Name:_____

Ocean Lab 116 Winter 2012

Lab 2: Geography of the World's Oceans

Goals:

1. Learn the names and locations of the world's major continental and oceanographic features
2. Using Google Earth: Latitude and Longitude
3. Google Earth: Geometry of the Earth

1. **Use your blank world map to locate and label the following geographic features.**

Continents

North America	South America	Asia	Africa
Australia	Antarctica	Europe	

Oceans, Seas, & Lakes

Atlantic Ocean	Pacific Ocean	Indian Ocean
Arctic Ocean	Southern Ocean	Gulf of Mexico
Mediterranean Sea	Gulf of California	Sea of Japan
Baltic Sea	Persian Gulf	Caribbean Sea
Bay of Fundy	North Sea	Red Sea
Black Sea	Bering Sea	Great Lakes
Lake Baikal	Lake Titicaca	Great Salt Lake
Strait of Magellan	Strait of Gibraltar	Strait of Hormuz

Countries & Islands

Chile	Peru	China
United States	Aleutian Islands	Russia
Iceland	Philippines	Greenland
Japan	Indonesia	Baja, Mexico
Hawaiian Islands	Galapagos Islands	New Zealand
Brazil	India	Great Britain
South Africa	Mexico	Italy
Midriff Islands, Baja		

Other important features – you may have to draw some of these in.

Equator	Tropic of Cancer	Tropic of Capricorn
Himalayas	The Alps	Andes Mountains

Cascade Range
East African Rift
Baja California
Arctic Circle
Prime Meridian
Antarctic Circle
International Date Line

2. USING GOOGLE EARTH IN INTRODUCTORY GEOSCIENCE COURSES

INTRODUCTION:

In the last few years, advances in computational power, development of high-speed internet delivery to home users, integration of Geographic Information Systems (GIS), and explosive growth of satellite imaging and aerial photography databases have made possible a remarkable product that can be utilized to aid learning of global geography and geology. Google Earth (http://earth.google.com/) was officially launched in 2005 after Google acquired Keyhole, Inc. in 2004.

Google Earth is an interactive, virtual globe program permitting users to actively manipulate a virtual sphere representing Earth that is overlaid with satellite or high-resolution aerial imagery of continental areas and ocean islands. Google Earth is available as a completely free downloadable program or in several subscription services. The subscription services offer a variety of advanced tools that enhance the utility of Google Earth for educational, scientific, or professional applications. However, the free version of Google Earth is a remarkable product that can be downloaded to any computer with high-speed internet access, and can be used as an effective learning tool in introductory geoscience courses.

Image data in Google Earth are seamlessly displayed on the globe, though differences in resolution of source imagery create a patchwork appearance to most areas of the Earth's surface.

Users can pan, zoom, spin, and tilt images of localities worldwide to examine details of geology, geomorphology, land use, and population centers. The primary image data for many locations worldwide are Landsat images (30 m resolution). However, higher resolution imagery (sub-meter) derived from the QuickBird satellite (Digital Globe) and aerial photography programs (particularly for the United States e.g., National Aerial Photography Program) are continually being incorporated to update the Google Earth product.

Presently, the greatest quantity of high-resolution imagery is available from the United States, and thus, exercises developed in this series are biased toward U.S. imagery in Google Earth. In the future, as more high resolution imagery from other regions of the planet is incorporated into Google Earth, it will be possible to include more examples from other regions.

Finally, the current stable version of Google Earth is version 3. As such, all exercises created for this project were created using Google Earth v.3. Version 4 of Google Earth is currently available as a Beta release, and some users may wish to download this version for their use. It is recommended that users become familiar and comfortable with the Google Earth v.3 interface, however, before using version 4. Future updates to these projects will revise exercises to take advantage of version 4 improvements.

ACQUIRING GOOGLE EARTH:

Note that using Google Earth requires continuous access to a high-speed (broadband) internet service. To obtain the Google Earth operating system, simply go to the Google Earth web site (http://earth.google.com) and locate the "Get Google Earth – Free Version" links on the page. Click on the "Get Google Earth" link to access the download page. Note on this page the minimum system requirements to run Google Earth; not all computers will be able to run this program. In general, computers purchased during the last two years should have no difficulty running Google Earth. For computers older than two years, please refer to the minimum system requirements listed on the download page.

Once on the download page, follow the link to the appropriate version of Google Earth. The current stable version is version 3 and version 4 is undergoing Beta testing. Users should be aware that downloading test versions of Google Earth may have unexpected errors or malfunctions; it is recommended always for educators and students to download the latest STABLE version of Google Earth.

Click on the download link and the program should automatically install on your local computer. For those working in computer labs, it may be necessary for the system administrator to install the program for you. Also, it is necessary to disable "pop-up blockers" on your browser software. Follow any other additional instructions you may receive during the download and installation process.

You will find that mastering navigation in Google Earth will require only a few minutes. Thus, all students can quickly learn to use Google Earth to visually explore the globe. Not only will they be able to locate sites illustrated in their textbooks, but they will be able to explore those sites three-dimensionally. As you will see in the exercises that follow, this tool provides a remarkable opportunity to illustrate geological principles in a way never before possible.

So, tune in, turn on, and link up with Google Earth! And happy navigating!

EXPLORING GOOGLE EARTH:

When the installation process for Google Earth has completed, locate the Google Earth icon on your computer's desktop. Click on the icon to see the opening page of Google Earth (Fig. 1). Below is a brief description of the Google Earth interface. While the interface is intended to be relatively intuitive, it is helpful to know details of some on-screen manipulation tools before proceeding. For additional assistance in learning to use Google Earth, you may wish to consult the on-line users guide (http://www.keyhole.com/GoogleEarthHelp/GoogleEarth.htm).

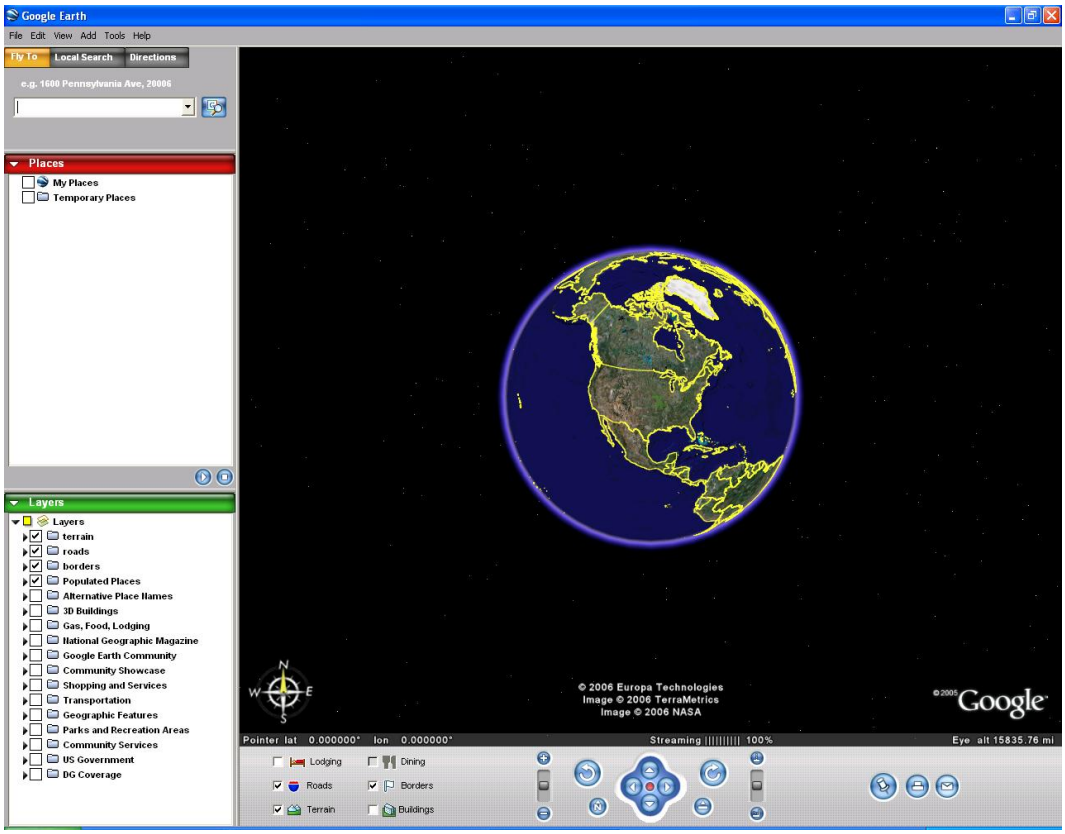

Fig. 1 The Google Earth opening image. Individual elements of the page are described in the text below.

The left screen column contains a query bar where you can enter the name of a geographic location to search in Google Earth. Entering a location name (e.g., Chicago) then hitting the 'Enter' key or clicking on the 'Go to' icon will pan and zoom Google Earth to that location. It is possible to enter either a place name, a geographic location in latitude/longitude, or an address into the query bar. Once entered, each place displays in the 'Places' area beneath the query bar. Finally, the 'Layers' section indicates which overlays will also be displayed on the Google Earth image. Visible overlays are indicated by the check marks in the boxes adjacent to each layer name.

NAVIGATING WITH GOOGLE EARTH:

Navigation with Google Earth is intended to be intuitive. The image below (Fig. 2) shows the basic navigation tools used to manipulate Google Earth. Refer to this guide as you experiment zooming, panning, rotating, or tilting your images in Google Earth.

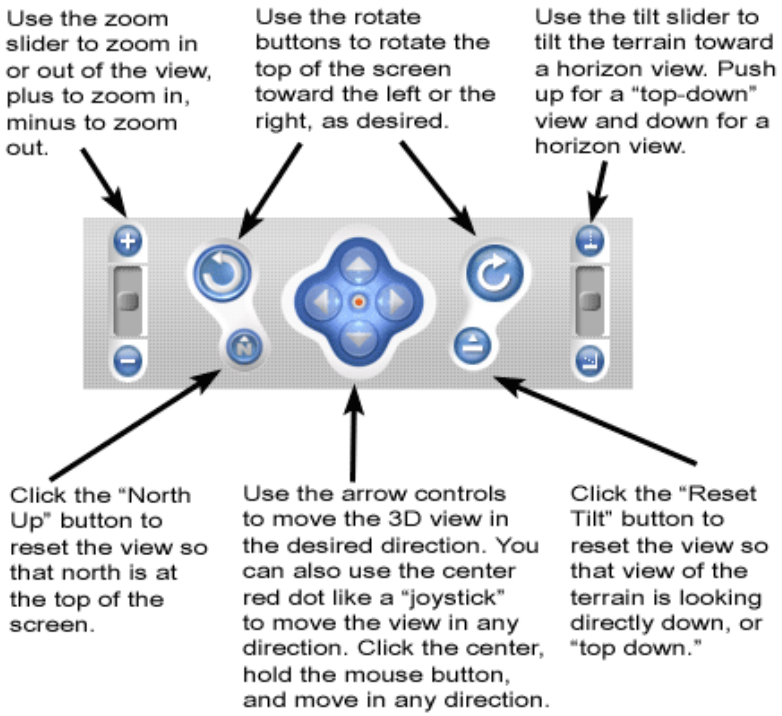

Fig. 2 Navigation tools available in Google Earth. To use each tool, use your mouse to place the cursor over each tool, then click the left mouse button and hold to achieve the desired manipulation (image taken from http://www.keyhole.com/GoogleEarthHelp/GoogleEarth.htm).

Additional advanced tools are available from the menu bar at the top of the page, and these will be discussed as they are utilized within each project presented in this series. Of particular importance will be the 'Measure' tool located under the 'Tools' menu.

That's really all there is to manipulating Google Earth! New tools and applications of Google Earth technology await in the exercises that follow.

LINKS TO RELATED SITES:

Digital Globe: http://www.digitalglobe.com/

Wikipedia entry on Google Earth: http://en.wikipedia.org/wiki/Google_Earth

LATITUDE AND LONGITUDE

Introduction to Coordinate Systems on Earth

This exercise is an introduction to a standardized coordinate system used throughout the world for centuries, Latitude and Longitude. While there are many coordinate systems that have been developed for a variety of mapping and geographic purposes, the great majority of maps produced for public use still rely on the traditional Latitude and Longitude system.

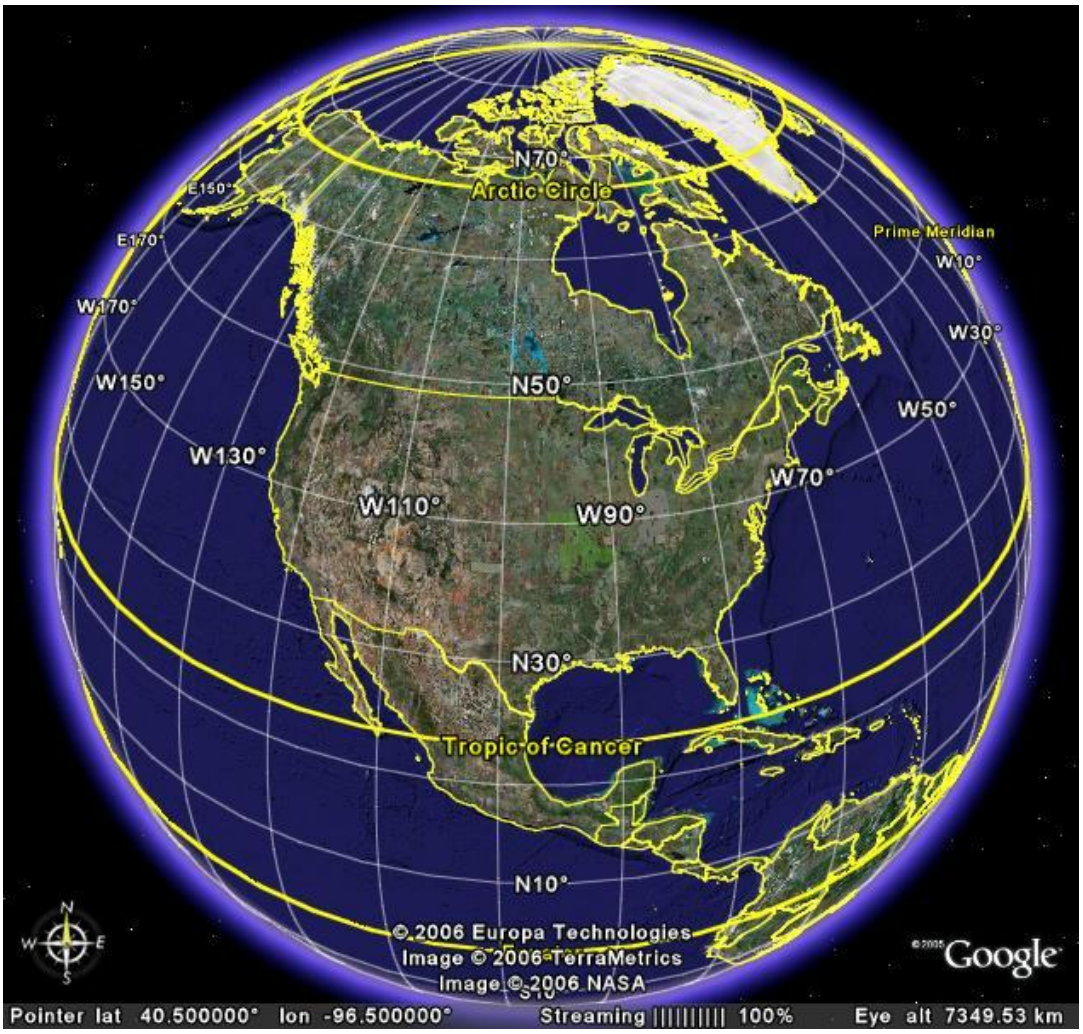

Fig. 1. Google Earth display of Earth with overlaid latitude/longitude grid.

In Google Earth, you can toggle the latitude/longitude grid on/off from the menu bar at the top of the page. Move your cursor to the 'View' option on the menu bar and click it. Locate the Lat/Lon Grid option and click it. You will see the latitude/longitude grid appear on the Earth image in Google Earth. Clicking on the Lat/Lon Grid option again will turn off the grid. Alternatively, you can toggle the latitude/longitude grid by simultaneously using the 'ctrl + L' keys on your keyboard.

In the latitude/longitude system, the nearly spherical Earth is divided into a grid composed of parallels of latitude (North-South grid lines) and meridians of longitude (East-West grid lines). The equator serves as the reference line for latitude and was arbitrarily assigned a value of 0 degrees centuries ago. Latitude is then measured in degrees north or south from the equator.

1. What is the angular distance from the South Pole to the North Pole?

2. What is the angular distance from the Equator to the South Pole?

3. What is the angular distance from the Equator to the North Pole?

Longitude is measured in degrees east or west from the Prime Meridian (rotate the Google Earth globe to locate the Prime Meridian). Note that the Prime Meridian is the meridian of longitude passing through the Greenwich Observatory in Greenwich, England. In 1884, this meridian was arbitrarily chosen as the 'zero meridian' for the world. Not only is the Prime Meridian the east-west origin of the global longitude grid, it is also the point of origin for the global system of time keeping – each new day begins on the Prime Meridian. This time is known as 0000 hours Greenwich Mean Time, corresponding to midnight at the Greenwich Observatory, and Greenwich Mean Time is often abbreviated as GMT.

Note on the Google Earth latitude/longitude grid that several grid lines are indicated in yellow. These are 1) the Prime Meridian, 2) the Equator, 3) the Tropic of Cancer, 4) the Tropic of Capricorn, 5) the Arctic Circle, and 6) the Antarctic Circle.

4. At what latitude is the Tropic of Cancer and what is its significance?

5. At what latitude is the Tropic of Capricorn and what is its significance?

6. At what latitude is the Arctic Circle and what is its significance?

7. At what latitude is the Antarctic Circle and what is its significance?

Compile a table showing the approximate latitude and longitude of the following locations. Enter the location name into the query bar of Google Earth, then record the latitude/longitude displayed in the Google Earth window for each site.

LOCATION	LATITUDE	LONGITUDE
Your college/university		
Your home town (list in space below)		
Bahia de Los Angeles, Baja California		
The Forbidden City		
The Taj Mahal		
The Eiffel Tower		
The Sydney Opera House		
The Pyramids of Giza		
The Parthenon		
CN Tower		
Big Ben		

LINKS TO RELATED SITES:

Wikipedia entry on Coordinates Systems: http://en.wikipedia.org/wiki/Latitude_and_longitude

Wikipedia entry on Latitude: http://en.wikipedia.org/wiki/Latitude

Wikipedia entry on Longitude: http://en.wikipedia.org/wiki/Longitude

Wikipedia entry on the Prime Meridian: http://en.wikipedia.org/wiki/Prime_meridian

Wikipedia entry on the Int'l Date Line: http://en.wikipedia.org/wiki/International_Date_Line

Wikipedia entry on the Tropic of Cancer: http://en.wikipedia.org/wiki/Tropic_of_cancer

Wikipedia entry on the Tropic of Capricorn: http://en.wikipedia.org/wiki/Tropic_of_capricorn

Wikipedia entry on the Arctic Circle: http://en.wikipedia.org/wiki/Arctic_circle

Wikipedia entry on the Antarctic Circle: http://en.wikipedia.org/wiki/Antarctic_circle

History of the Royal Observatory: http://www.nmm.ac.uk/server/show/conWebDoc.13496

U.S. Naval Observatory: http://www.usno.navy.mil/

3. GEOMETRY OF EARTH
Understanding Latitude and Longitude

This exercise is an examination of the latitude/longitude grid and an opportunity to learn some of its unusual characteristics. Before proceeding, enable the latitude/longitude grid in Google Earth by simultaneously holding down the 'ctrl + L' keys on your keyboard.

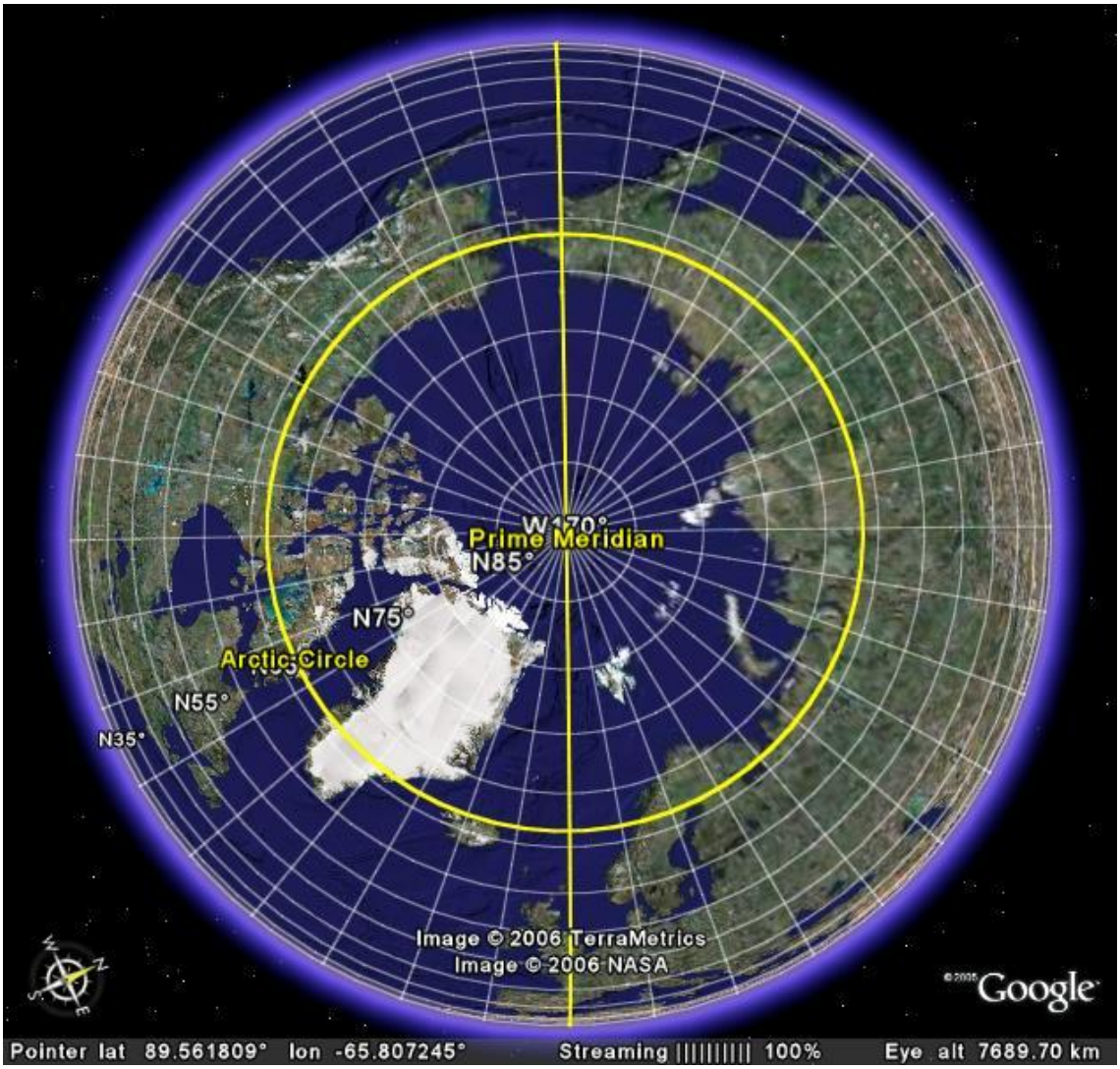

Fig. 1. North polar view of Earth with latitude/longitude grid.

In Google Earth, latitude/longitude can be displayed in two different formats: 1) Decimal degrees and 2) degrees, minutes, seconds. To change from one display format to the other, you must access the 'Tools' menu on the menu bar at the top of the Google Earth screen. Under 'Tools', choose 'Options'. The lower left of the Options dialogue box is labeled 'Rendering'. Here, you will see the two options for displaying latitude/longitude ("Degrees, Minutes, Seconds" or "Degrees").

Note that "Degrees, Minutes, Seconds" will display the latitude/longitude of the cursor position in the format DD° MM′ SS.SS″ where DD° = degrees, MM′ = minutes, and SS.SS″ = seconds of arc on the globe. The "Degrees" option displays latitude/longitude of the cursor position in decimal degrees (DD.DDDDDD°). It is quite easy to convert from DD° MM′ SS.SS″ to DD.DDDDDD° and from DD.DDDDDD° to DD° MM′ SS.SS″. Follow the steps below to do so:

EXAMPLE: Convert 36° 04′ 07.3236″N 94° 10′ 17.7672″E to decimal degrees.

A. First, you will convert the latitude to decimal degrees. Divide the seconds term by 60 (because there are 60 seconds in 1 minute); 07.3236 ÷ 60 = 0.12206. The new term is in units of decimal minutes.
B. Now add this result to 04′: 04′ + 0.12206 = 04.12206′
C. Divide the minutes term by 60 (because there are 60 minutes in 1 degree); 04.12206 ÷ 60 = 0.068701. This new term is in units of decimal degrees.
D. Finally, add this result to 36°: 36° + 0.068701 = 36.068701°N.

You should now be able to convert the longitude on your own!

1. Use your knowledge to convert 42.500564°N -90.664446°W to DD° MM′ SS.SS″. Note that the convention for decimal degrees is: north latitudes and east longitudes are positive numbers, south latitudes and west longitudes are negative numbers. Do you know why this convention exists? Perhaps your instructor will engage your class in a discussion of this topic.

2. Enter the decimal number above into the Google Earth query bar to determine where this point is. What did you discover?

Another oddity of the latitude/longitude system results from the geometry of parallels and meridians on the nearly spherical Earth.

3. Open Microsoft Excel so you will be able to enter some values and plot them on a graph.

4. Label four columns 'LAT', 'KM', 'LON', 'KM'.

5. Now, we will measure the distance along the Earth's surface associated with 1 degree of latitude and 1 degree of longitude. To do this, we will use the 'Measure' tool in Google Earth.

6. Next, return to the Google Earth window and enable the 'Measure' tool by clicking on the 'Tools' menu, then clicking the word 'Measure' (or simultaneously using 'ctrl + 6' keys on your keyboard). When the 'Measure' dialogue box appears, use the drop down window to choose kilometers as the unit of distance. Also select the tab labeled 'Path'.

7. Note that the 'Measure' icon on your image appears as a box with tick marks along the mid-points. This box can be used to add points along a path to measure distance. To experiment, simply click once with the 'Measure' tool. Now move the cursor to a new location and click again. A line will connect both points, and the 'Measure' dialogue box will show the length of this line in kilometers. To start again, simply click either the 'Clear Path' or 'Clear All' button.

8. Zoom in on your globe until you can see the latitude/longitude grid in 1-degree increments. Roll the Earth up or down until you see the equator. Use the 'Measure' tool to determine the length of 1 degree of latitude at the equator. On your Excel spreadsheet, type '0' in the LAT column, and the length of 1 degree in the adjacent KM column. Now measure the length of 1 degree of longitude at the equator. On your Excel spreadsheet, type '0' in the LON column, and the length of 1 degree in the adjacent KM column. Repeat this process at 10°N, 20°N, 30°N, 40°N, 50°N, 60°N, 70°N, 80°N, 90°N.

9. Once you have tabulated these data, describe what you observe. It may help for you to plot these data on a graph with either LAT or LON as the horizontal axis and KM as the vertical axis. Now can you describe your observations?

10. Why do you observe these phenomena?

LINKS TO RELATED SITES:

Wikipedia entry on Coordinates Systems: http://en.wikipedia.org/wiki/Latitude_and_longitude

Wikipedia entry on Latitude: http://en.wikipedia.org/wiki/Latitude

Wikipedia entry on Longitude: http://en.wikipedia.org/wiki/Longitude

Wikipedia entry on the Prime Meridian: http://en.wikipedia.org/wiki/Prime_meridian

Calculating Distances from Latitude/Longitude coordinates:
http://mathforum.org/library/drmath/view/51711.html

Latitude/Longitude Calculator: http://www.nhc.noaa.gov/gccalc.shtml

Another Latitude/Longitude Calculator: http://jan.ucc.nau.edu/~cvm/latlongdist.html

And Another: http://www.marinewaypoints.com/learn/greatcircle.shtml