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PLANET ICE:

AN EDUCATOR'S GUIDE

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PLANET ICE:

Mysteries of the Ice Ages

explores how cold and ice have shaped the Earth and impacted its inhabitants.

The exhibition shows how these forces are fundamental to our environment, ecosystems, history and culture. It also highlights threats to this reality caused by humans.

This guide includes:

- Essential questions that are explored in *Planet Ice*.
- A zone-by-zone description of what your students can do and learn during your visit.

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ESSENTIAL QUESTIONS

How have ice and cold shaped the world today?

Ice created much of the North American landscape we see today.

Roughly 75 000 years ago, massive ice sheets began to cover most of Canada and the northern United States. The Great Lakes and the **Canadian Shield** are products of glacial action, but ice is also responsible for many lakes, rivers, valleys, and hills around the world.

Ice creates and destroys habitat.

Along the coasts, the formation of ice lowered sea levels, revealing new lands and **niches** to occupy. Within continents, ice sheets encroached, splitting connected areas, cutting off migration routes, and separating populations from each other.

Through millions of years of cold, life has endured.

Over time, the cold has forced many plants and animals to adapt, relocate, or face extinction. Today's cold-adapted species use an astounding range of traits and behaviours to better their chances of survival.

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How has the Earth warmed and cooled over time?

Our planet's climate has changed many times.

From an ice-free hothouse to a frozen **Snowball Earth**, our planet has survived being extremely hot and cold.

The drivers of change, past and present, are well understood. The movement of the Earth around the Sun predictably changes over tens of thousands of years. These periodic variations, called **Milankovitch Cycles**, affect how much solar energy reaches the Earth's surface and impact the advance and retreat of ice on Earth.

Temperatures during the last **ice age** were also influenced by other things, like the creation of an ocean current surrounding Antarctica and the connecting of North and South America.

Today, humans are rapidly warming the planet by releasing large amounts of carbon dioxide into the atmosphere.

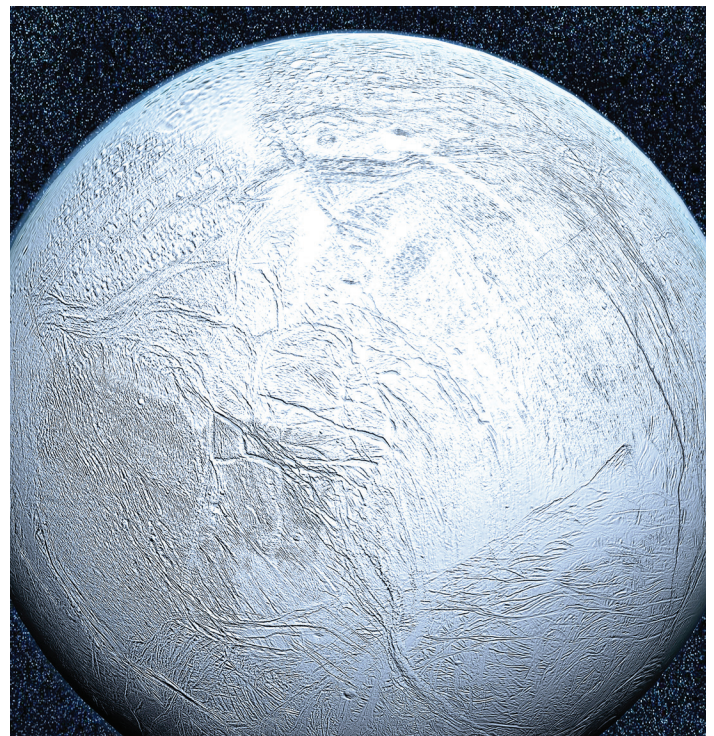
While human influence over the global climate started with the Industrial Revolution, half of all atmospheric CO₂ released by humans was produced in just the last 30 years.

Why are ice and cold important to life on earth?

Human life depends on cold and ice.

A world without ice at the poles would look dramatically different. If Arctic glaciers melt, sea levels would be significantly higher, changing what land is inhabitable. Ocean currents and global weather patterns would also be affected. Additionally, Arctic communities rely on seasonal ice and cold patterns for traditional hunting and fishing methods.

Even simple pleasures, like outdoor skating on outdoor rinks, snowball fights, and tobogganing could be at risk.



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Stable ice and predictable cold are also fundamental to ecosystem stability.

Arctic communities depend on it to sustain hunting and fishing practices. Ecosystems of dry regions rely on glaciers and winter snow to recharge the surface waters. The range of many pest populations are limited by colder climates. Good ice conditions are vital to movement and migration. Certain fruit trees, such as apple, pear, and cherry require seasonal cold in order to bear fruit.



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Is this the end of ice and cold?

As the planet warms, the risks of drought and fires grow, yet for many plants and animals, including humans, it could be the loss of cold and ice that are most threatening.

How will cold-adapted species respond? How will humans manage the rising oceans? There's a lot we can do to help maintain ice on Earth, lessen the impacts of climate change, and protect biodiversity.

Reducing our carbon footprint can happen through our food and transportation choices. Energy systems can be powered by **renewable** sources like wind and solar.

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Conservation and **rewilding** projects strengthen an ecosystem's resistance to disruptions and allow them a chance to adapt. Innovative science and engineering can help us to slow, mitigate, and adapt to the coming changes. Education and activism are necessary to galvanize humanity to take these collective actions.

CONNECTIONS TO CURRICULUM:

A visit to *Planet Ice* allows for meaningful exploration of three main ideas:

- All living things are interconnected and depend on their environment for survival.
- Global climate change is influenced by both natural and human factors.
- People have a responsibility to take action to ensure the sustainability of the planet.

For a detailed list of connections to provincial and United States curriculum by grade, see the links [here](#).

TEACHING IN PLANET ICE

Planet Ice is divided into several sections, with each section representing a different theme. Refer to the exhibit layout to find the sections.

Below you will find:

- Suggested stops
- Reflection questions

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Planet Ice explores several themes to engage visitors:

2.0. Power of Ice

3.0. Life in a Cold Climate

4.0. Lost Lands

5.0. A Land Shaped by Ice

6.0. The Importance of Ice and Cold Today

7.0. The Future of Ice



1.0 Entrance Experience

This first section transports us into a world shaped by cold and ice. It sets the stage for the exploration of our icy planet: Earth.

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Have your students propose answers to this first question:

Why is ice important to our planet?

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2.0

Power of Ice

Ice and cold have been critical throughout Earth's history. They have shaped landscapes, created ecosystems, and moderated our climate. What's more, humans have never lived on a planet without ice.

2.1. Earth Island

Explore the conditions that are needed for ice to form on our planet : Greenhouse gases, the intensity of the Sun and the Earth's **albedo**. Students can interact with this display by increasing or decreasing these three main conditions and observing the changes.

2.2. Tracking Ice Ages

Learn that Earth's tilt, wobble, and orbit have changed over time. These changes are called Milankovitch cycles. Students can visualize the factors that have shifted our planet in and out of ice ages and identify three major events that contributed to our current ice age.

2.3. The history of Earth's Ice Ages

Discover the five major ice ages in the Earth's 4.5 billion-year history. Students can identify them in the deep-time spiral.

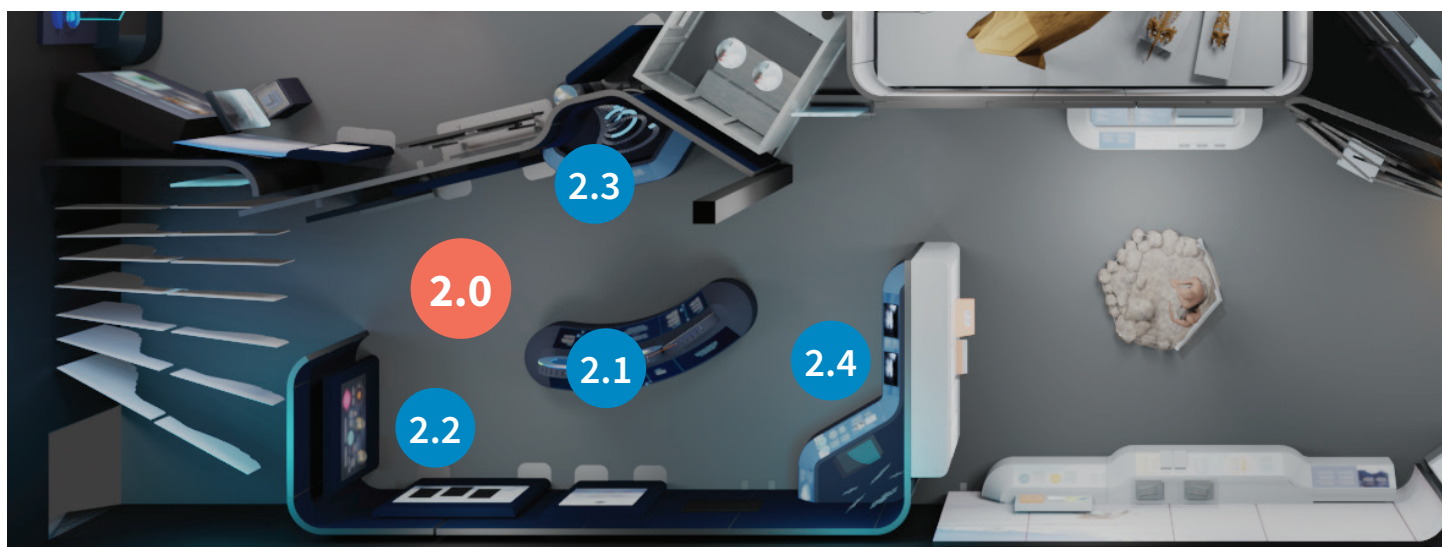
2.4. What is ice?

Explore the structure and properties of solid water. Students can use the interactive screen to create their own digital snowflakes.

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Get your students to reflect on what would happen if ice and cold were to completely disappear from Earth, with this reflection question:

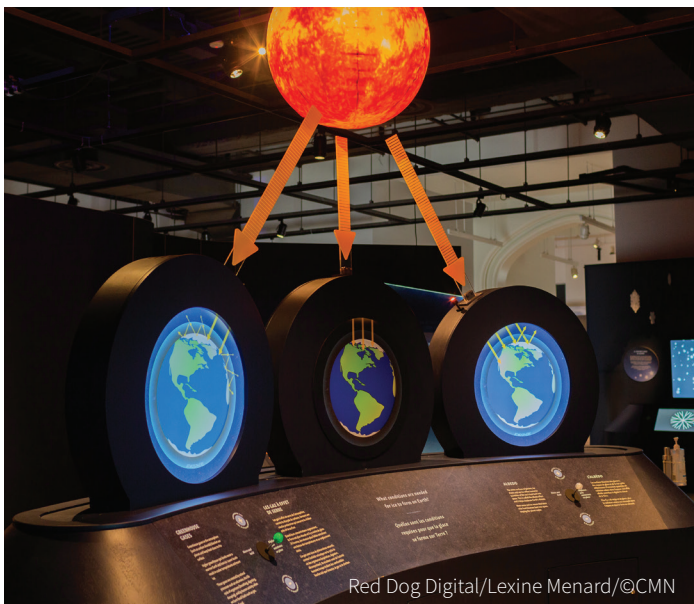
As the planet warms, is this the end of ice?



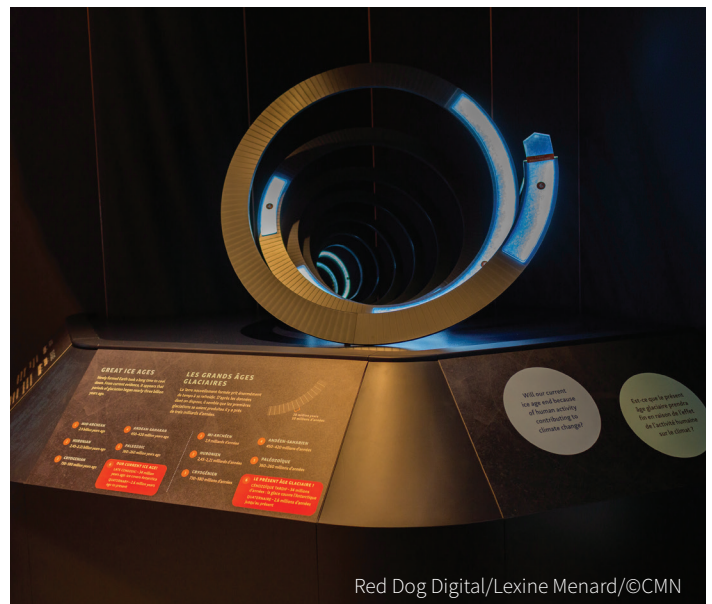
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2.0 Power of Ice

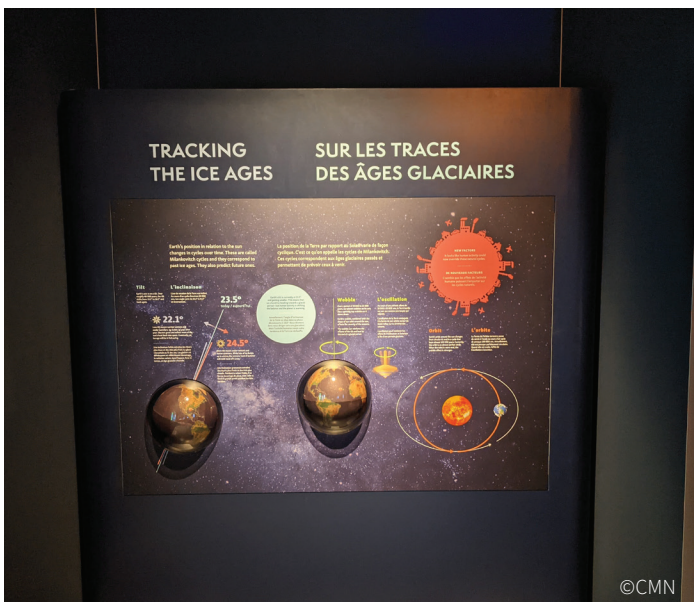
2.1. Earth Island



2.3. The history of Earth's Ice Ages



2.2. Tracking Ice Ages



2.4. What is ice?



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3.0

Life in a Cold Climate

As the Earth's climate has changed, so has the life on our planet. Cold and ice have shaped emerging adaptive traits. Several animals that thrived during the height of the last ice age are still around today.

3.1. Where are we?

Travel 80 000 years back in time to see what Northern **Eurasia** was like during glaciation. Observe a landscape, climate, and ecosystem from long ago. Ask your students if they can identify similarities and differences with our current world.

3.2. Adaptations

Meet animals that were built for the cold. Explore many **adaptations** that enable survival in a frozen environment. Try a heat-sensing camera and compare types of fat and fur. Challenge your students to find three adaptations that allow animals to thrive in the cold.

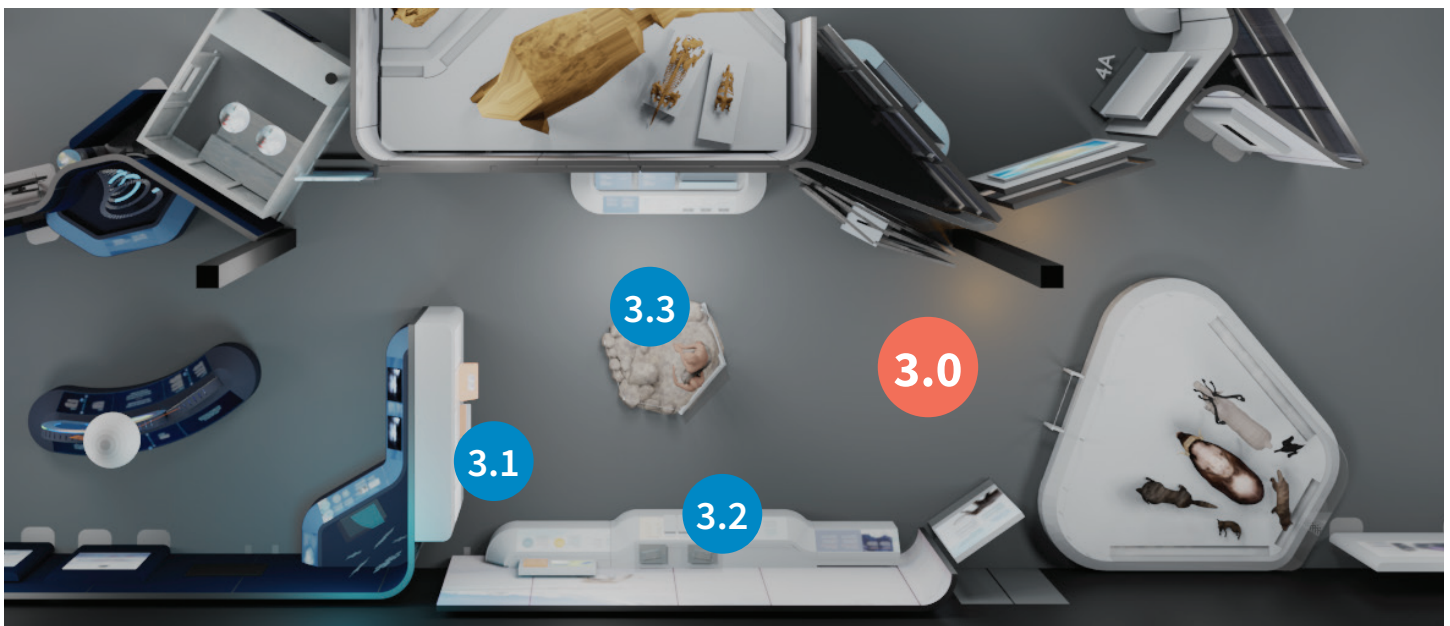
3.3. Neanderthals

Stand face to face with hyper-realistic models of our closest relatives, the **Neanderthals**. Learn how they made use of tools to improve survival to the cold. Ask your students to identify how Neanderthal bodies were better adapted to the cold than ours.

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Encourage your students to imagine the types of adaptations that might be needed to survive in a warmer future with this reflection question:

With less cold and ice, what adaptations will we need in the future?



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3.0 Life in a Cold Climate

3.1. Where are we?



3.3. Neanderthals



3.2. Adaptations



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4.0 Lost Lands

Ice regulates sea levels around the world. Fluctuating sea levels have submerged and exposed different lands throughout Earth's many glaciations. Let's see what has been lost beneath the world's oceans over time.

4.1. Beringia

Notice the interactive map of the Beringia land bridge. It used to connect Eurasia and North America. **Beringia** was both a habitat and a migration route between continents for many species, including humans. Students can advance through time to discover who lived and travelled through here.

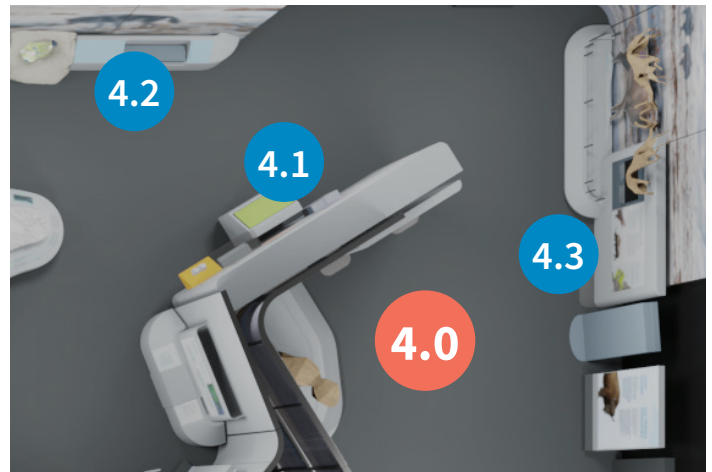
4.2. Bluefish Caves

See evidence of the earliest known human presence in North America, dating back 24 000 years. Invite students to inspect the animal bones. What physical clues suggest they were butchered by hunters?

4.3. Doggerland

Travel to Doggerland, a vast dry plain that connected the British Isles to Western Europe for thousands of years. Many surprising discoveries have been dredged up by fishing nets, like evidence of hippos and rhinos roaming this land. Students can take a photo with one of Doggerland's former residents, the massive Irish elk!

Take an #Elkie and tag@museumofnature



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Our landscape might change considerably in the future. Get your students to consider the consequences with this reflection question:

*As ice melts and sea levels rise,
what lands could be lost?*

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4.0 Lost Lands

4.1. Beringia



4.3. Doggerland



4.2. Bluefish Caves



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5.0

A Land Shaped by Ice

The world we see today was, and continues to be, impacted by ice. The advance and retreat of **glaciers** carved out much of the North American landscape. As ice sheets retreated, new ecosystems emerged and were populated.

5.1. Creating an inland sea

Discover the role that glaciers played in creating the **Champlain Sea**, an inland sea that covered the Ottawa Valley! Students will be surprised by the beluga skull, originally found in Pakenham, Ontario, as evidence of this sea.

5.2. Glaciation Island

Observe how landforms were created all over the country by the last glaciation. Each feature on this topographic map represents a unique glacial process for students to explore. Circle around the island and try to identify the different glacial landforms in the scene. Students might recognize places where they can visit these landforms.

5.3. Megafauna

Meet giant animals who once roamed what we now call North America. This **Megafauna** was impacted by past climate change and hunted by humans. These challenges might have changed their access to food, increased their competition, and altered their ranges. Have your students visualize what these animals' habitats might have looked like.

5.4. Growing in the cold

Notice how lands that were shaped by ice bring about incredible adaptations. Students will learn about a type of algae that grows in sea ice and that some mosses can lie dormant for centuries inside glaciers.

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Understanding how cold and ice have shaped our current ecosystem, explore this reflection question with your students:

With less cold and ice, what species might we lose?



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5.0

A Land Shaped by Ice

5.1. Creating an inland sea



5.2. Glaciation Island



5.3. Megafauna



5.4. Growing in the cold



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6.0

The Importance of Ice Today

Cold and ice were vital in creating the physical and biological world of today. They are still important now. Discover the many—and often surprising—ways that cold and ice impact our daily lives.

In this section, students explore the role of ice in storing water, preserving food, and ensuring safe travel and hunting. They will also see the importance of cold on fruit production and disease prevention.

6.1. Water is life

Discover that glaciers hold about 70 % of all fresh water on Earth. Students can follow the path of meltwater as it replenishes waterways that are essential to people all over the world.

6.2. Ice fishing shack

Come in out of the cold! Spot fish under the ice. Ice fishing provides essential and healthy winter food for many communities. It also offers an opportunity to enjoy the beauty of winter and the company of friends.

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Considering the importance of cold and ice in our daily lives, get your students to reflect on what they do for fun in the winter with this question:

What activities can you do because of cold and ice ?



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6.0 The Importance of Ice Today

6.1. Water is life



6.2. Ice fishing shack



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7.0

The Future of Ice

Ice on our planet is melting. In the coming centuries, millions of species will face extinction. Lands will be altered by floods or fires and potentially lost. How will species adapt? How will humans? Scientists and engineers are exploring ways to help keep the planet cool. Government and industry must take action on climate change, but there are helpful personal choices people can make right now.

From conservation efforts to massive geo-engineering projects, students will discover the range of solutions to slow warming, protect biodiversity, and build a liveable future. Seven different solutions are explored: **activism**, alternative energy, conservation, engineering, greener choices, **rewilding** and science innovation.

7.1 Snow-Globe Challenge

Reflect on the climate actions observed throughout the exhibition. Ask students to decide which one they think will make the biggest difference for our planet and watch the snow fall.

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We all benefit from our icy and cold planet. Let's keep it cool! Discuss with your students and encourage them to be stewards by answering this last big question:

What will you do to celebrate and protect our planet's ice?



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7.0 The Future of Ice

7.1 Snow-Globe Challenge



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GLOSSARY

Activism:

The practice of using action to achieve a result, to support or oppose a cause—usually of political, social, or environmental nature.

Adaptations:

A change in an organism that makes it better suited to live in a particular environment.

Albedo:

The amount of light, hitting a surface, usually a planet, that is reflected back into space.

Beringia:

A very large landform, currently under water, connecting north-west North-America (Alaska) to north-east Asia (Siberia). This region has been partially or fully exposed in the past when sea levels were lower during ice ages.

Canadian Shield:

An exposed portion of the continental crust visible from north-central Canada to eastern regions of Canada and US.

Champlain Sea:

An inland sea that once covered the Ottawa Valley. It originated from retreating ice sheets at the end of the last ice age.

Doggerland:

A large landform, currently under water, that connected Great Britain to continental Europe during the last glacial period.

Eurasia:

The landmass connecting Europe and Asia; the largest continental area on Earth.

Glaciers:

A persistent and large mass of ice—formed from falling snow that accumulated over the years—that is moving very slowly.

Ice age:

A period that can last hundreds of millions of years during which the global temperatures are colder and glacial sheets expand.

Ice ages are also referred to “glacial periods.” Conversely, “interglacial periods” are illustrated by the absence of large ice sheets.

Megafauna:

A term that describes animals above a certain weight that live in a particular region or during a specific period.

Milankovitch Cycles:

The collective effects of changes in Earth's position relative to the Sun that affect the planet's long-term climate. They are also responsible for triggering ice ages. These were hypothesized by Serbian scientist Milutin Milankovitch.

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Neanderthals:

Hominids living 200,000 years ago during the Pleistocene (2.6 million to 11,700 years ago) in Eurasia. The most recent Neanderthals fossil evidence dates back to 40,000 years ago but the cause of their extinction is still not known. *Homo sapiens* arrived in Europe more than 40,000 years ago.

Niche:

The role an organism plays in its ecological community.

Permafrost:

Ground that stays completely frozen—at least at zero degrees Celsius—for at least two consecutive years.

Renewable:

Something that can be renewed; a renewable resource is not depleted by use.

Rewilding:

The process by which an area of land is restored to its natural uncultivated state.

Snowball Earth:

A hypothesis that suggests that all of Earth's surfaces (oceanic and continental) were covered by ice from the poles to the Equator during at least two extreme cooling events that took place between 2.4 billion and 580 million years ago.



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