LAB MODULE 2: THE GEOGRAPHER'S TOOLS

Note: Please refer to the GETTING STARTED lab module to learn how to maneuver through and answer the lab questions using the Google Earth ( ) component.

Key Terms

Students should know and understanding these terms:

Absolute location	GIS	Relative location
Aerial photographs	Latitude	Remote sensing
Contour lines	Longitude	Satellite images
Coordinate systems	Map scale	Thematic maps
Geospatial technologies	Reference maps	

Lab Module Learning Objectives

After successfully completing this module, you should be able to do the following tasks:

- Use Latitude and longitude to find a location
- Explain the concept of absolute location
- Explain the difference between large and small scale maps
- Calculate map scale
- Identify and describe the three types of maps
- Interpret contour maps
- Identify change in land use, or land cover, or both

INTRODUCTION

This lab module examines some of the fundamental concepts and tools geographers use to study the earth. Topics include latitude and longitude, absolute and relative location, geospatial technologies, map types and scale. While these topics may appear to be disparate, you will learn how they are inherently related. The modules start with four opening topics, or vignettes, which are found in the accompanying Google Earth file. These vignettes introduce basic concepts of the geographer's tools. Some of the vignettes have animations, videos, or short articles that will provide another perspective or visual explanation for the topic at hand. After reading the vignette and associated links, answer the following questions. Please note that some links might take a while to download based on your Internet speed.

Expand the **INTRODUCTION** folder and then double click **Topic 1**: **Tools for Geography**.

Read **Topic 1**: **Tools for Geography**.

> **Question 1**: What are three geographic technologies geographers use to study the Earth?

Read **Topic 2: Maps**.

> **Question 2**: In what state was the first topographic map (relief map using contour lines) issued in the United States?

Read **Topic 3: Coordinate Systems and Location**.

> **Question 3:** Why is the Equator the only parallel of latitude that is also a great circle?

Read **Topic 4: Geospatial Technologies**.

> **Question 4**: List five applications or uses for remote sensing technology.

Condense and uncheck **INTRODUCTION**.

GLOBAL PERSPECTIVE

Latitude and *Longitude* form a grid on the earth's surface, enabling us to determine an absolute location for any given place or phenomenon.

Expand the **GLOBAL PERSPECTIVE** folder.

Turn on the latitude/longitude grid (Ctrl+L).

Lines of latitude, or *parallels*, divide the globe at the Equator, and run parallel in both the Northern and Southern Hemispheres. Locations in the Northern Hemisphere are denoted with an N (or a positive number), while locations in the Southern Hemisphere are denoted with an S (or a negative number). At the Equator, the parallel is 0°N or S, and increases to 90°N (or +90) at the North Pole, and 90°S (or-90) at the South Pole.

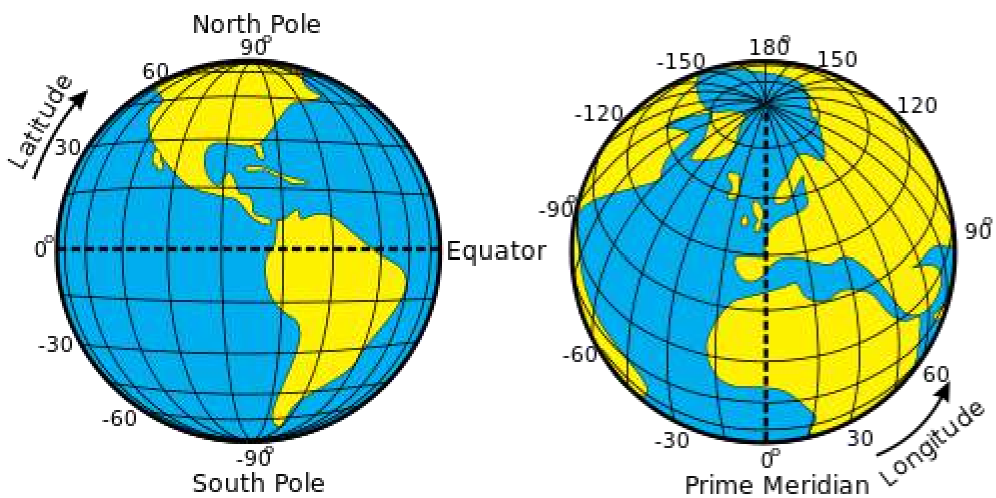


Figure 1. Poles, latitude and longitude, and prime meridian

Select and double-click on **Prime Meridian.**

Lines of longitude, or *meridians,* run from pole to pole. Along the Prime Meridian, which runs through Greenwich, UK, the Earth is divided into Eastern and Western Hemispheres. Locations in the eastern hemisphere are denoted with an E (or a positive number), while locations in the western hemisphere are denoted with a W (or a negative number). Meridians increase at move toward 180°E (or +180) or 180°W (or -180).

Latitude and longitude are measured in degrees, minutes, and seconds. Like a clock, with one hour equaling 60 minutes, and one minute equaling 60 seconds, each degree of latitude and longitude can be divided into 60 minutes (60’) and each minute of latitude and longitude can be further subdivided into 60 seconds (60”). For example, the White House in Washington, DC is located at 38° 53’ 51” N, 77° 02’11”W. Latitude and longitude can also be measured in decimal degrees, or degrees and decimal minutes, which convert the minutes and/or seconds into decimal fractions. So for the White House, the absolute location in decimal degrees would be 38.897, -77.0365.

- Click **Exit Street View** in the top right corner of the Google Earth 3D viewer.

- Change your units to degrees, minute and seconds. (Refer to the GETTING STARTED module for direction on how to change latitude and longitude units). As a reminder, include your hemispheric designation (N/S, E/W) for each location.

- Select and double-click **Location A**.

  Question 5: What are the latitude and longitude coordinates for Location A?

- Select and double-click **Location B**.

  Question 6: What are the latitude and longitude coordinates for Location A?

  Question 7: Which of these locations – A or B - is closer to the Equator?

  Question 8: By how many degrees (rounded to the nearest degree) is this location closer?

  Question 9: Which of these locations is closer to the Prime Meridian?

  Question 10: By how many degrees (rounded to the nearest degree) is this location closer?

- Select and double-click **Location C**.

  Question 11: What are the latitude and longitude coordinates for Location C?

  Question 12: Which location – A or C - is closer to the Equator?

  Question 13: Which location – A or C – is closer to the Prime Meridian?

- Condense and uncheck **GLOBAL PERSPECTIVE**.

- Turn off the latitude/longitude grid (Ctrl+L).

SCALE

Scale is the ratio of the distance between two features on the map and the distance between the same two features on the ground. Maps should provide a scale to the user; typically, map scales are shown in the bottom margin of the map.

Scale is expressed in one of four ways: *ratio*, *representative fraction*, *bar*, and *verbal*. For example, 1:12,000 (ratio), 1/12,000 (representative fraction), 1 inch 1,000 feet (verbal) or as a scale bar illustrated below.

Scale Expression

Ratio	`1:12,000`
Representative Fraction (RF)	`1/12,000`
Bar	
Verbal	`1 inch equals 1,000 feet`

Expand **SCALE** and then select and double-click **Boothbay Harbor** (Note: The topographic map might take a few seconds to display). To close the citation, click the **X** in the top right corner of the window.

> **Question 14**: In what ways is the scale on this map expressed or presented?

As you zoom in or zoom out on the map, the scale of the image changes, even though the scale provided on the map does not change. Hence, when using maps in Google Earth, you cannot use the scale provided on the map. To calculate distance you need to use the ruler tool, which will give you an approximation of the distance.

You can calculate scale using the equation **`S = d/D`**, where:

- `S` = scale
- `d` = distance between two features on the map
- `D` = distance between two feature on the ground

Whether using the metric system or the British/Imperial system, make sure that you know the conversions between the units.

Metric

1 m	100 cm
1 km	1000 m
1 km	100,000 cm

British/Imperial

1 ft	12 in
1 mile	5,280 ft
1 mile	63,360 in

Example 1: Two buildings are 8 inches apart on a map (d). The same buildings are 16,000 feet apart on the ground (D). Calculate the scale of the map.

To calculate the scale, divide d by D. But before we do this, both distances need to be in the same units. Currently d is in inches and D is in feet. We know there are 12 inches in a foot, so we can multiply D by 12 to convert the distance on the ground from feet to inches.

D = 16,000’ x 12” = 192,000”

Therefore, S = 8”/192,000”

We can then simplify S so that the numerator is a 1.

Thus, S = 1/24,000

This ratio can also be written as 1:24,000.

Example 2: Calculate the scale of a map in which the distance between two features is 6” on the map (d) and 12 miles on the ground (D).

We need to convert distances into the same units. There are 63,360 inches in a mile. If we multiply 12 miles by 63,360 we can convert D into inches

D = 12” x 63,360” = 720,360”

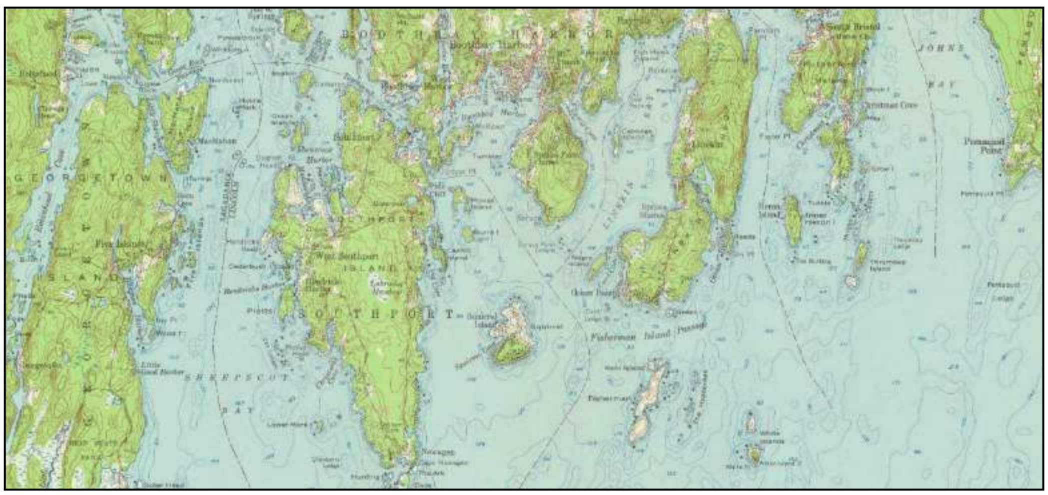
Thus, S = 6”/720,260”

We can simplify S and we get a scale of 1/126,720 or 1:126,720

Notice that Examples 1 and 2 have different map scales. The map scale in Example 1, at 1:24,000, is larger than the map scale in Example 2, at 1:126,760. Large-scale maps are more “zoomed in” and therefore show more detail, but less area. Conversely, small scale maps are more “zoomed out” and therefore show more area, but less detail. Figures 2 and 3 illustrates larger and smaller map scales.

Map with a 1:24,000 scale. Notice the size and detail of Southport Island.

Figure 2. Map with a 1:24,000 scale



Map with a 1: 62,500 scale. Notice the size and detail of Southport Island.

Figure 3. Map with 1:62,500 scale

Example 3. What is the distance on a map in centimeters between two features if they are 5km apart on the ground and the map has a scale of 1:100,000?

d = S x D

d = 1/100,000 x 5km = 5km/100,000

d = 0.00005km

d = 5cm

Example 4. What is the distance on the ground in kilometers between two features if they are 5cm apart on the map and the map has a scale of 1:50,000?

```
D = d/S

D = 5cm / 1/50,000 = 250,000cm = 2.5km
```

Question 15. Using Figure 4, we want to calculate the distance on the ground, in miles, between Mill Point and Oak Point. We measured 5 inches on the map itself, and know that the map scale is 1:63,360. Show your work.

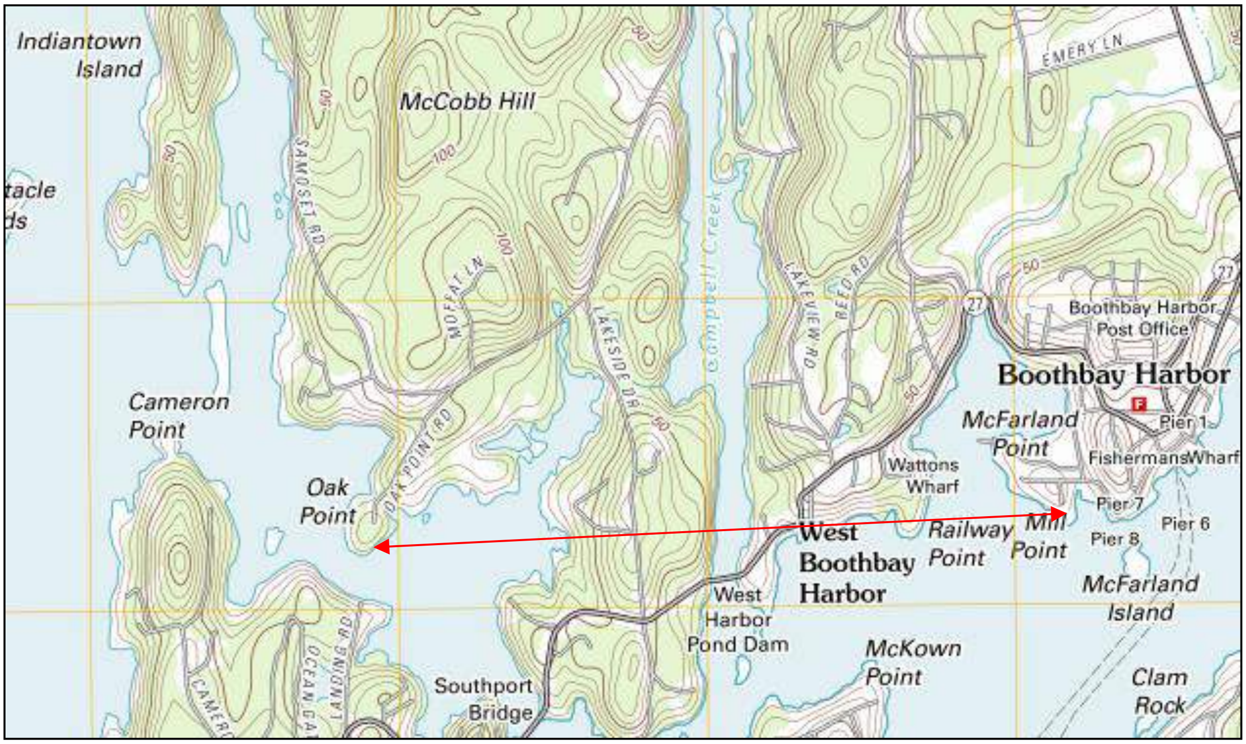


Figure 4.Mill and Oak Points.

Question 16: What is the distance on a map in centimeters between two features if they are 7.6km apart on the ground and the map has a scale of 1:125,000? Show your work.

Google Earth does not provide scale as a ratio, representative fraction, or a verbal scale, but as a bar (graphic) scale. This is found in the lower left hand corner of the screen. Although it may seem counter intuitive, the smaller the distance shown on the scale bar, the larger the map scale.

Double-click and select **Squirrel Island 1**.

Question 17: What is the distance, in feet, represented by the scale bar?

____

Uncheck **Squirrel Island 1**. Double-click and select **Squirrel Island 2**.

Question 18:What is the distance, in feet, represented by the scale bar?

____

Question 19: Which one has the smaller scale – Squirrel Island 1 or Squirrel Island 2?

Condense and uncheck **SCALE**.

CONTOURS

Contours are lines that connect places of equal elevation. A contour interval (CI) is the elevation difference between two consecutive contour lines, and is commonly provided in the margin of a map. In Figure 5, the contour interval is 10 feet, meaning each consecutive contour line represents a 10 foot change in elevation. Index contours are typically labeled and are bolder than regular contour lines. In Figure 5, the index contours are every 50 feet (every 5 contour lines); index contours at 50, 100, and 150 feet are clearly visible.

There some rules regarding contour lines:

- Contour lines always form a closed polygon although on a smaller map contour lines might run off the margin (see contour line designated A on the map).
- Contour lines spaced closer together depict a steeper slope; whereas a wider spacing of contour lines depicts a gentler slope (see contour line designated B on the map).

Figure 5. Contours

- Contour lines might touch where there is a steep elevation change, like a steep slope or cliff; however, contour lines never cross unless the cliff face has an overhanging ledge (hidden contours are then depicted as dashed lines).
- Concentric, closed contours denote a hill or summit (see C on the map); whereas closed contours with hachure marks on the downslope side depicts a depression.
- Contour lines point upstream, creating a V-shaped pattern wherever they cross a river (see D on the map).

Double-click and expand **CONTOURS**.

Double-click and select **Boothbay Harbor.**

Select **Red Squares.**

A USGS 7.5" map will appear, with two red squares near.Georgetown, ME. You may need to pan and/or zoom in or out to answer the following questions.

> **Question 21**:What is the contour interval of this map?
>
> **Question 21**: What is the highest elevation within the two squares?
>
> **Question 22**: Within the right square, determine which direction (North, East, South, West) the river is flowing.
>
> **Question 23**: Explain what contour rule helped you answer Question 22.
>
> **Question 24**: Within these squares, where is the steepest slope located?
>
> **Question 25**: Within these squares, where is the flattest area?

Uncheck **Red Squares.**

Double-click and select **Slope 1**.

> **Question 26**: As you move from left to right across the yellow line, is the elevation increasing or decreasing?

With your cursor located on the Slope 1 line, right-click and select **Show Elevation Profile**.

At the bottom of the screen is a cross section chart of the terrain over which the line is located. As you run the cursor along the line, the corresponding location along the cross section is identified. Additional information is located at the top of the graph area.

Question 27: As you move from the road intersection to the top of the hill, does the elevation continually increase?

Question 28: What is the length of the profile line (in feet)?

Question 29: What is the change in elevation of the line (the relief) from one end to the other (in feet)?

Question 30: Knowing that slope is the rise (relief of the line) divided by the run (distance of the line), compute the percent slope of the line. You must show your work to receive full credit.

Rise/Run *100 = _________ / ________*100 = ________________

- Uncheck **Slope 1**.
- Change the elevation exaggeration to 2 and Double-click and select **Perspective view** to see the landscape in three dimensions.
- Condense and uncheck **CONTOURS**.

REMOTE SENSING

Remote sensing is the art and science of acquiring information about a feature or phenomenon without being in direct contact of that feature or phenomenon. In this part of the lab, you will explore land use and land cover change using satellite imagery. For the rest of this lab, you will be working with Landsat satellite imagery, which is considered the longest continuous global record of Earth's surface.

- Expand **REMOTE SENSING** and click **NASA Landsat Flyby.**.

Question 31: How long has Landsat been collecting data on Earth?

Question 32: Natural disasters like the Mount St. Helens eruption and urban growth in places like Las Vegas are two uses of Landsat data. Based on the video, name two additional physical geography topics – and their example locations – for which Landsat imagery has been used.

Question 33: How much does Landsat data cost?

- Uncheck **NASA Landsat Flyby.**.

Click **Landsat Viewer**. (**Note:** if the webpage does not open or takes too long to load, open the web browser outside of Google Earth by choosing the browser icon at the top left corner of the Google Earth Viewer.)

In the ESRI web site, go to the top right hand corner in the ESRI website and click **View larger**. The default image should be Mount St. Helens, in Washington, USA. If it is not, type `Mount St. Helens` in the search box and press the **Enter** (**Return**) key on your keyboard. To zoom in or out, use any slider found in the top left-hand corner of an image area. Assume North is at the top of the images.

The images on the left (1975) and center (2000) panels are called false color composite images. They are displaying reflected infrared energy, which are wavelengths that are longer than visible light but shorter than micro waves. . Vegetation reflects a great amount of this energy, and as a result, appears as red in the images. The image to the far right is the change or difference between the 1975 and 2000 images. For a further interpretation of colors, see the legends found below the images.

Question 34: In which direction(s) was the 1980 eruption?

Question 35: How did you determine this from the remote sensing imagery?

Now type `Las Vegas, Nevada` into the search box and press the **Enter** (**Return**) key on your keyboard.

Question 36: In which direction(s) has the majority of urban growth occurred between 1975 and 2000?

Question 37: What is the bright red (green in the change detection image) rectangle features, many found on the west side of Las Vegas?

Question 38: Is urbanization in this region linked more to increase in vegetation, or a decrease in vegetation?

Question 39: What is the diagonal strip running SW-NE through the city?

Finally, type in your location (or the location provided by your instructor) into the search box and press the **Enter** (**Return**) key on your keyboard.

Question 40 Have there been any notable increases or decreases in vegetation? If so, where?

Condense and uncheck **REMOTE SENSING**. You have completed Lab Module 2.