Courtesy Kathy Crane, NOAA Arctic Research Office

WHAT ARE THE IMPACTS OF SHRINKING POLAR ICE CAPS?

"Rarely have we seen the Arctic show a clearer, stronger or more pronounced signal of persistent warming and its cascading effects on the environment than this year."

~ Jeremy Mathis, director of NOAA's Arctic Research Program

During the past thirty years, the Arctic environment has changed like never before. Temperatures have increased more than twice as much as on the rest of Earth and sea ice has been getting smaller and smaller. These changes have opened the Arctic to new commercial activities such as shipping, oil and mineral exploration and tourism. These new opportunities have increased the need to understand more about Arctic change and its effects on weather and climate, as well as how it may affect human communities and industry. The information that NOAA generates about the Arctic helps to conserve and manage Arctic resources to provide healthy, productive and resilient communities and ecosystems.

The Arctic Report Card for 2016 is a report that brings together the work of 61 scientists from 11 nations who report on air, ocean, land and ecosystem changes. It is used around the world to track changes in the Arctic and how those changes may affect communities, businesses and people.

What You Will Do

Make a poster to explain how climate change is affecting polar ice mass, how it may affect humans, and what we can do about it.

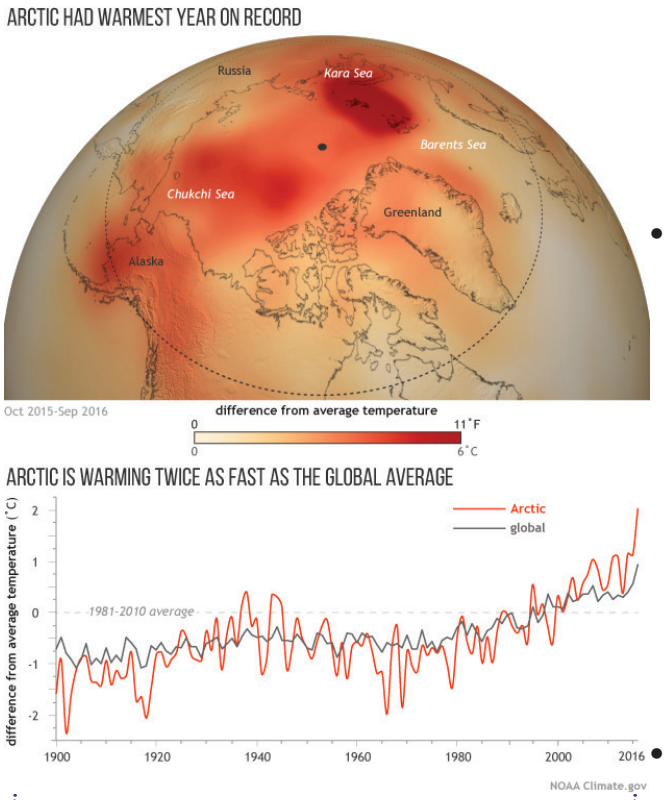
Major findings in the 2016 report include:

- Warmer air temperature: Average annual air temperature over land areas was the highest in the observational record, representing a 6.3 degree Fahrenheit (3.5 degree Celsius) increase since 1900. Arctic temperatures continue to increase at double the rate of the global temperature increase.

- Record low snow cover: Spring snow cover set a record low in the North American Arctic, where the May snow cover extent fell below 1.5 million square miles (4 million square kilometers) for the first time since satellite observations began in 1967.

- Smaller Greenland ice sheet: The Greenland ice sheet continued to lose mass in 2016, as it has since 2002 when satellite-based measurement began.

- Record low sea ice: The Arctic sea ice minimum extent from mid-October 2016 to late November 2016 was the lowest since the satellite record began in 1979. Arctic ice is thinning, with multi-year ice now comprising 22 percent of the ice cover as compared to 45 percent of ice cover in 1985.



(map) Temperatures across the Arctic from October 2015-September 2016 compared to the 1981-2010 average. (graph) Yearly temperatures since 1900 compared to the 1981-2010 average for the Arctic (orange line) and the globe (gray). NOAA Climate.gov map based on National Centers for Environmental Prediction (NCEP) reanalysis data from NOAA's Earth System Research Lab. Graph adapted from Figure 1.1 in the 2016 Arctic Report Card.

- Above-average Arctic Ocean temperature: Sea surface temperature in August 2016 was 9 degrees Fahrenheit (5 degrees Celsius) above the average for 1982-2010 in the Barents and Chukchi seas and off the east and west coasts of Greenland.

- Arctic Ocean productivity: Springtime melting and retreating sea ice allowed for more sunlight to reach the upper layers of the ocean, stimulating widespread blooms of algae and other tiny marine plants which form the base of the marine food chain, another sign of the rapid changes occurring in a warming Arctic.

The 2016 report also includes scientific essays on carbon dioxide in the Arctic Ocean, on land and in the atmosphere, and changes among small mammals.

- Ocean acidification: More than other oceanic areas, the Arctic Ocean is more vulnerable to ocean acidification, a process driven by the ocean's uptake of increased carbon dioxide from Earth's atmosphere. Ocean acidification is expected to intensify in the Arctic, adding new stress to marine fisheries, particularly those that need calcium carbonate to build shells. This change affects Arctic communities that depend on fish for food security, livelihoods and culture.

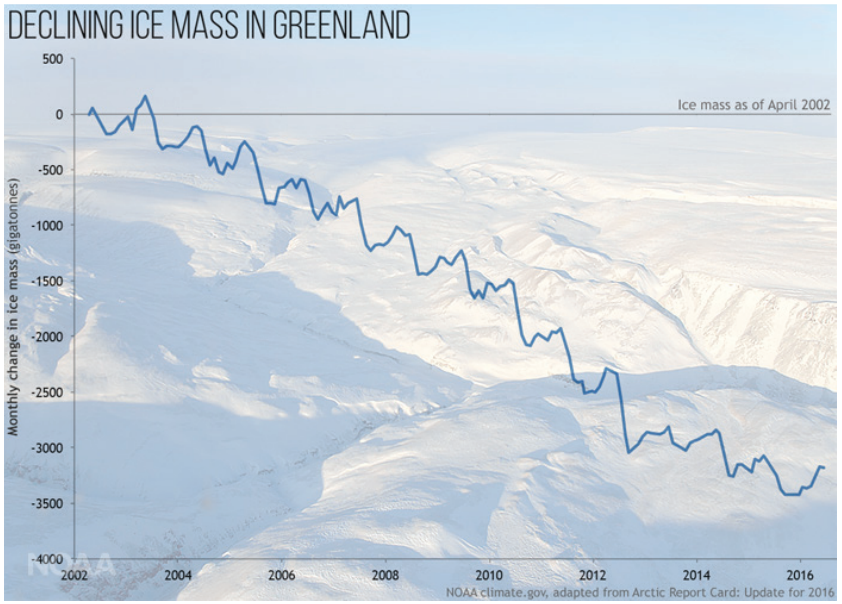
- Carbon cycle changing: Overall, the warming tundra is now releasing more carbon into the

atmosphere than it is taking up. Twice as much organic carbon is locked in the northern permafrost as is currently in the Earth's atmosphere. If the permafrost melts and releases that carbon, it could have profound effects on weather and climate in the Arctic and the rest of the Earth.

- Small mammals: Recent shifts in the population of small mammals, such as shrews, may be the signs of broader consequences of environmental change.

These changes spell big trouble for animals that depend on sea ice for their survival. Polar bears, for example, live on sea ice all year. They rear their young on the ice, and hunt along the edges where seals make holes in the ice to breathe. An adult polar bear usually eats one seal every four or five days. When the sea ice melts during the summer, polar bears have to swim between floating chunks of ice (called "floes") to continue their hunt. Until recently, the floes were usually less than 15 miles apart. But as more and more of the perennial ice melts, the floes have become much farther apart, and the bears have had to swim over much longer distances.

Polar bears face other problems, too. Ocean currents can carry chemical pollution thousands of miles, and some of it reaches the Arctic. Chemicals called PCBs, for example, have been found in polar bears. These chemicals cause problems with polar bears' immune systems, so the bears are more likely to get sick.



The Greenland ice sheet continued to lose mass in 2016, as it has since 2002 when satellite-based measurement began. Melting began the second earliest in the 37-year record of observations, close to the record set in 2012. Graphic shows Greenland ice sheet mass each month since April 2002. (Climate.gov; data provided by Marco Tedesco/Lamont-Doherty)

What You Will Need

- ❒ Color copies of images from "Images for Shrinking Polar Ice Caps" or other images you find in web searches
- ❒ Information from the introduction to this activity.
- ❒ Crayons, colored markers, or colored pencils
- ❒ Poster board
- ❒ Scissors

Warning

Be careful with sharp scissors!

How to Do It

1. Use the images and information to create a poster that explains what is happening to arctic sea ice, how this is related to climate change, why this is important to us, and what we can do about it.

2. Show your poster at school, to your parents, and to other groups. The more people know about climate change and how it affects life on Earth, the more they will take action to protect Earth's ecosystems.

Want to Do More?

Take a look at the short video of Arctic Report Card 2016. www.youtube.com/watch?v=G0rp6-BEur8&feature=youtu.be

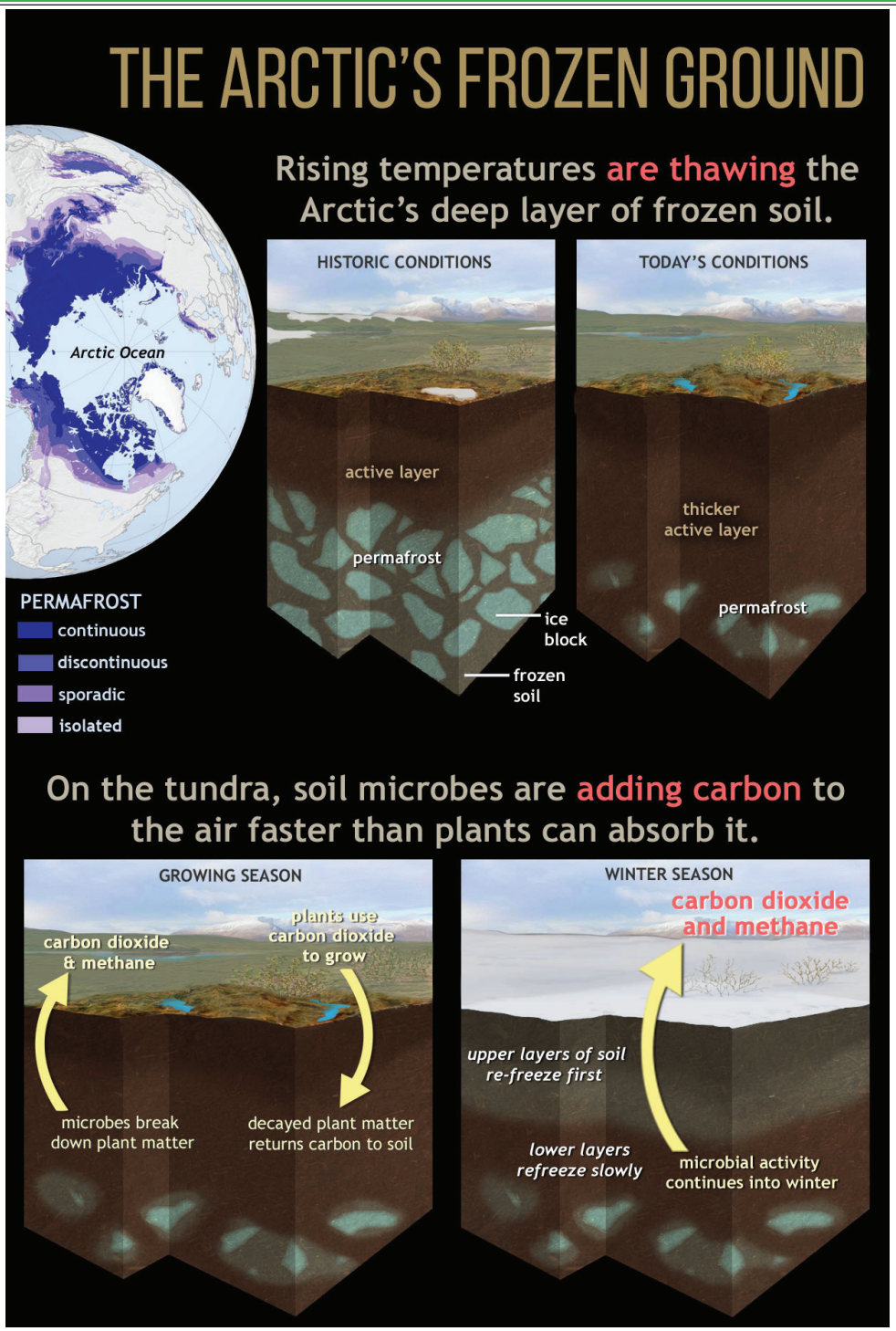
For an in-depth read, go to the Arctic Report Card: Update for 2016 www.arctic.noaa.gov/Report-Card/Report-Card-2016

www.arctic.noaa.gov/ – NOAA's Arctic Theme Page with information and data about the Arctic for scientists, students, teachers and the general public.

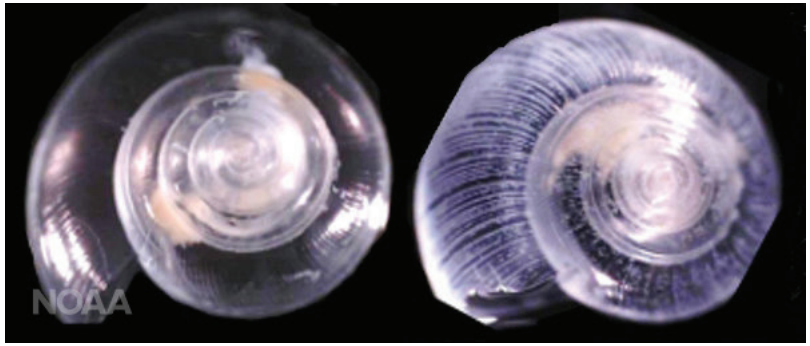
For more information on methane, see www.climate.gov/print/827815

For more information on ocean acidification, see http://oceanacidification.noaa.gov

Images for Shrinking Ice Cap Posters



(map) Stretching from Alaska to Scandinavia to Russia, and hundreds of feet deep in places, the Arctic's frozen soils--permafrost--contain twice as much carbon as what's already in the atmosphere. As the Arctic heats up, permafrost may become a major source of greenhouse gases, which would further accelerate global warming. (top middle) Permafrost is like a giant freezer for carbon: thousands of years worth of plant, animal, and microbe remains mixed with blocks of ice. Historically, only a shallow "active layer" thawed in the short summer. (top right) In today's warming Arctic, permafrost is thawing and the active layer is getting deeper. (bottom left) Warming in the growing season has increased plant growth and allowed plants to remove more carbon dioxide (CO_2) from the air during photosynthesis, but it is also thawing the frozen soils and stimulating decomposition of organic matter by soil microbes. Microbial activity releases the greenhouse gases CO_2 and methane (CH_4). (bottom right) When winter comes, the uppermost soil layer re-freezes quickly as air temperatures drop. But deeper layers, insulated from the frigid air, re-freeze more slowly. In the past decade, the parts of the Arctic tundra that are routinely observed have become a net source of carbon-containing greenhouse gases because microbial activity is continuing well into winter after plants go dormant. NOAA Climate.gov drawing. Permafrost map from NSIDC.



Ocean acidification impact on pteropods
Pteropods, or sea butterflies, are a vital food source for salmon and other commercially important fish. Shown here in laboratory conditions are (left) a pteropod that has lived for six days in normal waters and (right) a pteropod showing the effects of living in acidified water for the same time period. The white lines indicate shell dissolution and explain why ocean acidification is often called "osteoporosis of the sea." (NOAA)

Courtesy Joel Garlich-Miller, USFWS

Methane bubbles trapped in ice on Abraham Lake, in Alberta, Canada, during winter 2016-17.
Photo by Flickr user juneaidrao, used under a Creative Commons license .

One species of shrew is now invading north into the Arctic, setting off a major reorganization of animal communities at the top of the world. Accelerating climate change in the Arctic is spurring the northward invasion of shrews, bringing an array of tapeworms and other parasites, according to authors of an essay in 2016's report card, "Small species indicate big changes: Shrews and their parasites. www.arctic.noaa.gov/Report-Card/Report-Card-2016/ArtMID/5022/ArticleID/268/Shrews-and-Their-Parasites-Small-Species-Indicate-Big-Changes"

Phil Myers, photographer; copyright holder/Museum of Zoology, University of Michigan-Ann Arbor