MiSP Ecology/Pollution — Global Warming Worksheet #1, L2

Name _____ Date _____

GLOBAL WARMING AND ICE EXTENT

Introduction:

Sea ice is found in remote polar oceans. On average, sea ice covers about 25 million square kilometers (9,652,553 square miles) of Earth or about two-and-a-half times the area of Canada. Because most of us do not live in the polar regions, we may live for several decades and never see sea ice. Although it may not directly affect us, sea ice is a critical component of our planet because it influences climate, wildlife, and people who live in the Arctic (http://nsidc.org/seaice/).

The following are excerpts from a press release from the National Snow and Ice Data Center (NSIDC), which is part of the Cooperative Institute for Research in Environmental Sciences at the University of Colorado at Boulder:

6 October 2009

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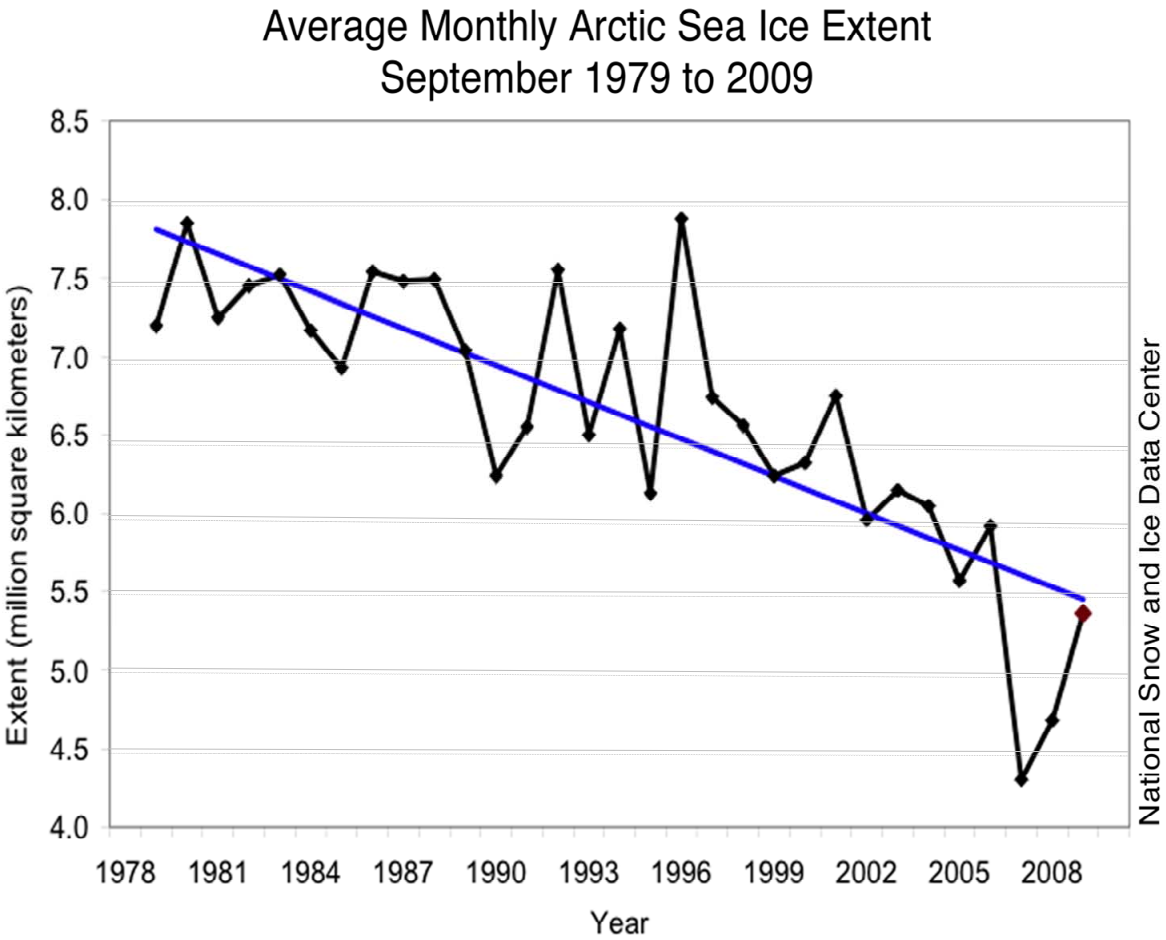
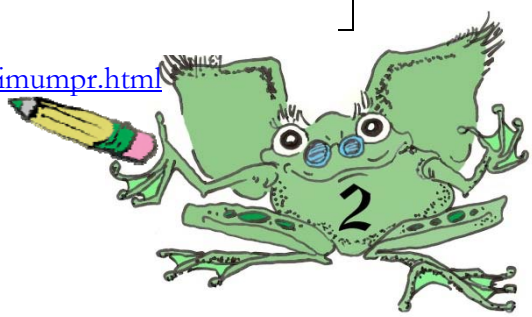


Source: http://nsidc.org/news/press/20091005_minimumpr.html



Procedures:

- Study the graph of September sea ice extent from 1979 to 2009. Satellites were used to measure how much frozen ocean there was in the Arctic region. September is the end of the "summer" in the Arctic so it is a time when the sea ice is at its minimum. Scientists drew a best-fit line on the graph.
- Answer the discussion questions.

Discussion Questions:

1. On the September sea ice graph, what is the independent variable (manipulated variable) and what is the dependent variable (responding variable)?

   Independent variable: _____

   Dependent variable: _____

2. Describe the changes in the amount of sea ice from 1978 to 2009 using the connected data point lines.

   _____

   _____

   _____

3. Describe the changes in the amount of sea ice from 1978 to 2009 using the best-fit line.

   _____

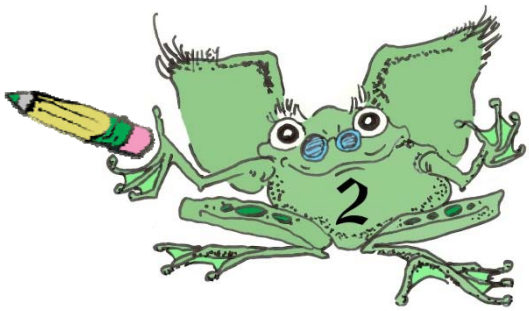
   _____

   _____

4. Why do scientists and mathematicians use a best-fit line?

   _____

   _____



5. Using the data point connected lines, predict what the sea ice extent will be in 2012.

   _____ million square kilometers

6. Using the best-fit line, predict what the sea ice extent will be in 2012.

   _____ million square kilometers

7. Which of the predictions that you made in 5 and 6 is the better prediction? Explain your answer.

   _____

   _____

   _____

8. In the introduction above, a scientist is quoted as saying, "We still expect to see ice-free summers sometime in the next few decades." He is basing that expectation on the same graph that you have been studying. Does the graph support this statement? Refer to the graph in your answer.

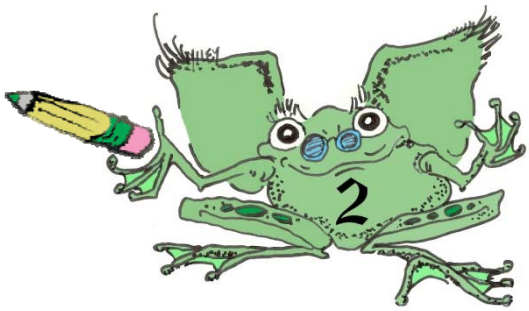
   _____

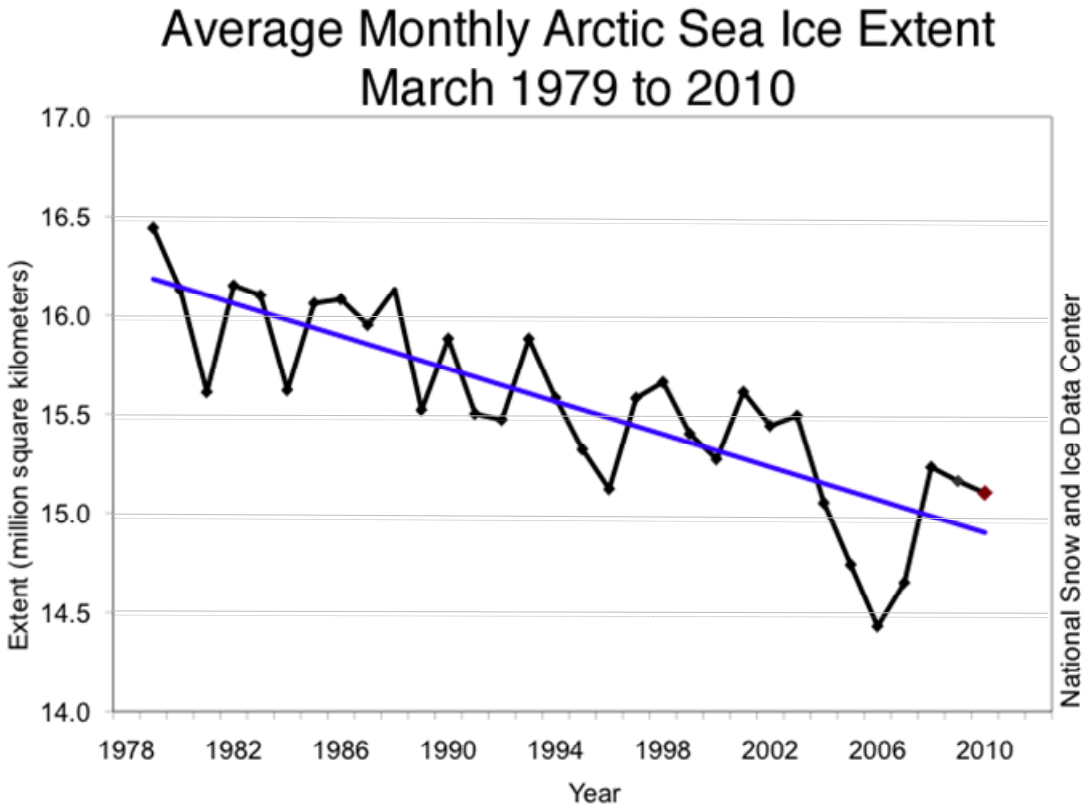
   _____

   _____

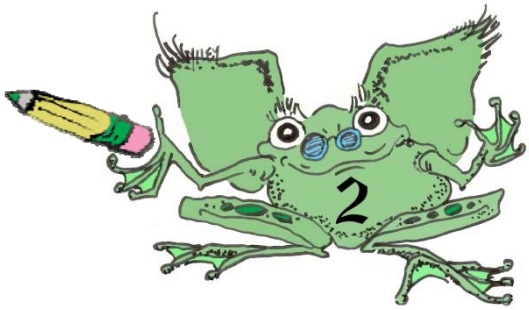
Additional Information:

The extent of winter ice is measured in March, the end of the Arctic winter. The average ice extent for March 2010 was 670,000 square kilometers (260,000 square miles) higher than the record low for March, observed in 2006. The linear rate of decline of the winter ice extent in the 1978–2010 period is 2.6% per decade. The graph below depicts the yearly data from 1978 to 2000.





9. The graph on the previous page shows the extent of Arctic sea ice in March 1979–2010. March is at the end of the wintry months in the Arctic and it is when sea ice is at its greatest spread and thickness. Compare the March graph with the September graph. How are they similar and how are they different?



10. If the September and March data points were plotted on the same graph, where would the best-fit line for the March data points be compared to the best-fit line for the September data points?

_____

_____

11. Use the best-fit line to calculate unit rate of change over time (slope) in the September Arctic sea ice extent (the first graph).

$$\text{Unit Rate of Change} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)} = \frac{\Delta \text{ Ice Extent (million square kilometers)}}{\Delta \text{ Time (years)}}$$

Unit Rate of Change (slope)

Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Ice extent (million square kilometers) Δy	Δ Time (years) Δx	**Unit Rate of Change (slope)** $\Delta y / \Delta x$

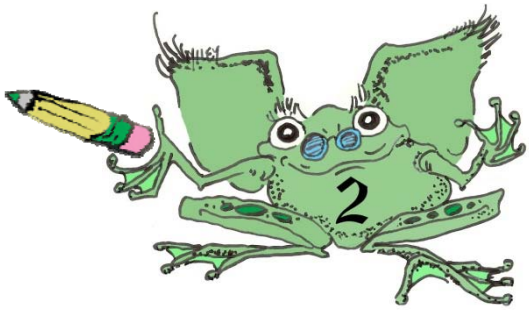
12. What is the sign (positive/+ or negative/-) of the unit rate of change (slope)?

_____

13. What does the sign (+ or -) tell us about how the sea ice is changing over the years?

_____

_____



14. If the best-fit line on the September graph were extended, it would intersect the *y*-axis. Notice, however, that unlike many other graphs you have seen, in this graph the origin is not (0, 0). In order to calculate the *y*-intercept, you will need to change the *x*-value of the ordered pair you used. Make 1978 equal to 0 on the *x*-axis of your graph. Then the *x*-value for 1979 will become 1; the *x*-value for 1983 would be 5 [*x*-value = year – 1978].

Ordered pair used to calculate slope (x_1, y_1) (x_2, y_2)	Ordered pair with adjusted *x*-values (x_1, y_1) [*x* = year – 1978] (x_2, y_2)