

The Future of Arctic Sea Ice

GRADE LEVEL: 9th through 12th

TIME PERIOD: 3 (45 minute) class periods

BACKGROUND

Although the Arctic Ocean is the smallest ocean on our planet it is not easily explored. For most of the year this ocean is covered with drifting packs of sea ice. Polar sea ice has an important role in our planet's climate. One of its roles is in insulating the ocean water below it and preventing heat and moisture from moving into the atmosphere. Sea ice impacts our planet's solar radiation budget in reflecting most incoming solar energy. The process of sea ice freezing and melting affects the salinity and density of ocean water in the poles. Although 7 % of the our planet's oceans is covered with sea ice, satellite images are showing us the dramatic changes that are happening to sea ice as a result of global warming. Some specialists believe it is possible that the Arctic may be completely free of sea ice in the very near future.

The importance of sea ice is not limited to our climate. There are numerous creatures that rely on the ice and its sympagic (ice specific) food web to survive. Within the sea ice itself are algae, fungus, bacteria and viruses. Melting ice releases organisms and nutrients into the water below providing an energy source for the polar food chain. Below the sea ice are communities of zooplankton that feed on the sea ice algae. Fish, squids, and sea mammals feed on these zooplankton. Even polar bears rely on the sea ice food chain to survive. With diminishing sea ice, these organisms are sure to be affected, but how?

CONTENT STANDARDS

NEW JERSEY

5.1

A. Habits of Mind

When making decisions, evaluate conclusions, weigh evidence, and recognize that arguments may not have equal merit.

Assess the risks and benefits associated with alternative solutions.

Engage in collaboration, peer review, and accurate reporting of findings.

Explore cases that demonstrate the interdisciplinary nature of the scientific enterprise.

B. Inquiry and Problem Solving

Select and use appropriate instrumentation to design and conduct investigations.

Show that experimental results can lead to new questions and further investigations.

5.5

A. Matter, Energy, and Organization in Living Systems

Relate the structure of molecules to their function in cellular structure and metabolism.

Explain how plants convert light energy to chemical energy.

Describe how plants produce substances high in energy content that become the primary source of energy for life.

Relate disease in humans and other organisms to infections or intrinsic failures of system.

B. Diversity and Biological Evolution

Explain that through evolution the Earth's present species developed from earlier distinctly different species.

Explain how the theory of natural selection accounts for extinction as well as an increase in the proportion of individuals with advantageous characteristics within a species.

5.8

A. Earth's Properties and Materials

Explain the interrelationship of the geosphere, hydrosphere, and the atmosphere.

B. Atmosphere and Weather

Describe how weather (in the short term) and climate (in the long term) involve the transfer of energy in and out of the atmosphere.

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OBJECTIVES:

Students will analyze the seasonal extent of polar sea ice

Students will describe the abiotic and biotic structure of sea ice communities

Students will create a model of current Arctic sea ice communities.

Students will predict the future of Arctic sea ice communities.

VOCABULARY

Atmosphere	Algae	Energy source	Squids	Organism
Sympagic	Viruses	Solar radiation	Organism	Biotic
Sea-ice realm	Fungi	Zooplankton	Bacteria	Abiotic
Diatoms	Sea Ice extent	Food web	Insulating	Nutrients

MATERIALS

Computer with internet access

Poster and arts or crafts materials

PROCEDURES

Class period 1

- Have students complete part 1.
- Discuss their research as a class.
- Review the differences we are finding about the affect of global warming on the North and South pole.
- Discuss possible implications of Arctic sea ice extent to all organisms in that region.

Class period 2

- Have students begin to research organisms that rely on sea ice.
- Assign groups for creating the models
- Review the plans for each group's models

Class period 3

- Have students create their models for the present and future Actic sea ice communities.

ASSESSMENT

Poster Rubric

<http://school.discoveryeducation.com/schrockguide/assess.html>

Student model description / presentation

CITATIONS: Modified from activities

<http://oceanexplorer.noaa.gov>

http://www.oceanexplorer.noaa.gov/explorations/02arctic/background/education/media/arctic_crystal.pdf

http://serc.carleton.edu/eet/seaice/case_study.html

STUDENT INSTRUCTIONS

PART 1 Analyzing Seasonal Changes in Sea Ice.

Go to the “National Snow and Ice Data Center..Sea Ice Index” webpage

http://nsidc.org/data/seaice_index/

Scroll down to “Animated Images”

Click on “Animated Images”

Set the hemisphere choice to **Northern**, year to **2006**, month to **January** and image to **Sea Ice Extent**.

Go through the 12 months of 2006 one by one to view the seasonal changes in sea ice. If need be you can control the speed of the pictures by clicking slower or faster.

Follow the same procedure for the Southern hemisphere.

Answer the following questions for the **Northern Hemisphere**

1. Month of maximum sea ice extent
2. Total sea ice extent ismillion square km.
3. Month of minimum sea ice extent
4. Total sea ice extent is.....million square km

Answer the following questions for the **Southern Hemisphere**

5. Month of maximum sea ice extent
6. Total sea ice extent is.....million square km.
7. Month of minimum sea ice extent
8. Total sea ice extent ismillion square km
9. Based on the 2006 data, times of maximum sea ice extent occur in the Northern and Southern Hemispheres at about
 - a. the same time of year
 - b. a half year apart
10. Times of minimum sea ice extent occur in the Northern and Southern Hemispheres at about
 - a. the same time of year
 - b. a half year apart
11. Based on the 2006 data, times of maximum and minimum sea ice extent in the two hemispheres occur.....their respective winter and summer solstices
 - a. during the same months of the year as
 - b. two to three months later then

12. Assuming data in the animation are representative from year to year, it appears that a larger percentage of thesea ice melts back in the summer

- a. Arctic
- b. Antarctic

Read the press release from the NSIDC about the sea ice measured in 2007

http://nsidc.org/news/press/2007_seaiceminimum/20071001_pressrelease.html

13. What was significant about the extent of ice measure in 2007?

14. List the various factors contributing to the extent of sea ice that are mentioned in the press release.

15. What is significant about the timing of the sea ice melt in 2007?

16. What predictions are made about the future of sea ice?

PART II. Is There a Future for Life in the Sea Ice

Your teacher will be assigning groups for this section.

1. Use the websites below to collect background information on sea ice communities. Develop a model for what sea ice communities look like presently in **either** summer or winter.

http://www.arctic.noaa.gov/essay_kremsdeming.html

http://oceanexplorer.noaa.gov/explorations/02arctic/background/sea_ice/sea_ice.html

<http://ngm.nationalgeographic.com/2007/06/vanishing-sea-ice/sea-ice-text/1>

<http://dsc.discovery.com/news/2008/11/12/arctic-ocean-plankton.html>

2. Using what you have learned about the future of sea ice in the Arctic create a second model illustrating how the sea ice community will look in the same season (summer or winter) 10 years from now.

3. Prepare a plan for your models, including the size of the model, key features, and biological organisms to be included. Your teacher should approve these plans before you begin constructing their models.

4. Complete the models using felt or paper cutouts.

EXTENSION

5. Have each group present to the class conditions in the sea ice community as illustrated by their models.

6. Have students write a discussion about relationships among organisms, and how these organisms use the physical features of the sea ice community to survive. Key points are the changes in the brine channels between summer and winter, increased salinity of the brine liquid in the winter months, the insulating effect of the sea ice layer, use of brine channels as habitats by algae and animals, and the ways in which the sea ice community affects animals in adjacent communities such as polar bears, fishes, and seals.