Name:

# Student Instructions Sheet

## Graphing Sea Ice Extent in the Arctic & Antarctic

**DIRECTIONS** Large amounts of ice form in some seasons in the oceans near the North Pole and the South Pole (the Arctic Ocean and the Southern Ocean). This ice, which forms when seawater freezes, is called sea ice. In this activity, you will learn about sea ice and how the amount of sea ice changes from month to month and from year to year. The size of the area covered by sea ice is called the "extent" of the sea ice. In this activity, you will graph the extent of the sea ice over time.

Start by looking at the sea ice around the North Pole in the Arctic Ocean. Your teacher will give you a piece of graph paper. In a few minutes, you will graph data about the changes in the extent of sea ice in the Arctic Ocean. But first, you will need to think about how you expect the sea ice extent to change throughout the year and make a hypothesis about how you expect the sea ice graph to look.

You will graph the average sea ice extent for each month for a period of three years, from January 2016 through December 2018. The x-axis of your graph is time, in months. The y-axis of your graph is the extent of sea ice, in millions of square kilometers.

Think of what you know about snow, ice, and the seasons. During what months would you expect there to be the most ice? During which months do you think there would be the least ice?

1. Between 2016 and 2018, the largest extent of sea ice was about 14 million $km^2$. The smallest extent of sea ice was about 5 million km2. Pick a colored pencil to use for drawing your hypothesis. Sketch a line or curve on the graph paper showing your hypothesis about how the sea ice extent changed from January 2016 through December 2018.

2. Next, your teacher will provide you with actual data of monthly sea ice extent in the Arctic from January 2016 through December 2018. Pick a different colored pencil than the one you used to sketch your hypothesis and plot the actual data on the same graph paper you used for your hypothesis. Add a key to your graph showing which colors you are using for each set of data.

3. Compare your hypothesis with the actual data. How similar are the two curves? If there are differences, what might explain those differences?

4. In which month is there the most sea ice? In which month is there the least? Is it the same month each year?

5. Next, let's consider sea ice extent near the South Pole around Antarctica. Think about the ways that the changes in sea ice extent over time near Antarctica might be similar to, and different from, changes in the Arctic. Once again, choose a different colored pencil, and sketch in a curve showing your hypothesis about sea ice extent over time in the Antarctic. Do this on the same piece of graph paper you have been using all along. Between 2016 and 2018, the largest extent of the sea ice in the Antarctic was about 18 million $km^2$. The smallest extent of sea ice was about 2 million $km^2$.

6. Your teacher will give you another set of data. This set lists actual sea ice extent from January 2016 through December 2018 for the Antarctic. Again, choose a different colored pencil and plot this new set of data on your same graph.

7. How does the actual data for the Antarctic compare with your hypothesis? If there are differences, think about the possible causes of those differences. In which month is there the most sea ice in the Antarctic? In which month is there the least? Is it the same month each year? How does the actual data from the Arctic compare with the data from the Antarctic? What might be the causes of the differences between sea ice patterns near the two poles?







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Now that you have seen how sea ice extent changes throughout the seasons near both poles, we'll take a look at a longer time frame. Let's see how sea ice extent changes (if at all!) from one year to the next. We'll look at a period of 35 years, from 1980 to 2015. We'll examine data for the time of minimum sea ice each year, and also for the time of maximum sea ice each year. You will plot data at 5-year intervals for the years 1980, 1985, 1990, 1995, 2000, 2005, 2010, and 2015.

Your teacher will give you two new sheets of graph paper. The y-axis on each of these graphs is like the y-axis on your other graph; it represents the sea ice extent in millions of square kilometers. The x-axis on this new graph also represents time; but instead of months, it is in years. Choose two different colored pencils to use for graphing on these new sheets: one for data about the Arctic, and the other for data about the Antarctic. It is OK to use the same colors you used on the earlier graph.

Your teacher will give you two more tables of data. "Data Table #3: Arctic Sea Ice Extent" lists sea ice extent in the Arctic during March and September for eight different years. "Data Table #4: Antarctic Sea Ice Extent" lists Antarctic sea ice extent for February and September for the same eight years.

1. Choose one of your colored pencils. On Graphing Worksheet #2, plot the Arctic data from 1980 through 2015 for the month of March.
2. Select another color. On Graphing Worksheet #2, plot the Antarctic data from 1980 through 2015 for the month of September. Include a key on your graph to show which color represents which data.
3. Use the same color for Arctic data from step 1. On Graphing Worksheet #3, plot the Arctic data from 1980 through 2015 for the month of September.
4. Use the same color for Antarctic data from step 2. Plot the Antarctic data from 1980 through 2015 for the month of February.
5. Look at the graphs you just made. Does the sea ice extent change over the years for any of the four data sets? Is the amount of sea ice in the Arctic changing over this 30-year period? Are the changes happening when the ice is at its least extent, greatest extent, both, or neither? Is the amount of sea ice in the Antarctic changing over this 30-year period? If so, is it at the least extent or the greatest extent?