Answer Key
Student Activity Sheet – Whither Sea Ice?

Instructions to accompany this activity sheet can be found online at:
http://serc.carleton.edu/eet/seaice/index.html

Students who complete this lesson will know and be able to do:

- Measure the seasonal variations in sea ice extent
- Discover long-term changes occurring in sea ice extent
- Visualize the relationship between sea surface temperature and sea ice extent
- Grasp the complex linkage between the sea-ice extent to the Arctic food web and human activities
- Download tabular and image data related to sea ice extent and temperature
- Manipulate image data with digital image processing tools
- Animate a stack of images
- Plot tabular data as graphs and examine trends to make predictions

Read the Background Information Page and answer the following questions.
(*on the teacher page*)

1. List three impacts of the loss of sea ice. In each case, explain what system is being impacted and give details and examples.

    a. change in albedo - and surface air and water temperatures
    b. decreased ocean salinity
    c. decrease in habitat for animals
    d. increase in erosion

2. What animals depend on sea ice to breed? Name two and explain their role in the marine ecosystem.

    Polar bear and walrus
    They are both top predators and need the sea ice to breed.

Read the Sea Ice Primer to answer the following questions.
(*a link from the background page*)

3. What is sea ice and how does it form?
        Sea ice is frozen ocean water. It forms in the cold Arctic winters.

4. Describe the difference between single and multi-year sea ice.
>   First year ice is less dense and often will re-melt the following summer. It is the first stage of sea ice pack. Multi year ice is denser and forms the ice pack that lasts all summer. It is typically 2-4 meters thick.

5. What is albedo and how does sea ice help to regulate climate?

>   Albedo is how reflective a surface is to solar energy. The polar Ice caps reflect much of the suns's energy and therefore help to keep the planet cool.

6. How do the native peoples of the Arctic depend on sea ice for their existence?

>   Native populations depend on the ice especially for hunting and dwelling. If the ice breaks up earlier and faster it is more difficult to hunt. The ice becomes treacherous to cross and people must adapt their hunting pattens.

Read the Case Study Page and answer these questions

7. Who is Dr. Meier?
>   He is a research scientist at the NSIDC in Boulder, Colorado.

8. What tools does he use to study sea ice?
>   Primarily he uses data gathered by satellites to monitor changes in sea ice.

9. Why is he concerned about the changes that he sees?

>   The changes seen show much less sea ice is forming and at later than normal times of year. This causes the solar warming to significantly increase, thus warming the earth faster.

Part 1. Download data and Image J software

10. After downloading the data sets from NASA, browse through the files in the folder "monthly".

What are the first and last file names?   Copy the names here.
>   nt_197810_f07_v01_n.bin
>   nt_200606_f13_v01_n.bin

What information is in these file names? (hint: look at the instructions for this information.)
>   the file name is the year and month ie 1978 October

Part 2. Import, Animate and Measure.

Step 1.
11. After importing and animating the datasets, describe your general impressions of the seasonal changes in the sea ice.

It is surprising how much change has occurred in the ice. It is obvious that not all the ice is returning and that the ice could eventually disappear altogether.

Step 2.
12. What is the purpose of a look-up table (LUT)?

The LUT provides a better visual reference for the problem. Adding color makes the differences easier to see.

13. Describe other places where you might have used a similar tool.

Weather maps use color scales to indicate temperature. Other maps use LUT scales to indicate elevation. Anywhere you use color to indicate a numerical value it is a LUT.

Step 5.
14. Read the text from Dr. Meier. Why do we use extent rather than concentration for our measurements?

Sea ice extent makes analysis easier and simpler to interpret. It is one dimensional.

15. Why is concentration also an important factor to discuss when talking about the decline in sea ice? (hint: return to the Sea Ice Primer and study the section on multi- year ice)

Concentration shows how thick the ice is and not just the amount. If ice is thinner, it will melt and break up easier.

Part 3. Import and Process the data in Excel

Step 3.
16. Graph the data from this step. Sketch or paste your graph here.

Sea Ice Extent 1978 -2005
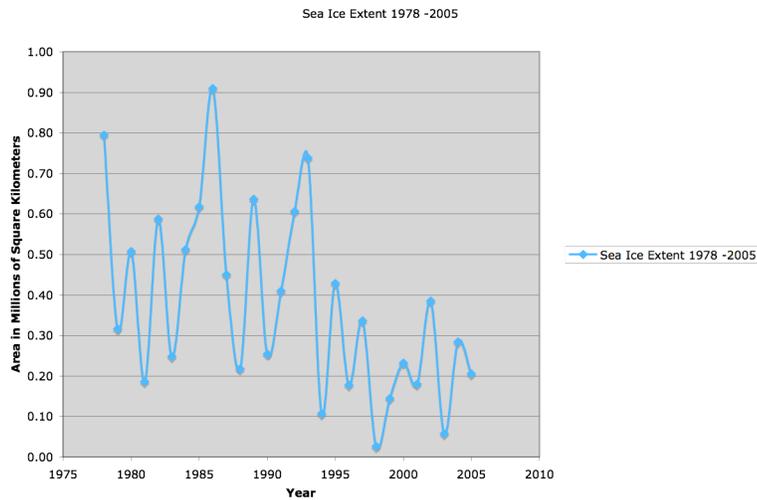
17. What does the data say? Is the sea ice extent really getting smaller in November of each year? Is it true that polar bears are having to wait longer for the ice to return to Hudson Bay?

> Yes, the ice is getting smaller each year and it is returning later.

18. What does the general slope of your trend line say about sea ice in Hudson Bay since 1979? Describe the relationship shown by your trend line.

> The trend line points to the dramatic decrease in the sea ice extent.

19. At the rate of decline shown by your chart, how much ice would you predict will be in Hudson Bay in November, 50 years from now?
Explain how you arrived at this answer.

> The ice will be completely gone by 2060. One just needs to extrapolate the line.

Part 4. Arctic Temperature Trends.

20. Plot your data and examine the trends. Sketch or paste your graph here:
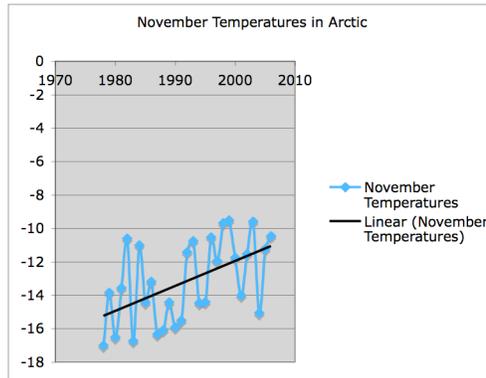
21. What does your trend line say about November temperatures from 1978 to 2006? Describe the relationship shown by your trend line.

The temperature is going up.

22. Describe the relationship you see between the 2 datasets, temperature and sea ice extent.

One is going down while the other is going up.

Part 5. Check the trends elsewhere in the Arctic.

23 -25. Select one more village to examine from the suggested list, or pick your own area of interest. Plot both the sea ice extents and temperature trends for this region. Sketch or paste your graph here and describe what you see.

Answers will vary