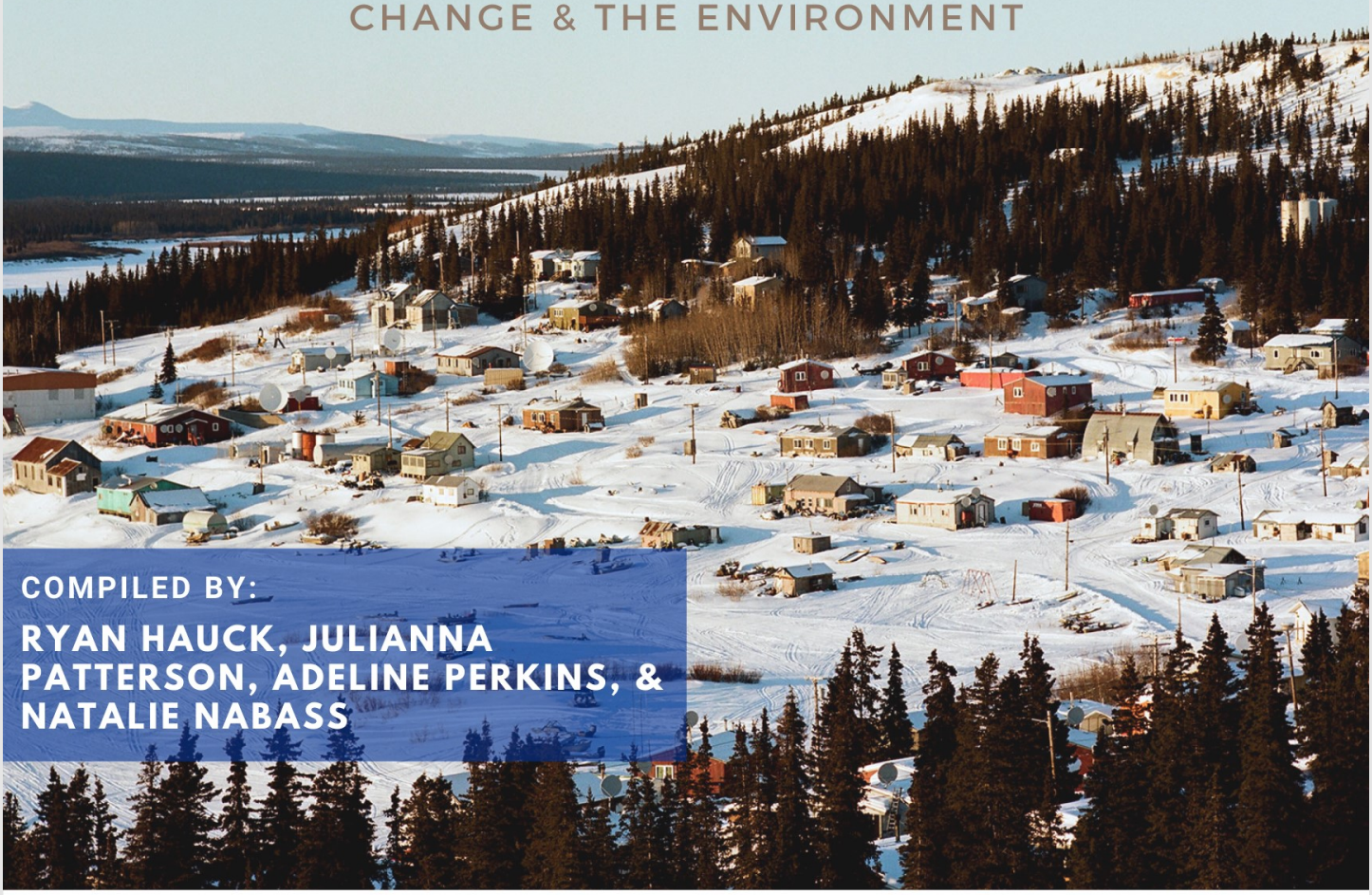
RESOURCE GUIDE FOR EDUCATORS

ARCTIC SERIES 2021

WORLD AFFAIRS COUNCIL
Celebrating 70 Years

THE ARCTIC TODAY: INDIGENOUS PEOPLES, CLIMATE CHANGE & THE ENVIRONMENT



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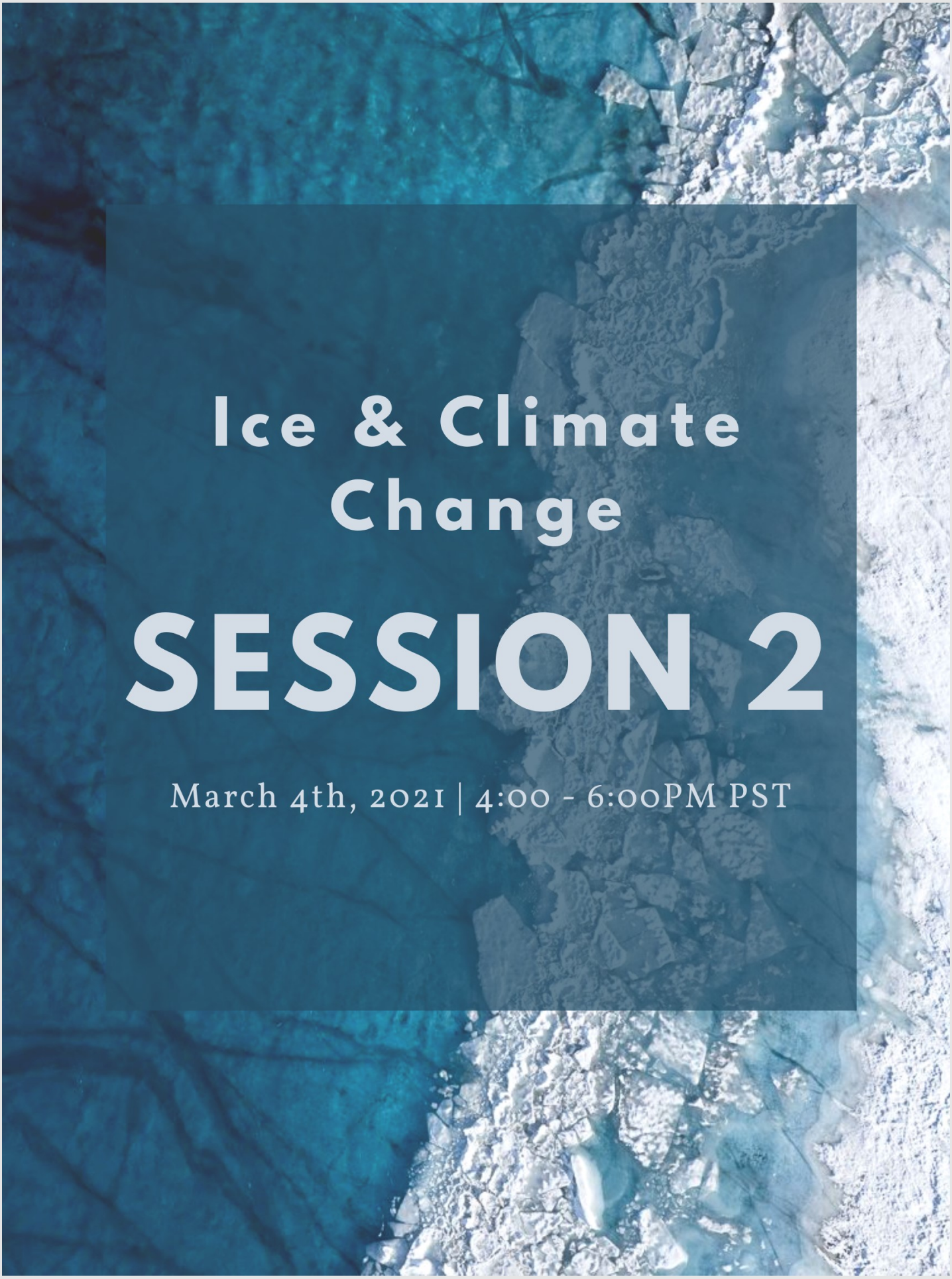
Ice & Climate Change
SESSION 2
March 4th, 2021 | 4:00 - 6:00PM PST

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GLOBAL CLASSROOM WANTS TO KNOW HOW YOU HAVE USED THIS RESOURCE PACKET IN YOUR CLASSROOM!

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Outlining Standards

A Note on Learning Standards Presented in this Guide

Three sets of standards have been linked to each of the learning objectives in this packet. The **Washington State K-12 Social Studies Learning Standards** and the accompanying Grade Level Requirements are the social studies standards for WA State.

The College, Career, & Civic Life C3 Framework for Social Studies State Standards are the standards published by the National Council for the Social Studies. Guiding the packet as a whole is the Framework for Global Learning created by the Asia Society and the Council of Chief State School Officers titled ***Educating for Global Competence: Preparing Our Youth to Engage the World*** *(2011).*

Cross-objective standards are listed at the beginning of the packet, and content-specific standards can be found after each learning objective.

The standards provided have been selected for relevance, but are not exclusive: many other standards, such as Common Core, may be applicable to the resources and learning objectives identified in this packet. The intention for this packet's organization is to provide educators with an idea of resources available and possible uses for resources. Users should feel free to create their own learning objectives and to select resources according to the specific needs of their classrooms.

The student understands and applies reasoning skills to conduct research, deliberate, and form and evaluate positions through the processes of reading, writing, and communicating.

WASHINGTON STATE K-12 SOCIAL STUDIES LEARNING STANDARDS

There are five EALRs in Social Studies, one for each of the discipline areas: civics, economics, geography, and history, and a fifth for social studies skills.

(1) Social Studies EALR 1: CIVICS

The student understands and applies knowledge of government, law, politics, and the nation's fundamental documents to make decisions about local, national, and international issues and to demonstrate thoughtful, participatory citizenship.

(2) Social Studies EALR 2: ECONOMICS

The student applies understanding of economic concepts and systems to analyze decision-making and the interactions between individuals, households, businesses, governments, and societies.

(3) Social Studies EALR 3: GEOGRAPHY

The student uses a spatial perspective to make reasoned decisions by applying the concepts of location, region, and movement and demonstrating knowledge of how geographic features and human cultures impact environments.

(4) Social Studies EALR 4: HISTORY

The student understands and applies knowledge of historical thinking, chronology, eras, turning points, major ideas, individuals, and themes on local, Washington State, tribal, United States, and world history in order to evaluate how history shapes the present and future.

(5) Social Studies EALR 5: SOCIAL STUDIES SKILLS

The student understands and applies reasoning skills to conduct research, deliberate, and form and evaluate positions through the processes of reading, writing, and communicating.

Outlining Standards

COLLEGE, CAREER, & CIVIC LIFE C3 FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS

The C3 Framework is organized into the four Dimensions, which support a robust social studies program rooted in inquiry.

The four Dimensions are as follows:

(1) Developing questions and planning inquiries;

(2) Applying disciplinary concepts and tools

(3) Evaluating sources and using evidence;

(4) Communicating conclusions and taking informed action

Dimension 1: Developing Questions and Planning Inquiries	Dimension 2: Applying Disciplinary Tools and Concepts	Dimension 3: Evaluating Sources and Using Evidence	Dimension 4: Communicating Conclusions and Taking Informed Action
• Developing Questions and Planning Inquiries	• Civics • Economics • Geography	• Gathering and Evaluating Sources • Developing Claims and Using Evidence	• Communicating and Critiquing Conclusions • Taking Informed Action

Dimension 2 has four disciplinary subsections: **(1) Civics; (2) Economics; (3) Geography; (4) History**. Each disciplinary subsection has three to four additional categories, which provide an organizing mechanism for the foundational content and skills within each discipline

C 3Framework Organization

Civics	Economics	Geography	History
Civic and Political Institutions	Economic Decision Making	Geographic Representations: Special Views of the World	Change, Continuity, and Context
Participation and Deliberation: Applying Civic Virtues and Democratic	Exchange and Markets	Human-Environment Interaction: Place, Re-	Perspective
Processes, Rules, and Laws	The National Economy	Human Populations: Spatial Patterns and Movements	Historical Sources and Evidence
	The Global Economy	Global Interconnections: Changing Spatial Patterns	Causation and Argumentation

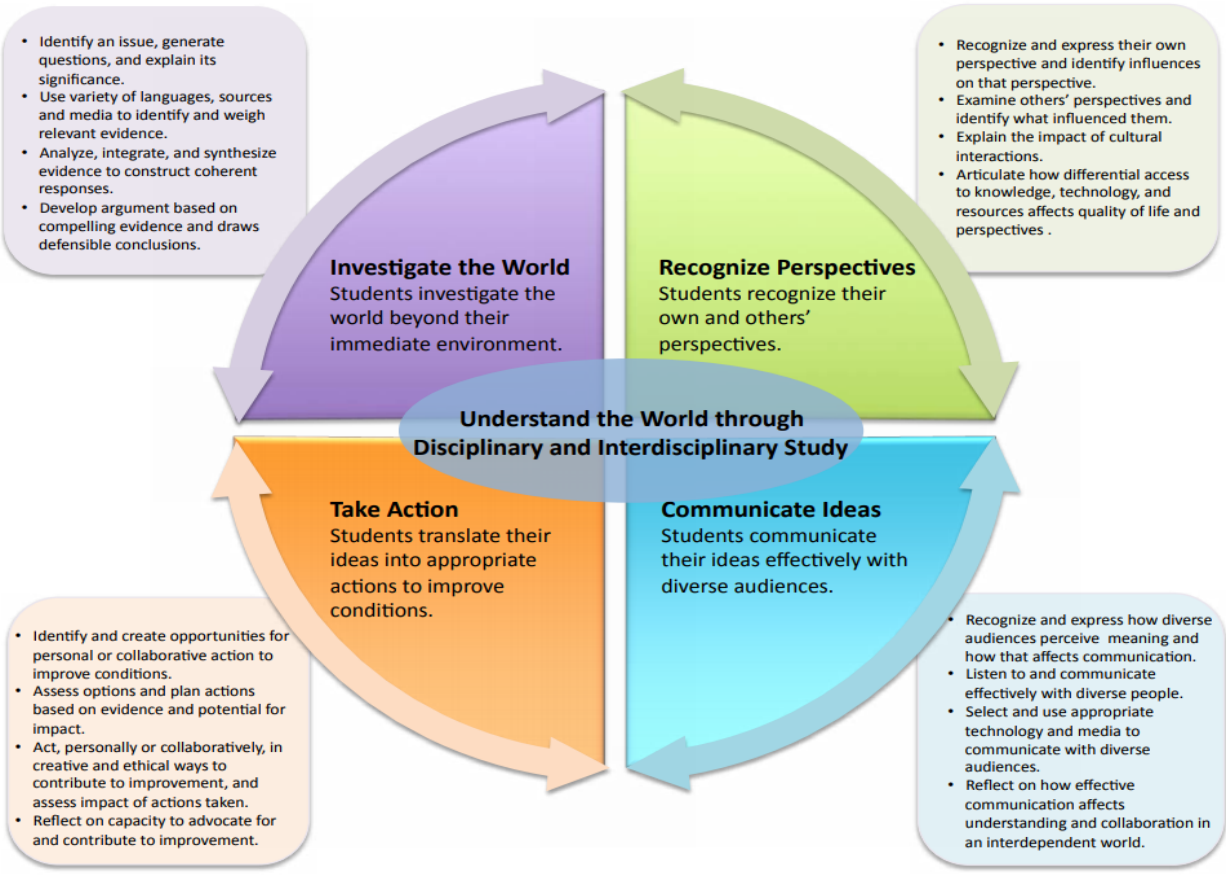
Educating for Global Competence

Frameworks taken from *Educating for Global Competence: Preparing Our Youth to Engage the World (*Asia Society and the Council of Chief State School Officers 2011*).*

"**Global competence is the capacity and disposition to understand and act on issues of global significance**" (Chapter 2).

Globally competent students are able to perform the following four competences:

1. **Investigate the world** beyond their immediate environment, framing significant problems and conducting well-crafted and age-appropriate research.
2. **Recognize perspectives** others' and their own, articulating and explaining such perspectives thoughtfully and respectfully.
3. **Communicate ideas** effectively with diverse audiences, bridging geographic, linguistic, ideological, and cultural barriers.
4. **Take action** to improve conditions, viewing themselves as players in the world and participating reflectively.



Learning Objectives

1. Students will be able to analyze the biodiversity of the Arctic and discuss how Arctic Indigenous communities are leading conservation and research efforts in the region.

2. Students will be able identify, analyze, and discuss the impact of climate change on the Arctic, including local communities. In addition, students will be able to assess approaches by Indigenous communities and NGOs to address the impact of climate change on the Arctic.

3. Students will be able to identify and evaluate challenges facing the ecosystem of the Arctic.

4. Students will be able to analyze and discuss the geography and history of the circumpolar world.

5. Students will be able to analyze and discuss the complexity of Arctic social, political, and environmental systems from interdisciplinary perspectives.

6. Students will be able to identify, analyze, and discuss technological innovations for Arctic sustainability. In addition, students will be able to identify, discuss, and make connections between indigenous knowledge and environmental sustainability.

7. Students will be able to identify, assess, and discuss Arctic Indigenous agency, including the role of regional and local governments.

8. Utilizing the Arctic as a case study, students will be able to evaluate and make connections between local and global issues across selected regions of the world

Supplemental Goals

1. Be able to define "cryosphere" as a global environment.
2. Understand why Sea Ice is a unique habitat.
3. Name the key types of organisms in Sea Ice.
4. Understand how Sea Ice microbiology influences the broader ecosystem.
5. Understand that Landscape Components are Interrelated.
6. Understand that the Implications of Climate Change are Complicated.

Key Terms

Paleolimnology: The study of ancient lakes from their sediments and fossils.

Sea Ice: Sea ice formed by the freezing of seawater and floats on the surface of the polar oceans. Its coverage varies with the seasons; in the Northern Hemisphere sea ice ranges from a minimum of about 9 million km2 in September to a maximum of about 16 million km2 in March. In the Southern Hemisphere the range is from 3 million to 19 million km2, with the minimum and maximum coverage occurring in February and September respectively.

Hydrology: Quantitative measurements of rainfall, snowfall, the rate at which water penetrates into and moves through soil, streamflow, the rise and fall of LAKE and GROUNDWATER levels, and the evapotranspiration of water into the atmosphere are vital.

Trans-Alaska Pipeline: Connects the oil fields of Prudhoe Bay in northern Alaska, U.S., with the harbor at Valdez, 800 miles (1,300 km) to the south.

Tundra: Tundra, which comes from a Sami word meaning "barren land," refers to a treeless arctic region characterized by permafrost.

Climate Change: Climate change occurs when long-term weather patterns begin to shift. These periods of change have occurred throughout the Earth's history over extended periods of time. However, since the Industrial Revolution the world has been warming at an unprecedented rate. Because of this, the current period of climate change is often referred to as "global warming." The implications of this global increase in temperature are potentially disastrous and include extreme weather events, rising sea levels and loss of habitat for plants, animals and humans.

Sustainable Development: Sustainable development is the overarching paradigm of the United Nations. The concept of sustainable development was described by the 1987 Bruntland Commission Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Global Warming: The phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries.

Albedo Effect: determines how much sunlight will be absorbed and warm the surface compared to another surface that reflects most of the light and does not change temperature.

Ship Noise: Underwater-radiated noise from commercial ships may have both short and long-term negative consequences on marine life, especially marine mammals. The issue of underwater noise and impact on marine mammals was first raised at IMO in 2004. It was noted that continuous anthropogenic noise in the ocean was primarily generated by shipping. Since ships routinely cross international boundaries, management of such noise required a coordinated international response.

National Oceanic and Atmospheric Administration: is an agency that enriches life through science. Our reach goes from the surface of the sun to the depths of the ocean floor as we work to keep the public informed of the changing environment around them.

Air-Sea Exchange: is important for the cycling of gases such as carbon dioxide, methane, nitrous oxide, dimethylsulfide and ammonia. These compounds are important for our climate because they are either greenhouse gases or influence the production and growth of particles in the atmosphere that reflect solar radiation away from the Earth's surface.

Introduction to Session Speakers

Max Showalter is one of our UW alums having earned his PhD in Oceanography & Astrobiology at the University of Washington in 2020. He now works as the Knauss Ocean Policy Fellow engaging in both Ocean & Arctic science policy. He has a background in sea ice microbiology & life at the extremes. In over 500 days at sea, including expeditions to both Antarctica & the North Pole, he has performed laboratory & computational work to understand how bacteria & their viruses support life in sea ice & hold clues to life in outer space. While you may not have ever considered bacteria in sea ice, Max brings ice alive in his presentations. While at UW, Max also studied Inuktitut through the Canadian Studies Center (supported, in part by the Center for Global Studies) to connect human & microbial elements of sea ice.

Dr. Kevin Turner, is the University of Washington's 2020-21 Fulbright Canada Chair in Arctic Studies. He is an associate professor at Brock University where he is a co-founder of the Water & Environment Lab. Using techniques spanning multiple disciplines including hydrology, paleolimnology, remote sensing, & spatial analysis, his research team investigates relations among climate, land cover, ground conditions, disturbance & lakes and rivers. Fostering collaborations with the Vuntut Gwitchin First Nation, Parks Canada, & other partners has been essential for maintaining long-term projects of Kevin & his students. Indeed the music you were listening to at the opening of this session is from one of the artists in that town of less than 300 people.

Ecology of the Arctic

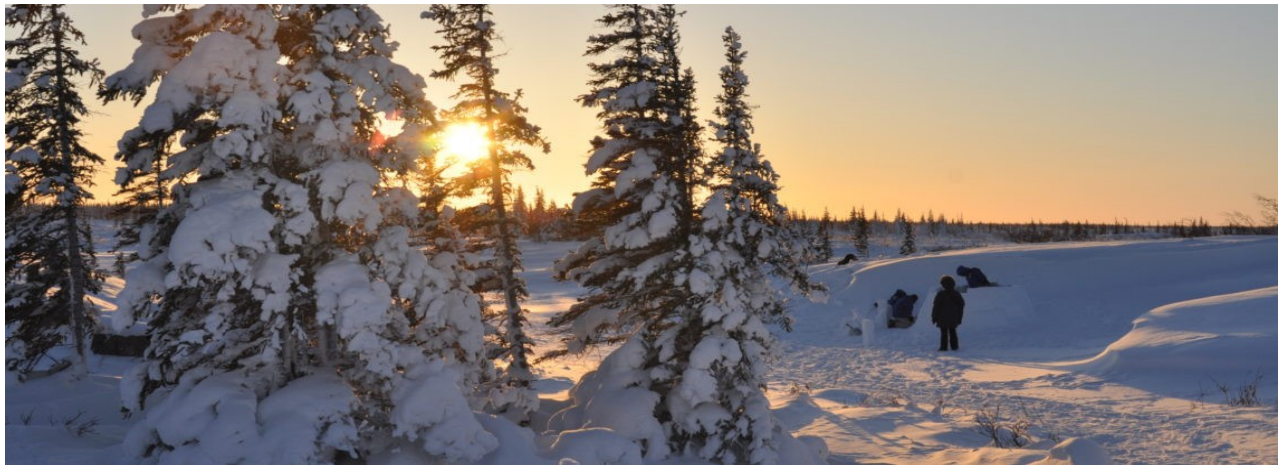
Ecology

An Introduction to the Arctic

This short blog exemplifies the changing of the arctic subject to time and environmental conditions People may often think of the Arctic as a barren, timeless place, but it is in fact quite the opposite.

Arctic Ocean Ecosystem

Life in the arctic endures some of the most extreme environmental conditions on the planet. Predators like Great Polar bears rely on a complex ecosystem that includes plankton, fish, birds, seals, walruses, and even whales to eat. Phytoplankton and algae support this complex food web.

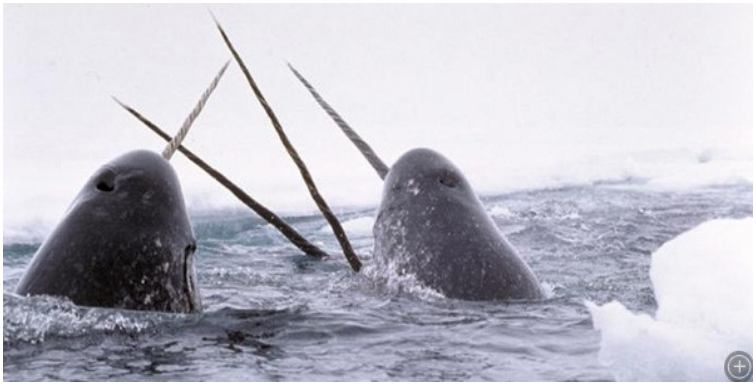


Arctic Exploration: Background

The Arctic sea ice has a complex structure which houses a community adapted to its conditions. This resource highlights the wealth of knowledge now known related to organisms and microorganisms that live in the arctic.

Hot Ecology- Hot Science in Cold Biomes

Further research is needed as shifting environmental conditions impact the Arctic's ecological processes with great consequences for the region. This research would further inform policies made by the Antarctic Treaty Consultative Parties. Challenges remain from within and outside the region as initiatives continue to be threatened by political ups and downs.



Monitoring Arctic and Boreal Ecosystems

This USGS article gives an overview of how researchers are using remote sensing to better comprehend ecosystem conditions in the Arctic and the changing landscape of permafrost-affected areas.

More Detailed Data on Thermal Conditions of Arctic Ground

The University of Helsinki discusses how understanding thermal ground conditions can improve the broader understanding of climate change in relation to permafrost, Arctic ecosystems, and societies.

The Arctic

The Arctic is a vast, ice-covered ocean, surrounded by tree-less, frozen ground, that teems with life, including organisms living in the ice, fish and marine mammals, birds, land animals, and human societies. Changes in the Arctic are happening rapidly, meaning that time is of the essence in exploring and gathering information needed to assess rapid environmental change not only in the Arctic, but around the globe, so that we can prepare for future global impacts.

The Arctic: A Delicate Icy Ecosystem

The Arctic is one of the most rapidly changing regions in the world. Diminishing sea ice, thawing permafrost and melting glaciers are all direct effects of rising global temperatures – driven by human-made emissions. Learn more about how satellites flying 800 km above our heads can help us monitor and understand the changes occurring in this remote region.

Arctic Sea Ice, Rivers, & Lakes

Sea Ice: A Refuge for Life in Polar Seas?

This article discusses the role of sea ice in Arctic ecosystems, ranging from its role while frozen to when it melts.

There Are Diseases Hidden in Ice, and They Are Waking Up

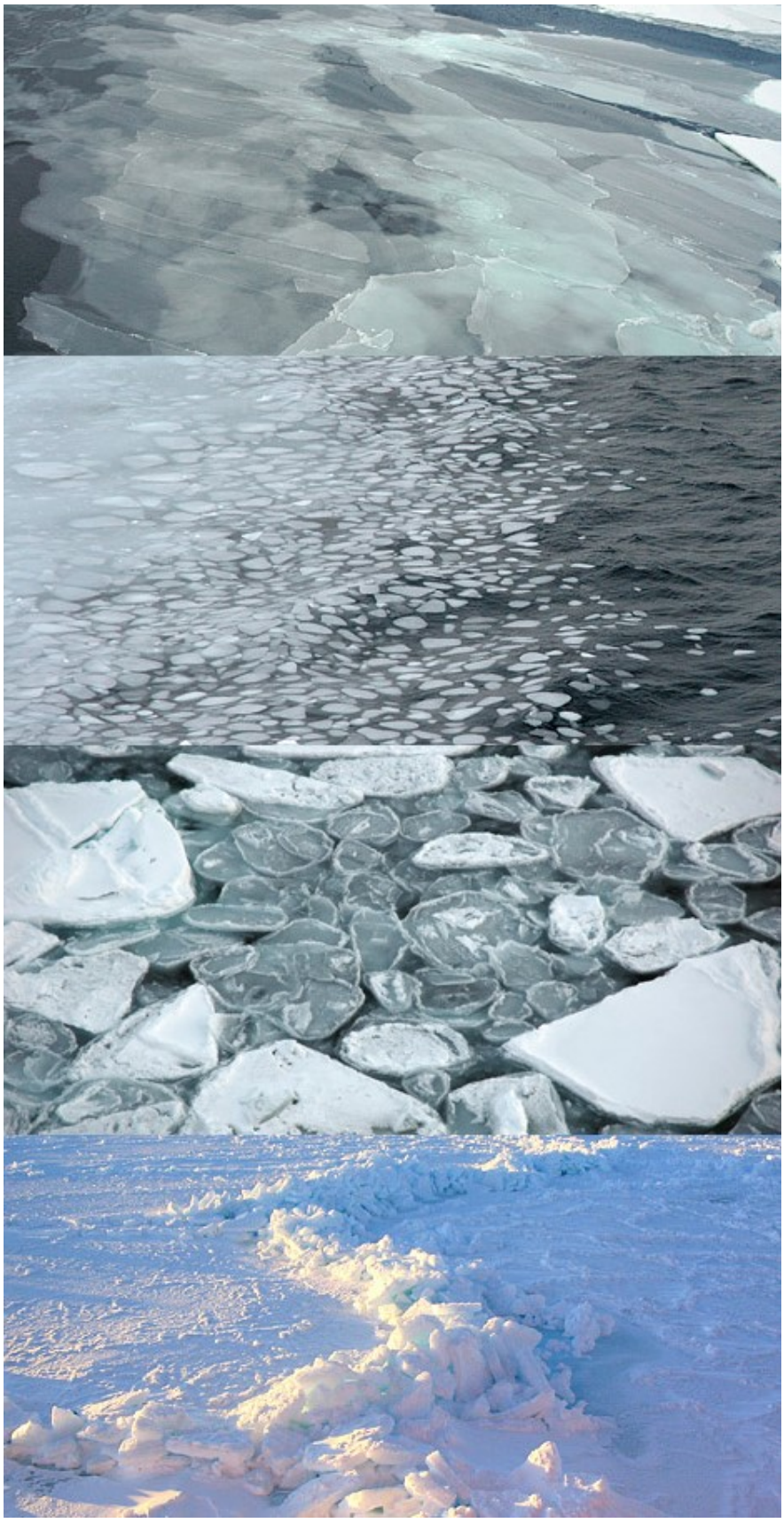
As climate change is warming up Arctic ice, dormant bacteria and viruses that were once trapped are now being released into the environment, harming Arctic populations and wildlife.

Arctic Landscapes—What to Expect on an Expedition to the Far North

The wildlife may hog all the attention on expeditions to the far north but the Arctic landscapes soon reveal themselves to be the most magical of surprises.

Freshwater Ecosystems in the Arctic

The Arctic, which may be of a surprise, is home to an abundant and diverse range of freshwater ecosystems including lakes, ponds, rivers and streams in addition to deltas and wetlands. Some of the rivers and associated deltas located in the Arctic are the world's largest including the Lena, Ob and Yenisei.

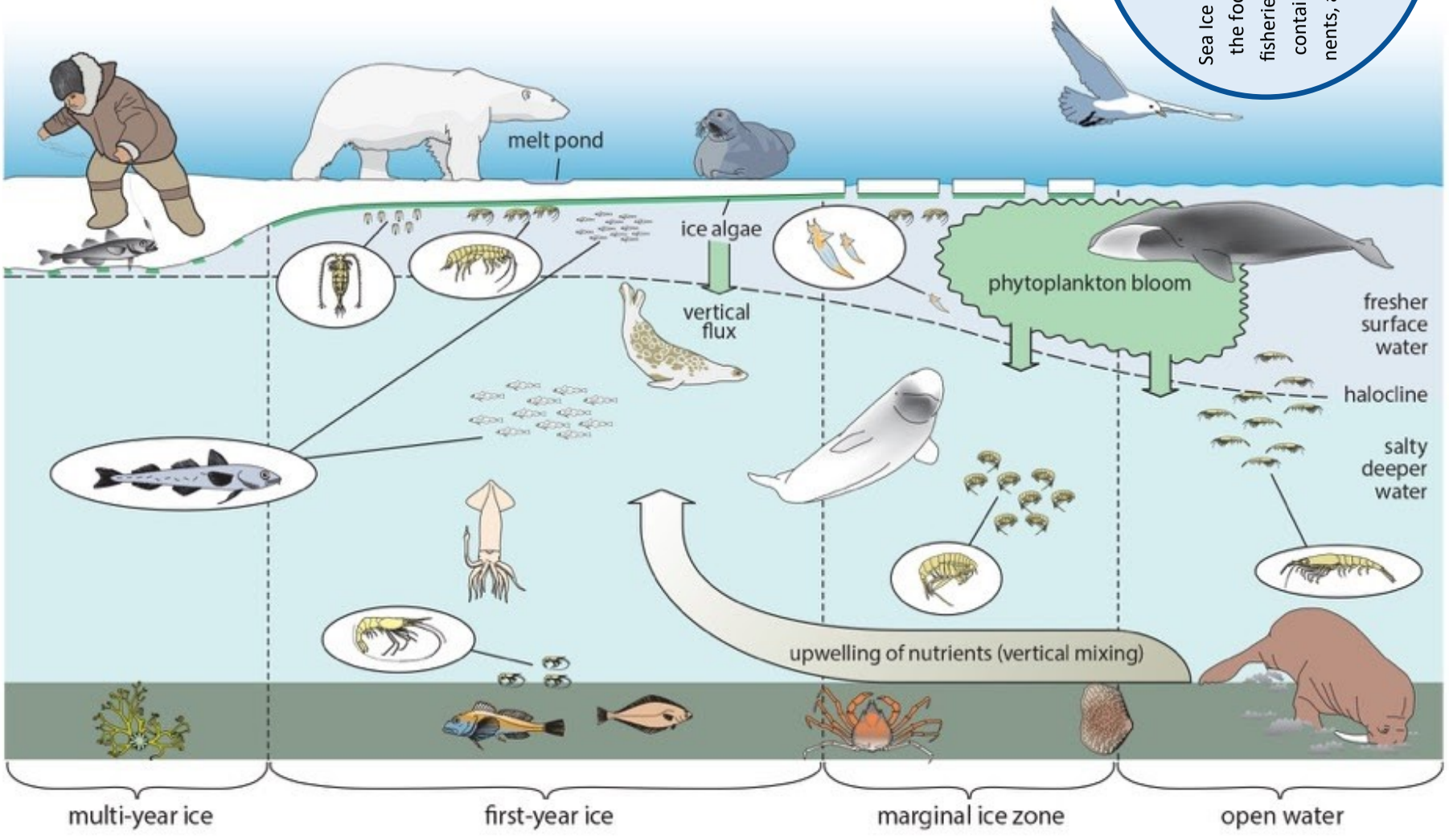


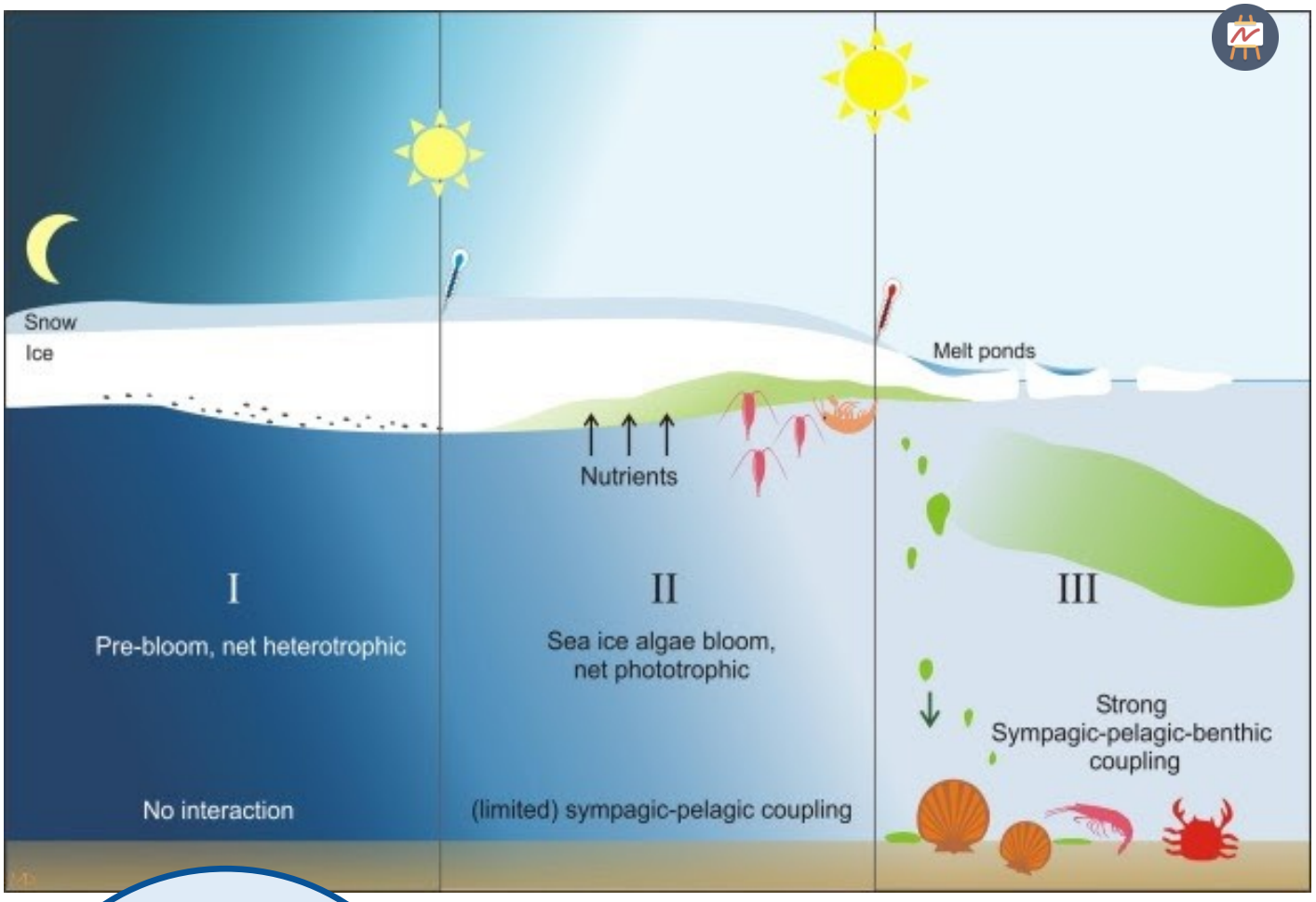
Arctic Monitoring and Assessment Programme

Arctic Climate Issues 2011

Fast Fact:

Sea Ice microbiology is the base of the food web. It supports global fisheries, influences ice structure, contains unique genetic components, and is an example of life in extreme habitats.



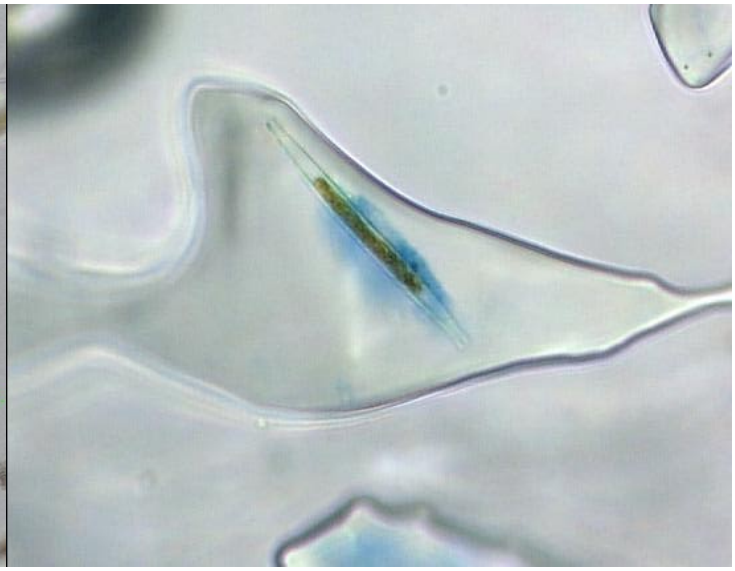


Key Organisms Found in Sea Ice

1. Bacteria
2. Viruses
3. Algae (Diatoms)

Fast Fact:

Sea Ice is a unique habitat because the salt within frozen sea water creates habitable space within the ice for life to exist .

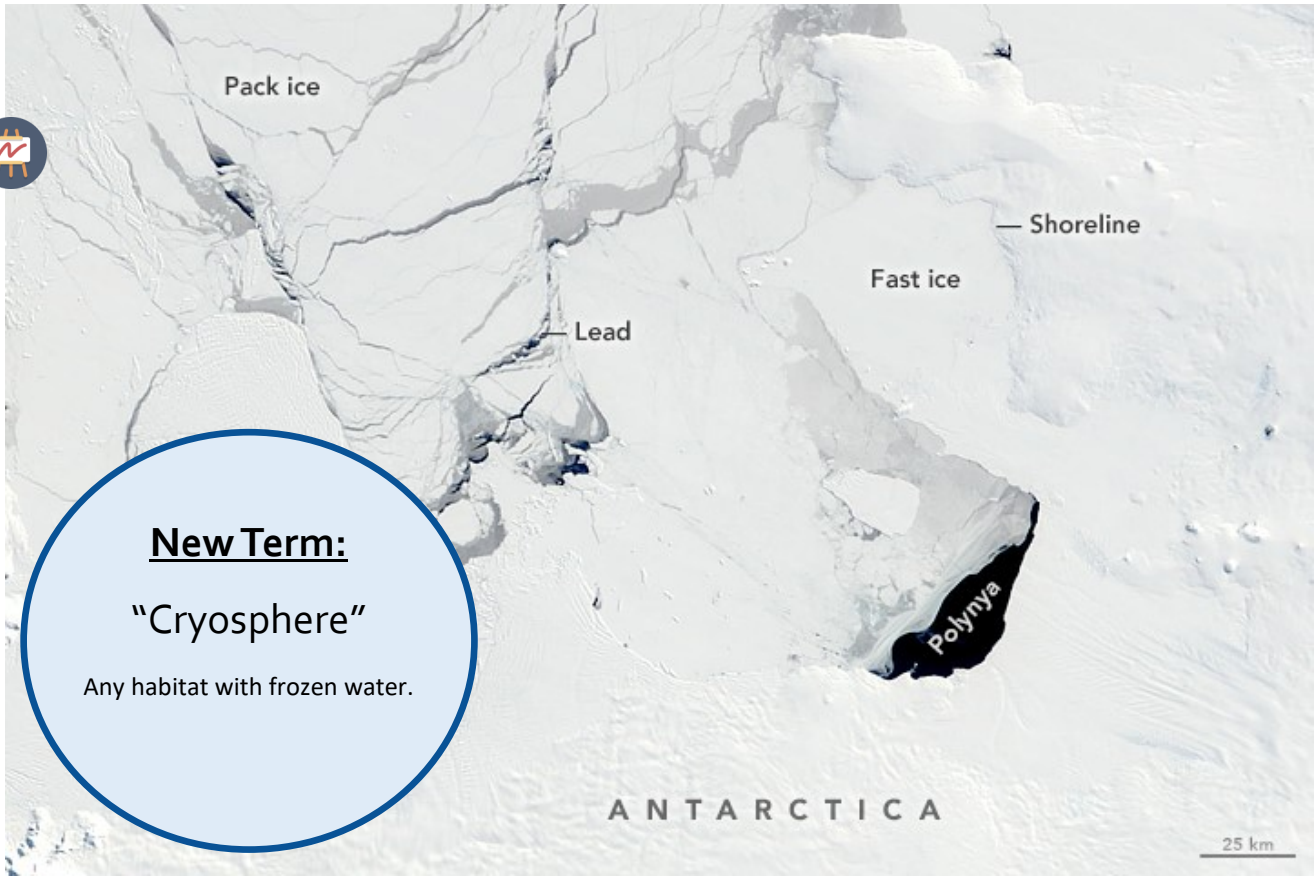


Arctic Microbial Ecosystems

Lakes and rivers are prominent features of the Arctic landscape and provide diverse habitats for plants, animals and microbes. In many places, these waters also provide important hunting and fishing grounds for Inuit communities, as well as drinking water supplies and a key resource for certain industries such as hydroelectricity, transport and mining. The Arctic contains an extraordinary diversity of lake types ranging from freshwater to saline, and from highly acidic to alkaline. Many of the lakes are crystal clear, while some are stained brown by colored dissolved organic carbon (mostly humic materials) derived from the vegetation and wetlands in their surrounding catchments. The largest river in arctic Canada, the Mackenzie River, is especially rich in dissolved organic carbon and in suspended sediments, and much of its microbial activity appears to be associated with cells attached to sediment particles that are mixed through the water column.

Research in the Arctic

Recent studies have shown the Arctic is undergoing significant change. In 2011, the summer sea-ice minimum was the second lowest in recorded history (2007 was the lowest recorded minimum). This, along with changes in terrestrial fluxes and warming temperatures, have likely cascaded into the ecosystems with unknown consequences to primary production, air-sea exchange of CO_2, the fate of organic matter, and the extent and responses to ocean acidification. It is critical to gain a better understanding of how these processes impact the carbon biogeochemistry of the region.

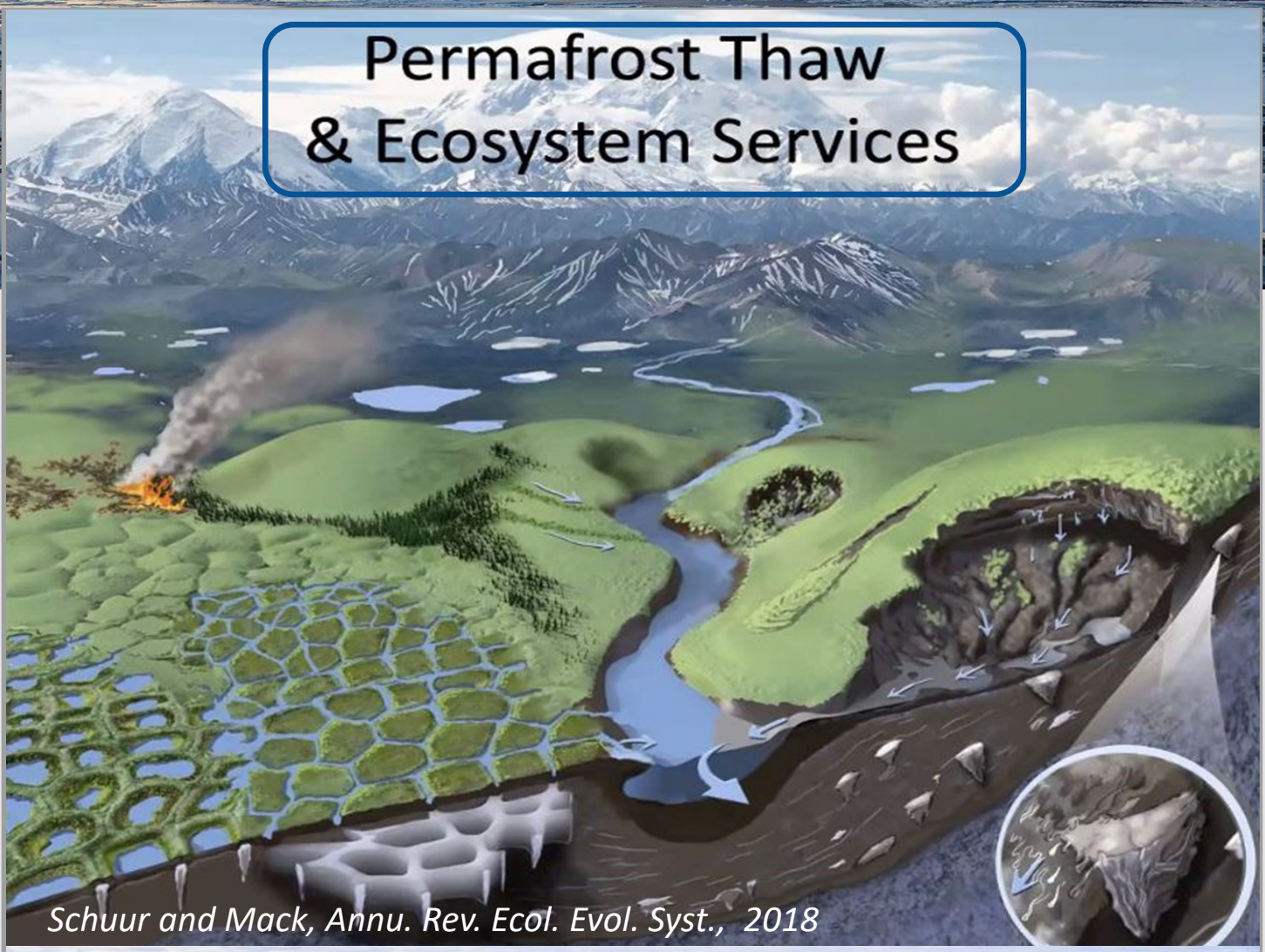


New Term:

"Cryosphere"

Any habitat with frozen water.

Permafrost Thaw & Ecosystem Services



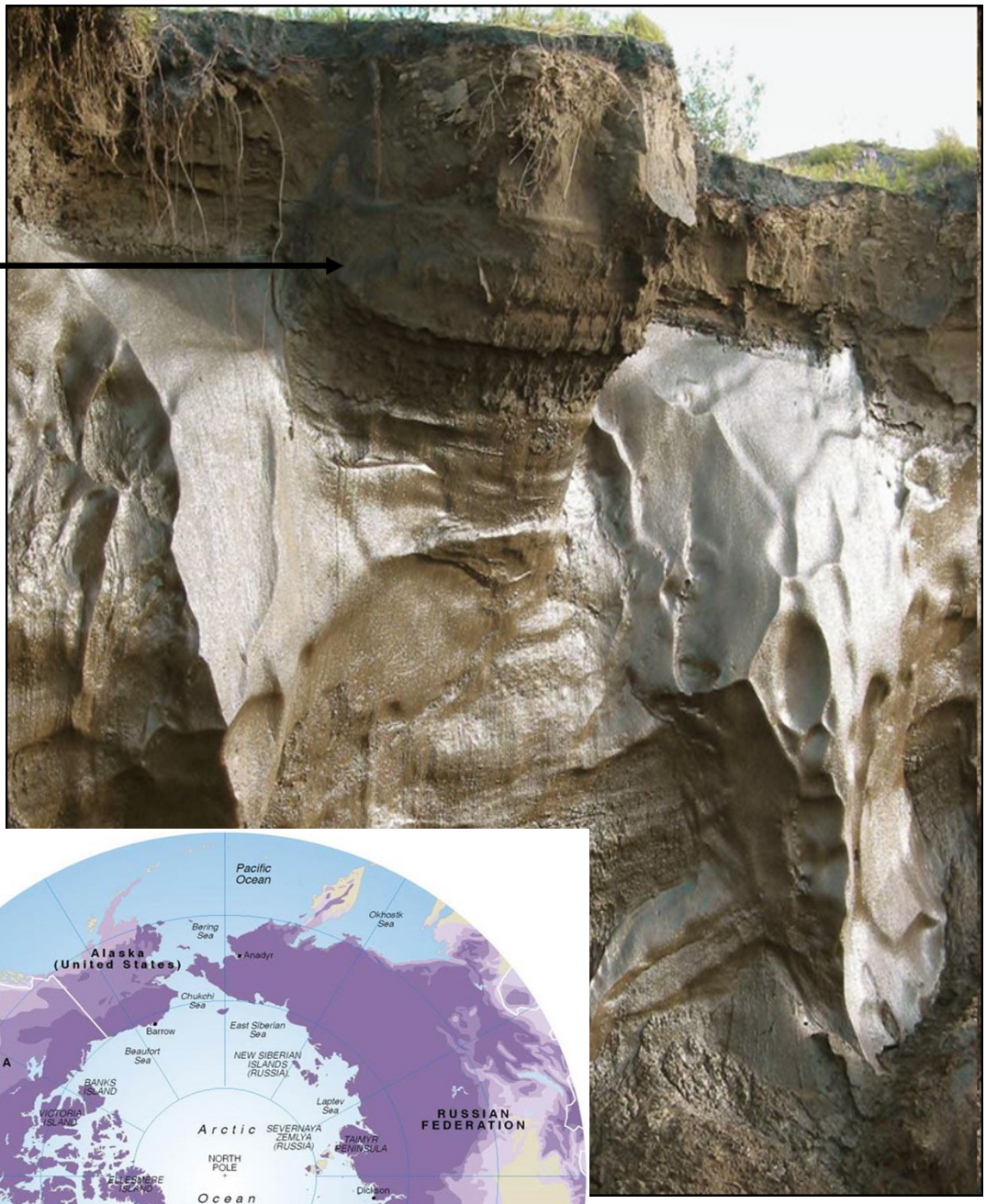
Schuur and Mack, Annu. Rev. Ecol. Evol. Syst., 2018

© K. Turner

Permafrost

Active layer:

Layer of ground above permafrost that thaws every summer and re-freezes during winter



Permafrost:

- Contains ice
- When thawed, ground sinks, water accumulates (called subsidence)
- Contains carbon
- When thawed, digested by microbes releasing CO_2 or CH_4
- More C in permafrost than the atmosphere
- Amount of thaw depends on present and future greenhouse gasses

- Ground that has remained at or below 0°C for 2 or more years

Common Research Questions and Goals

- What climate conditions promote these landscape changes?
- How do these changes (disturbances) then affect other components of the landscapes
- Relationships among landscape components?

  drained lakes - vegetation? permafrost? carbon?

  thaw slumps - carbon? aquatic environment?

  shrub growth - permafrost? nutrients?

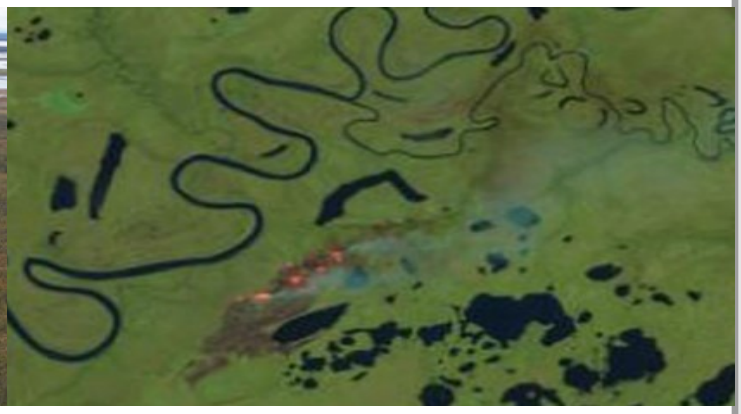
  fire - permafrost? carbon? slumps?

- What are the feedback mechanisms at work?
- Use this information to predict future conditions and implications under varying climate scenarios

More Surface Water

More Retrogressive Thaw Slumps

More Fire



More Drained Lakes

More Shrub

Wildlife

Arctic Wildlife

Millennia of evolution have prepared Arctic species like the polar bear, walrus and narwhal for life on and around the sea ice. Now their habitat is radically shifting in a matter of decades.

Wildlife of the Arctic

Wildlife in the Arctic are particularly adapted for the climate and environment. Some adaptations include extra insulation to stay warm (such as the muskox), white coloring to blend in (like Arctic fox, Dall's sheep, and polar bears), and feet that are adept at walking on the spongy tundra, across slippery ice, and swimming, as conditions require (such as caribou or reindeer).

Exploring the Arctic for Kids: Arctic Animals and Climates for Children—FreeSchool

The Arctic is an amazing place! You probably know that it is a very cold, icy place, home to polar bears, whales, and walrus, but there is more to the Arctic than that! The Northern Lights dance in the sky during long winters when the sun does not rise. In the summer, plants grow and animals flourish on the treeless Arctic tundra. Would you like to see puffins, humpback whales, polar bears, walrus, and more? Watch this video all about the Arctic!

They're Arctic Survivors. How Will They Adapt to Climate Change?

The Arctic is rapidly changing, warming much faster than any other region, and the snow is melting earlier. Researchers want to understand how wolverines will adapt. Peter Mather, a photographer, documented researchers' fieldwork over several seasons. The images provide a rare glimpse at wolverines in the Arctic wilds.

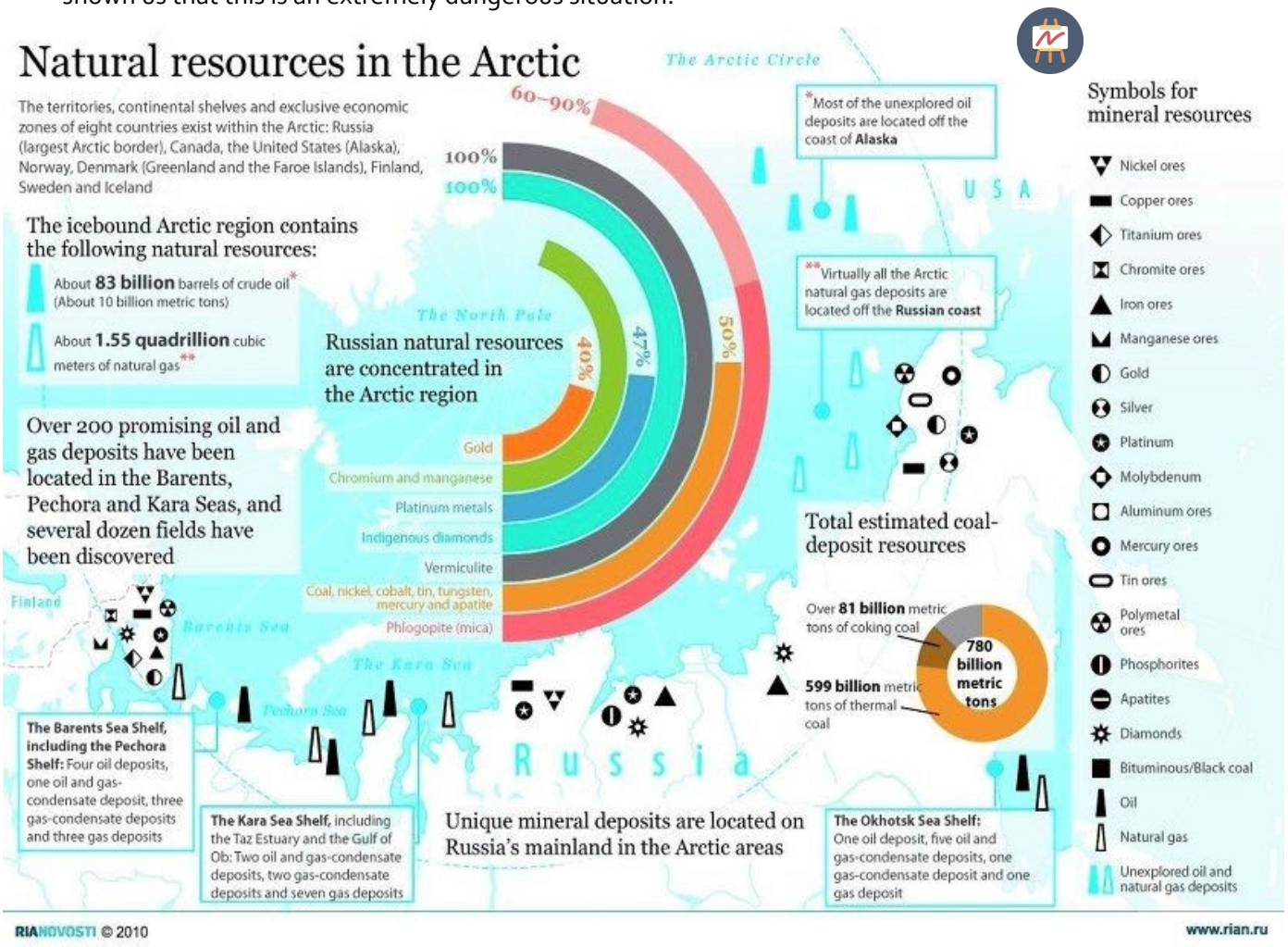
Natural Resources

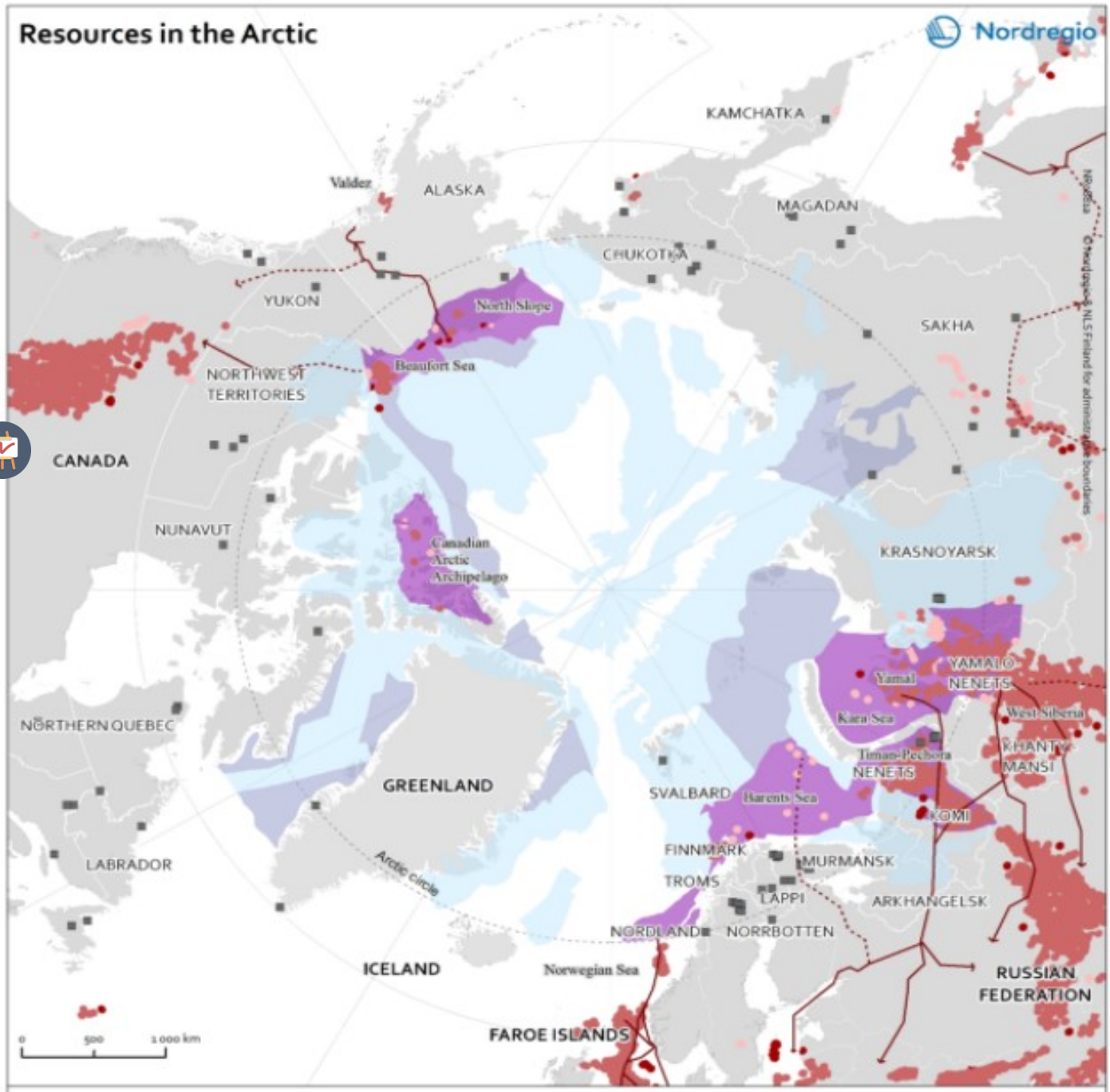
Resources in the Arctic 2019

This map reveals the main sites for gas and oil mining sites in the Arctic. Accessibility of these resources is being influenced by the effects of global climate change both on land and in the Continental Shelf.

Oil and Gas in the Arctic | Ice Race | Free Documentary

As the Polar ice starts to melt the oil industry is dreaming about making major oil and gas finds in this more or less untouched territory. The violent conflicts and wars that are taking place in some of the world's most affluent oil states are adding further fuel to these dreams. But who should be entitled to extract future oil and gas reserves in the Arctic? Where do the borders run in this icy territory? History has shown us that this is an extremely dangerous situation.





Main oil and gas resources & Mining activities in the Arctic

Oil/gas: exploration and production

- Gas
- Oil
- Oil and gas

Oil/gas: prospective areas and reserves

< 50%	Probability that at least one accumulation over 50 million barrels of oil or oil-equivalent gas exist after USGS (areas North of Arctic Circle included)
50-99 %	
100 %	

- Main mining site

- Main existing oil/gas pipeline (indicative direction)
- Main proposed oil/gas pipeline (indicative direction)

Regions included:

US - Alaska; CA - Yukon, Northwest Territories, Nunavut, Newfoundland & Labrador, Northern Quebec; GL; IS; FO; NO - Nordland, Troms, Finnmark, Svalbard; SE - Norrbotten; FI - Lappi; RU - Komi, Arkhangelsk, Nenets, Khanty-Mansi, Yamalo-Nenets, Krasnoyarsk, Sakha, Kamchatka, Magadan, Chukotka.

Data source: Nordregio, NSIDC, PRIO, United Sates Geological Survey USGS and several homepages for oil, gas and mining companies.

Challenges Facing the Arctic

Environmental

Threats to Arctic Ecosystems

Climate change, ocean acidification, pollution and more are threatening the extensive Arctic ecosystems.

Scientific Challenges in the Arctic

Both scientists wanting to monitor the effects of climate change in the Arctic as well as businesses hoping to expand are racing up to the top of the Northern Hemisphere. However, governmental interest also poses a threat to continued scientific exploration in the region.

Arctic Exploitation May Harm Animals Large and Small

As global warming has made it easier for enterprises to enter the Arctic, the human footprint their are leaving is expected to harm both the tiny zooplankton and the large whales of the region, through a variety of means.

New Warning Over Climate Change from Siberian Arctic—BBC News

Stark new findings of an international team of scientists led by the UK Met Office has raise profound questions about the future of the earth's climate.

Economic & Political

The Economic Importance of the Arctic

Climate change is impacting the accessibility of raw resources in the Arctic, making it a hot spot for economic interests and development.

The Emerging Arctic: Risks and Economic Opportunities

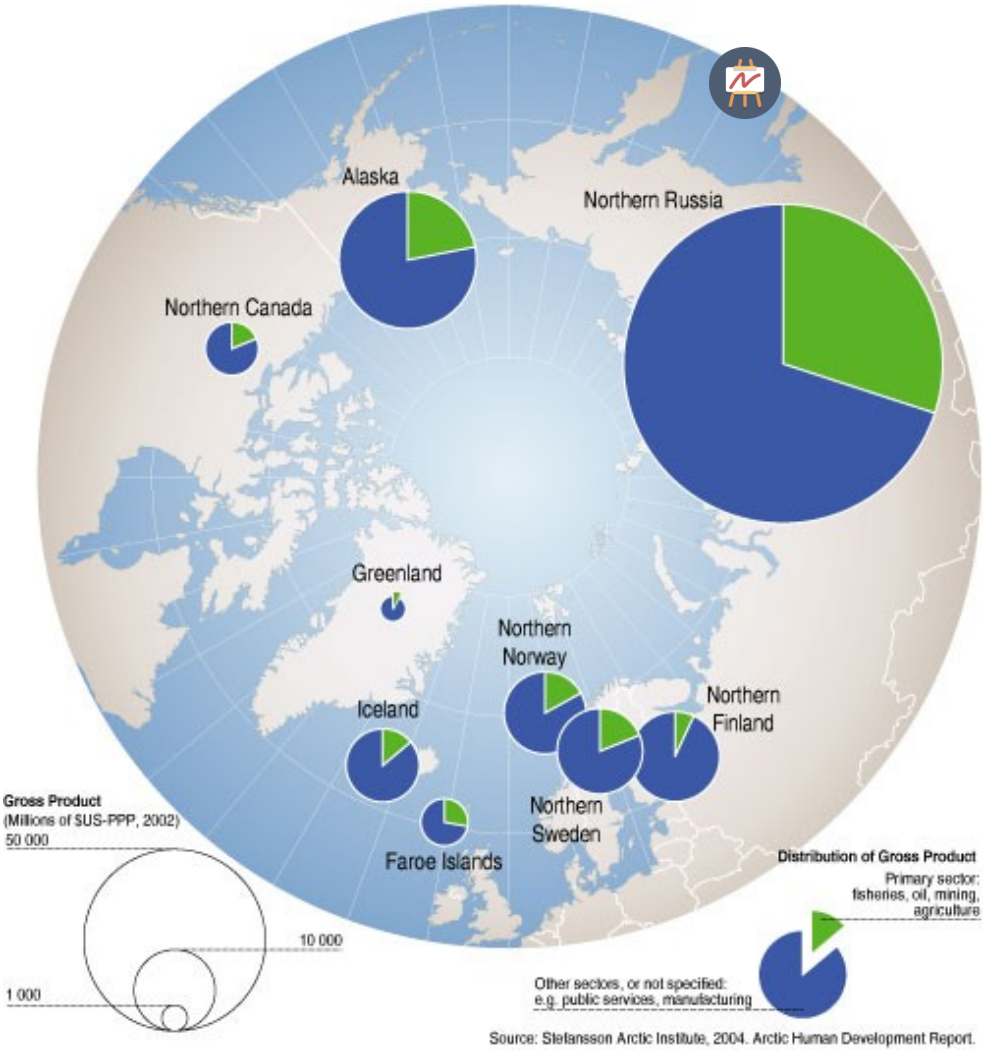
Melting sea ice is allowing for increased access to various economic prospects, with oil and shipping lanes being two of the most lucrative. However issues of security and sovereignty over disputed areas in the region as well as concerns over how to preserve the ecosystem are making the Arctic a contentious area.

Political and Environmental Issues

Countries claiming Arctic land have their own approaches to governance in their respective territories, but they all face concerns about the environment of the Arctic being threatened by increasing economic activity.

Governing a Changing Arctic | The Brookings Cafeteria Podcast (2015)

The Arctic is changing. As the polar ice cap recedes, new shipping routes are opening up and access to Arctic energy resources is expanding. **John Banks**, a non-resident senior fellow with the **Energy Security Initiative** at Brookings, explains what these changes mean for Arctic governance and for U.S. leadership of the Arctic Council in 2015.



Social

Lessons from the Pandemic and the Arctic

Three approaches are necessary for the Arctic to ensure its existential security while facing the pandemic: a focus on human security, exploring traditional practices and technologies, and choosing a coping action that will yield the most gains for people and nature

The Changing Shape of Arctic Security

While the Arctic has traditionally been a region of "high north, low tension" and the Arctic Council working to promote cooperation, changing great power policies, specifically between the United States and Russia, as well as the increasing interest by non-Arctic states, such as China, are impacting Arctic Security.

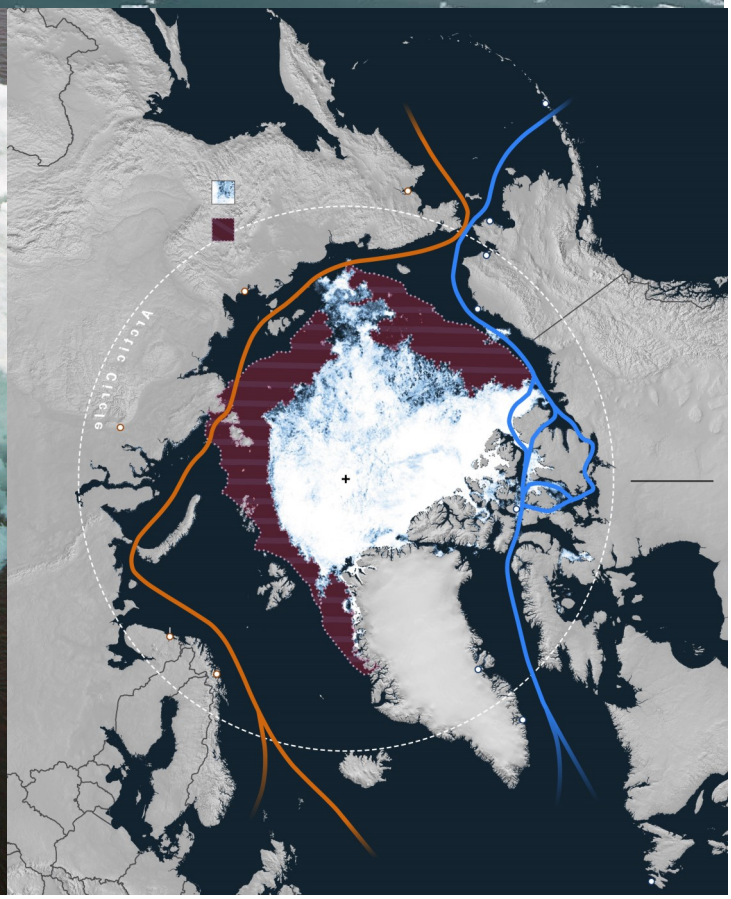
Coronavirus concerns force Arctic mission to cancel research flights

Efforts to conduct research in the Arctic have been halted due to COVID-19, including the mission of a $150 million German research ship hoping to understand the impacts of climate change in the region.

Why Climate Change in the Arctic Affects Us All

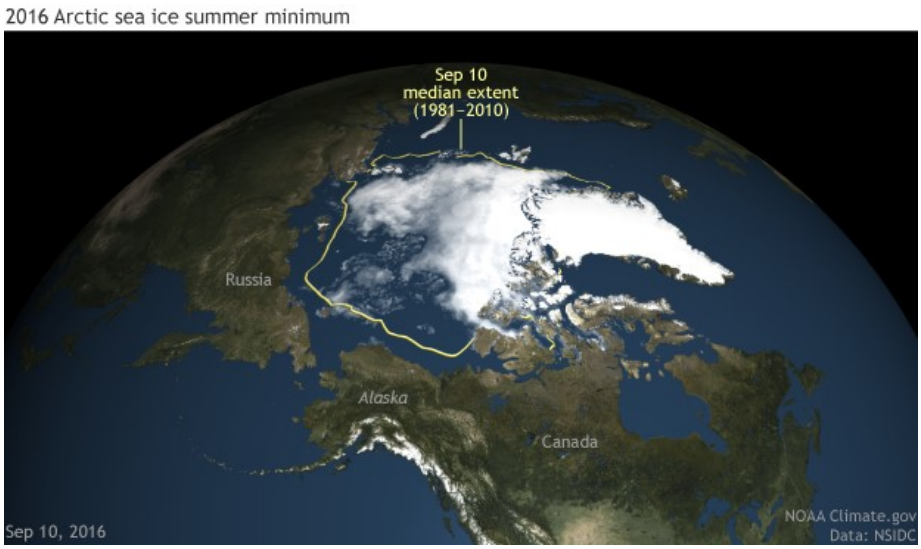
It was another year of dramatic climate change in Canada's Arctic. Inuit activist and Nobel Peace Prize nominee Sheila Watt-Cloutier has spent her life witnessing the changes and explains what's at stake for Canada and beyond.

Climate Change



[New Warning Over Climate Change from Siberian Arctic - BBC News]

The Siberian Arctic has faced forest fires pushed by climate change. Worry looms about how this will drive weather conditions in places like the UK and Europe.



[Melting Arctic Ice Fuels Climate Change and Extreme Weather Events | DW News]

Experts' warnings about the issue of climate change are being visible for people to see in the arctic.

[A Front-Row Seat for the Arctic's Final Summers With Ice]

Effects of climate change begin to show as ships take less time to cross the arctic waters forcing scientists to research on how this may affect the planet's future.

[Dramatic Arctic fires and sea ice melt, show need for urgent climate action]

The WMO responds to the noticeable increase of the average arctic temperatures. Data shows irreversible threats to the Arctic which could affect many parts of the globe.

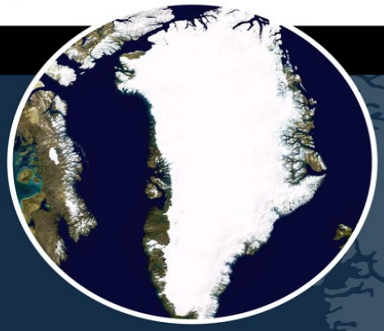
THE GREENLAND MELTDOWN

World Science Festival

If Greenland's ice sheet completely melts, scientists predict that global sea levels will rise at least 20 feet. While there's still a sizable amount of ice left, researchers think the melt is starting to accelerate; glaciers in the northeast part of the sheet, once thought to be the most stable of all, have actually been losing 10 billion tons of ice every year for the past decade. Here are some fast facts about the Arctic crisis you don't hear as much about.

GREENLAND'S ICE SHEET...

- ...covers 656,000 square miles, 80% of Greenland's surface, 3 times the size of Texas
- ...is the 2nd largest body of ice on Earth after Antarctica
- ...contains 10% of Earth's fresh water supply
- ...is over 10,500 feet thick at its highest point



This graph shows changes in the mass of the Greenland Ice Sheet, estimated to hold around 3 million gigatons (1 Gigaton=1 billion metric tons, or around 2.2 trillion pounds) of ice in total. Measurements come from the GRACE satellites, which examine Earth's gravity field. Source: Danish Meteorological Institute

ANNUAL GLOBAL SEA RISE

Greenland's ice sheet alone contributes 16% of the total annual sea level rise we've seen over the past 20 years.

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[Milne Ice Shelf: Satellites capture Arctic ice split]

The Milne Ice Shelf, the second largest ice shelf in the Arctic, was captured by satellites splitting into fragments, providing visuals of the impact of climate change on the Arctic.

[There's a Heatwave at the Arctic 'Doomsday Vault']

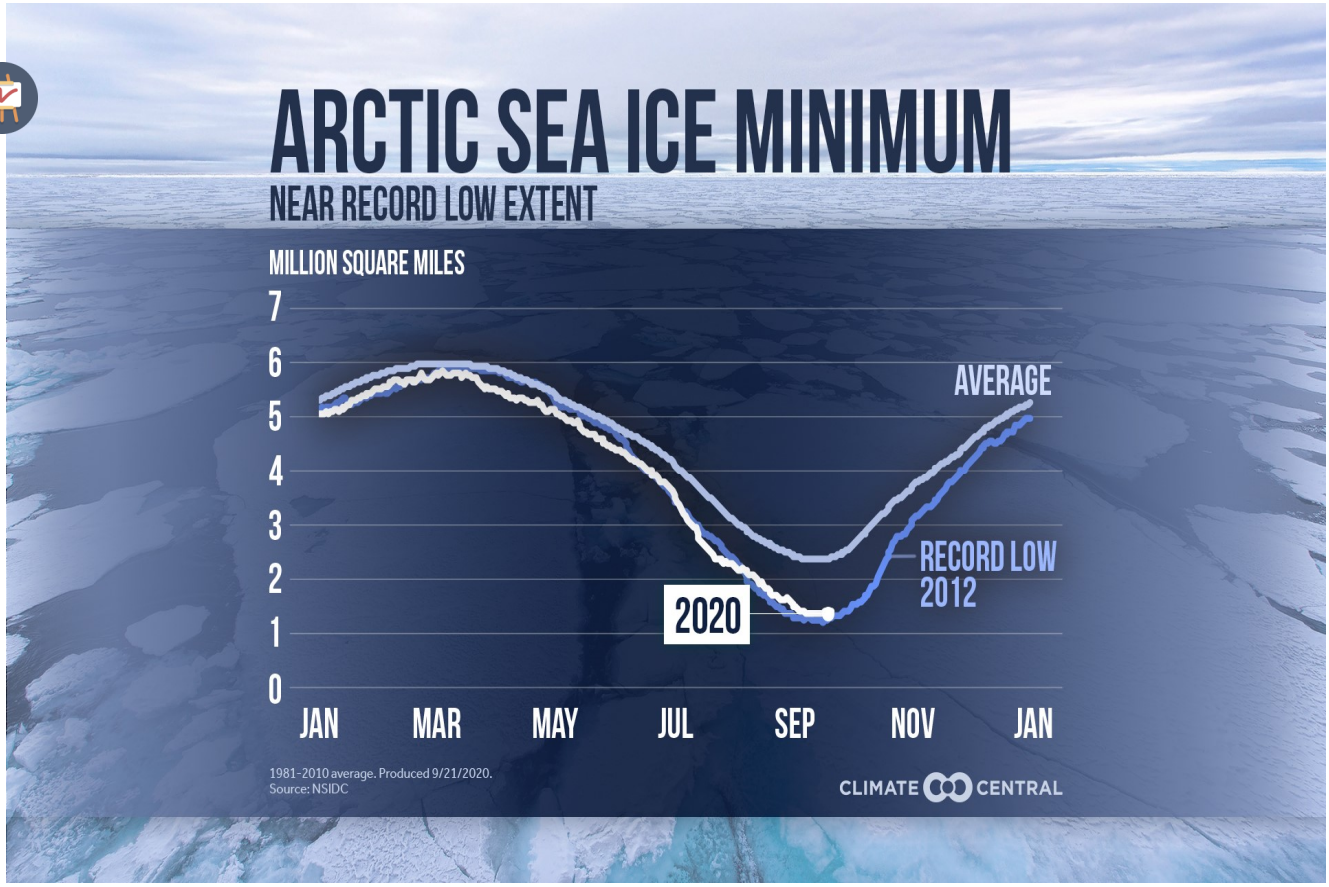
In Svalbard, Norway the "Doomsday Vault" that contains nearly 900,000 seeds for research, breeding, and education, is at risk for overheating due to climate change.

[Arctic Summer Sea Ice Could Disappear as Early as 2035]

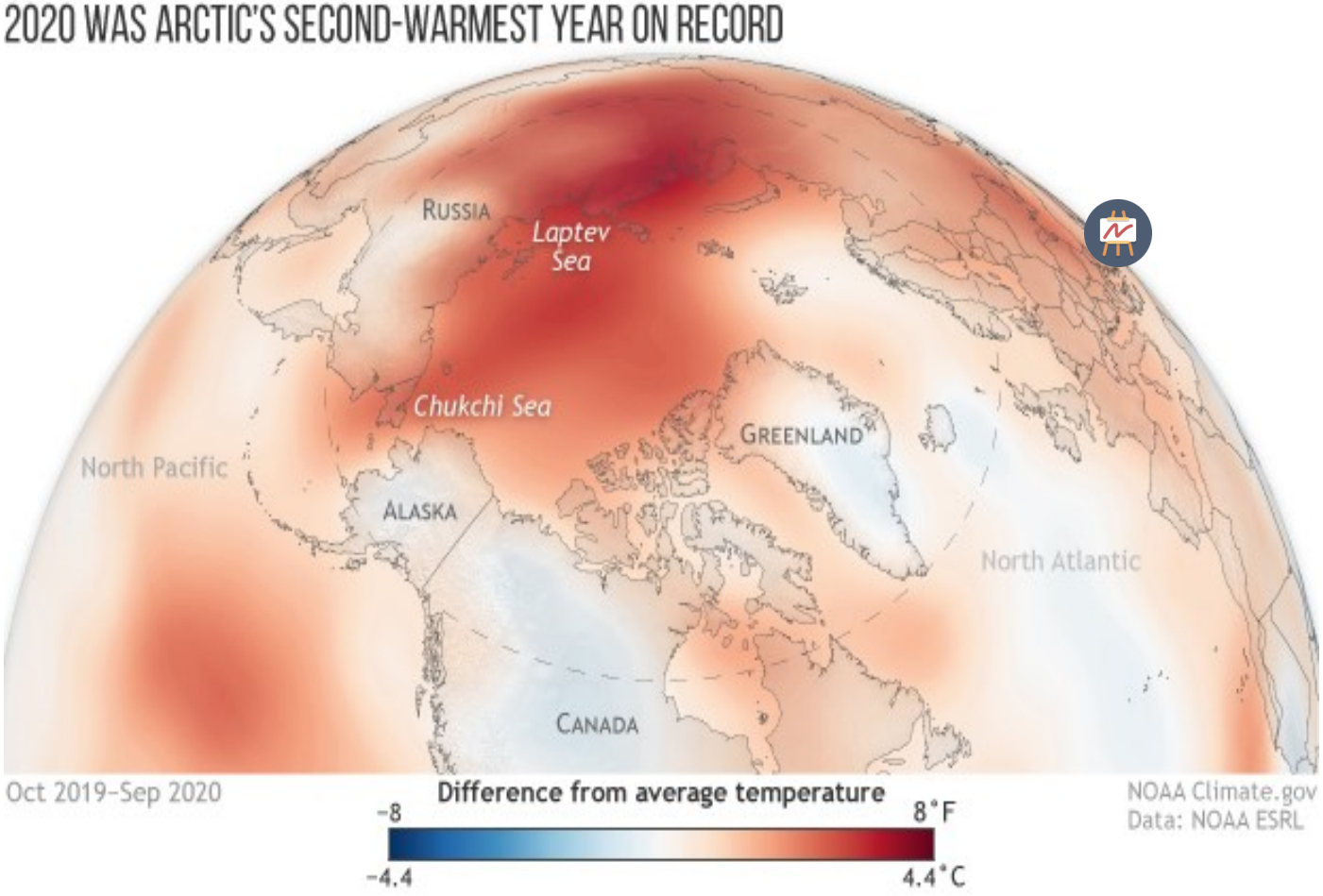
With Arctic sea ice at its lowest point in 2020, fears about the summer ice are solidifying into a disappearance date of 2035.

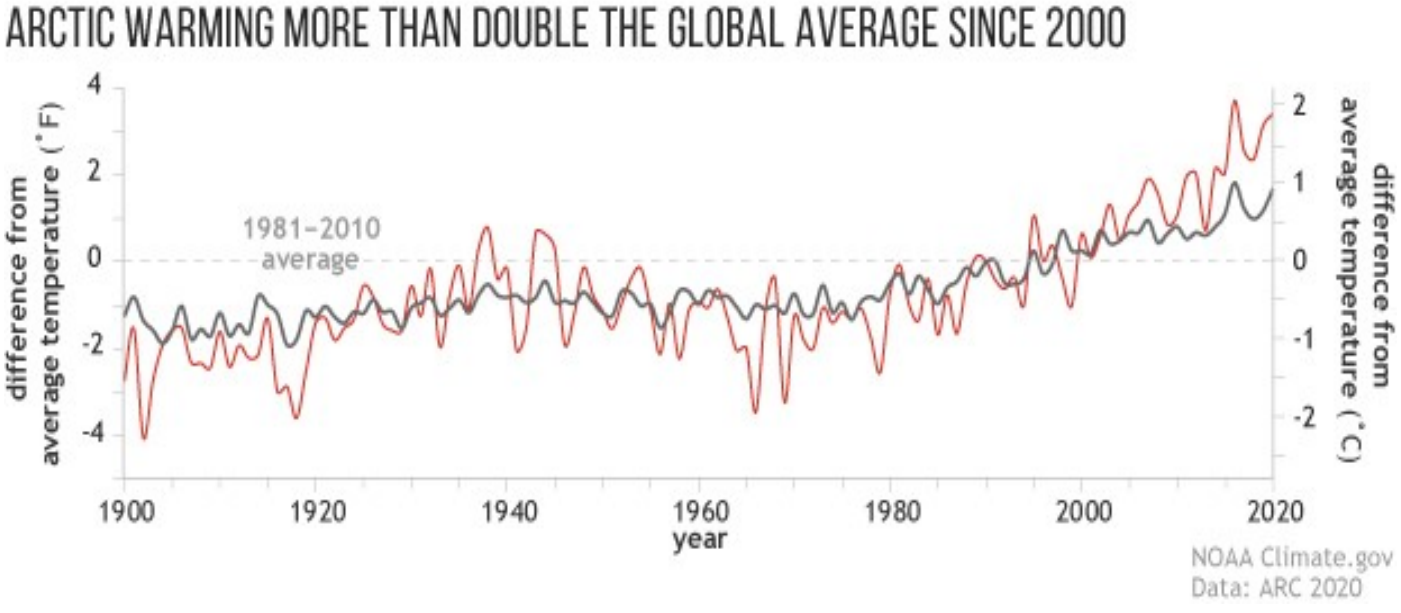
[Global Warming: Scientists 'Stunned' by How Much Ice We've Lost]

The "worst-case scenario" models over the disappearance of Arctic sea ice are becoming the reality, as the underestimation of the rate of temperature increases is wreaking havoc on the region. Scientists are encouraging incorporating further climate change policy in the Paris Agreement to combat the quickly increasing temperatures



Navigating the Impacts of Climate Change





Normative Life in the Arctic

Arctic Indigenous Peoples, Climate Change Impacts, and Adaptation

The effects of climate change on humans has been seen on indigenous peoples of the Arctic. Steps have been taken against the violation of human rights of the Inuit by CO_2 emissions emitted by developed states like Canada, Russia, and the US. The challenges faced by the arctic are urgent as the people are considered the first to need to adapt to the changing environment.

Indigenous People of the Arctic and Impacts of Climate Change

The warming of the equator has an amplified effect on the warming in the Arctic leaving the Inuit people vulnerable both economically and culturally. Some countries have plans on exploiting the oil and gas reserves protected under the melting ice bringing another challenge to the Inuit people.

Arctic Peoples Faced with New Challenges

Anthropologist Joëlle Robert-Lamblin shares her views on how the Arctic has changed and is challenging the Arctic indigenous populations over the past 50 years.

Climate Change Is Making This Alaskan Town Fall Into the Ocean (HBO)

For decades, a small village in Alaska has been disintegrating and falling into the surrounding river. And for decades, the village's residents, most of them native Alaskans, have been asking state and federal agencies for the help and funding they need to relocate the entire community. So far, the money they've gathered falls far short of the estimated $130 million they'll ultimately need to make that happen. Now, the village is running out of time.

Native Lands

An Ecosystem-wide Reproductive Failure with More Snow in the Arctic

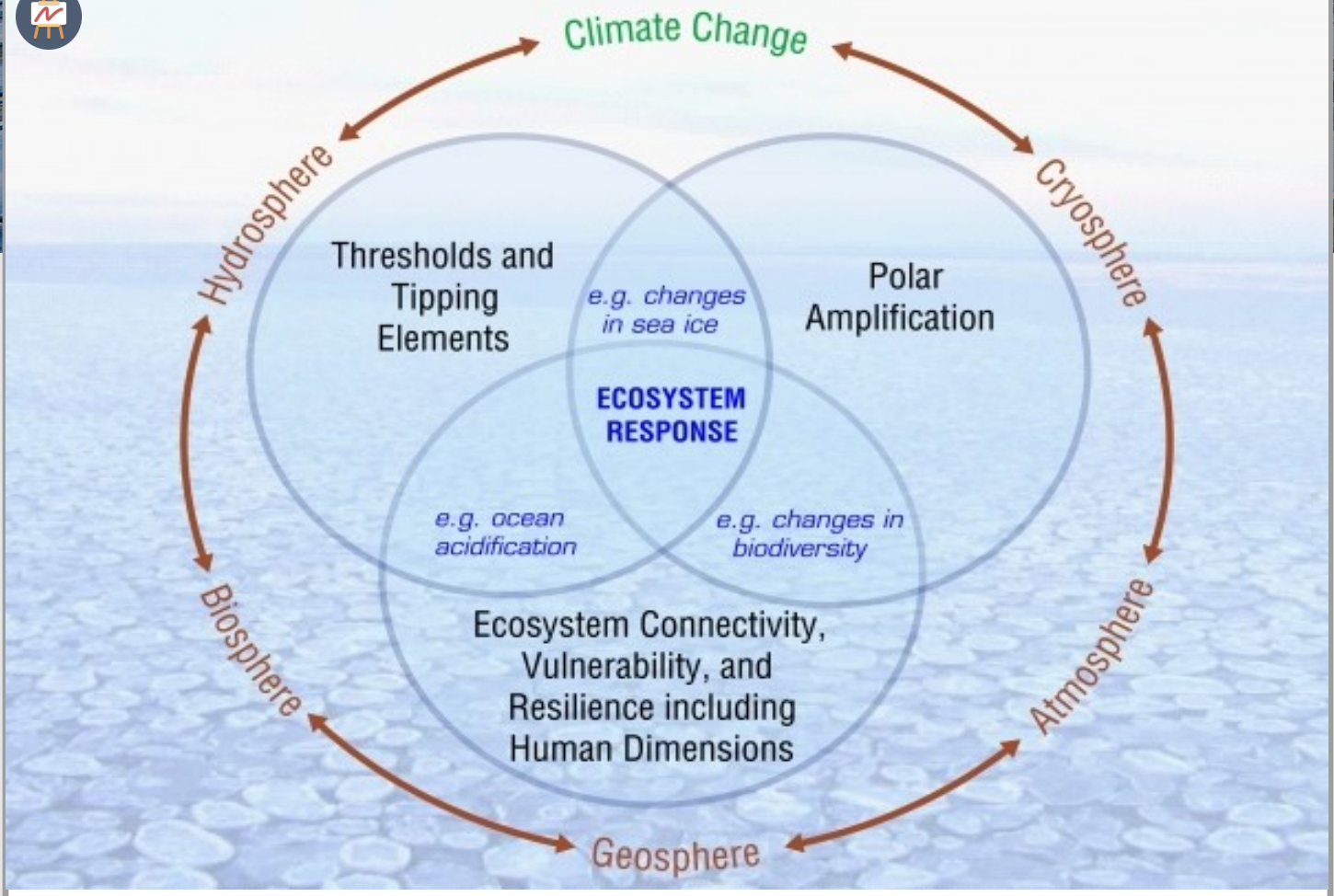
While focus in the Arctic has been on rising ocean temperatures and melting sea ice, a new phenomenon has emerged: increased snowfall. The impact on the Arctic ecosystem has been enormous, as a well-studied ecosystem in Northern Greenland had complete reproductive failure with increased precipitation.

Marine Researchers Find a Dramatic Ecosystem Shift in Russian Arctic Waters

Researchers on the *Professor Levanidov*, a vessel conducting trans-arctic research, have found evidence of species unfamiliar to the Arctic in its waters, such as halibut. The finds from this research are expected to lead to the beginning of commercial fisheries in the region.

Canada's Change Climate Report

Published in 2019, this report is about how and why Canada's climate has changed and what changes are projected for the future. Led by Environment and Climate Change Canada, this document is the first of a series to be released as part of Canada in a Changing Climate: Advancing our Knowledge for Action. It documents changes across Canada in temperature, precipitation, snow, ice, permafrost and freshwater availability as well as in Canada's three oceans.



Impacts at the Ecosystem Level

Arctic ecosystems are being damaged in a variety of ways, including vanishing habitats, changing species interaction, population declines and extinctions, and more.

What Melting Sea Ice Means for Life in the Arctic

Vox has created a three-part series discussing the changing Arctic. This video discusses how flora and fauna are adjusting to rising sea temperatures and melting ice.

Climate Change and Arctic Ecosystems

In this activity, students learn about how climate change is affecting the Arctic ecosystem and then investigate how this change is impacting polar bear populations. Students analyze maps of Arctic sea ice, temperature graphs, and polar bear population data to answer questions about the impact of climate change on the Arctic ecosystem.

Warmer Shorter Winters Disrupt Arctic Terrestrial Ecosystems

Climate change is now impacting the length of seasons, and with the Arctic being reliant on steady weather and seasonal patterns, ecosystems are experiencing a variety of consequences.

The Future of the Arctic

Policy & Sustainable Development

It's Our Table: Indigenous People Shaping Arctic Policy

This commentary highlights the essential contributions of indigenous peoples to the shaping of Arctic policy. These policies' impacts are described to be immediately felt in native communities.

United Nations Decade of Ocean Science for Sustainable Development (2021-2030)

The United Nations has proclaimed a Decade of Ocean Science for Sustainable Development (2021-2030) in its mission to support adaptation strategies and sustainable development in response to global change.

Linking Changes in the Arctic Marine Ecosystem to the Provisioning of Ecosystem Services and Inuit Wellbeing

This research relies on a case study on the connections between ecological processes, ecosystem services, and human wellbeing in the community of Cambridge Bay, or Ikaluktutiak, an Inuit hamlet of Nunavut in the context of a changing arctic environment.

No Sea Ice? No Problem! How Deep Arctic Ecosystems May Benefit from our Changing Climate

This article points to a brighter side of the effects of climate change related to a potential increase in some of the benthic habitats that live in the deeper waters of the Arctic. It also adds to our understanding of the relationship between ocean depth and productivity, countering previous knowledge.

Intergovernmental Panel on Climate Change (IPCC)

The IPCC provides regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

Arctic Climate Impact Assessment (ACIA)

This subsite presents information products and materials relating to the results of the 2004 Arctic Climate Impact Assessment (ACIA).

Terrestrial Multidisciplinary Distributed Observatories for the Study of Arctic Connections (T-MOSIAiC)

T-MOSAiC is an IASC pan-Arctic, land-based program that extends the activities of the IASC flagship program MOSAiC: 'The Multidisciplinary drifting Observatory for the Study of Arctic Climate', MOSAiC is a multinational year-round study (2019-2020) of the central Arctic Ocean to measure the coupling between atmosphere, sea ice, ocean and ecosystem processes. The objective of the satellite program T-MOSAiC is to coordinate complementary activities that will both aid and benefit from MOSAiC (especially the modelling components) by extending the work to the lands surrounding the Arctic Ocean and to the northern communities who live on those lands.

NASA Arctic—Boreal Vulnerability Experiment (ABoVE)

Climate change in the Arctic and Boreal region is unfolding faster than anywhere else on Earth, resulting in reduced Arctic sea ice, thawing of permafrost soils, decomposition of long- frozen organic matter, widespread changes to lakes, rivers, coastlines, and alterations of ecosystem structure and function. NASA's Terrestrial Ecology Program is conducting a major field campaign, the Arctic-Boreal Vulnerability Experiment (ABoVE), in Alaska and western Canada, for 8 to 10 years, starting in 2015. ABoVE seeks a better understanding of the vulnerability and resilience of ecosystems and society to this changing environment.

Canadian Permafrost Association

The global effort to address climate change currently lacks a technical or policy framework that adequately accounts for major feedback mechanisms, including the accelerating thaw in global permafrost. Accordingly, for the first time ever, world-class experts are convening in a series of workshops to begin creating a PCF Intervention RoadMap – an action guide for policy makers and investors. This process is intended as a regional supplement to global decarbonization efforts and a complement to initiatives addressing the local geophysical impacts of permafrost thaw.

Curriculum

CCTV America Documentary: 'On Thin Ice: the People of the North'
This 2015 film shot in northern Alaska and Canada portrays the lives of people in the arctic challenged by climate change.

Keeping the Inuit Way of Life Alive in a Changing World | Short Film Showcase
National Geographic provides a short video of an Inuit man watching and experiencing Arctic Canada changing before his eyes and impacting the Inuit way of life.

Arctic Climate Curriculum
This first activity provided by NOAA's climate.gov allows for students to explore the Arctic and it's various components such as vegetation, people, and more. Included in the guide are teaching tips, technical details, and more.

Arctic Climate Connections
CIRES education and outreach designed a project focusing on polar science that focused on high school students. Explore their three-part curriculum series complete with materials, learning goals, descriptions, and even standards alignment information!

The Future of the Arctic: What Does It Mean for Sea Ice and Small Creatures?

We seek to connect curious minds to the experts and information that will motivate them to ask informed and critical questions about real science throughout their lives. By working directly with scientists, we ensure that our content is of the highest quality. By working directly with kids, we help foster curiosity both in and out of the classroom and engage the next generation of citizens and scientists.

Education Lesson Plans

The NOAA has compiled various lesson plans grouped in categories based on grades From 5-12 that discuss relevant research being conducted in the Arctic. Content is framed around topics such as Arctic Climate Change with regard to glaciers, Arctic biology like zooplankton, and social consequences of climate change.

Polar Climate Change Lesson Plans

With lesson plans ranging across various issues relevant to climate change and its impact on the Arctic, the American Museum of National History provides detailed information about each unit they have created and which grade group it should address.

Lesson Plan: Arctic Animals and a Changing Climate

This lesson plan for grades 5-8 by PBS has student to go in-depth about the impacts of climate change on animals in the Arctic. Complete with videos, questions, charts, and more!

Sea Level Rise: Climate Change

Provided by Everglades National Park, this lesson plan wants to show students grades 3-5 how melting Arctic ice sheets will impact low-lying cities, states, and countries, such as Florida, and provides an opportunity for students to discuss how such communities can adapt and mitigate rising sea levels.

Polar Literacy

A program designed to connect scientists, educators, and students using data and research from the Arctic and Antarctic regions.

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