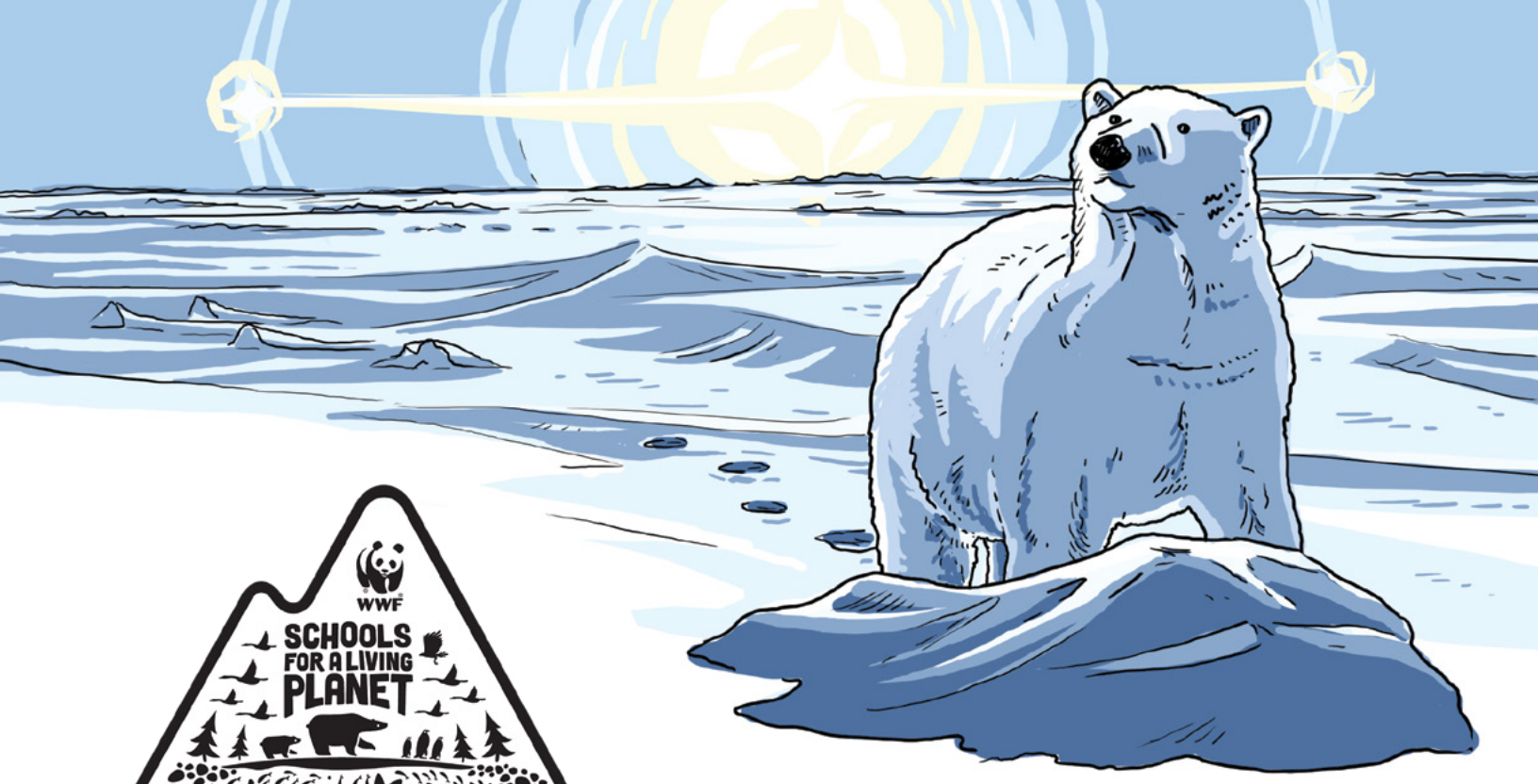


Gr.5 Snow Mechanics

SNOW AMAZING!

OBJECTIVE Students will examine how snow impacts life in Nunavut.

Northerners live in a world dominated by ice and snow. Snow is an excellent way to discuss the concepts of property change in matter. A snow crystal begins as a single drop of water on a particle in a cloud. As snow collects in the autumn, it develops layers depending on the amount of snow that falls. Snowflakes change through action of wind and warmth from the sun, causing drifts, ridges and cornices.

Snow is absolutely essential for plant, animal and human life in the Arctic. Polar bears, for example, rely on sea ice to hunt for seals and on snow to make the maternity dens where female polar bears spend the winter nursing their cubs. Perhaps your students have not considered the importance of snow to other species' ability to survive.

Polar Bear

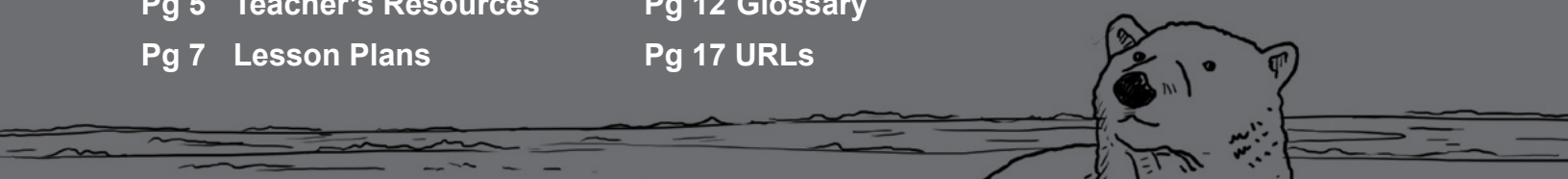
Snow Amazing! Inspiration

Polar bears are the Arctic's top wildlife predator. With its amazing sense of smell, a polar bear can smell a seal nearly 1.6 km away. One seal provides the polar bear with the same amount of meat found in 400 hamburgers! But this mighty species is at risk as climate change melts the sea ice beneath polar bears' paws.

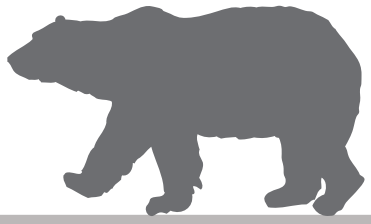
Polar Bear *(Ursus maritimus)*

SMART Board / Promixa Ready

Northern Resources



CURRICULUM Links



The activities and resources in this document are intended to tie in with Grade 5 science curriculum *Matter and Materials: Properties of Change in Matter and Earth and Space Systems: Weather*, Grade 5 language arts as well as the *Inuuqatigiit* curriculum relating to the land. You can find specific learning outcomes for each of these by following the links below.

The Inuuqatigiit curriculum contains a lot of useful advice about bringing northern culture, language and traditional knowledge into the classroom. In culture-based education, teachers are expected to offer students the opportunity to extend learning experiences necessary in K-12 skills. Teachers are to involve students in key experiences, both on the land and in school. In addition, culture-based education is enhanced with the involvement of Elders. The Government of the Northwest Territories Department of Education has developed a resource to provide valuable information about inviting Elders to contribute to lessons and related activities. Interview templates are included as well as practical advice about compensation (see **Teacher's Resources**).

Here are some examples of where the lessons in this resource connect with these different curricula. Some suggestions for making connections have been included in the lesson plans, too.

Grade 5 Science & Technology

General Learning Outcome

Investigate common changes of state (e.g., melting, freezing, condensing, evaporating) and make informed choices about materials when finding solutions to problems in designing and constructing objects based on their understanding of the states of matter.

Specific Learning Outcomes

Students will compile data gathered through investigation in order to record and present results, tally charts, tables and labeled graphs produced by hand or with a computer (e.g., accurately use a thermometer to read and record the results).

Connected Lessons

Lesson 2 - How Snow Changes

This lesson provides an opportunity to discover and measure a snow profile.

Grade 5 Language Arts

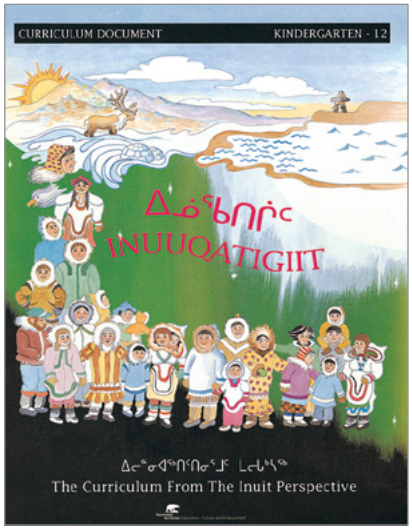
ELA: (GO.SO)
1.1, 1.2, 2.2, 2.4, Lesson 1, 2, 3, 4: Snow Notes Notebook 3.1

CURRICULUM Links

Inuuqatigiit

General Objectives

Students will begin to develop a habit of frequently observing the weather and noting changes, explore beliefs about weather and how Inuit cope with the weather, and begin to learn traditional ways of predicting weather using the Sun, moon, stars, etc.



Key Activities

Have the students write stories about being caught in a storm. *What did their families do during the storm?* As a class observe the weather several times each day and keep detailed records. Continue this over a period of time - notice patterns and challenge students to begin to predict the weather.

Connected Lesson

Lesson 1 - The Science of Snow
Lesson 2 - How Snow Changes

These lessons provide opportunities to discuss how the land will always have winter, cold and storms and that children will need to be prepared to cope with the weather.

JOURNALS

© Peter Ewins / WWF-Canada

Lichens growing on a partially snow-covered rock surface, Igoolik, Nunavut, Canada.

Snow Notes Notebooks

Students can design their own snow notes notebooks for recording observations and questions as they explore the snow and weather. Keeping a field journal helps develop scientific inquiry and research skills. Journals can be simple, homemade books with lined pages or sections for note taking and plain sections for sketching. **Great Stems** has an excellent, step-by-step guide for making nature journals. You can find the link in the **Teacher's Resources** section on page 6.

Journals can be used as assessment tools for almost all of the lesson ideas in this resource. Some suggestions for how to use them have been included. Consider pairing students who need help writing their ideas down with a student who can scribe for them, allow them to complete their notebook on the classroom computer or create a video blog.

Green Teacher Magazine

See the section on evaluating nature journals.

TEACHER'S Resources

© Sybille Klenzendolf

Komatik ready for use in the community of Arviat.

Books

APUN The Arctic Snow Teacher's Guide
Matthew Sturm
University of Fairbanks Press, 2009
ISBN 978-1602230705

APUN The Arctic Snow Student Text
Matthew Sturm
University of Fairbanks Press, 2009
ISBN 978-1602230699

Snow
Valerie Bodden
Creative Paperbacks, 2014
ISBN 978-0898129212

Plants and Animals of the North
Heather Kissock and Leia Tait
Weigl Educational
Publishers LTD, 2010
ISBN 978-155388949

Snow Amazing: Cool Facts and Warm Tales
Jane Drake and Ann Love
Art by Mark Thurman
Tundra Books, 2004
ISBN 978-0887766701

Snow and Ice Canadian Winter Weather
Nicole Mortillaro
Canada Up Close series
Scholastic Canada, 2005
ISBN 978-0439957465

Videos

Bill Nye the Science Guy (24:00)
Full episode on seasons - check school library/interlibrary loan.
www.dailymotion.com/video/x3cy9j0

The Chemistry of Snowflakes (2:00)
www.youtube.com/watch?v=VYrF3sFBY20

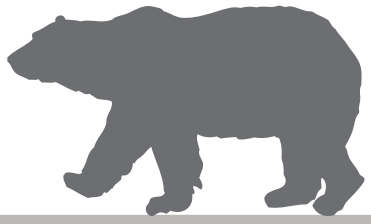
Building a Snow Cave: Ray Mears' Extreme Survival (4:00)
How to make a warm, snow cave hideout if caught in the mountains. This video demonstrates the utility of the snow.
www.youtube.com/watch?v=XOJQPz1s-1c&list=PLA1C1470F81D49D8D&index=6

How to Build an Igloo: A Boy among Polar Bears (3:00)
A young Inuit builds his first igloo
www.youtube.com/watch?v=R-x5QOSqP3E

How to Make a Perfect Igloo: Ray Mears' World of Survival (4:00)
Make the best igloo
www.youtube.com/watch?v=1aSL9La5ivo

Snowflake Safari (animated) (4:00)
How to hunt for a variety of snowflakes.
www.sciencefriday.com/video/12/31/2009/snowflake-safari.html

TEACHER'S Resources



Websites

Elders in Schools Handbook
www.ece.gov.nt.ca/files/publications/elders_in_schools_handbook_en_web.pdf

Great Stems
Find a step-by-step guide for making journals
www.greatstems.com/2013/05/wildlife-projects-for-kids-making-a-nature-journal.html

Green Teacher Magazine
A handy guide for evaluating students' nature journals
www.greenteacher.com/back-issues-index/green-teacher-69-fall-2002/

Historical weather data for communities in Nunavut
www.climate.weather.gc.ca/climate_normals/index_e.html

AVG snowfall for Canadian cities
www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/phys08a-eng.htm

"The Unfrozen North" article
www.theglobeandmail.com/news/national/the-unfrozen-north-circa-2067/article17934974/

Species At Risk
www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=823

WWF polar bear information
www.wwf.ca/conservation/arctic/wildlife/polar_bear/

Polar Bear Fact Sheet from the Government of Nunavut
www.gov.nu.ca/sites/default/files/Polar%20Bear_0_0.pdf

LESSON Plans

Lesson 1:
The Science of Snow

1 class period. Includes formations of snow, types of snowflakes how they form and the science of snow.

Begin your exploration of snow with your students by asking them to share what they think of when they hear the word **snow** using a mind web or mind map.

Based on your class discussion, ask students to reflect on what they know and what they might like to find out about snow. See **Teacher's Resources** for detailed weather information if needed.

Snow Discovery (3:30)

Discovery video on historical research on snow and snowflake formation.

Science Friday: Snowflake Safari (4:00)

Present-day research on snowflake shapes (amusing animation and commentary).

Chemistry of Snow (2:00)

Bytesize science clip on the chemistry of snow.

© Benjamin Balázs

Mind Map it out!

Discussion Questions

- *How does snow form?*
- *How many shapes can a snowflake be?*
- *How many different kinds of snow have you seen?*
- *How many different words do you know to describe snow?*
- *What happens to the snow that is on the bottom layer of the snow cover?*
- *Explore the idea of where snow falls and why. What is the range of snow accumulation in Canada? In North America? On planet Earth?*

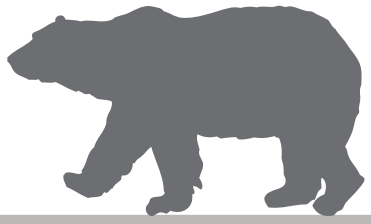
Assessment Opportunity

Provide an opportunity for students to create their own snow notes notebooks (see **Journals** section). Students can also create their notebooks using a computer (if possible).The mind map could also be used as an assessment tool as it can be used to compare what the students knew coming into the lesson, and what they have learned at the end.

Based on your class discussion, review and guide your students to reflect on what they know and what they might like to find out about snow. Ask students to fill in the first two pages of the notebook.

Page 1 - When I think of snow I think about...

Page 2 - K-W-L Chart - Fill in 5 ideas in the **Know**, and **What I Want to Learn** of students' personal K-W-L chart.



Lesson 2: How Snow Changes

2 to 3 class periods.

Before snow can accumulate to build a layer of snow cover, the ground must freeze. The first snowfall of the year usually melts upon contact with the ground, as there is a lot of heat stored in the ground. Once the ground has frozen, the snow does not melt and the layering process begins. Researchers are noticing that the evening average temperatures are rising as the Earth is absorbing more heat energy. Some climate change researchers say that climate change happens at night. The following link provides more information on this research.

The unfrozen north, circa 2067

There are three main metamorphic (change) factors that alter the original snowflake: wind, heat and cold (Source: APUN).

Wind blows the snow around, beating the flakes together, often grinding them into fine particles.

Temperature Gradient is the difference in temperature within the snow pack. Under the snow cover, the heat from the Earth is released and it causes water vapour to move between snow particles. This movement of vapour happens through the process of **sublimation** and **condensation**. Sublimation occurs when the snow crystal changes to water vapour. Condensation occurs when the water vapour cools and changes to liquid water. Under the snowpack, this water then refreezes which is why the deepest layer of snow has the largest grains and is very crumbly.

Solar Heat heats the top layer of snow and can cause the surface to become hard and icy, as well as causing meltwater to create "hidden icicles" within the snowpack.

In order to see the changes in the snow your students will need to have a close-up look at a snow profile.

Classroom Investigation Snow Pit

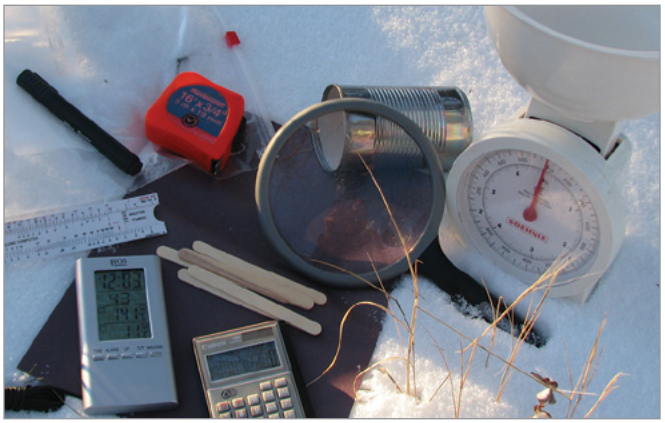
Students will work as a class or a group to construct a snow pit near their school and study the exposed layers of snow. The class or group will identify an undisturbed area and dig a snow pit. Students will then examine the snow pit to see if they can identify and mark different layers in the snowpack.

Show one of the videos on igloo building

(see **Teacher's Resources**).

Teacher Notes

- This activity will likely be most effective if run towards the end of the winter season.
- If you are doing a weather study as part of the *Earth and Space* strand or *Inuuqatigiit - Weather and Weather Forecasting*, conduct this activity at the end of the weather observation month. The top layers of snow will correlate to the most recent weather events.
- Depending on the class size, have students work as a class or in large groups to do this activity.
- Assign responsibility in the activity process (e.g., one person measures the snow profile depth, two people identify the layers, one person measures the thickness, one person records the measurements, etc.).
- It will be useful for the teacher to explain why the differences in the snow layer happen and what the names of the snow crystals are (e.g., large coarse crystals at bottom of snow cover are called "depth hoar" (some may call it "sugar snow"), firmer upper layers are made of bonded snow crystals that have "sintered" (bonded together). This type of snow can be cut or sliced into snow blocks for igloos). *Can they identify an icy crust between layers?* This would indicate a former top layer that changed due to wind and sun exposure.



Snow Pit Activity Continued

You'll need:

- black construction paper
- sampling cylinder (you can use an old soup can with both ends removed)
- shovel
- permanent black markers
- magnifying glasses
- medium-sized plastic freezer bags
- measuring tape
- popsicle sticks
- thermometer
- ruler or metre stick
- calculator
- digital camera.
- Optional - Multiple graduated cylinders and a weigh scale (small spring scales are useful outside)

Snow Pit Investigation Steps

1. Take your students out to explore the snow in the school yard, a neighbouring yard or park. You will need to find a section of snow cover that has been undisturbed by human impact (no snowmobile tracks or footprints). As a class, identify the ideal location to dig the snow pit(s).
2. Assign each student a responsibility in the activity process (e.g., one person measures the snow profile depth, two people identify the layers, one person measures the thickness, one person records the measurements, etc.).
3. Students are to take turns digging out a 1 m x 1m square pit (can be made larger if necessary).
4. Students should be able to identify several different types of snow crystals in the snow pit.
5. Pushing the sampling cylinder into each layer of snow, students can collect the snow samples. Spread the sample out on black construction paper and provide the students with magnifying glasses so they can see the crystals clearly.

Assessment Opportunity

On page 3 of their snow notes notebooks, students will record their observations about their snow pit.

Snow pit data to be recorded in snow notes notebook:

- Total depth of the snowpack
- For each layer: thickness (distance from top to bottom of snow layers), temperature (current), range of snow grain size (describe), volume of snow sample (use graduated cylinders) and weight of snow sample (weigh melted sample).

Snow blowing on ice in Grise Fiord, Nunavut

Extension

If your class has also been recording daily weather observations, students can compare the data that they collected for each layer in the snow profile with the daily weather measurements. Have students identify relationships between the physical characteristics of each snow layer data and their weather data.

Student Reflection

Now is a good time for students to revisit their K-W-L charts in the snow notes notebooks. In addition to reflecting upon what they learned through the process of digging and measuring a snow pit, encourage them to reflect on the changes in the temperature of the snow layers. *What does this mean for the survival of plants and animals?*

Lesson 3: Cultural Connection

1 to 2 class periods.

Using the cultural curriculum for your region, provide your students with several choices of activities that relate to an area of interest (weather predicting, northern lights, etc.). Consider inviting an Elder to discuss the importance of snow to animals, plants and people (see guide to **The Elders in the Schools Handbook** in **Teacher's Resources**).

WILD Ideas

Snow block.

Catch snowflakes

On a snowy day, take the students outside with black construction paper and magnifying glasses. If possible, take digital photos and prepare a snowflake slideshow.

Snow Sculpture

Students can be provided with large blocks of snow to sculpt. Preparation: fill a large cardboard box with loose snow - allow to set overnight. Have an outdoor art show of all the snow sculptures.

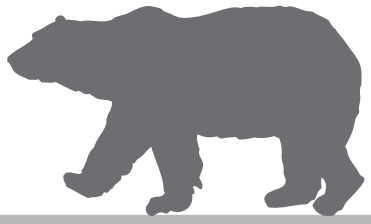
Art activity

Make cutout snowflakes. Templates can be printed and traced, but it is better if students create their own; as in nature, no two should be alike.

Imagine snowflake

Students write about the journey of the flake starting in the cloud and following its path to landing somewhere on Earth.

Glossary



Nunavut has two official languages: Inuktitut and Inuinnaqtun. Inuvialuktun is used in some parts of western Nunavut. Languages develop over thousands of years and they tell us a lot about the people who speak them and the environment that they live in. You've probably heard that Inuit have many different words for snow. This is because there are many different types of snow in the Arctic and knowing the difference between them and what they can be used for at one point in time would have meant the difference between life and death. We asked speakers of some of these languages to translate some of the key words in these resources and provide literal back translations. You'll see that some words translate easily while some require very long explanations. The same is true when trying to translate from Aboriginal languages into English and French. There are many words that have no translation. Try using these translations to have a conversation with your students about the differences between languages and how they reflect different ways of life and ways of thinking. This would be a great opportunity to invite a native language speaker into the classroom too.

Polar bear

Inuktitut Nanuq / Polar Bear

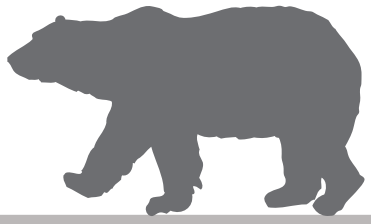
Inuvialuktun Nanuq

Snow Crystal / Diamond Dust

Very tiny amount of water frozen to a particle – formed in a cloud

Inuvialuktun Pukak

Glossary



Snowflake

Snow crystal that has grown in size and becomes heavy enough to fall out of a cloud.

Inuktitut	**Qanniq** / Snowflake
Inuvialuktun	**Qanik**
Inuinaqtun	**Qanik**

Ice

Frozen water

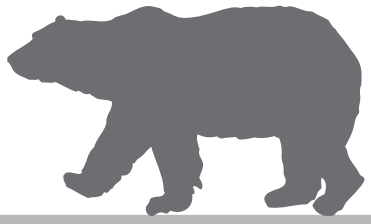
Inuktitut	**Siku** / Ice
Inuvialuktun	**Siqu**
Inuinaqtun	**Hiku**

Condensation

Water that collects as droplets on a cold surface when humid air is in contact with it.

Inuvialuktun	**Qakurnaktuaq**
Inuinaqtun	**Aumaluangniq** / Sweating droplets

Glossary



Freezing

(of a liquid) be turned into ice or another solid as a result of extreme cold

Inuktitut	**1. Quaqpalliajuq** / Starting to freeze / **2. Sikujuq** / Newly formed ice on the sea
Inuvialuktun	**Piqsiq**
Inuinaqtun	**Hikutingniq** / Areas of ice forms

Hoar Frost

A grayish-white crystalline deposit of frozen water vapor formed in clear still weather on vegetation, fences, etc

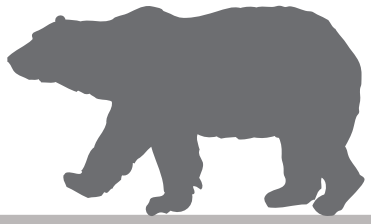
Inuktitut	**Ilusimajuq** / It is covered with frost
Inuvialuktun	**Qakurnaktuaq aryaqpauk-qatiqtuq**

Metamorphic

A change of the form or nature of a thing or person into a completely different one, by natural or supernatural means

Inuktitut	**Asijjiqpalliajuq** / Beginning the transformation of change(s)
Inuvialuktun	**Ungavausigaa nuna** / Land that is changing

Glossary



Melting

Make or become liquefied by heat.

Inuktitut 1. Aukpaliajuq / In the process of melting /
2. Auktuq It is melted / 3. Manguqsiaq / Food: thawing

Inuvialuktun Auqinigaa

Inuinaqtun Auktuqtiliqtuq

Sublimation

The process whereby a solid substance transforms directly into a vapor when heated.

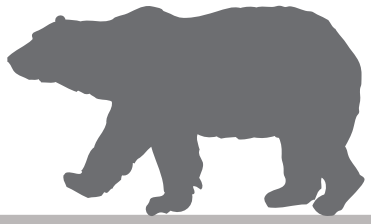
Inuvialuktun Auqiniktuaq puyuqmun / When ice melts there is steam

Evaporation

To turn from liquid into vapor

Inuvialuktun Imaqmun puyuq

Glossary



Temperature

The degree or intensity of heat present in a substance or object, especially as expressed according to a comparative scale and shown by a thermometer or perceived by touch.

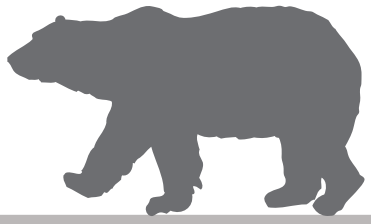
Inuktitut	**Niglinarninga** / The level of coldness / **Uunarnarninga** / The level of hotness
Inuvialuktun	**Sila** / Refers to the weather
Inuinaqtun	**Qiqautilaanga** / Measurement of coldness / **Uunaqtilaangalu** / Measurement of heat

Temperature Gradient's Effect on Snow

It makes water molecules move from warm snow grains (which are nearer the ground) to cold ones (which are nearer the air). The bottoms of the grains grow fast. The tops of the grain disappear (evaporate).

Inuvialuktun	**Silaam ungavauigaa apun** / How the temperature affects the snow

URLs



Some hyperlinks have been embedded throughout the **Snow Mechanics** resource. If a link appears to be broken, try visiting the homepage or keying in the URL as it's written below.

Learn more about polar bears
http://www.wwf.ca/conservation/arctic/wildlife/polar_bear/

Grade 5 science curriculum
http://www.ece.gov.nt.ca/files/Early-Childhood/K-6%20Science%20%26%20Technology%20CurriculumFINAL%20.pdf

Inuuqatigiit curriculum
http://www.ece.gov.nt.ca/early-childhood-and-school-services/school-services/curriculum-k-12/aboriginal-languages#inuuqatigiit

Elders in Schools Handbook
http://www.ece.gov.nt.ca/files/publications/elders_in_schools_handbook_en_web.pdf

Green Teacher Magazine
http://greenteacher.com/back-issues-index/green-teacher-69-fall-2002/

Discovery Video
https://www.youtube.com/watch?v=fd-hb2xzvZI

Science Friday
http://www.sciencefriday.com/video/12/31/2009/snowflake-safari.html

Chemistry of snow
https://www.youtube.com/watch?v=VYrF3sFBY20

Climate change article in the Globe and Mail
http://www.theglobeandmail.com/news/national/the-unfrozen-north-circa-2067/article17934974/

Igloo-building video 1
https://www.youtube.com/watch?v=R-x5QOSqP3E

Igloo-building video 2
https://www.youtube.com/watch?v=1aSL9La5ivo

Arctic Council SWIPA
http://www.amap.no/swipa

WWF is working to build a future where people live in harmony with nature. The Schools for a Living Planet program empowers educators and students of all ages with the tools they need to lead us into a sustainable future. Schools for a Living Planet is grounded in the principles that make WWF a global success - including strong science and a focus on solutions.

Ecology North is a charitable, non-profit organization that has engaged Northerners in hands-on learning opportunities in the Northwest Territories since 1971. Our mission is to bring people and knowledge together for a healthy Northern environment. Education, public engagement and youth involvement are integral to all of our program streams that include climate change adaptation, watershed protection planning, waste reduction, food sustainability and alternative energy promotion.

This project was made possible with the financial support of CIBC.
For more information, visit www.cibc.com.

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