain (river otter); Nathan Graff | USFWS Yukon Delta NWR (ptarmigan); Fiona Paton | flickr (ermine); Erwin Weston | USFS (beaver); skeeze | Pixabay (walrus); Todd Paris | UAF (raven); Denali Whiting (cranberry); Rain Carnation | Pixabay (wolf); Klaas Huizenga | Pixabay (lynx); David Hemmings | wikimedia (owl); and Denali Whiting (willow).

Anigutyaq
Snow House

photo by Siri Spjelkavik | flickr

How can we use apun to stay safe in the Arctic?

Snow can be both dangerous and helpful in a survival situation. It is essential to know how to prepare for traveling on apun and what to do if you are stranded in the snow. One strategy is to build a snow shelter. Iñupiat have been building snow shelters for millennia, because snow is good uqquutaq (insulation). There are many different ways to build a snow shelter. Different shelters require different types and amounts of snow. One kind of snow shelter is the anigutyaq (snow house). Other snow shelters involve tunneling into snow near willows, digging a trench or a snow cave, or using materials such as tarps to create shelters that then accumulate snowy uqquutaq. Have you heard survival stories that involved building snow shelters? If so, what did you learn from the stories? Have you retold the stories to others?

> **Snow is one of the important things around... it's the cheapest building material in the world. You can saw right there and build an iglu right there, right where you sawed it. That there is a real good use for the snow.**
>
> *John Igauqpak Goodwin*
> *Kotzebue, Alaska*

ON TRACK FOR SAFETY

Put willows, a tarp, grasses, spruce branches or other material under you to keep yourself as dry as possible in the shelter.

illustration by Hannah Foss, UAF

Snow shelters work by insulating you from the cold. The snow shelter slows the transfer of heat so that it is warmer inside the shelter than it is outside. The heat from your body and other sources such as a small candle can be enough to make the inside of a snow shelter comfortable.

Lucy Schaeffer sheefishing in 1949 with a windbreak made of snow blocks behind her.

photo by Gladys Knight Harris

ACTIVITY 9

Build a Snow Shelter

Iñupiat Iḷitqusiat: ***Savaqatigiiyuƚiq*** *(Cooperation),* ***Kamaksriḷiq Utuqqanaanik*** *(Respect for Elders),* ***Kamaksriḷiq Nutim Iñiqtanik*** *(Respect for Nature),* ***Savvaqtuƚiq*** *(Hard Work),* ***Aŋunialguƚiq*** *(Hunter Success),* ***Piqpaksriḷiq Iḷiḷgaanik*** *(Love for Children),* ***Iḷisimaƚiq Uqapiaƚiġmik*** *(Knowledge of Language)*

Iñupiaq people have lived in the Arctic for thousands of years, and have passed down survival knowledge for generations. Have you seen an emergency snow shelter? Learn how to build a snow shelter from Elders or hunters in your community. Share what you learn with younger students.

Procedure:

1. If local health conditions allow, invite an Elder, hunter or another Iñupiaq knowledge bearer who knows about snow survival to the school to help guide your class in building a snow shelter.
2. Depending on the snow conditions in your community, you may need to gather a tarp, shovel, snow knife, or other supplies. Ask your local expert what you will need.
3. With the help of your local expert, find a spot near the school and work together to construct a snow shelter that will fit one or two people.
4. Ask your local expert to share any stories they have about winter survival or rescue situations. Think about their story. What contributed to the danger of the situation? How did the person survive, or rescue another? How did they know what to do? What can you learn from the story?
5. Invite younger students to explore the snow shelter. Remind them to use caution around the shelter to ensure it does not become damaged or collapse. Explain to younger students the importance of snow and snow safety in your community and teach them some of the Iñupiaq terms that you learned related to snow. Share with them one of the snow stories you learned from the video or from the local experts who visited your classroom.
6. Changes to the snow can degrade the snow shelter over time. Destroy the snow shelter immediately after you have completed the activity, so there is no risk of it collapsing on someone later.

Northwest Arctic Borough School District photo

Maggie Melton tries out a snow cave she helped build. A snow cave is one kind of emergency snow shelter.

Please note:
The Iñupiaq terminology in this Student Guide is from the Coastal Iñupiaq dialect spoken in the Kotzebue area. Check with local speakers to find out if some of the terms in your community are different.

Quyaanna (thank you):
Special thanks to the native villiage of Kotzebue and the Qikiqtaġruŋmiut people. Kotzebue Iñupiaq community members Lena Suuyuk Hanna, Hannah Paniyavluk Loon, Lance Qaluraq Kramer and Macy Kikiktagruk Kenworthy guided content development for this publication. Quyaanna to this team and the many additional local knowledge bearers, educators and scientists who contributed their expertise, interviews, data, and pictures to this project. The information provided in this publication is for educational purposes only and not for commercial use.

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