Part B: Exploring the Arctic - Teacher Guide

Setting the Stage

Students take a virtual tour of the Arctic and Arctic research sites using Google Earth. The short tutorial introduces students to all technology features necessary to complete the activity. The PowerPoint file includes screenshots of step-by-step descriptions of answers.

Northern Lights in the Arctic. Photo Credit: Rawpixel

Lesson Overview

In this sequence of lessons, students will use Google Earth to find the Arctic.

- ***Lesson 1*** *– (20 minutes) Start Google Earth Exploration*
  Students use Google Earth to explore their hometowns, identify landforms and vegetation, and create a labeled placemark.
- ***Lesson 2*** *– (80 minutes) Let's Visit the Arctic*
  Students will explore Arctic research stations on Google Earth, measuring distances, observing vegetation, and analyzing climate data.
- ***Lesson 3*** *– (30 minutes) Thinking Deeper*
  Students will explore how Earth's axis tilt affects the Arctic's climate.

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Instructional Overview

Grade Level	Middle/High School
Instructional Time	130 minutes *(total time needed)*
Unit Goals	• Define what the Arctic is • Describe the Arctic environment and life of Indigenous people • Define how feedback loops work, specifically the effects of albedo
Lesson Driving Question	• Who participates in international research on Arctic weather and climate? • What role do Arctic people play in Arctic research efforts?
Building Toward	NGSS: ESS2D, LS2C
Three Dimensions	Science and Engineering Practices: • Planning and Carrying Out Investigations Disciplinary Core Ideas: • ESS1: Earth's Place in the Universe • ESS2: Earth's Systems Crosscutting Concepts: • Scale, Proportion, and Quantity • Energy and Matter: Flows Cycles & Conservation
Materials	❏ Student Guide ❏ Student Worksheet (Student worksheet includes both Part A and Part B questions) ❏ Computers with Google Earth installed and internet connectivity ❏ Powerpoint file with relevant images and step-by-step description of answers
Material Preparation	❏ Go to https://www.google.com/earth/ to explore Google Earth. You can use **Google Earth Web** directly in your browser or download **Google Earth Pro** for desktop by clicking the **"Download Google Earth Pro"** button. Follow the installation prompts if downloading.
Vocabulary	IASOA - International Arctic Systems for Observing the Atmosphere. A network of research stations in the Arctic that study weather and climate. Observatories - Places with special equipment used to study and collect data about the environment, weather, or space.

Brief Google Earth Tutorial

- **When downloading Google Earth Pro**
  - **Go to the Website** – Visit https://www.google.com/earth/versions/.
  - **Download Google Earth Pro** – Click **"Download Earth Pro on Desktop"** and choose the version for your operating system (Windows or Mac).
  - **Install the Software** – Open the downloaded file and follow the on-screen instructions to complete the installation.
  - **Launch Google Earth Pro** – Open the program after installation.

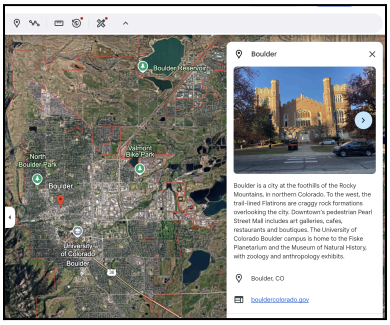
- **When using Google Earth Web**
  - **Open Google Earth Web –** Go to https://earth.google.com/web/ in your browser (Chrome, Edge, or Firefox).

- **Become familiar with using Google Earth (both Pro and Web)**
  - **Search for a Location –** Click the search icon in the left panel and type in a place name or address.
  - **Navigate the Map –** Click and drag to move around, scroll to zoom in and out, and use the compass tool in the bottom right to adjust your view.
  - **Switch to 3D View –** Click the 3D button in the lower right corner to see buildings and terrain in 3D.
  - **Use Street View –** Drag the yellow Pegman (bottom right) onto the map to explore streets in 360°.
  - **Explore Layers –** Click the map layers icon on the left to turn on features like borders, roads, and weather.
  - **Create and Save a Project –** Click the Projects icon to create a custom map with placemarks and notes, which you can save to Google Drive.

Lesson 1: Start Google Earth Exploration *(20 minutes)*

How does geography shape the landscape and environment of our hometown?

1. Launch Google Earth on your computer and "fly" to your school by typing the name of the school (and possibly the street address) in the **Search** box at the top. You will see an overview of the neighborhood of the school. You can zoom in further to look at the school buildings, sports facilities, and parking lots. Once you zoom in enough, Google Earth will change to Street View, and you can look at the school in 3D.



Can you recognize any landforms like ponds, parks, rivers, streams, lakes, hills, and valleys?

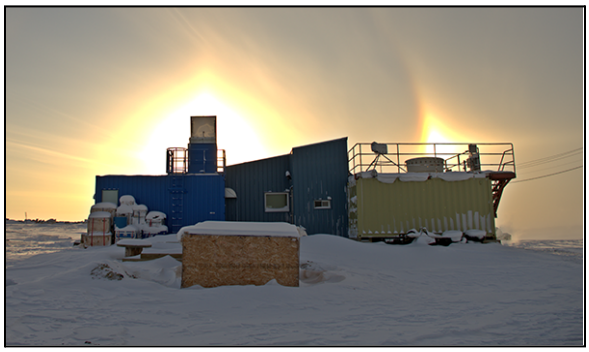
2. Add a "placemark" at your school by clicking on the yellow pin icon at the top of the screen. A pin shows up on the Google Earth image, and you can move the pin while it has a yellow border until it sits right at your front door. Please name the placemark by typing the name you choose in the New Placemark window that appears. If you want to edit your placemark, right-click and choose "Get Info".

3. Use the navigation tools to navigate around your hometown. Make sure to note what vegetation you can see in the images– can you see trees, grass, and shrubs? Describe the vegetation that you can identify.

Lesson 2: Let's Visit the Arctic *(60 minutes)*

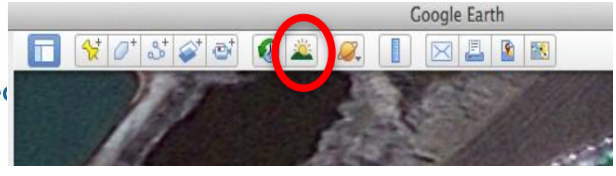
How does location affect climate data in Arctic research stations?

Later in this module, you will use meteorological data collected by a research team from Boulder, CO – Drs. Andrey Grachev and Ola Persson, who study Arctic weather and climate. They are part of a pan-Arctic IASOA research network, which has weather stations located across the Arctic. Using Google Earth, you can "visit" a few of the sites where they collect their data.

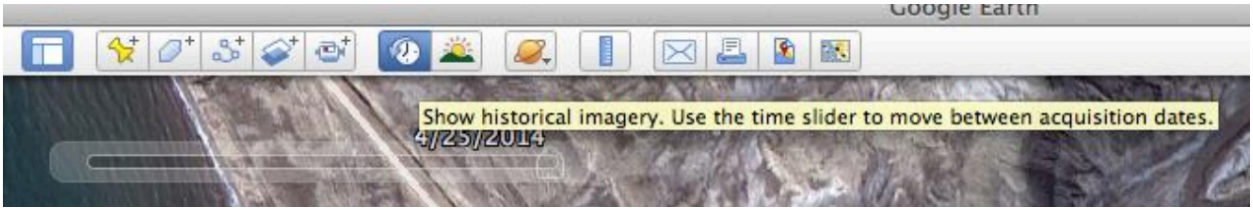


Eureka field station. Photo Credit: NOAA

1. (Slide 9-11) The first site you will visit is **Eureka** in Canada. Type in your Google Earth search box, "Eureka, Canada." Add a placemark that you name, "Eureka". Now zoom out to see where the placemark (=Eureka) is located relative to your hometown and where in Canada.
2. Explore the settlement. Make a simple hand sketch on a separate piece of paper that shows the layout of the settlement.
    - What type of vegetation do you see around Eureka, Canada?
    - Describe the physical setting (mountains, rivers, ocean) of Eureka, Canada, using cardinal directions (N, S, E, W).
    - What does the infrastructure of Eureka, Canada, look like (roads, buildings)?
    - (Slide 12) What is the elevation above sea level of Eureka, Canada?
3. (Slide 13) Click on the icon with the sun in the top bar above the image. You will see the amount of daylight in Eureka at the current time. Move the slider to find out when it gets light in Eureka today. You can also play a time slider animation that shows the amount of daylight throughout the year by



clicking the “Show historical images” icon that has a globe with a left-pointing arrow. That will open the time slider. By clicking on the wrench icon, you can choose the time and day, but can also just use the time slider function. When does it get light in Eureka today, and when does it get dark?



4. (Slide 14-15) Go to https://psl.noaa.gov/arctic/observatories/eureka/, then read more details about Eureka’s observatories. Next, look at some images from the settlement by scrolling down the page to “site map”. Click on the image and find the location of the flux tower on the photograph (marked in green). Now go back to Google Earth. Look for the location of the flux tower that you just saw on the IASOA website in Google Earth. You will measure the distance from the NOAA observation tower to the ocean.
    - Select the ruler icon in the menu bar above the image.
    - Choose a sensible unit of measurement.
    - Click the starting point of the measurement (tower).
    - Click the endpoint of the measurement (ocean).

    Approximately, how far is the flux tower away from the ocean (make sure to include the unit you used for the measurement)?
5. Now visit the research station in **Utqiagvik, Alaska** (formerly Barrow)**,** using Google Earth. The research station is located exactly at 71.325 N 156.625 W outside the town of Utqiagvik. Copy or type the geographic coordinates in the Search field to find the exact location of the station. Set a placemark where the station is and choose an appropriate name for your placemark.

6. Measure the distance (in a straight line) from the station to the airport in the town of Utqiagvik (following the instructions about distance measurements under question 5).

7. (Slide 16) Click on the sun icon at the top of the screen to see whether it is light or dark in Utqiagvik (same process as for question 4). Then go to the website from IASOA about the Utqiagvik station: https://gml.noaa.gov/obop/brw/ and look at the live webcam. Does the webcam show the same light/darkness as you see in Google Earth? If not, please explain and explore if there is a way to replicate the webcam light conditions.

8. (Slide 17) Now visit **Ny Ålesund**, Svalbard in Norway, and set a placemark. You can see little image icons around the town. Click on some of the pictures and see what Ny Ålesund looks like. What does the vegetation in Ny Ålesund look like based on the pictures?

9. Now visit **Tiksi** in Russia, another IASOA station. Explore the town using Google Earth and visit the IASOA website: https://psl.noaa.gov/arctic/observatories/tiksi/. Set a "placemark".

10. (Slide 18-19) Determine the distance from each of the four stations (see your placemarks) to the Arctic Circle (66° 33′ 44″N or 66.5622°N). Use the ruler and determine the distance between each station and the Arctic Circle–make sure to use a sensible unit:
    Eureka – Arctic Circle:
    Ny Ålesund – Arctic Circle:
    Tiksi – Arctic Circle:
    Utqiagvik (formerly Barrow) – Arctic Circle:
11. Save your work: Right-click on the folder that includes the four placemarks that you created. Choose **Email** and follow the instructions for sending an email. The program will automatically create a .kmz file (zipped version of the .kml file for each placemark) of all your placemarks. Send the .kmz file to your teacher and your school email, or in your learning platform.

Lesson 3: Thinking Deeper *(15 minutes)*

- (Slide 20) In these activities, you have defined what the Arctic is and explored sites across the Arctic. What effect does the tilt of the Earth's axis have on the Arctic?

- Now imagine Earth's axis wasn't tilted. What would the effect be on the Arctic in terms of temperatures, daylight, and vegetation?

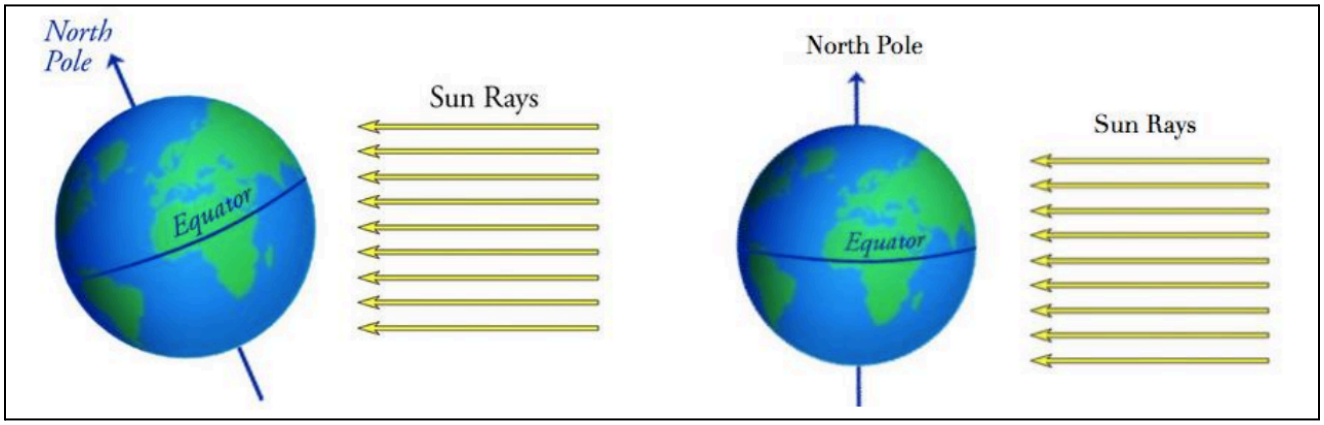


Image: Earth with an axial tilt of about 23.5 degrees (left) and without a tilt (right). Modified from Illustrative Mathematics

- (Slide 22-23) Going back to the four definitions of the Arctic we have provided and the four corresponding maps, can you identify any locations that are being considered part

of the Arctic based on one (or more) of the four definitions but not considered part of the Arctic by one of the other definitions? Explain.

	Arctic Circle	**Average summer temperature**	**Polar treeline**	**Political boundaries**
Arctic Circle - Average				
Average summer temperature				
Polar treeline				
Political boundaries				

Find more curriculum here:
https://ceee.colorado.edu/lesson/arctic-climate-connections