Name: ________________________________

Date: ________________________________

Chapter 1: Essentials of Geography

Chapter 1 introduces you to some of the essential spatial concepts of geography, including location and time on Earth, map scale, remote sensing, and geographic information systems (GIS). An essential for geographic science is an internationally accepted, coordinated grid system to determine location on Earth. The terms *latitude* and *longitude* were in use on maps as early as the first century A.D., with the concepts themselves dating back to Eratosthenes and others.

Coordination of international trade, airline schedules, business and agricultural activities, and daily living depends on a worldwide time system. Today, we take for granted standard time zones and an agreed-upon prime meridian but such a standard is a relatively recent development.

A map is a generalized view of an area, usually some portion of Earth's surface, as seen from above at a greatly reduced size and detail. Although Google Earth™ is not a map in the traditional sense, it meets these criteria. The key difference between Google Earth™ and a traditional map is that maps are projected, or transformed from the spherical surface of Earth to the flat surface of the map.

Another key feature of maps is their scale, or the ratio of distance on the map to distance on the ground. Cartographers have traditionally had to choose the projection that minimized distortion for their map, as well as the appropriate scale and level of detail for their map. Google Earth™ avoids these potential problems by presenting data and imagery draped over a spherical surface with dynamically changing levels of detail and scale. Layers are loaded in increasing levels of detail as you zoom in and replaced with more generalized layers as you zoom out.

Geographers probe, analyze, and map our home planet through remote sensing and geographic information systems (GIS). These technologies enhance our understanding of Earth. Geographers use remote-sensing data to study—among many subjects—humid and arid lands, natural and economic vegetation, snow and ice, Earth energy budgets, seasonal variation of atmospheric and oceanic circulation, sea-level measurements, atmospheric chemistry, weather, geologic features and events, changes in the timing of seasons, and the human activities that produce global change.

This exercise will introduce you to latitude, longitude, and time on Earth. It will also introduce you to remote sensing and geographic information systems (GIS) methodology. After completing these exercises, you should be able to:

- ***Explain*** Earth's reference grid: latitude and longitude and latitudinal geographic zones and time.
- ***Define*** cartography and mapping basics: map scale and map projections.
- ***Describe*** remote sensing and ***explain*** geographic information systems (GIS) as tools used in geographic analysis.

Download the essentials.kmz file from www.mygeoscienceplace.com and open it in Google Earth™.

Exploration 1: Latitude and Longitude

After reviewing the section "Location and Time on Earth" in your text, double click on the Equatorial Latitude placemark. You will be finding locations based on their latitude and longitude, as well as finding the latitude and longitude of locations.

1. Lines of latitude are called parallels because they are parallel to each other and never meet, unlike lines of longitude, which converge at the poles. From the menu bar, select view and turn on the grid. Also, select tools on the menu bar, open the options and set the display units to decimal degrees (on a Mac this will be in "Preferences," under the Google Earth™ menu.) Select the measure tool from the toolbar and set the units to kilometers. The angular distance from placemark A to placemark B is 10° of latitude. Using the measure tool, measure the linear distance from the equator to 10° north and write the answer in the blank below. Double click on the Polar Latitude placemark to fly to the North Pole. Make sure that you have checked the radio button so that the placemarks will display; otherwise you will fly to the correct location but the placemarks will not be shown. The distance from placemark C to placemark D is also 10° of latitude. Next, measure the distance from 80° north to 90° north. (A) What is the distance from 0° to 10°? *~1108 km*

(B) From 80° to 90°? *~1118 km*

2. What is the difference between these measurements? *~10 km* km

3. Why does 10 degrees of latitude have a different distance at the equator than at the poles? *Because Earth is an oblate spheroid that is flattened at the poles.*

4. Double click on the Equatorial Longitude placemark. The angular distance from placemark A to placemark E is 10° of longitude. Using the measure tool, measure the linear distance from placemark A to placemark E, which will represent 10° of longitude at the equator. What is the linear length of 10° of longitude? *~1114 km*

5. Double click on the Tropical Longitude placemark and measure 10° of longitude along the Tropic of Cancer at 23.5°. What is the distance at 10° of longitude at 23.5° N latitude? *~1020 km*

6. Double click on the Mid-Latitude Longitude placemark and measure 10° of longitude along 45° north. What is the distance at 10° of longitude at 45° N latitude? *~785 km*

7. Double click on the Sub-Arctic Longitude placemark and measure 10° of longitude along 60° north. What is the distance at 10° of longitude at 60° N latitude? *~555 km*

8. Double click on the Arctic Longitude placemark and measure 10° of longitude along the Arctic Circle at 66.5° north. What is the distance at 10° of longitude at 66.5° N latitude? *~446 km*

9. Double click on the Polar Longitude placemark and measure 10° of longitude along 80° north. What is the distance at 10° of longitude at 80° N latitude? *~195 km*

10. Why does the linear distance of 10° of longitude decrease as you travel from the equator to the pole? *Because the circumference of a line of latitude decreases as you go from the equator to the poles from a distance of 40,075 km at the equator down to nothing at the poles*

11. Double click on the box next to the Latitudinal Zones placemark to make the overlay visible.

(A) What latitudinal zone are you in now? *Personal answer*

(B) What is the southernmost latitudinal zone you have visited? northernmost? *Personal answer*

12. What latitudinal zone is Kauaʻi in? *Equatorial*

13. What latitudinal zone is Vancouver, B.C., in? *Midlatitude*

14. What latitudinal zone is Dunedin, N.Z., in? *Midlatitude*

15. What latitudinal zone is Moosejaw, Saskatchewan, in? *Midlatitude*

16. What latitudinal zone is Miami, FL, in? *Subtropical*

17. What latitudinal zone is Reykjav´k, Iceland, in? *Sub-arctic*

18. What latitudinal zone is Longyearbyen, Svalbard, in? *Arctic*

Exploration 2: Time and Time Zones

After reading the section "Prime Meridian and Standard Time" in your text, click on the box for the Time Zones placemark to make it visible. This layer has standard time zones labeled with their hours ahead or behind UTC.

1. How many hours away from Greenwich, U.K., do you live? *Personal answer*

2. What time is it now where you are? *Personal answer*

3. What time is it in Greenwich, U.K., now? *Personal answer*

4. If you wanted to call someone in Paris, France, at 9 A.M. their time, what time would that be in your local time? in UTC time? *Personal answer*

Exploration 3: Map Scale

In the past, map scales were fixed and static, because maps were printed or drawn by hand. With computer mapping, scales are no longer fixed, but change to accommodate different levels of detail depending on the data and view desired. Map scales are given as a graphic scale, usually with a scale bar at the bottom of the map; as a representative fraction such as 1:24,000; or as a written scale such as one centimeter equals one kilometer. Google Earth™ gives you the option to view a scale legend at the bottom of the screen. As you know, map scale is the ratio of map units to ground units. You will be using rulers to measure distances on your screen and the ground—both an actual ruler and Google Earth™ mapping service's built-in ruler tool. To avoid confusion, we will refer to your actual ruler as "your ruler" and to Google Earth™ mapping service's ruler as the "ruler tool."

1. Double click on the Map Scale View 1 placemark. Measure the distance from placemark 1 to placemark 2 by placing your ruler against the screen. What is the distance in cm? *Personal answer depending upon size and resolution of monitor for questions 1-9.*

2. Measure the same distance using the ruler tool in Google Earth™. To make it easy, set the units in the ruler tool to cm as well. What is the distance in cm? *Personal answer depending upon size and resolution of monitor for questions 1-9.*

3. Complete the following:

Personal answer depending upon monitor size and resolution.

_______________cm (screen length) = ______1______cm (ruler tool length)

4. Write the written scale of View 1: one cm equals *Personal answer*____________________________ km

5. Double click on the Map Scale View 2 placemark. Measure the distance from placemark 3 to placemark 4 by placing your ruler against the screen. What it the distance in cm? *Personal answer*_____________

6. Using the ruler tool, measure the same distance. To make it easy, set the units in the ruler tool to cm as well. What is the distance in cm? *Personal answer*____

7. Complete the following:

Personal answer depending upon monitor size and resolution.

_______________cm (screen length) = ______1______cm (ruler tool length)

8. Write the written scale of View 2: one cm equals *Personal answer*____________________________ km

9. Which scale is larger, View 1 or View 2? *Personal answer*_____________________________________

10. Bonus question: Imagery captured during different seasons or by different sensors will often look very different from other imagery of the same location. This can be especially obvious in areas with a pronounced difference between summer and winter. How many different sources of imagery can you count in this view? *At least three seasons, as shown by green vegetation, brown vegetation, and snow cover, at least until Google Earth updates the imagery again.*________________________

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Exploration 4: Remote Sensing

Double click on the Remote Sensing placemark. Google Earth™ has the ability to display active and passive remote sensing data. The default view is of passive remote sensing data, but Google Earth™ can also display radar imagery.

1. You may notice checkerboard patterns on the surface as you fly to different locations. This is due to Google Earth™ displaying different sets of imagery. The imagery might have been captured at different resolutions or at different times of year. A good example of this is in the Sahara Desert. You may have noticed this when you were measuring 10° of longitude along the Tropic of Cancer. Double click on the Tropical Longitude placemark to fly back there. Just to the south of the Tropic of Cancer you can see lighter-colored strips running north-south across the desert. Measure one of these with the ruler tool (set to kilometers). How long are these strips? *~223 km*

2. Double click on the Aguemar placemark inside the Remote Sensing folder. Using the measure tool, how long is the longer runway at this airport? *3.59 km*

3. Set the ruler tool units to meters and zoom in until you can see the square edges of the squares that make the image of the runway lines. These squares are called pixels, and an image that is magnified so that they are visible as individual squares is said to be pixelated. In the lower right corner, Google Earth™ will give you your eye altitude, or roughly how far above the surface you are. How wide are the white lines on the runway in meters and how close to the ground can you get before the lines pixelate? *1.3m, 1.7 km*

4. The quality and resolution of imagery in Google Earth™ is constantly improving, but there are still some areas that have better quality imagery than others. Fly to either your hometown or the town where you now live. Imagery analysts look for soccer fields because they are very common worldwide and they are all the same size. This makes it easy for analysts to calculate the scale of imagery. Find a feature with a known length, such as a soccer or football field in your town. Zoom in until the image begins to pixelate and complete the following to calculate the best scale at which you can see the image:

Personal answer depending upon monitor size and resolution.

____________________ cm (screen length) = ______1_______ cm (ruler tool length)

Continue to zoom in until you can see the edges of the pixels. Thin lines on the ground are excellent for this--lines in a parking lot, for example. Use the ruler tool to measure across one pixel to determine the resolution of the imagery. The imagery on the runway at Aguemar, Algeria, had a resolution of roughly 1.5 m per pixel. This would be called 1.5 m imagery, meaning that each pixel was 1.5 m on each side.

5. What town did you use and what feature did you use? *Personal answer* ______________________________

6. Most of the imagery used in Google Earth™ is passive imagery, however Google Earth™ can display radar imagery, which is one type of active remote sensing imagery. Turn on the Clouds layer and the Radar layer in Layers > Weather. Zoom out so you can see all of North America. The radar imagery is limited to North America, so if there is no active weather, there may not be any radar imagery shown. Hopefully this won't be the case. In the space provided, describe the pattern of active weather across North America. Where are there clouds? Where are there clear skies? Where is it raining (green radar imagery) or snowing (white radar imagery)? *Answer will depend upon time of year and weather activity.* ____________________

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Exploration 5: GIS

Google Earth™ is actually a very sophisticated geographic information system (GIS) with an easy-to-use interface. GIS combine location data (where is it?) with attribute data (what is there?). Google Earth™ manages many layers of imagery. Take a few minutes to explore the different layers of data that Google Earth™ can display. Pay particular attention to the Gallery, Ocean, Global Awareness, and Places of Interest sections.

1. Which was the most interesting layer and why was it interesting? *Personal answer* ________________

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2. GIS analysts combine layers of information to answer geographic questions. Pick at least three layers that you could combine to answer a geographic question. For example: How would I go from my home to Disneyland and where could I stay? I would use the Tourist Spots, Roads, Transportation, Dining, and Lodging layers. I would use the ruler tool to measure the distance from the hotel to the park. I would use the directions tool to estimate how long it would take me to drive. What is your question? What are the layers that you would use to answer it? How would you go about answering the question with those layers? *Personal answer* ____

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