

Northwest Passage

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CLEAN Page: <http://cleanet.org/resources/42724.html>



Name _____

Feel free to use the back of these sheets for additional space for answering questions.

The National Snow and Ice Data Center (NSIDC) performs and supports research and makes scientific information available concerning the parts of the Earth that are typically frozen, which make up the cryosphere. In this activity, we will study changes that are occurring in the cryosphere by examining maps and other information from NSIDC and other sources.

According to [Wikipedia: Northwest Passage](#):

“The Northwest Passage is a sea route through the Arctic Ocean, along the northern coast of North America via waterways amidst the Canadian Arctic Archipelago, connecting the Atlantic and Pacific Oceans. The various islands of the archipelago are separated from one another and the Canadian mainland by a series of Arctic waterways collectively known as the Northwest Passages or Northwestern Passages”.

“Sought by explorers for centuries as a possible trade route, it was first navigated by Roald Amundsen in 1903–1906. The Arctic pack ice prevents regular marine shipping throughout the year, but climate change is reducing the pack ice, and this Arctic shrinkage may eventually make the waterways more navigable”.

- 1) The NSIDC’s [Icelights](#) page discusses various changes that are occurring in the Arctic. What are some of the types of changes that are occurring there, and how may they affect other parts of the world?
- 2) How do changes in the extent of ice on land and in the ocean differ in their effects on the ocean? How do they affect each other?
- 3) What trends in sea ice extent are described on the NSIDC [Arctic Sea Ice News & Analysis](#) page?

4) According to Smithsonian: [Arctic Shipping: Good For Invasive Species, Bad For the Rest of Nature](#), how is transportation activity changing in the Arctic?

5) Start Google Earth and Choose the Google Earth **Ruler** tool. Select the **Path** tab. **Mouse navigation** needs to be **on** while you draw the path. It can be turned back on for exploring the route with the mouse.

- a) How long is the shortest route by ship, in kilometers, between Germany and Japan that does not go through the Arctic Ocean?
- b) How long is the shortest route by ship, in kilometers, between northern Alaska and New York City that does not go through the Arctic Ocean?

6) Examine the **daily image update of sea ice extent** on the [Arctic Sea Ice News and Analysis](#) page of the National Snow and Ice Data Center.

- a) In what month is Arctic sea ice extent typically at its minimum? Explain why this occurs in terms of seasonal cycles.
- b) What was the average extent of sea ocean with at least 15% of sea ice (in millions of square kilometers), at the beginning of the current month of the year, from the years 1979 to the most recent year?
- c) What was the average extent of sea ocean with at least 15% of sea ice (in millions of square kilometers), at the beginning of this the current month, this year?

7) Link to NSIDC: [View NSIDC Data on Virtual Globes: Google Earth](#). Under **September Sea Ice Extent, 1979-(the most recent year)**, open the **September sea ice extent, 1979-(the most recent year) file for Google Earth**.

- a) Gradually drag the time slider at the top of the 3D Viewer from left to right. The display may flicker as each image loads, so give this time to occur. What is the general trend in sea ice extent for **September**?

- b) Expand the **September** folder in the **Places** Pane. Fully-expand the time slider by dragging the left and right range markers all the way to the two ends of the range.
 - Right-click the **Data** folder that appears underneath it and choose **Properties** (Windows) or **Get Info** (Mac).
 - Click the **Show contents as options (radio button selection)** box to place a check in it.
 - Click the **OK** button.
 - Expand the **Data** folder.
 - If the radio button next to the **Data** folder is selected, click it to de-select it. Click it again to select it. This will make only one of the overlays listed underneath visible at a time.
 - Starting from the top overlay, make each one visible, in turn, noticing changes until the last one.

In addition to the general trend, how does September sea ice extent vary from year to year? For what year do you notice the greatest change in ice extent from the previous year?

8) Link to [NASA: 2008 Arctic Sea Ice from AMSR-E](#) and [Telegraph: Arctic becomes an island as ice melts](#).

- a) What historic event in the Arctic was revealed by satellite images?
- b) Taking this event into account, how long is the shortest route by ship, in kilometers, between Germany and Japan?
- c) Taking the same event into account again, how long is the shortest route by ship, in kilometers, between northern Alaska and New York City?

9) Return to the link to [NSIDC Data on Virtual Globes: Google Earth](#).

Under ***Changes in glaciers, the Larsen B ice shelf, and Arctic sea ice extent***, open ***Glaciers, ice shelves, and sea ice file for Google Earth***. Make the ***Larsen B Ice Shelf*** folder visible. It is a network link, so give the data time to arrive. Once the data arrives and a + appears to the left of the folder icon, expand the folder. Double-click on the ***Larsen B Images*** folder and also expand it. Click on the ***Larsen B Breakup*** placemark.

- a) Where is the Larsen B Ice Shelf?
- b) Transform the ***Larsen B Images*** folder into a radio button folder. (See question 3 b to review the technique for this.) What happened there in early 2002? The four digits after the ***t*** in the layer name indicate the year.
- c) Link to [NSIDC: State of the Cryosphere: Ice Shelves](#). What is underneath an ice shelf?
- d) What effect on sea level can be brought about by a large number of changes in ice shelves similar to the Larsen Ice Shelf event? Explain your answer.

10) Under **Greenland annual surface melt, 1979 - 2010**, also from the [View NSIDC Data on Virtual Globes: Google Earth](#) page, open **Greenland melt file for Google Earth**.

- a) What has been the trend in maximum annual melt extent?

- b) Double-click and highlight the **annual data** folder. Run the animation, using the play button on the time line. This will load the images. You can then use the time slider to view the images at your own pace. What has been the trend, over time, regarding the area in Greenland that has experienced 60 or more melt days during a calendar year?

11) Link to [Science @ NASA: A Chilling Possibility](#).

- a) How could melting of Arctic ice lead to climate change in eastern North America and western Europe? (Do not bother to listen via streaming audio.)

12) Link, in turn, to [Reuters: Arctic ice second-lowest ever; polar bears affected](#), to [Field and Stream: Discussion Topic: Alaska Governor To Sue Over Polar Bear Listing](#), and to [Wikimedia Commons: Image:Polar Bear Habitat.png](#).

- a) What effect is the ice reduction having on the lives of polar bears?

- b) According to the Polar Bear Habitat map, what is the long term trend in frequency of occurrence of polar bear habitat?

- c) Why did the State of Alaska decide to challenge the listing of polar bears as a threatened species by the federal government?

13) In question 5, you saw how the opening of the passages in the Arctic changed distances required for shipping. Describe adverse effects on the Arctic environment that might result from utilizing these new shipping routes.

14) At [Energy on the Map](#), scroll through the list of places in the upper-left corner. Click on places that are located in the Arctic or Antarctic. What human activities in other parts of the world may be causing changes that are occurring in those places? How may those changes affect human society in other parts of the world?

15) Identify positive and negative effects related to changes in polar ice conditions that were presented in this exercise. In your opinion, what action should be taken by governments, corporations, organizations, and individual citizens to either mitigate, cope with, or benefit from these conditions? Be sure to take into account how various components of your solutions interact with each other.