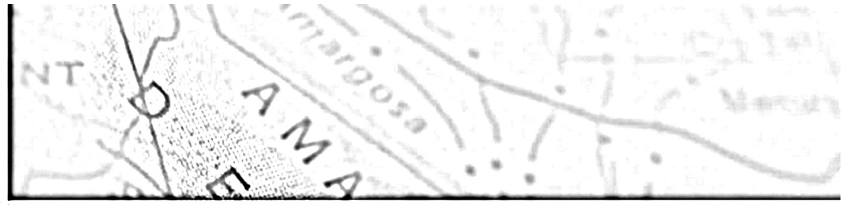
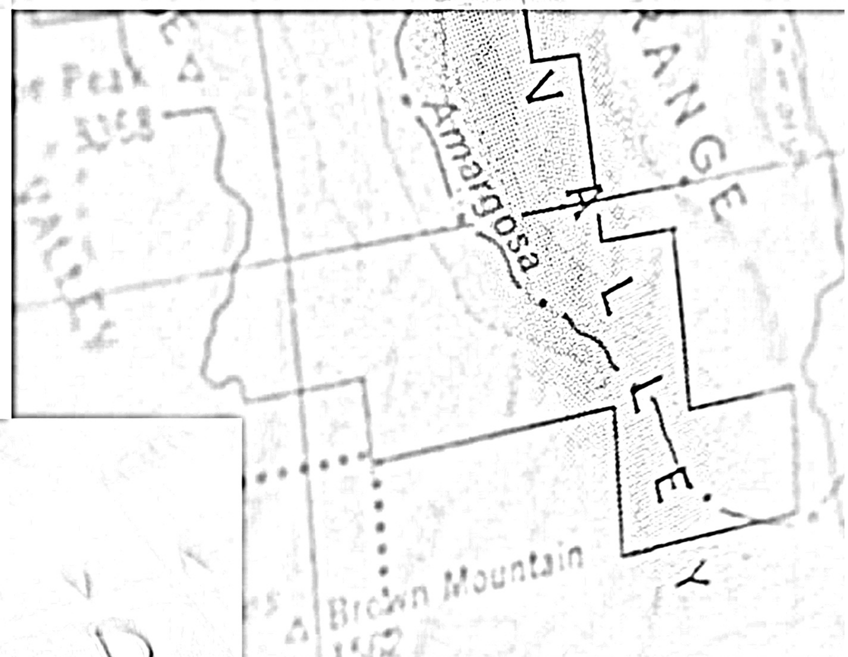
LAB MANUAL

Geography 101L

Physical Geography Laboratory: Earth's Surface Landscapes





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This manual was produced by members of the faculty of Antelope Valley College's Department of Geography & GIS: Michael W. Pesses, Susan Welsh, and Steven Adams. Certain labs reference *The Essential World Atlas*, and *Physical Geography*, both published by Oxford University Press.

Thank you to the US Geologic Survey and the National Oceanic and Atmospheric Administration for continued public access to geographic data and information and to the Antelope Valley College Foundation for financial support of our program.

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Introduction to the class

0.1. Introduction

Welcome to Geography 101L! This class is designed to complement *Geography 101 – Physical Geography: Earth's Surface Landscapes* and gives you hands-on experience with some of the topics you'll cover.

Today, your instructor will assign the lab exercises you will be completing throughout the semester and explain what you can expect in the weeks to come.

0.2. Some basic rules of the geography lab

1. No open-toed shoes. The lab is full of heavy equipment, large rocks, and glass. Sometimes they fall off the table.

2. Dress appropriately. Plan to get a little dirty in the lab. You'll be working with old dusty maps and rocks. Some activities will take us out of the lab and out onto campus. You'll be walking quite a bit and exposed to whatever heat, cold, wind, or rain is out there.

3. No food or drink. This is to keep our lab clean as well as keep you safe. We have toxic materials that could contaminate any food you bring into the lab.

4. Do not write on anything you don't own. Our maps have been around for a number of years and we'd like to keep using them for a number more.

5. **Be prepared.** Read the lab before class so you know what to expect and what you should bring.

0.3. Collecting spatial data

Your first lab activity will entail you filling out the following survey. Take your time and make your answers thorough.

1. Reason for taking this class (be honest):

2. What are your plans after Antelope Valley College?

3. How do you currently use geography in your life?

4. Explain as best you can how a magnetic compass can be used to find your way in the wilderness.

End of Lab 00

Name____________________

Physical Geography
Lab Activity #01

Due date__________

Système International

COR Objective 2, SLO 2

1.1. Introduction

While the general public in the United States still uses the "Imperial" system of weights and measures, (e.g., feet, pounds, gallons, Fahrenheit), most of the rest of the world – and the entire scientific community – uses the metric system, (e.g., meters, kilograms, liters, Celsius). Today, the metric system has been incorporated into what is formally known as the *Système International*, or *S.I.* system of measurement. Most of us are very familiar with the Imperial (American) system, but the vast majority of scientific inquiry and research is conducted using the metric system and we should be able to convert units from one system into the other.

There are two levels of conversion accuracy that are useful to us. First, it is helpful to have a rough idea of the equivalents – the kind of conversions you can do quickly in your head without a calculator or computer program. For example, it is useful to know that one kilometer is about $^2/_3$ of a mile, or that a meter is about 39 inches, just slightly longer than a yard. The second kind of conversions are exact equivalents – for example, one kilometer equals 0.621 mile. These exact conversions are necessary if a precise measurement in one system must be duplicated in the other system.

1.2. Rounding

In scientific work, many of the numbers used are measured quantities and so are not exact – they are limited by the precision of the instrument used in the measurement. Further, calculations based on measured quantities can be no more precise than the original measurements themselves. Therefore, measurements and the results of calculations should be recorded in a way that shows the degree of measurement precision. For example, if you use an electronic calculator to divide the following two measured quantities, you would get:

5.7 centimeters ÷ 1.75 minutes = 3.2571429 cm/min

But, is 3.2571429 a truly correct answer? Not really. In general, the greater the number of digits in a measurement or calculation answer, the greater the implied precision of measurement. A mathematical operation cannot make your measurements more precise. In the example above, our distance measurement is only accurate to a tenth of a centimeter, (perhaps limited by the measurement device we used), and our final answer can be no more precise than this. So:

5.7 centimeters ÷ 1.75 minutes = 3.3 cm/min

When rounding off numbers, if the first digit to be dropped is less than 5, leave the preceding digit unchanged; if the first digit to be dropped is 5 or greater, increase the preceding digit by one. So: 6.64 becomes 6.6, while 6.75 becomes 6.8.

1.3. Practicing Conversions

Complete the following conversions and use the rounding rules outlined above. A conversion program can be downloaded from the class website (http://avconline.avc.edu/mpesses/geog101l.html).

S.I. Units	American Units
198 centimeters	________ inches
24 meters	_________ feet
1,300 kilometers	_________ miles
4.5 liters	________ quarts
144 grams	_______ ounces
228 kilograms	_______ pounds
12° C	__________ ° F
29 meters	_________ yards
175 kilometers	________ miles
42 liters	_______ gallons
37° C	__________ ° F

American Units	S.I. Units
3 inches	____ centimeters
4.3 feet	_______ meters
18 yards	_______ meters
375 miles	__________ km
5.5 quarts	_________ liters
16 gallons	_________ liters
14 ounces	________ grams
65 mph	__________ kph
72° F	__________ ° C
my weight	___________ kg
my height	__________ cm

S.I. Units	S.I. Units
198 centimeters	________ meters
24 meters	________ mm
1,300 kilometers	________ meters
500 meters	___________ km
318 centimeters	________ meters

S.I. Units	American Units
40 ˚ C	____________ ˚ F
3.0 liters	_______ cubic in.
10 km	__________ miles
1 cm	_________ inches
0 ˚ C	____________ ˚ F
100 ˚ C	____________ ˚ F

S.I. Units	S.I. Units
2280 grams	______ kilograms
13 kilograms	_________ grams
1,600 meters	___________ km
1.75 meters	___________ cm
1.75 meters	_____ decimeters

American Units	S.I. Units
25 mph	___________ kph
40 pounds	____________ kg
50 miles	___________ km
85 ˚ F	___________ ˚ C
1 quart	__________ liters
10 gallons	__________ liters

End of Lab 01

Name______________________

Physical Geography

Lab Activity #02

Due date___________

Latitude and Longitude

COR Objective 1, SLO 1

2.1. Introduction

We often take for granted the ability to locate a single, unique place on the surface of our planet. We can tell Google or our GPS receiver where we want to go and get simple directions to that destination. It's really easy. But the ability to find a location on our huge, round planet is actually an impressive feat. At the **global scale** we use lines of **latitude** and **longitude** to impose a grid on the Earth (see Figure 2.1). Latitude lines, or **parallels**, run horizontally (east to west) and measure vertically (north or south of 0°). Longitude lines, or **meridians**, run vertically (north to south) and measure horizontally (east or west of 0°).

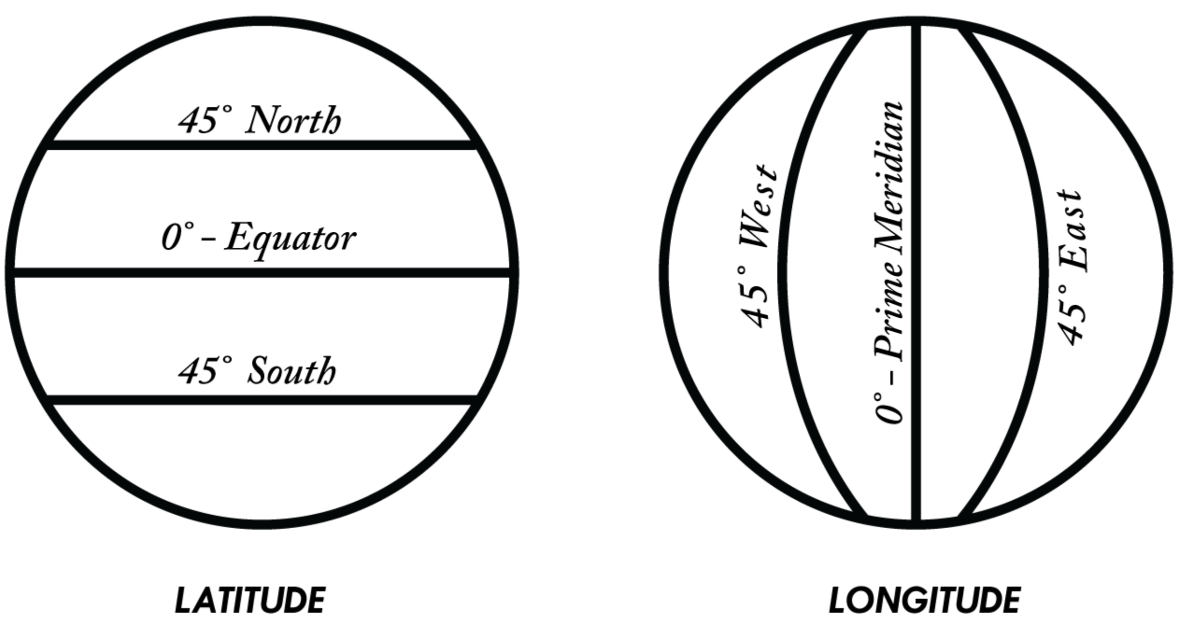


Figure 2.1. Lines of latitude and longitude

When we put the two sets of lines together we get a grid system typically referred to as the **graticule**. When given the latitude and longitude, we can easily find any point on the Earth.

2.2. The Hemispheres

Our graticule divides the globe into four hemispheres, northern, southern, eastern, and western. If it is easier, you can think of the graticule as an x,y graph like you've encountered in an algebra class. Rather than using positive and negative values, geographers use direction to distinguish where coordinates go. As you can see in the graphic below, having a set of longitude and latitude coordinates without the proper direction can place you into any one of the four hemispheres. *Direction is crucial!*

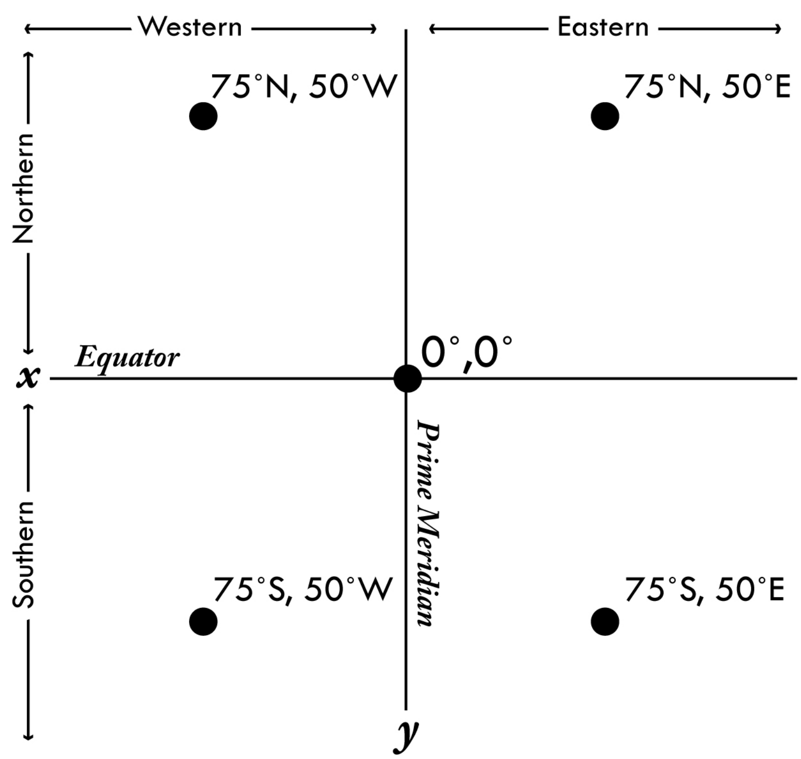


Figure 2.2.Graticule as Cartesian grid

Using Figure 2.2, answer the following questions

1. If we treat the graticule like an algebraic x,y grid, i.e. using positive and negative values, would the latitude in the coordinates 75°N, 50°W be positive or negative?

2. If we treat the graticule like an algebraic x,y grid, how would we express the coordinates for 75°S, 50°E?

2.3. Understanding Degrees Minutes Seconds

Latitude and longitude coordinates are expressed in degrees minutes seconds (DMS). Degrees are given the symbol °, minutes are given the symbol ', and seconds are given the symbol ". *Always remember that when finding latitude and longitude, "minutes" and "seconds" have nothing to do with time!* In this case, one minute is simply $^1/_{60}$ of a degree. In other words, each degree can be broken up into 60 minutes, and each minute can be broken up into 60 seconds. To get a precise location we give coordinates to the second. For example, Los Angeles, California is located at 34° 03' 00" N, 118° 15' 00" W.

The fact that minutes and seconds are fractions of degrees is a simple concept, but it can be difficult to grasp at first. The trick is to think of minutes in terms of simplified fractions. For example, 142° 30' W is the same as saying 142 ½° W or 142.5° W.

On Figure 2.3, draw lines for the following lines of latitude and longitude:

3. 33° 15' N
4. 34° 45' N
5. 118° 30' W
6. Using the above coordinates for Los Angeles, plot a point showing where it is on Figure 2.3.

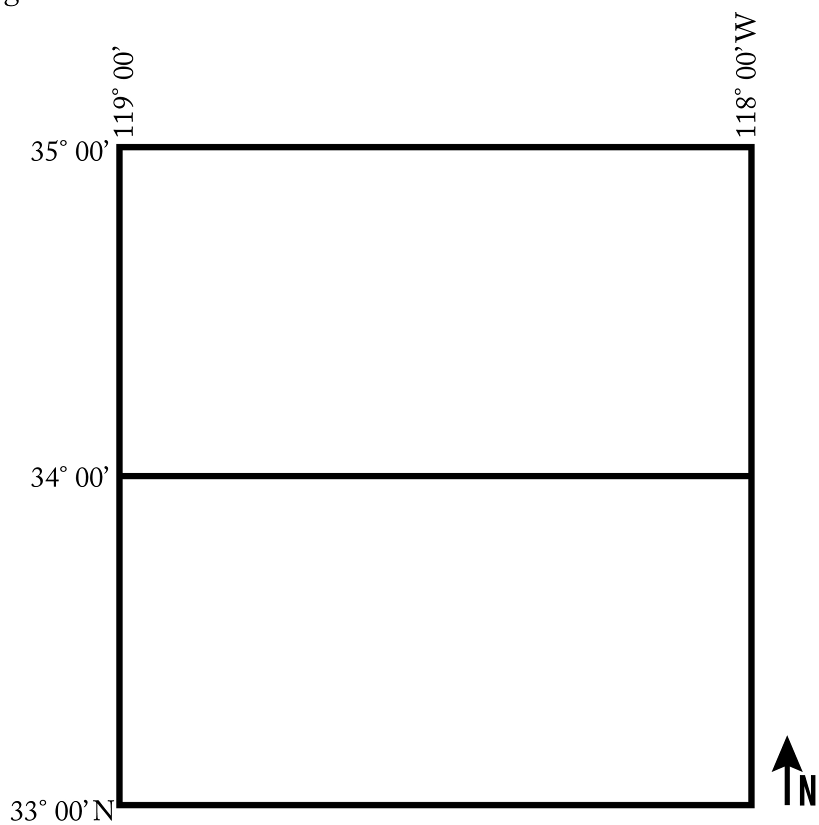


Figure 2.3. Sample of graticule lines

2.4. Focusing on Latitude

Latitude runs north or south of the Equator in parallel lines. Each line of latitude or "parallel" corresponds with its angle poleward of the Equator. We'll use **Figure 2.4** below to demonstrate this.

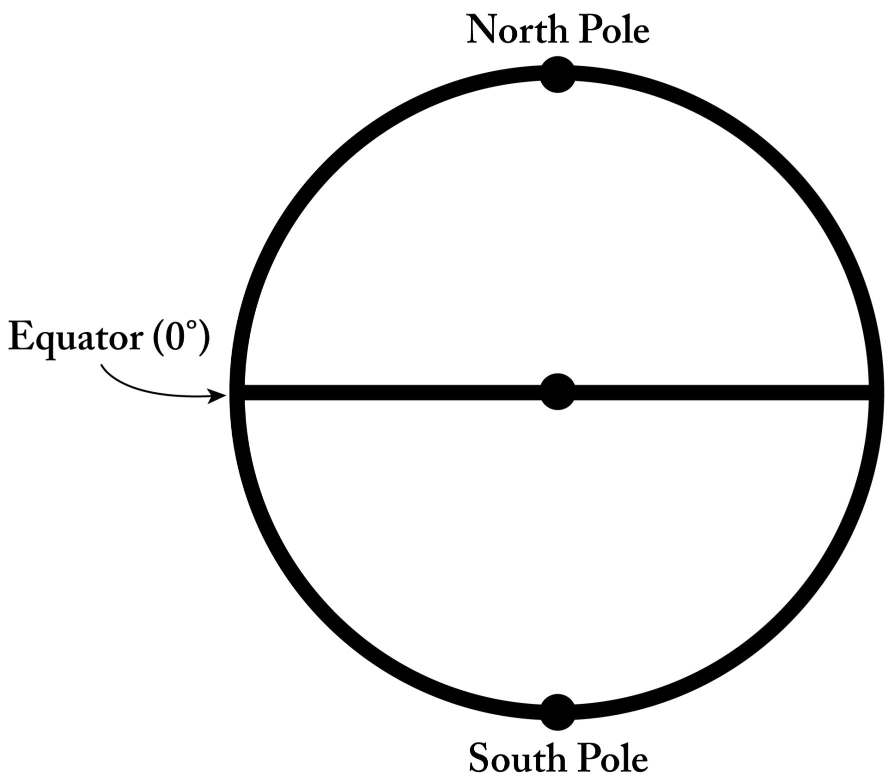


Figure 2.4. Measuring latitude angles

Imagine **Figure 2.4** is a cross section of our planet and the interior point represents the center of the Earth. We would find the latitude of places on the surface by drawing a straight line to the center and then measuring the angle with a protractor.

7. Draw a line from the North Pole to the center of the Earth. What is that angle?

8. Draw a line from the South Pole to the Center of the Earth. What is that angle?

Those two answers are the highest latitude coordinates you can have.

9. Draw a line at a 23.5° angle from the Center to the Northern Hemisphere. The spot your line hits the globe shows 23.5°N latitude. *What is significant about that location?*

10. Draw a point at the latitude where Los Angeles should be.

11. Use your *Essential World Atlas* to find the following cities, which are roughly found on the 42nd parallel in the Northern Hemisphere. Based on the maps, first estimate the city's latitude to the nearest minute. Write that down and then check your answer in the atlas' index.

City & pg. number	Estimated lat. & min.	Exact lat. & min.
Medford, OR, USA (pg. 76)		
Shenyang, China (pg. 33)		
Tbilisi, Georgia (pg. 19)		
Girona, Spain (pg. 21)		
Samsun, Turkey (pg. 19)		

12. Now do the same for these cities located near the 32nd parallel in the Southern Hemisphere:

City & pg. number	Estimated lat. & min.	Exact lat. & min.
Cordoba, Arg. (pg. 94)		
Perth, Australia (pg. 61)		
Queenstown, S. Africa (pg. 56)		

2.5. Focusing on Longitude

There are 360° of longitude running around the globe, east or west of the Prime Meridian. We also call them "meridians." We will use meridians much more in the next lab when you practice navigational techniques and finding your location out at sea.

13. Estimate the longitude of the following cities, then look up the exact location:

City & pg. number	Estimated long. & min.	Exact long. & min.
Timbuktu, Mali (pg. 52)		
Minsk, Belarus (pg. 17)		
Seattle, WA, USA (pg. 78)		

2.6. Test yourself

Without using any references, write definitions for latitude and longitude. Check your definitions using De Blij et al's *Physical Geography* and this lab manual and improve and/or correct your definitions as needed.

14. Latitude –

15. Longitude –

2.7. Using the graticule

When we know both the latitude and longitude of a place we can find exactly where it is on a globe or map. Using your Figure 2.5, and your atlas, plot the following cities on the map. Draw a point and label it (as already done for Los Angeles).

16. Lafayette, LA
17. Houston, TX
18. Detroit, MI
19. Missoula, MT
20. Lincoln, NE

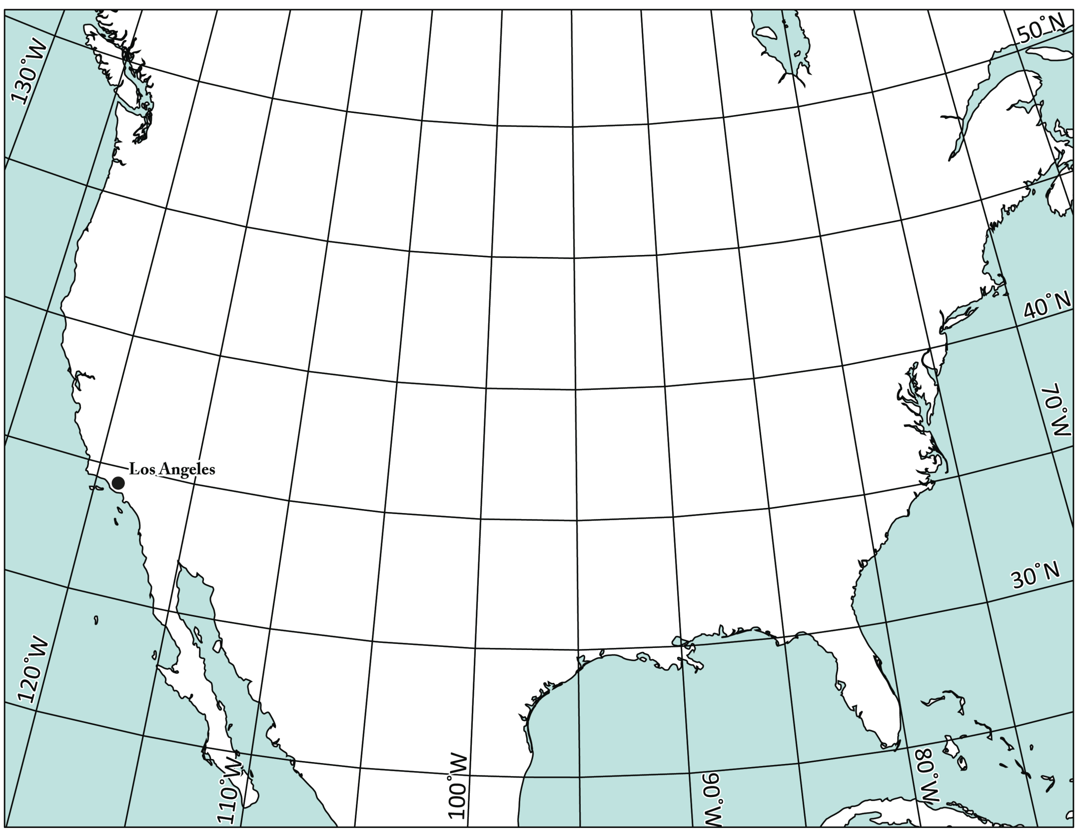


Figure 2.5. Blank U.S. Map

Now it is time to do this in reverse. Below you are given coordinates for five cities around the world. Using your *Essential World Atlas* and/or a world globe locate the cities that correspond with the latitude and longitude

21. 55° 0' N, 83° 5' E = ______________________________

22. 16° 20' S, 68° 10' W = ______________________________

23. 35° 30' N, 51° 30' E = ______________________________

24. 9° 2' N, 38° 42' E = ______________________________

25. 12° 59' N, 77° 40' E = ______________________________

End of Lab 02

Name______________________

Physical Geography

Lab Activity #03

Due date___________

Navigation

COR Objective 2, SLO 2

3.1. Introduction

In the previous lab you learned how to use latitude and longitude to find a location on a map or globe, but what if you didn't have those coordinates to begin with? Imagine being on a ship out in the middle of the Atlantic Ocean with no idea as to where you were *exactly*. Are you close to land? Are you dangerously close to jagged coastal rocks?

Ptolemy developed our system of the graticule back in the year A.D. 2. The ability to actually measure the graticule out in the real world didn't come for another 1,700 years. This lab will introduce you the basic theories behind locating your latitude and longitude using the shape of the Earth and our place in the solar system. Yes, GPS can tell us where we are, but electronics aren't always reliable. Plus it's way cooler to navigate using the stars…

3.2. Latitude

The ability to find one's latitude came before longitude. We can use the angle of the stars in the sky to calculate our angle of latitude. For this lab we will use the sun, but both Polaris (the North Star) and the Southern Cross constellation can be used depending on your hemisphere.

3.3. The Analemma

The one trick with using the sun to measure your latitude is that you need to take into account the changing declination of the sun throughout the year. Fortunately, we have the Analemma, a lopsided figure 8 the charts the subsolar point for every day of the year (see figure 3.1).

1. What is the subsolar point? (use **De Blij et al's** *Physical Geography* or your class notes to answer this)

In Figure 3.1 below you should notice the lopsided figure-eight shape that is divided into 365 days. Running along the left side are latitude values, starting with 24° S at the bottom, reaching 0° (the Equator) at the middle, and 24° N at the top. By picking a day on the Analemma and looking directly to the left, you can see the latitude of the subsolar point on that day. For example, on November 10 the subsolar point is at 17° S.

Use the Analemma to find the subsolar point for the dates listed below:

2. October 15
3. August 15
4. June 22
5. December 22
6. September 23
7. March 21
8. What is special about the dates for questions 4-7?

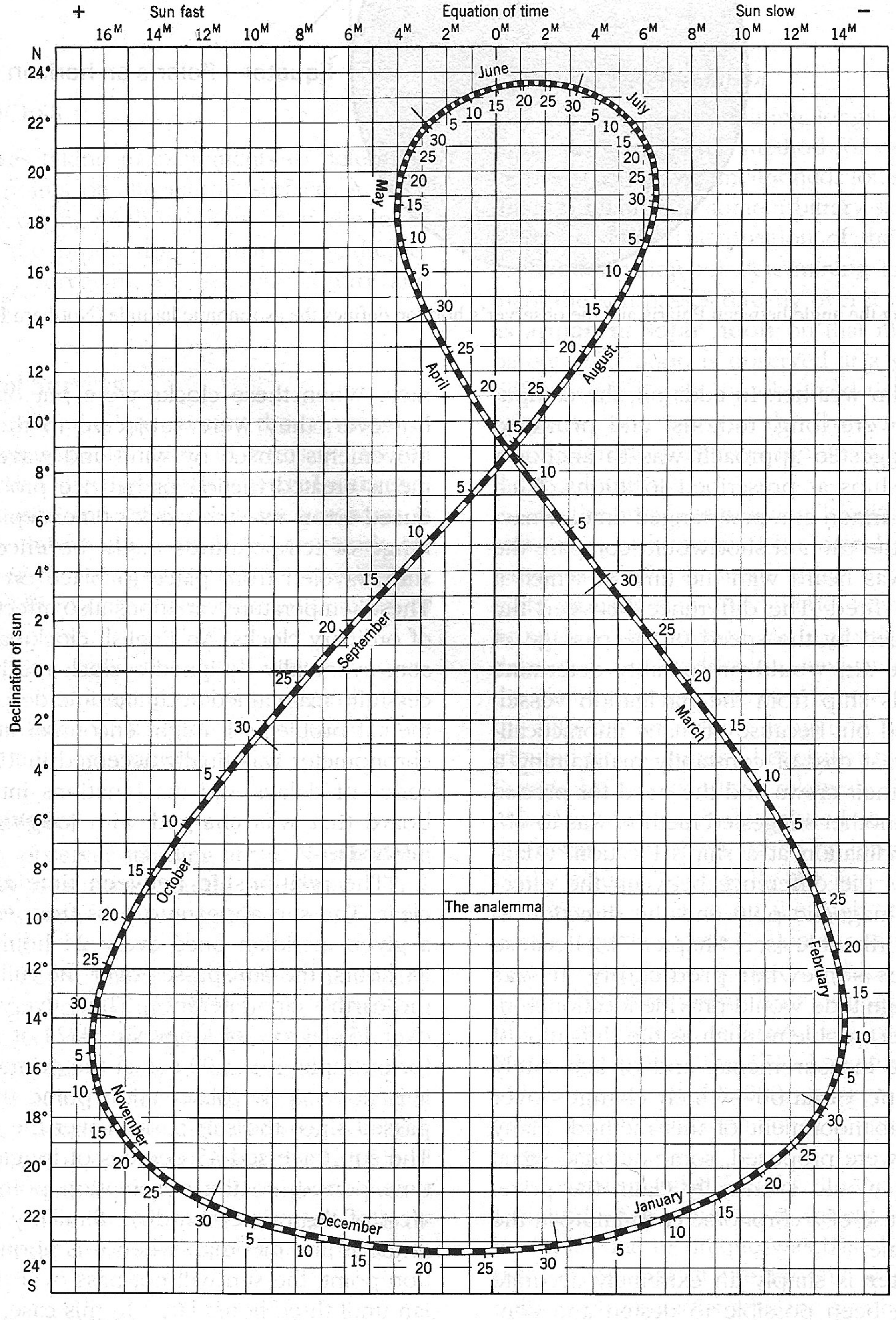


Figure 3.1. The Analemma, courtesy of the U.S. Coast and Geodetic Survey

3.4. Finding Latitude

Now that you can use the Analemma, you are ready to find latitude based on the sun's angle in the sky. As long as you know the sun's angle, the date, your hemisphere (north or south), and the correction based on the Analemma you can locate your current line of latitude.

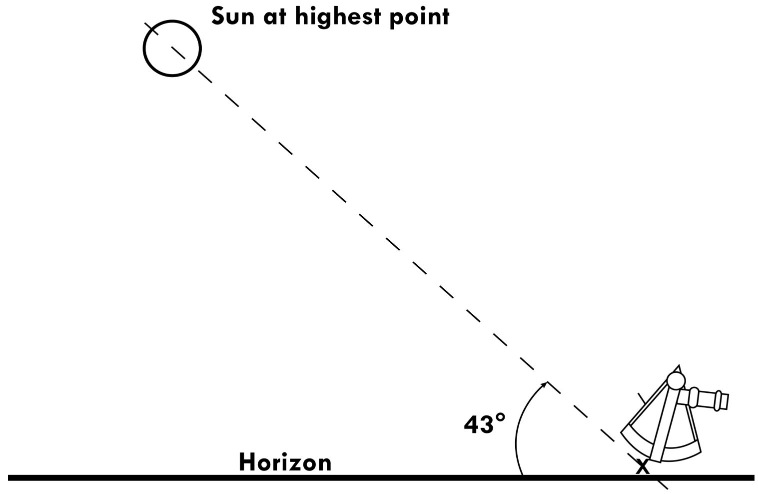


Figure 3.2. "Using" a sextant to measure the Sun's altitude

To determine latitude you only need to know three things. They are:

- The sun's angle above the horizon at the highest point in it's daily arc found using a sextant (or protractor for this lab),
- The date, and
- The correction for Earth's seasonal variations for that day as shown on the analemma.

Here is the formula used by sailors to determine their latitude:

Latitude = (90 - solar angle at midday) ± the analemma correction for that day

Let's work through this together. **Assume that Figure 3.3 below shows the location of a person at mid-day on April 20.**

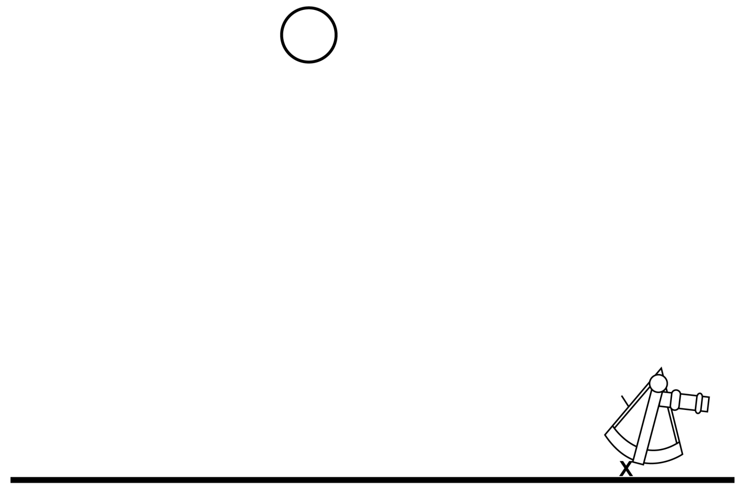


Figure 3.3. Sun's altitude on April 20th

9. First, draw a pencil line from the X at the bottom of the sextant through the middle of the sun. Measure this angle exactly using a protractor. This is the solar angle for this location:

   Solar angle ____________________

10. Subtract the solar angle from 90

    90 - __________ =____________

11. Analemma correction for this date is:

    April 20th = _____________________

12. Notice that the formula both adds and subtracts (±) the analemma correction giving us two possible locations. Write them here:

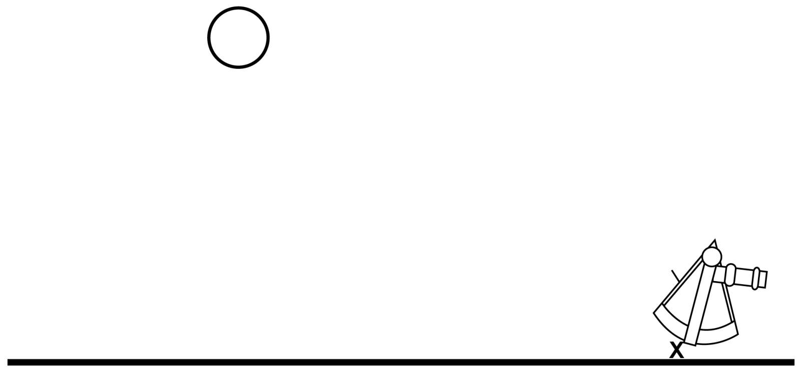
    ________________ & _________________

13. Generally one is in the northern hemisphere and the other in the southern hemisphere. The larger of the two possible numbers will be located the hemisphere which is experiencing longer days (i.e. experiencing spring or summer). Let's assume that the Figure 3.3 is from somewhere in the Northern Hemisphere. What is the latitude of our lost person?

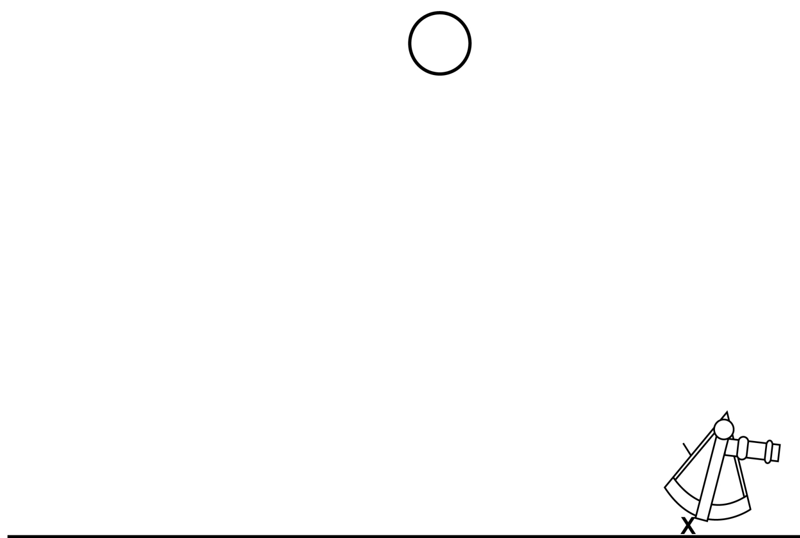
3.5. Practicing Finding Latitude

Using the technique outlined above, find the latitude for the following locations.

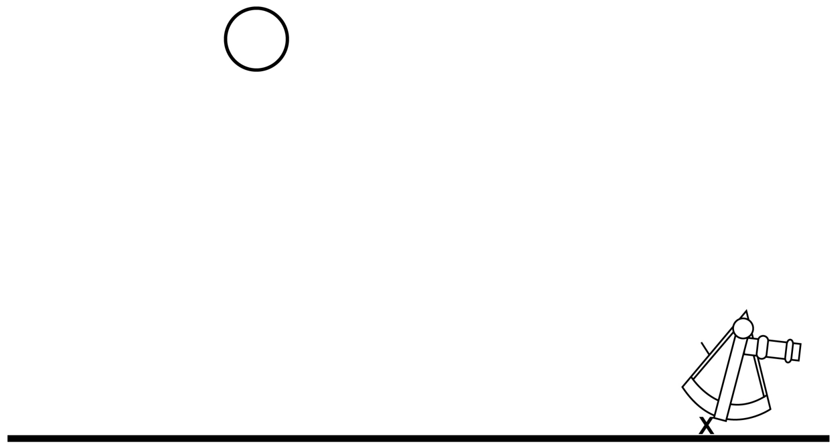
14. Location 1 – Northern Hemisphere, February 1



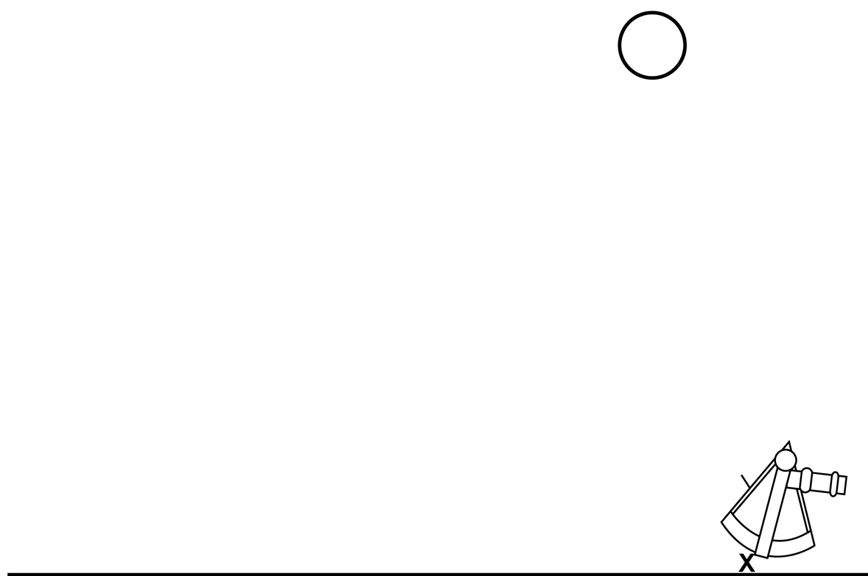
15. Location 2 – Northern Hemisphere, May 20



16. Location 3 – Southern Hemisphere, July 1



17. Location 4 – Southern Hemisphere, November 5



3.6. Finding Longitude

Longitude proved to be elusive for early explorers. In fact, the British Government was so desperate for a way to calculate one's longitude out at sea that they offered up a cash prize to whoever could come up with a viable technique. Many people tried, and it would ultimately be clockmaker John Harrison who came up with a watch that could keep accurate time while rocking on a ship at sea. That watch was crucial to calculating longitude. His first model was completed in 1735; over 1,700 years after Ptolemy had developed the graticule.

The method is rather simple. You need to know the time at a fixed point, typically somewhere back home, and the local time. For example, if I head out to sea from England, I have a watch set to Greenwich Time (Greenwich, England is where the Prime Meridian originates). When I get out to sea and cannot see any landmarks, I wait until noon (calculated by the sun at its highest point in the sky) and check the time back home.

Now in order to derive my actual longitude, I need to know something about the rotation of the Earth and the speed at which the sun "travels" through the sky.

18. If we assume the Earth is a perfect sphere, it represents how many degrees?

19. How long does it take for the sun to return to the same point each day (i.e. how many hours pass between solar noon on Tuesday and solar noon on Wednesday)?

20. Using the previous two answers calculate how many degrees the sun "travels" through the sky per hour. Be sure to show your work.

21. How many minutes go by for each degree travelled?

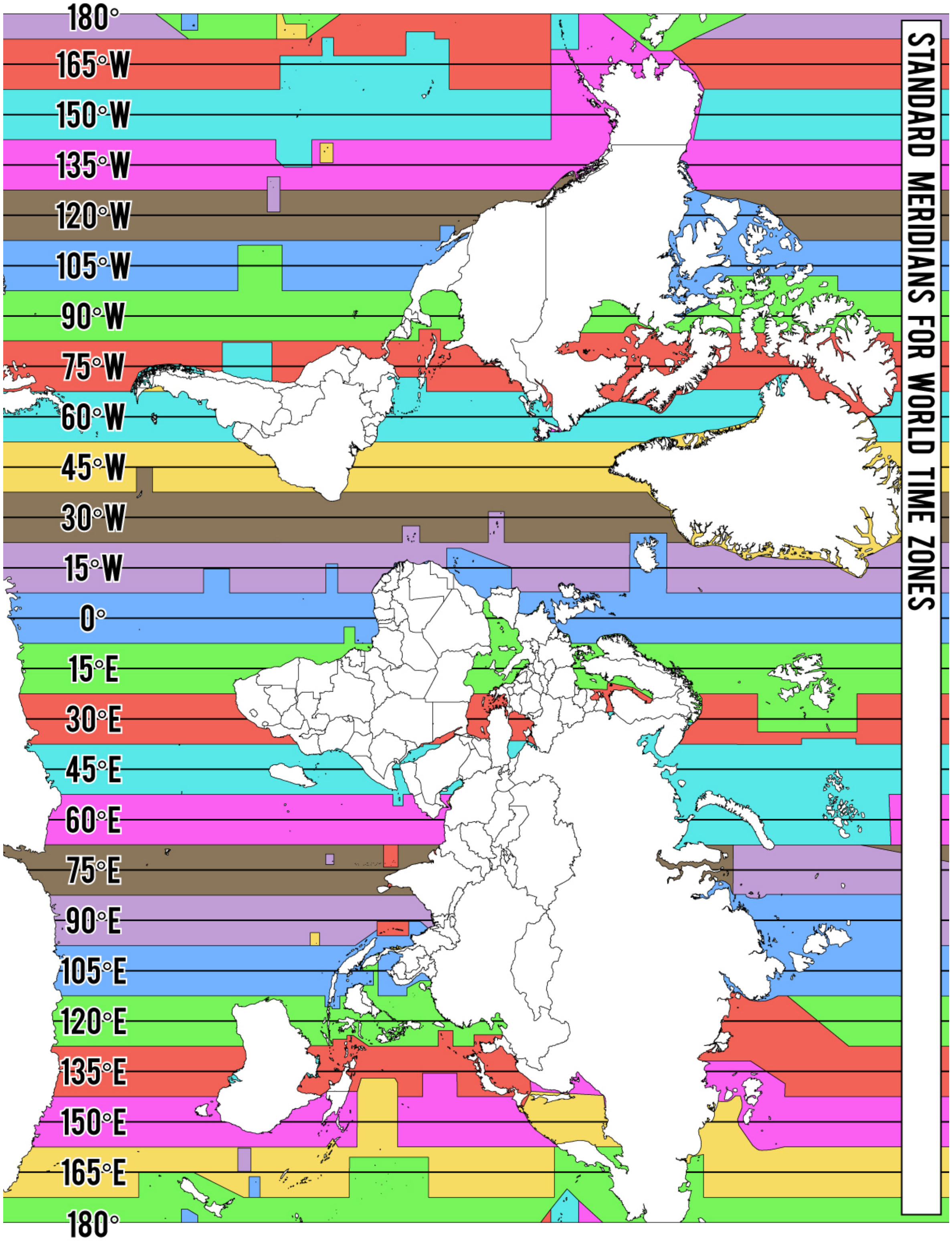
This also ties in with time zones. Each time zone on the planet corresponds with your answer to question 20 above.

22. If we have 24 equal time zones on the planet, how wide is each one (in degrees)?

To keep track of our time zones, we use a standard, or controlling, meridian in the middle of each one, as shown in the following map.

23. Pacific Standard Time has a controlling meridian of 120° W, meaning when our watches here at Antelope Valley College say 12:00pm, the sun is at its highest point in the sky over 120° W. But what is the exact longitude (to the degree) of Lancaster, California?

24. Since the Earth rotates to the East, will the sun in Lancaster reach the highest point in its daily arc before or after our watches show 12:00pm?


STANDARD MERIDIANS FOR WORLD TIME ZONES
180°
165°W
150°W
135°W
120°W
105°W
90°W
75°W
60°W
45°W
30°W
15°W
0°
15°E
30°E
45°E
60°E
75°E
90°E
105°E
120°E
135°E
150°E
165°E
180°

25.

26. How much time difference between the sun's highest point in Lancaster & 12:00pm on our watches?

27. Based on the fact that the Earth rotates to the East, if noon at your location is *later* than the time back home (e.g. Greenwich Time) you have travelled east. If noon at your location is *earlier* than the time back home, you have travelled west. Using this information and your answers for questions 20 and 21, calculate your longitude if your noon occurs at 4:45pm Greenwich Time.

3.7. Finding your location

Now that you understand the basics of finding latitude and longitude you will practice finding your location in a variety of situations. This is yet another example of how this class will someday save your life. Good luck getting that in a biology lab…

Geographic Situation #1

On your way to a much needed vacation in Hawaii your small plane runs out of gas. You land safely, but are now left floating in the ocean. Thank goodness you completed your geography lab class and always wear a Rolex and sextant when you fly. You also have a radio and if you can figure out your exact coordinates you can get rescued.

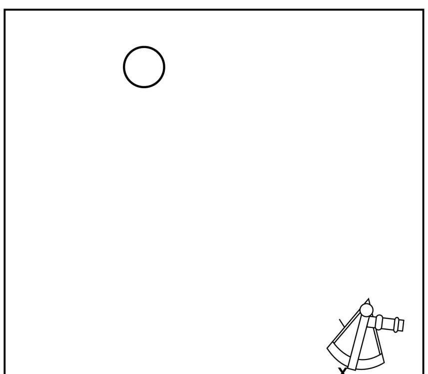


Figure 3.4.

Using the following information we can calculate our latitude & longitude coordinates.

- Figure 3.4 shows the Sun's altitude at midday.
- Yesterday was February 25th.
- Your very accurate watch is set to PST which reads 2:07 PM when the sun is at the highest point in the sky at your spot in the ocean.

Finding Your Latitude

28. Use the solar angle and analemma correction to calculate your possible latitudes. They are:

    ________________________ & ___________________________

29. Given that you were on your way to Hawaii from California, what hemisphere are you most likely in?
30. So your latitude is (be sure to write the direction, i.e. N or S):

Finding Your Longitude

31. First you need to compare local noon to the time at a known location. What is the time difference between the time at your watch and local noon?

32. Convert that time to minutes (no hours)

33. What is the time difference as you travel one degree east or west (you answered this in question 21)?

34. Using your answers for 31 and 32, convert the time minutes to longitude degrees.

35. What is the longitude of the controlling meridian for the time zone at your known location?

36. Are you in the Eastern or Western hemisphere?

37. Are you east or west of your known location? How do you know?

38. Your longitude is (be sure to write the direction, i.e. E or W):

Geographic Situation #2

Fortunately you paid attention in geography lab and were rescued from certain death in the Pacific Ocean. The stress of that ordeal led you take another vacation, this time driving across country to sunny Florida. Of course you bring your geography equipment with you just in case and while fiddling with your radio you pick up a faint cry for help:

> Mayday... Mayday.... My yacht has sunk leaving me on a deserted island. The sun is directly overhead at its highest point each day. And my watch, which is set to Greenwich Mean Time, gives the time of 5:13 PM when it's noon here. There's a $10,000,000 reward for anyone who can save me before I go crazy!

Luckily the stranded wealthy person was very specific. That information along with the fact that today is May 15 should be enough to help you find him. What are the latitude & longitude coordinates where you will begin your search?

Geographic Situation #3

Geography has paid off once again! You collect the reward and are able to retire to a life of leisure. You quickly blow a large chunk of your money on a sailing yacht and crew. Money has made you lazy though and you allow others to do your navigation for you. While traveling in the South Pacific your navigator gets drunk and falls overboard. You haven't been paying attention to where you are but know the next stop was to have been Singapore. You notice the Southern Cross constellation one evening and wake up in the morning with land in sight. What country are you looking at? Here are your clues:

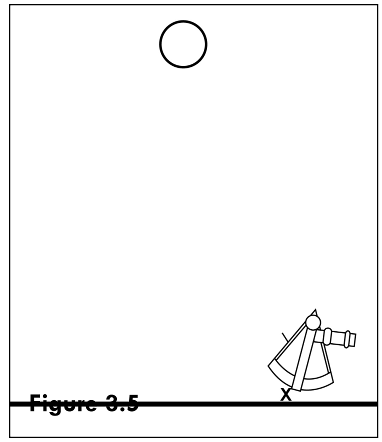


Figure 3.5

- You are able to measure the solar angle at local noon as shown in Figure 3.5.
- Today is December 15.
- Your Rolex, which was set to local time in Perth, Australia reads 4:30 PM when the sun is at its highest point overhead. Luckily you kept a copy of your Essential World Atlas and De Blij et al's *Physical Geography* on your ship just in case you had to look up Perth's location and time zone…

39. What are your latitude & longitude coordinates?

40. What country are you closest to?

41. In what compass direction should you head if you want to get to Singapore?

Geographic Situation #4

You cancel the Singapore trip and instead head to the Seychelles. After exactly three months of island life, the sea is calling once again. A crew member mentions "I always wanted to see the Maldives…" After six days of debauchery and a lack of proper navigation (money certainly has changed you) you wake up becalmed. The sun is directly over head at its highest point and your watch, which you never bothered to change from Perth time, reads 10:20 AM.

42. What are your latitude & longitude coordinates?

43. Which direction should you go to get to the Maldives?

End of Lab 03

Name____________________

Physical Geography
Lab Activity #04

Due date___________

Map Scale

COR Objective 2, SLO 2

4.1. Introduction

Maps and globes are scaled representations of reality. We shrink the landscape to see and analyze it, but how much we shrink it is an issue of scale. Knowing the scale of the map you are using is a vital piece of information. Not only will it help you measure distances on the ground, but it will tell you if the map you are using is appropriate for the task at hand. Cartographers (i.e. map makers) make specific choices as to what should and shouldn't be on maps of a certain scale. This reduction of detail is called generalization, and isn't a problem if you pick the right scale for the job.

4.2. Examining scale

Using your Essential World Atlas, answer the following questions:

1. Map 1. *Political World Map, pg. 2-3*
   Scale of map (*example: 1:1,000,000*):
   How wide (in miles) is the area shown on the map from east to west?
   What types of cities are shown on the map (e.g. capitals, major cities, small towns, all of them)?

2. Map 2. *U.S. Map, pg 74-75*
   Scale of map:
   How wide (in miles) is the area shown on the map from east to west?
   What types of cities are shown on the map (e.g. capitals, major cities, small towns, all of them)?

3. Map 3. *Central and Southern California Map, pg. 79*
   Scale of map:
   How wide (in miles) is the area shown on the map from east to west?
   What types of cities are shown on the map (e.g. capitals, major cities, small towns, all of them)?

We can describe the maps you just examined as being either large, medium, or small scale maps. The wording can be somewhat tricky, but a *large scale map covers a small area* and a *small scale map covers a large area*. These are relative terms usually used in comparison to another map. So a map of North America would be a small scale map when compared to a map of California. We can also use the term medium scale when we've got a map that falls somewhere in the middle.

4. Using this concept, write down the names of the three maps you just looked at in order from *largest* scale to *smallest*:

4.3. Expressing scale

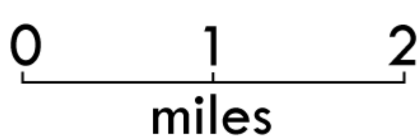
We have three ways in which we express *linear* scale. Each way has its benefits and problems, but no one is necessarily better than the others.

Verbal scale
Example:

One inch is equivalent to one mile

This scale is the most common one for the general public, mainly because it's easy to understand and is said in plain English. It is usually in a format that makes sense to us; we can visualize how far one mile is and easily measure one inch on the map. The problem with this scale is that it isn't very useful in terms of unit conversion or comparing the scale of two separate maps.

Graphic scale
Example:

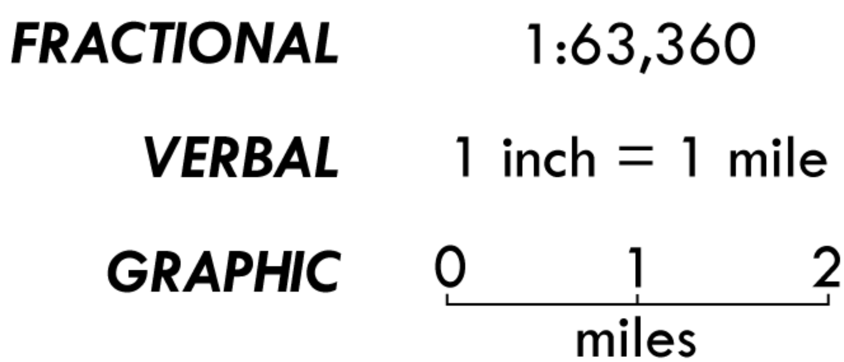


This scale makes it even easier to visualize because, well it does the visualizing for you. The map user can easily use a ruler, piece of paper, string, or pipe cleaner to measure a distance on the map and then hold it up to the scale to see the represented distance.

Fractional scale
Example:

1:63,360

This scale is surprisingly versatile, yet can be confusing thanks to verbal scales. Students often look at this scale and think it means "1 inch equals 63,360 miles." A representative fraction (or RF) scale actually uses the same units on each side of the colon. So the above should be read as "1 inch equals 63,360 inches." What makes this scale versatile is the fact that we can substitute any unit of linear measurement into the scale. So the above scale could be "1 inch equals 63,360 inches" or "1 centimeter equals 63,360 centimeters" or "1 millimeter equals 63,360 millimeters."



It is worth noting that all of the above scales are representing the ***same scale***. They are just expressed in different ways. Quite often maps will have their scales expressed multiple ways so that the map user can select the best possible one for the task at hand.

4.4. Converting scales

Using the scale examples above, determine exactly how many inches are in one mile. Then take it a step further and figure out how many feet are in one mile.

5. 1 mile contains ______________ inches.
6. 1 mile contains ______________ feet.

7. You have just gathered some valuable information for the next part of this lab. Below you will find a table with one type of a scale (verbal, graphic, or fractional) on each row. Calculate the missing scales and ***make sure to use a ruler to ensure your graphic scale is accurate***.

FRACTIONAL	VERBAL	GRAPHIC
1:100,000		
	1 inch = 4 miles	
		0 25 50 miles

4.5. Using Linear Scale

Solve the following scenarios.

8. You have a map that is missing a scale. The distance from Point A to Point B is five inches on the map, and after driving it, you know it is 250 miles in reality. Prepare the three scales for the map, and be sure to simplify your scale (e.g. *for the verbal scale, reduce it to 1 inch = x miles instead of 5 inches = 250 miles*).

    Fractional:
    Verbal:
    Graphic:

9. Using a different map that is once again missing a scale, you measure the distance from Point C to Point D as five inches, but on the ground it is 500 miles. Prepare the three scales for the map, and be sure to simplify your scale.

    Fractional:
    Verbal:
    Graphic:

10. You have a map with a scale of 1:63,360. On that map, you see your hiking destination is seven inches from your current location. How far away is that in reality? Explain how you arrived at this decision.

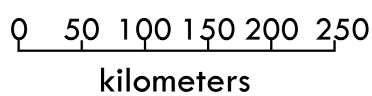
So far, so good… but what if you're forced to use <*gasp*> the metric system? The metric system is incredibly easy to use, yet often foreign to Americans. You can use the appendix at the end of this lab to answer the following questions.

11. One centimeter equals _______ millimeters.
12. ________ centimeters equals one meter
13. ________ meters equals one kilometer.
14. ________ centimeters equals one kilometer.
15. One mile equals ________ kilometers.
16. One kilometer equals _________ miles.
17. I need to drive to a city 257km away. How many miles is that? ___________
18. Barstow is 96 miles away from Antelope Valley College. How many kilometers is that? ________________

19. It still might be difficult to visualize metric measurements in relation to their American counterparts. Convert the three scales from metric to American. ***Does the fractional scale change?***

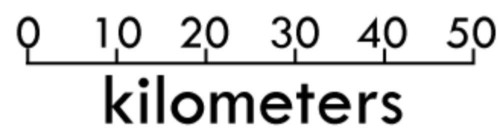
1:5,000,000

1 cm = 50 km



equals

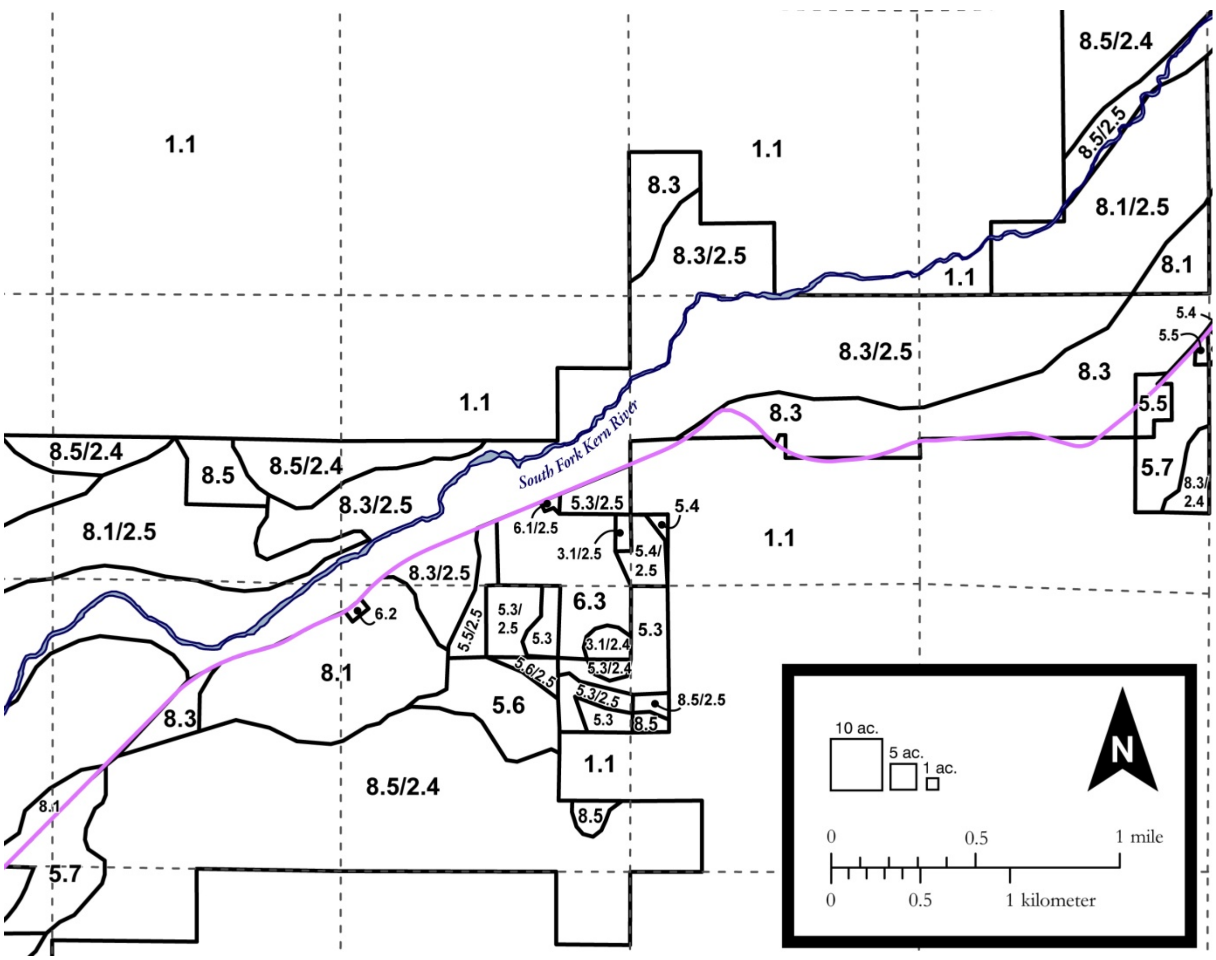
20. Now fill in the table below with the proper metric scales. *Make sure to use a ruler to ensure your graphic scale is accurate.*

FRACTIONAL	VERBAL	GRAPHIC
1:100,000		
	1cm = 40 km	
		

4.6. Using Areal Scale

Sometimes knowing how far away something is isn't very helpful. Sometimes we're more interested in how large an area is instead. When we study land use we want to know the amount of vegetation based on square meters or acres, not simply how long it is. This can be done quite easily when we have an areal scale on our map.

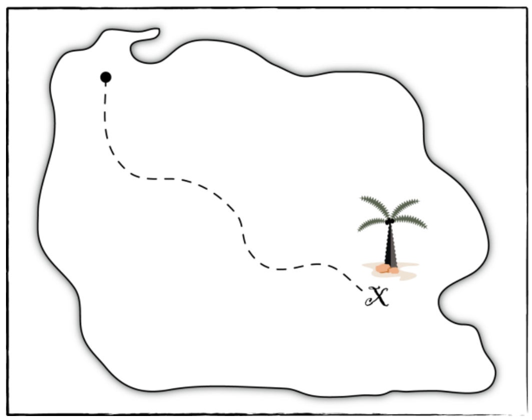
21. The following map shows the land use designations for an area in Kern County, California. The numbers represent what the land is currently designated as, for example 1.1 is government owned land, 8.1 is agricultural, and so on. Using the areal scale in the lower right corner of the map, find the total acreage of land designated 6.3.



4.7. Understanding Scale

Even after all this work with scale, it can be difficult to grasp what it really means when using a map. Yes, it determines how far you measure on the map to figure out distance on the ground, but it also affects the accuracy of a map as well.

Look at the map below. Legend has it that there is treasure buried underneath the ground where the "X" was drawn, but we still really don't know exactly where the treasure lies. Is it underneath the center of the X? The upper right? We may need to dig up the entire area around the X to be sure we find it, but the amount of that area will change depending on the scale of the map. Let's assume the each side of the X covers $^1/_8$ of an inch.



If the map is drawn with a scale of 1:5,000, how much area would the X cover?
Step 1.If 1 inch = 5,000 inches, how many inches would $^1/_8$ of an inch cover? Convert $^1/_8$ to a decimal _______________ and multiply it by 5,000. You get ______________ inches.
Step 2. Now convert your answer from above into feet. ___________________
Step 3. Since we're interested in an areal amount and not linear, you need to determine the square feet covered by the X. If we assume the X is a perfect square, it would cover ________ square feet.

Now do the same thing for the following scales:

22. 1:10,000; X = _____________________________________ square feet
23. 1:24,000; X = _____________________________________ square feet
24. 1:100,000; X = _____________________________________ square feet
25. 1:250,000; X = _____________________________________ square feet

You should now see that even a little change in scale can make a big difference on the ground.

26. Which scale would be the best for finding the treasure? Is it a large scale or a small scale?

Lab 04 Appendix – Metric Units & Conversions

Metric standard units

1 centimeter (cm) = 10 millimeters (mm)
1 meter (m) = 100 cm
1 kilometer (km) = 1,000 m

American customary system standard units

1 foot (ft) = 12 inches (in)
1 yard (yd) = 3 ft
1 rod (rd) = 16.5 ft
1 chain (ch) = 4 rd
1 furlong = 10 ch or 220 yd
1 mile (mi) = 5,280 ft
1 acre (ac) = 43,560 square feet (ft^2)

Converting from Metric to American

Inch to centimeters – multiply inches by 2.54
Centimeters to inches – multiply cm by 0.3937
Feet to meters – multiply feet by 0.3048
Meters to feet – multiply meters by 3.281
Miles to kilometers – multiply miles by 1.61
Kilometers to miles – multiply km by 0.62

End of Lab 04

Name______________________

Physical Geography

Lab Activity #05

Due date___________

Map Projections

COR Objective 2, SLO 2

5.1. Introduction

The Earth's roundness really screws up our maps. It may not seem like a big deal, but imagine you're peeling an orange. Making a flat map out of a globe is a similar task. We can get the peel off an orange in one continuous piece, but it's going to be torn and maybe even stretched.

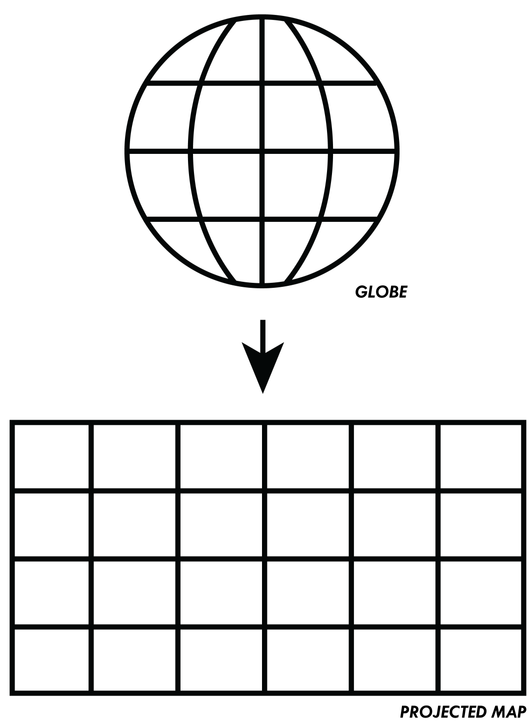


Figure 5.1. Simplified concept of a map projection.

A map projection is an attempt to minimize the distortion that occurs from flatting the globe. We have dozens of common map projections, mainly because there isn't one perfect way to flatten it. Every map projection has a certain amount of distortion in it. It is up to the cartographer and map user to decide where the distortion will be the least intrusive.

5.2. Retained Spatial Properties

A map projection falls into one of three categories based on the spatial properties it retains.

1. Conformal Maps
    a. These maps maintain *conformality*, which is a fancy way of saying countries are the proper shape. The proper angles of coastlines are retained, giving them their proper shape on the map. A clue to a map being conformal is that the latitude and longitude, or graticule, lines cross at 90° angles, which is how they cross in reality.
    b. Proper angles are useful for navigation. Conformal maps allow sailors to find a compass direction on the map and then point their ships in that same direction to get to their destination. Of course, without being able to find their longitude (as discussed in Lab 03) they did not know how close they actually were to arriving at their destination.
    c. A problem with conformal maps is that they maintain shape at the expense of size. The countries and continents look good, but their sizes are distorted when compared to one another.
2. Equal-Area Maps
    a. These maps maintain *equivalence*, meaning the proper sizes of landforms are kept when a map uses this projection. Figure 5.2 shows three separate projections of Peru. The shapes are all different and some look strange, but the size of the country is kept the same. This is useful if you want to measure amount of land use or see disaster effects in terms of area affected.

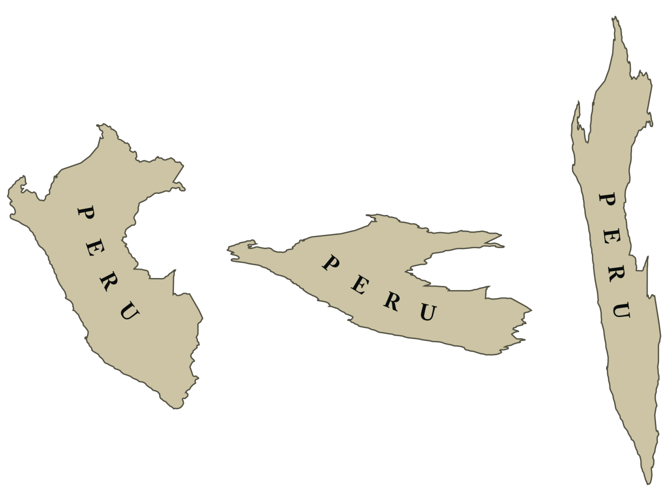


Figure 5.2. Equal-Area Peru

b. When looking at a world map, you can use the countries of Greenland and Mexico to figure out if a map retains equivalence. When looking on the globe the two countries are roughly the same size.

Figure 5.3. Greenland compared to Mexico

3. Compromise Maps
   a. A comprise map attempts to find middle ground between conformality and equivalence. Sometimes you simply need a map to show a pretty good representation of the Earth and you don't plan on using it for navigation or areal measurements.
   b. You can typically tell a map falls into the compromise category if it does not perfectly fit into the other two.

In the next section of this lab you will spend time looking at the globe and maps to see what properties they retain and determine what category they fall under.

5.3. The globe

Using a globe, answer the following questions.

1. Are the cardinal directions (i.e. N, S, E, and W) accurate everywhere on the globe? If not, where are they distorted?

2. If you are in Beirut, Lebanon, in which direction is Murmansk, Russia?

3. Are the distances everywhere on the globe equally accurate? If not, where are they distorted?

4. Are the continental shapes accurate? Where can you find any distortions?

5. Is the area covered by two square inches the same everywhere on the globe? Compare the equatorial regions to the polar regions.

6. Describe the angles at which longitude and latitude lines cross on the globe. Are these angles consistent?

7. Using the globe and a piece of string describe the shortest air route from Los Angeles, California to Moscow, Russia. Use degrees of latitude and longitude from at least five equally spaced locations on this line for the description.

8. Which of the following properties is not accurate using the projection: Direction, distance, shape, or area? Which projection class does this map belong to?

9. What types of information is the globe best used for? What are its disadvantages?

5.4. The Mercator Projection

Using the attached map, answer the following questions.

10. Are the cardinal directions (i.e. N, S, E, and W) accurate everywhere on the map? If not, where are they distorted?

11. If you are in Beirut, Lebanon, in which direction is Murmansk, Russia?

12. Are the distances everywhere on the map equally accurate? If not, where are they distorted?

13. Are the continental shapes accurate? Where can you find any distortions?

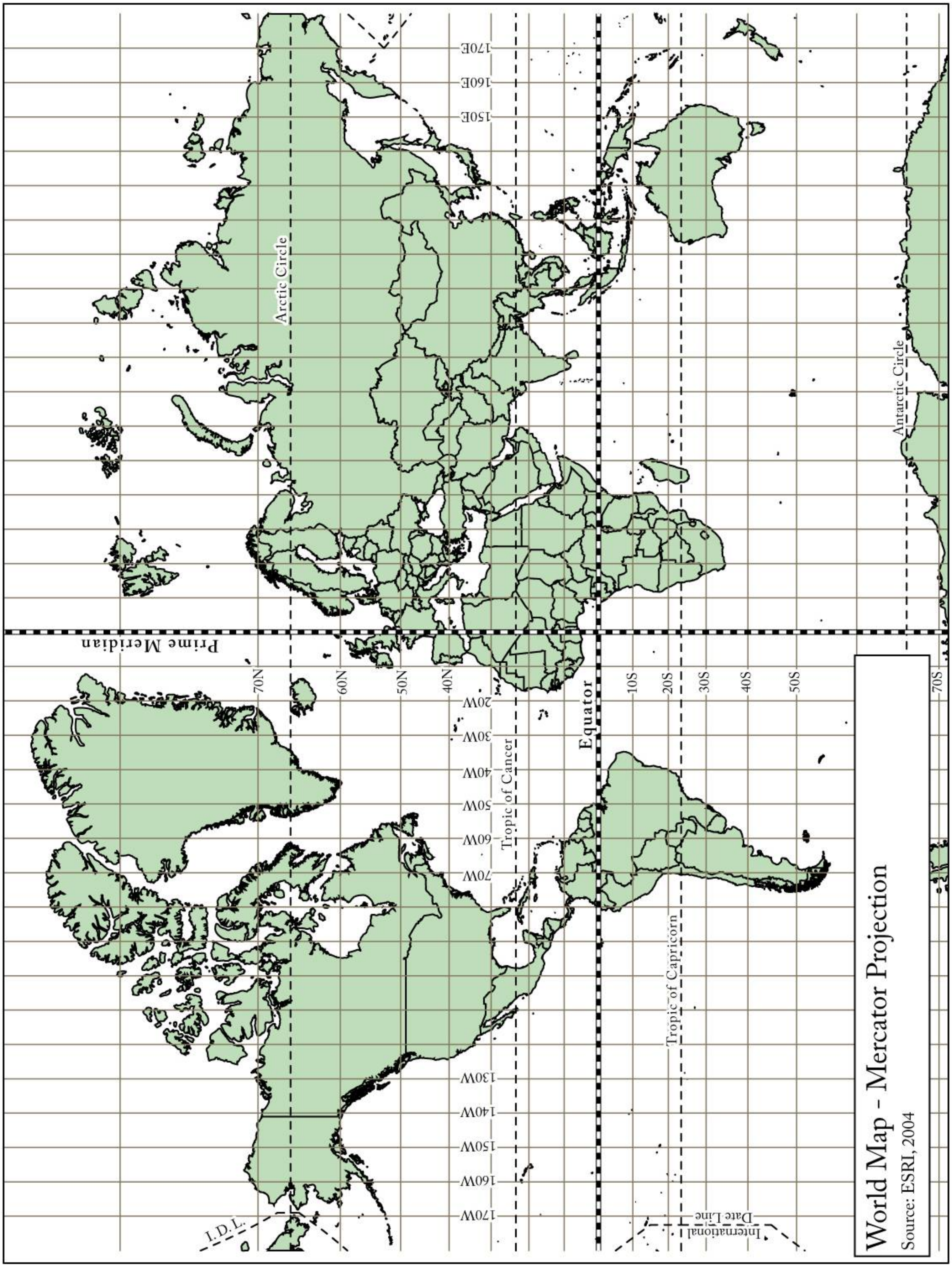
14. Is the area covered by two square inches the same everywhere on the map? Compare the equatorial regions to the polar regions.

15. Describe the angles at which longitude and latitude lines cross on the map. Are these angles consistent?

16. On the attached map, draw a straight line from Los Angeles, California to Moscow, Russia. Then plot the coordinates from question 7 on the same map. What do you notice about the two lines?

17. Which of the following properties is not accurate using the projection: Direction, distance, shape, or area? Which projection class does this map belong to?

18. What types of information is the Mercator projection best used for? What are its disadvantages?


World Map - Mercator Projection
Source: ESRI, 2004
Arctic Circle
Antarctic Circle
Prime Meridian
Equator
Tropic of Cancer
Tropic of Capricorn
I.D.L.
International Date Line
70N
60N
50N
40N
10S
20S
30S
40S
50S
70S
20W
30W
40W
50W
60W
70W
130W
140W
150W
160W
170W
150E
160E
170E

5.5. The Sinusoidal Projection

Using the attached map, answer the following questions.

19. Are the cardinal directions (i.e. N, S, E, and W) accurate everywhere on the map? If not, where are they distorted?

20. If you are in Beirut, Lebanon, in which direction is Murmansk, Russia?

21. Are the distances everywhere on the map equally accurate? If not, where are they distorted?

22. Are the continental shapes accurate? Where can you find any distortions?

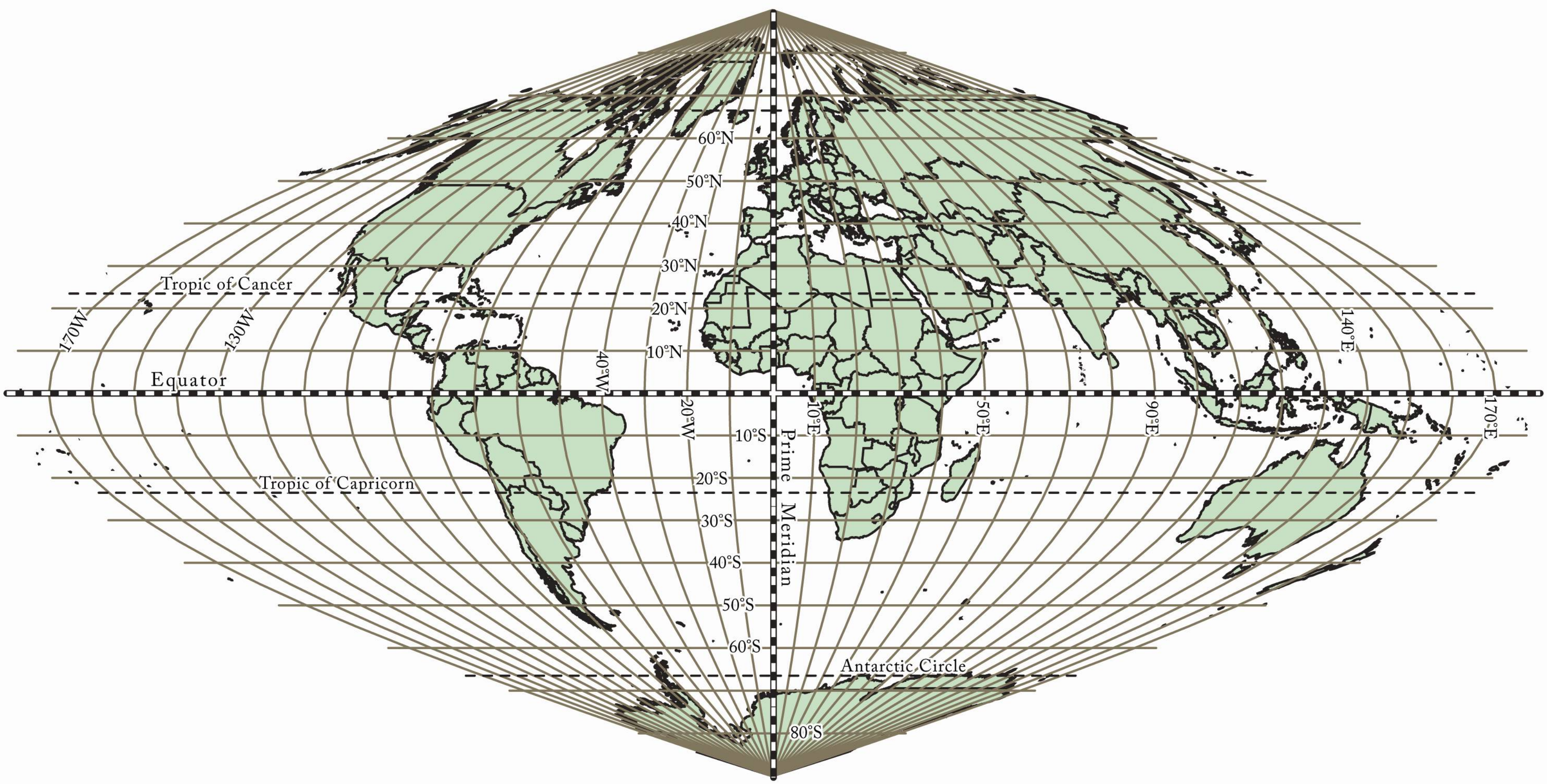
23. Is the area covered by two square inches the same everywhere on the map? Compare the equatorial regions to the polar regions.

24. Describe the angles at which longitude and latitude lines cross on the map. Are these angles consistent?

25. On the attached map, draw a straight line from Los Angeles, California to Moscow, Russia. Then plot the coordinates from question 7 on the same map. What do you notice about the two lines?

26. Which of the following properties is not accurate using the projection: Direction, distance, shape, or area? Which projection class does this map belong to?

27. What types of information is the Sinusoidal projection best used for? What are its disadvantages?



World Map - Sinusoidal Projection

Source: ESRI, 2004

5.6. The Robinson Projection

Using the attached map, answer the following questions.

28. Are the cardinal directions (i.e. N, S, E, and W) accurate everywhere on the map? If not, where are they distorted?

29. If you are in Beirut, Lebanon, in which direction is Murmansk, Russia?

30. Are the distances everywhere on the map equally accurate? If not, where are they distorted?

31. Are the continental shapes accurate? Where can you find any distortions?

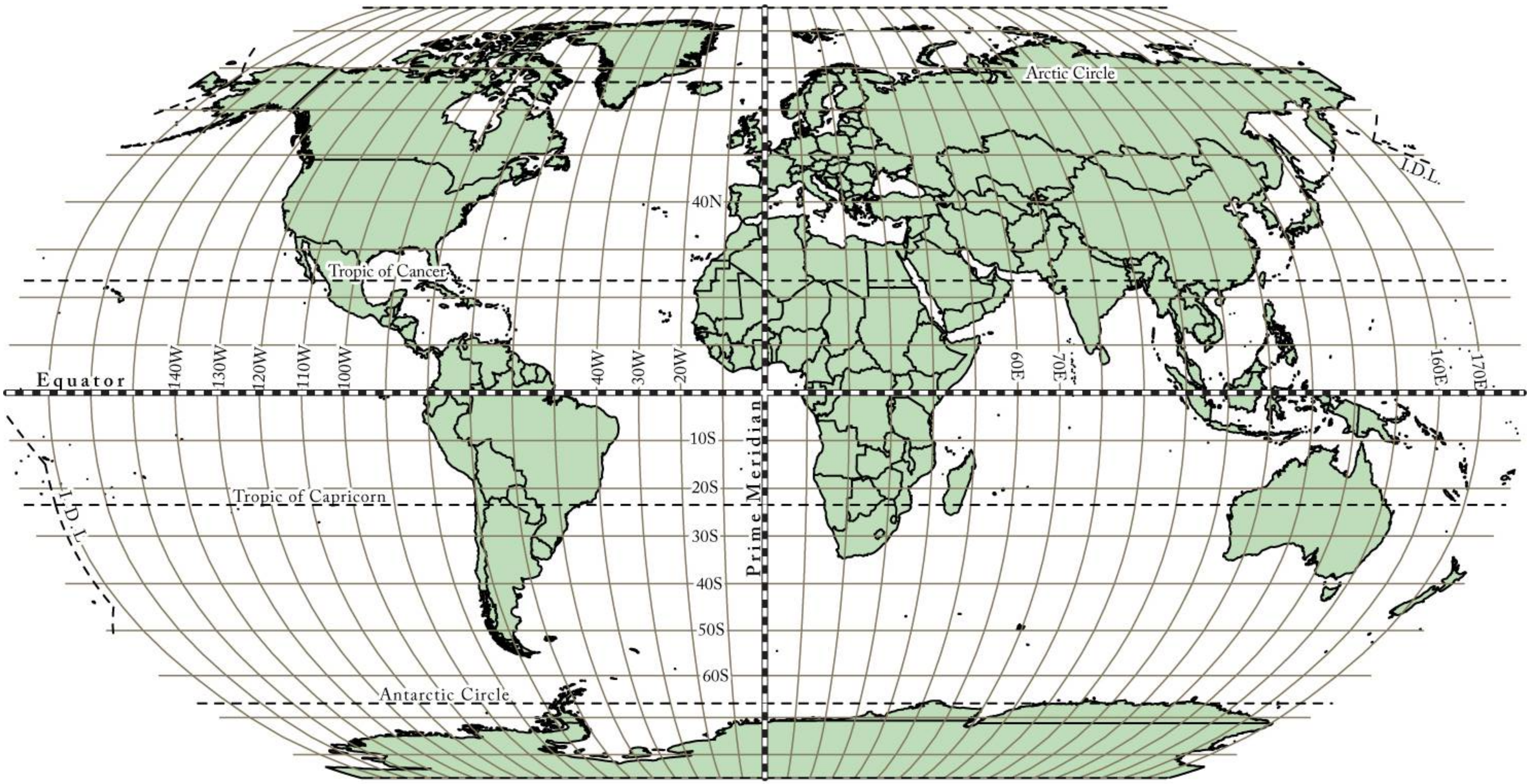
32. Is the area covered by two square inches the same everywhere on the map? Compare the equatorial regions to the polar regions.

33. Describe the angles at which longitude and latitude lines cross on the map. Are these angles consistent?

34. On the attached map, draw a straight line from Los Angeles, California to Moscow, Russia. Then plot the coordinates from question 7 on the same map. What do you notice about the two lines?

35. Which of the following properties is not accurate using the projection: Direction, distance, shape, or area? Which projection class does this map belong to?

36. What types of information is the Robinson projection best used for? What are its disadvantages?



World Map - Robinson Projection

Source: ESRI, 2004

5.7. Deciding on projections

Whether you plan on making maps for a living as a cartographer or use maps in your daily life, it is important to understand which projection is right for the job. Imagine you are a cartographer tasked with creating the below maps. Think about what each map needs to show and what it will be used for. Then, using table 5.1, determine the best possible projection to use.

37. A map comparing the agricultural areas between North America and Australia

38. A map comparing the ocean route distances of three competing cruise lines

39. A map showing hiking trails in Yosemite National Park

40. A map of the world for classroom discussions on global events

41. Navigation charts showing compass directions between Hawaii and New Zealand

42. A map of Antarctica

Projection	Surface	Properties							Suitable for mapping							General Use					
		Conformal	Equal Area	Equidistant	True direction	Perspective	Compromise	Straight rhumbs	World	Hemisphere	Continent/Ocean	Region/Sea	Medium Scale	Large Scale	Polar regions	Topographic Maps	Geological Maps	Thematic Maps	Presentations	Navigation	USGS Maps
Globe	Sphere	Y	Y	Y	Y				Y									Y	Y		
Mercator	Cylindrical	Y			P			Y	P			Y				Y	Y			Y	Y
Transverse Mercator	Cylindrical	Y									Y	Y	Y	Y		Y	Y				Y
Oblique Mercator	Cylindrical	Y									Y	Y	Y	Y		Y					Y
Space Oblique Mercator	Cylindrical	Y												Y		Y					Y
Miller Cylindrical	Cylindrical						Y		Y									Y			Y
Robinson	Pseudocylindrical						Y		Y									Y	Y		
Sinusoidal Equal Area	Pseudocylindrical		Y	P					Y		Y							Y			Y
Orthographic	Azimuthal (planar)				P	Y				P					Y						Y
Stereographic	Azimuthal (planar)	Y			P	Y				Y	Y	Y	Y	Y	Y	Y	Y			Y	Y
Gnomonic	Azimuthal (planar)				P	Y						P			Y				Y	Y	
Azimuthal Equidistant	Azimuthal (planar)			P	P				P	Y	Y	Y		P		Y					Y
Lambert Azimuthal Equal Area	Azimuthal (planar)		Y		P					Y	Y	Y						Y	Y		Y
Albers Equal Area Conic	Conic		Y								Y	Y	Y					Y	Y		Y
Lamber Conformal Conic	Conic	Y			P						Y	Y	Y	Y		Y	Y		Y	Y	Y
Euqidistant Conic	Conic			P							Y	Y									
Polyconic	Conic			P			Y						P	P		Y					Y
Bipolar Oblique Conic Conformal	Conic	Y									Y						Y				Y

Y = yes, P = partly

Adapted from USGS

End of Lab 5

Name____________________

Physical Geography
Lab Activity #06

Due date___________

Coordinate Systems & Land Division

COR Objective 1, SLO 1,3

6.1. Introduction

Latitude and longitude are great for sailing around the world, but can be difficult for using large scale maps. Fortunately for us, we have other ways of dividing up the landscape and finding location. A Cartesian coordinate system is one that is rectangular in nature and is mathematically placed upon a map. We will learn more about this below with the UTM coordinate system. The second half of the lab will focus on land division, when instead of finding a specific point on a map, we want to find a specific area, which is what the Public Land Survey System is used for.

6.2. UTM

Universal Transverse Mercator (UTM) is comprised of both a specific map projection and a type of grid coordinate system. The projection takes a cylindrical projection surface and orients it in a transverse manner, meaning the line of tangency runs north-south along the globe (Figure 6.1; also see Lab Activity #05 for more explanation).

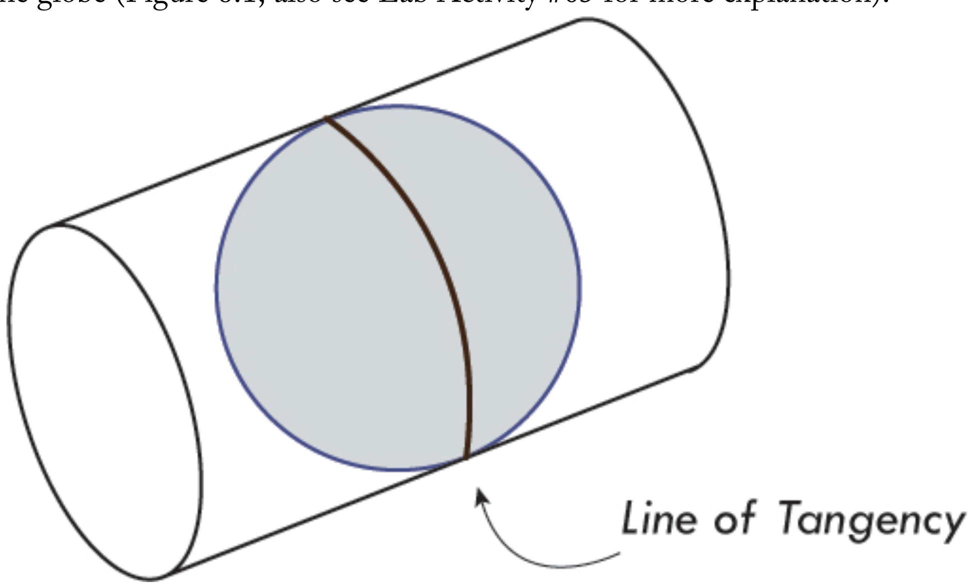


Figure 6.1. Transverse orientation of projection surface.

UTM was designed to be a global coordinate system that could be used on large scale maps. This is achieved by using 60 separate projections to create 60 separate zones that ensure better accuracy for specific parts of the globe. The line of tangency for each zone runs directly through the center of each zone, meaning that each zone maintains minimal distortion, but only within itself. Using UTM Zone 11 coordinates for a place that falls within Zone 20 would have horrible distortion, but using Zone 20 coordinates would make for an extremely accurate map. Figure 6.2 shows the UTM zones that the United States falls under.

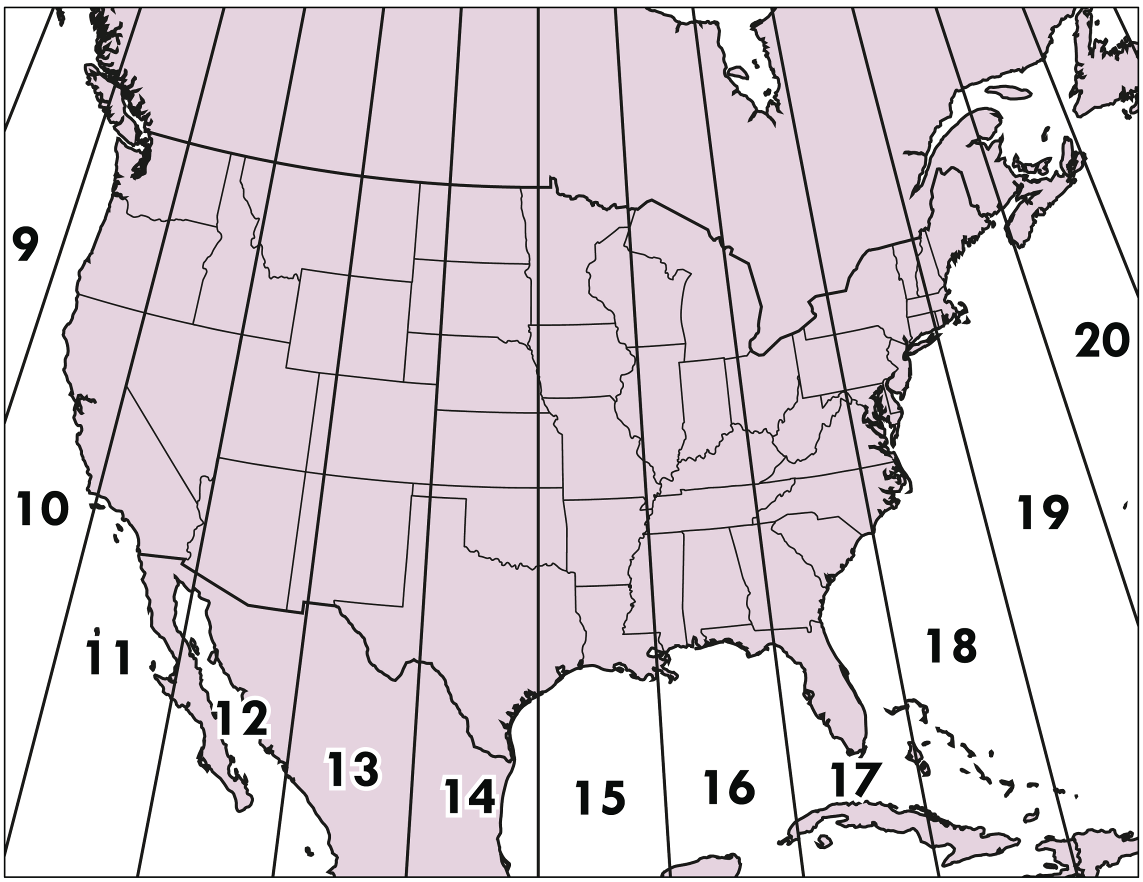


Figure 6.2. UTM zones for the United States

1. How many zones cover California and which ones are they?

2. Which zone would you use in Lancaster, California?

Just as latitude and longitude give us a precise location, UTM uses an easting value and a northing value. The easting is the x coordinate in this Cartesian grid and the northing is the y coordinate. Simply put, the easting is how many meters east of the origin point of each zone your location is, and the northing is the number of meters north. In UTM, you always write the easting value first, then the northing. A phrase used to remember this is “over, then up.”

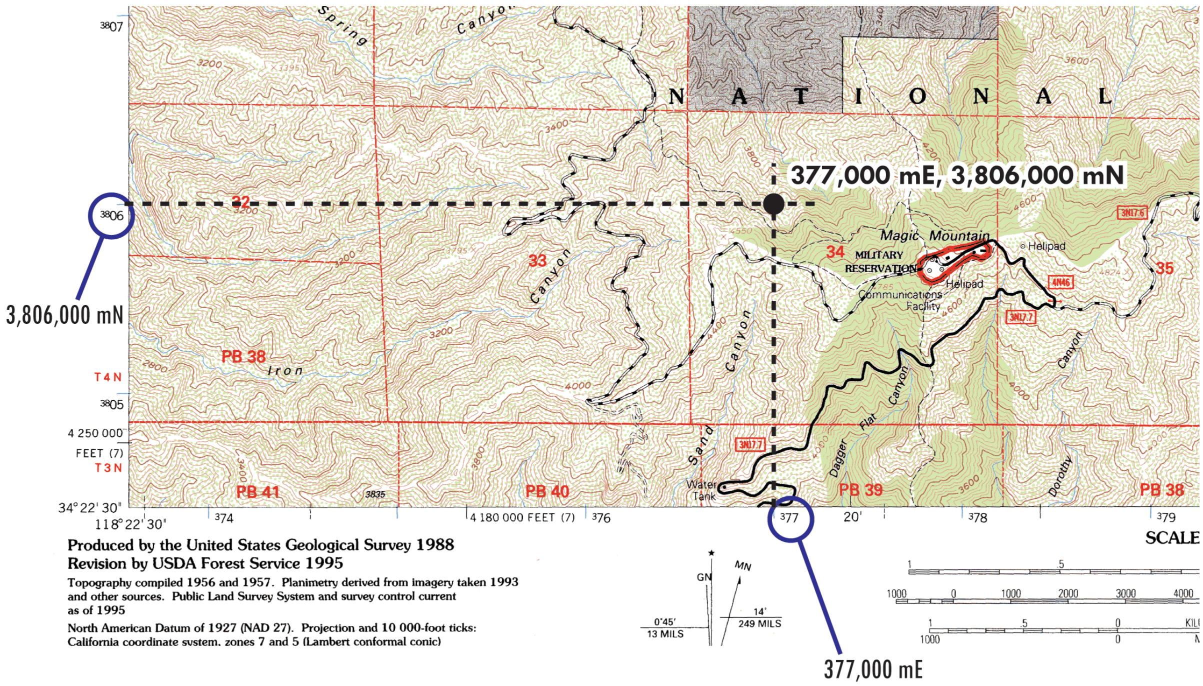


Figure 6.3. South East corner of Agua Dulce topographic map (courtesy USGS).

Figure 6.3 shows a section of the Agua Dulce topographic map. On all of the US Geological Survey (USGS) maps, UTM coordinates are noted with blue tic marks and specially formatted numbers. The easting values run along the bottom of the map and running from west to east are listed as $^{3}74$, $^{3}76$, $^{3}77$, $^{3}78$, and $^{3}79$. For each of these values, you should add three zeroes to the end. For example, $^{3}77$ actually means 377,000 meters east (or mE). On the y axis, 3806 actually means 3,806,000 meters north (or mN). Because this map is located in Los Angeles County, the coordinates are based in UTM zone 11.

The fact that UTM uses meters makes it very easy to measure on a map. With little effort you can locate accurate points using this system.

Use Figure 6.4 to answer the following questions.

3. What is located at 243,632 mE, 4,315,218mN?

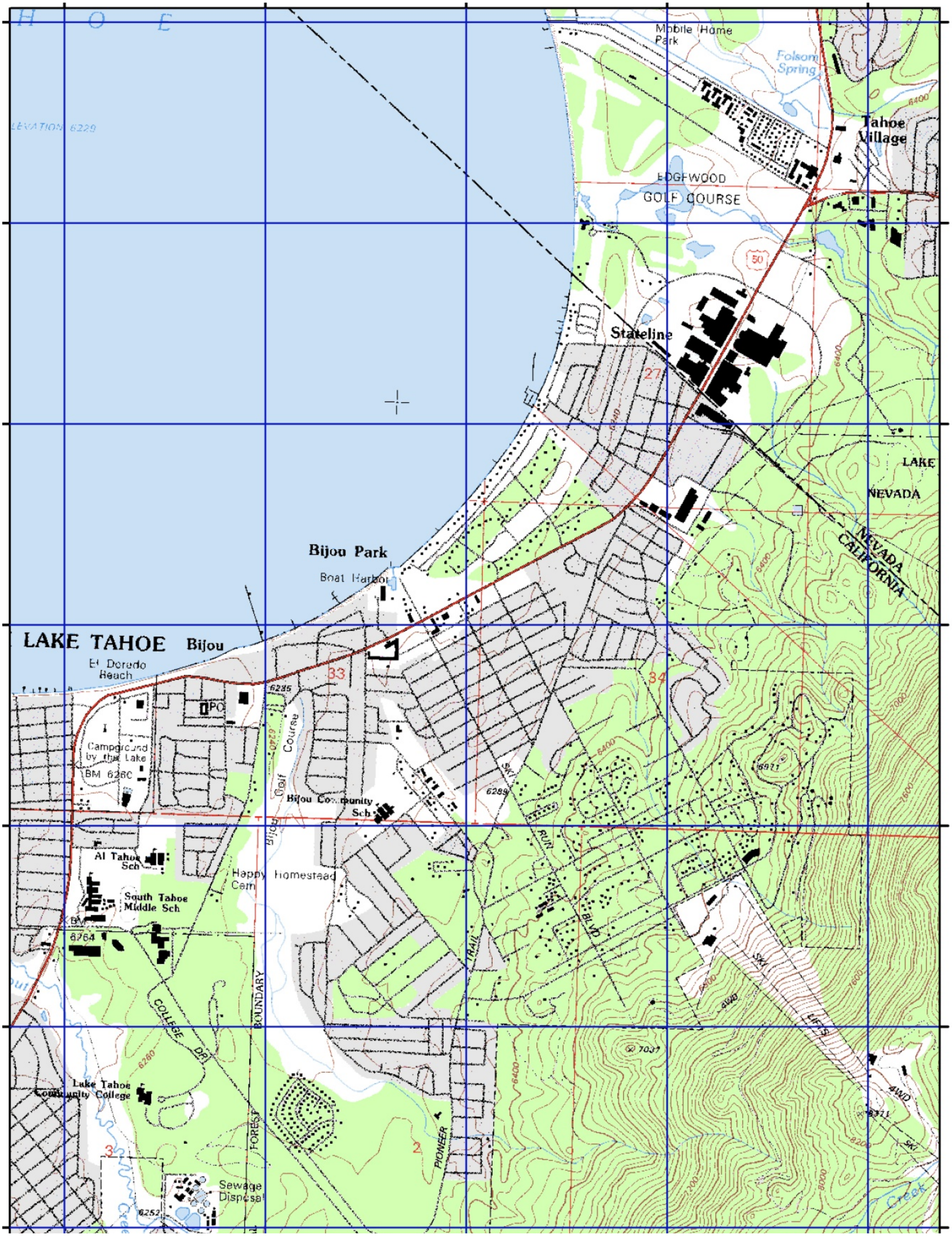
4. What is located at 243,580mE, 4,314,061mN?

5. What are the UTM coordinates (to the nearest 10 meters) for Lake Tahoe Community College? *Be sure to format properly.*

6. What are the UTM coordinates (to the nearest 10 meters) for El Dorado Beach?

7. What are the UTM coordinates (to the nearest 10 meters) for the summit of Heavenly Ski Resort (at the top of the ski lifts)?

8. What are the UTM coordinates (to the nearest 10 meters) for the California/Nevada state border at Hwy 50?



LAKE TAHOE
Bijou
El Dorado Beach
Bijou Park
Boat Harbor
Stateline
Tahoe Village
Mobile Home Park
Folsom Spring
EDGEWOOD GOLF COURSE
50
LAKE
NEVADA
NEVADA
CALIFORNIA
ELEVATION 6229
Campground by the Lake
BM 6260
PO
Golf Course
Bijou Community Sch
Al Tahoe Sch
South Tahoe Middle Sch
Happy Homestead Cem
Lake Tahoe Community College
Sewage Disposal
COLLEGE DR
BOUNDARY
FOREST
PIONEER TRAIL
SKI RUN BLVD
SKI LIFTS
4WD
27
33
34
3
2
6285
6289
6764
6252
6971
7037
6400
4318
4317
4316
4315
4314
4313

6.3. PLSS

The United States found itself with a wealth of land when it formed over 200 years ago and had to figure out a way to keep track of it. Luckily, Thomas Jefferson loved a challenge and developed a rational way to divide the landscape and create real estate for westward moving Americans. It is called the Public Land Survey System (PLSS) or sometimes Township and Range. The thing to remember with the PLSS is that it was developed to locate a specific *area* rather than a specific *point*.

6.4. Origin Points

States that use the PLSS have one or more base lines and principal meridians to start the system. The base line runs in an east-west fashion much like a line of latitude. The principal meridian runs north-south. In California we have three separate base lines and principal meridians (figure 6.5). Land in Los Angeles County is divided using the San Bernardino Base Line and Meridian.

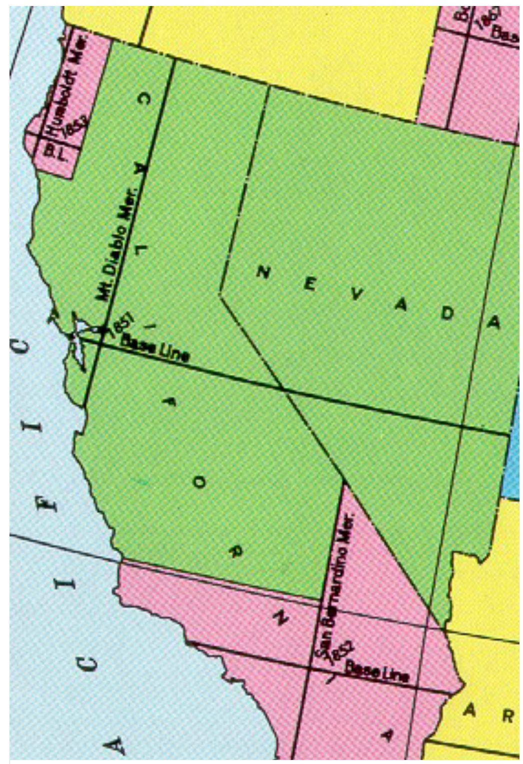


Figure 6.5. Base lines and principal meridians in California

From the intersection of a base line and principal meridian land is divided into perfect squares called *Townships*. Each township measures six miles by six miles. We identify townships by their position in the grid, giving them both a "township" coordinate and a "range" coordinate. *To find the PLSS coordinates for a township do the following:*

- Count the distance north or south from the base line. This gives you the "township" coordinate.

- Then count the distance east or west from the principal meridian. This gives you the "range" coordinate.

Figure 6.6 shows a township grid. To find the coordinates of the township marked "A" you would first count how many squares north of the base line it is (six). Then you would count how many squares east of the principal meridian it is (four). We write this as T. 6 N, R. 4 E, which means Township Six North, Range Four East. Using the proper format and order, as well as always including direction (N, S, E, W) is crucial when using PLSS.

Using Figure 6.6, find the coordinates for "B" through "E".

9. B =
10. C =
11. D =
12. E =

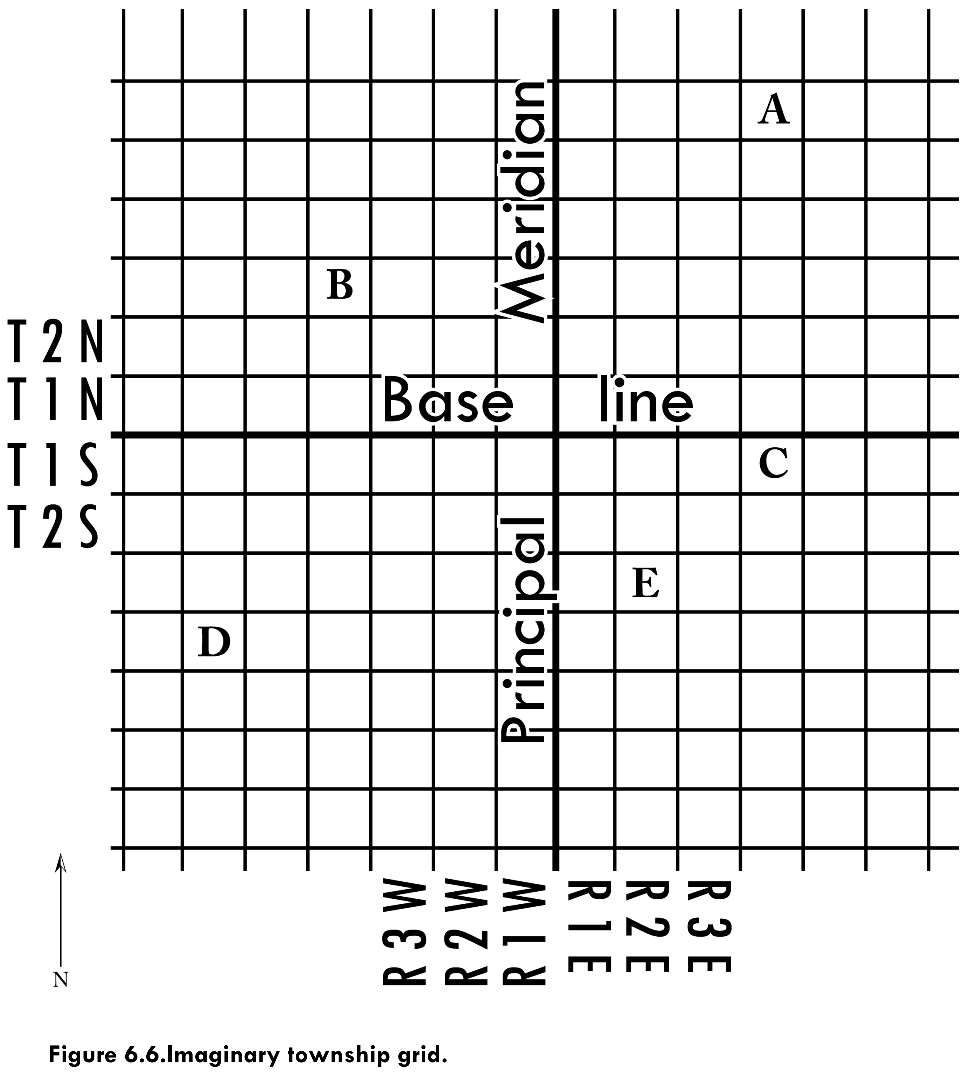


Figure 6.6.Imaginary township grid.

6.5. Dividing Townships

Since the PLSS was designed to divide the country and give farmable land to average Americans, we can't stop at just the township and range level. Thirty-six square miles is too much for anyone to successfully farm, so Jefferson further divided the landscape by using Sections. Each township is divided into thirty-six equal sections.

13. How many square miles is each section?

The numbering of sections is down in a standard (yet confusing) pattern. Section 1 is always in the northeast corner. The numbering then moves west until Section 6, then drops south one square and continues east, and so on (as shown in figure 6.7). This section number is added to the township and range coordinates to make it more exact. For example, the southeastern most square in Figure 6.7 would be Sec. 36, T. 6 N, R. 4 E, meaning Section thirty-six of township six north, range four east.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

N

T. 6 N, R 4 E.

Figure 6.7.Example of section numbering.

6.6. Aliquot subdivision

We divide the land even further, and this is where it gets fun. We can the division of sections *aliquot subdivision*, which refers to dividing the sections into equal quarters. We first subdivide a section into four equal quarters and distinguish them by their compass direction from the center of the section. For example, the quarter in figure 6.8 marked with an "A" would be the Northeast Quarter. We then add that to the beginning of our coordinates – NE ¼, Sec. 36, T. 6 N, R. 4 E. Each quarter section can then be divided up into their own quarter sections. "B" in figure 6.8 would be NE ¼, NW ¼ Sec. 36, T. 6 N, R. 4 E, meaning it is the northeast quarter of the northwest quarter of section thirty-six, township six north, range four east. "C" in figure 6.8 would be NE ¼, SW ¼, NW ¼, Sec. 36, T. 6 N, R. 4 E. As you can see our coordinates can be quite lengthy. Remember to write your coordinates in the proper order. A small mistake can place you a mile from where you should be!

"D" in figure 6.8 is a rare exception to subdividing in quarters. We can divide a quarter section into two halves, represented similarly to the quarter sections. "D" would be N ½, SE ¼, Sec. 36, T. 6 N, R. 4 E. When a natural feature such as a lake intrudes on the land, we use the term "lot" to describe the remaining land. The area around the lake in figure 6.8 would be Lot 1, SE ¼, Sec. 36, T. 6 N, R. 4 E.

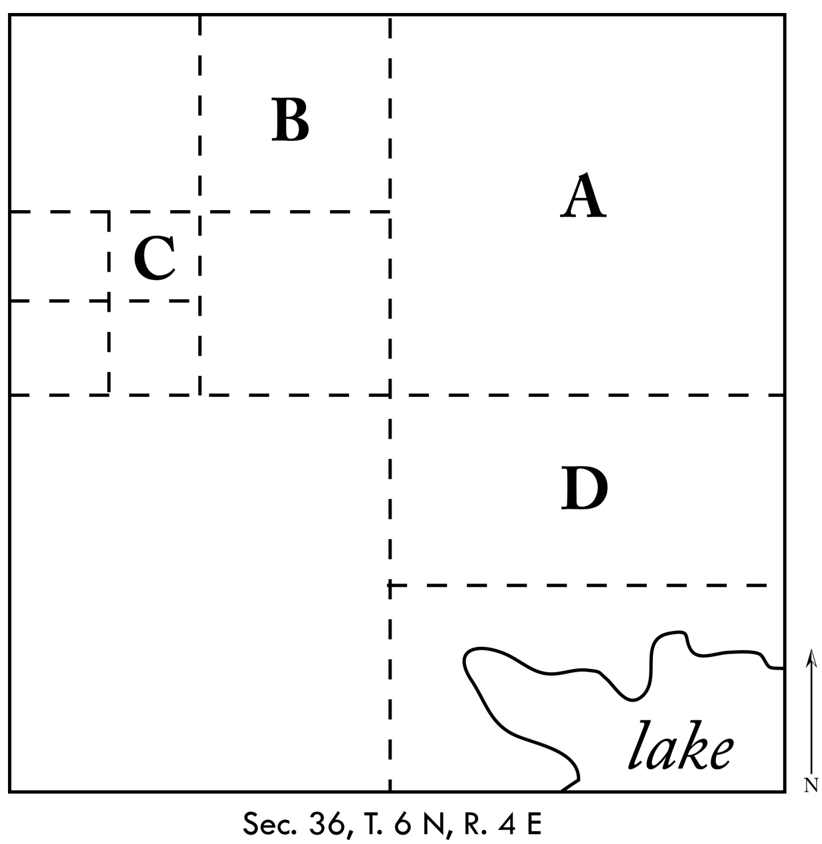
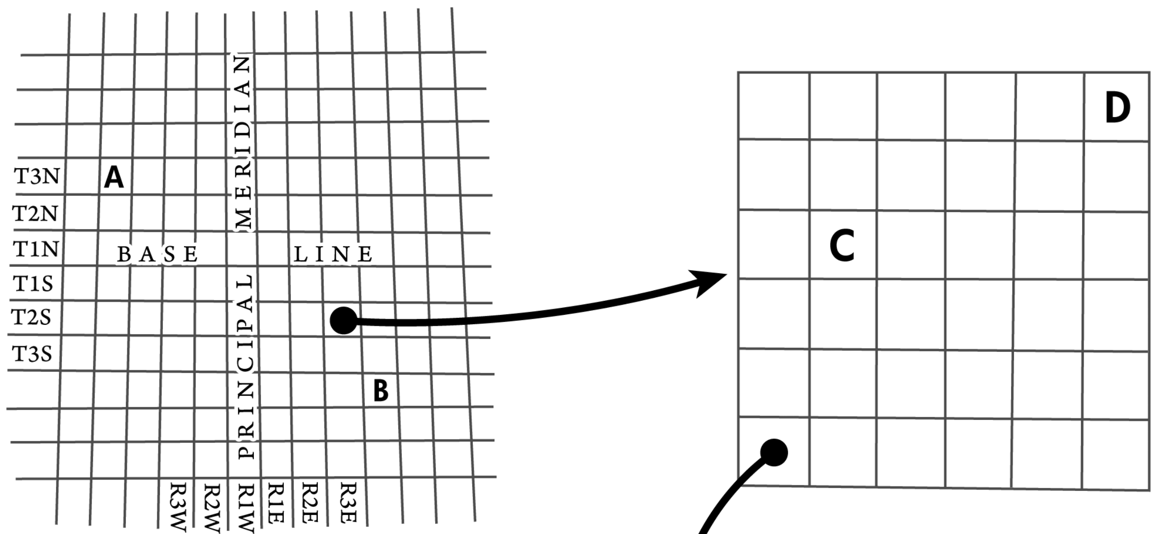
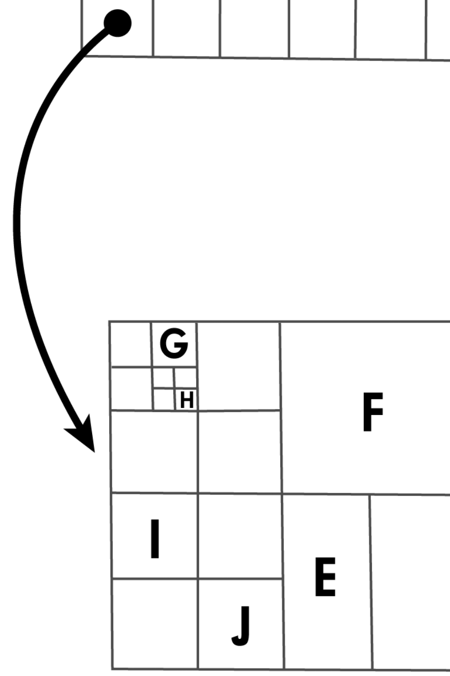


Figure 6.8.Example of aliquot subdivision.

6.7. Finding PLSS coordinates

Using the diagram below, find the coordinates for each letter. A and B will only have Township and Range descriptions, C and D will have Section, Township and Range descriptions, and E-J will have Aliquot, Section, Township and Range descriptions.





14. A =
15. B =
16. C =
17. D =
18. E =
19. F =
20. G =
21. H =
22. I =
23. J =

24. How much land (in acres) is found in each of these areas:
    - B=
    - D= 640 acres
    - E =
    - F =
    - G =

6.7. Using the PLSS

In this final part of the lab you will use two USGS topographic maps to locate PLSS coordinates. On USGS topographic maps the PLSS lines and coordinates are drawn using red ink. You may notice that the lines don't always form a perfect grid pattern.

25. What could be the causes of this?

Using one topographic map, find five prominent locations. This can include buildings, peaks, intersections of roads, etc. Describe their locations accurately to at least the ¼ section and write them below in the column labeled "PLSS coordinates" but do not write anything in the "Name or description" column. Once you have your five places located switch your lab with someone else. He or she will use the same topographic map and your PLSS coordinates to try and locate the places you selected. The student will write down the place in the "Name or description" column and then hand the lab back to you. Did he or she find the exact places, or do both of you need more practice with PLSS?

Topographic map used: *Name of person switched with:*

	PLSS coordinates	Name or description
Place 1		
Place 2		
Place 3		
Place 4		
Place 5		

End of Lab 6

Name____________________

Physical Geography
Lab Activity #07

Due date___________

Rocks & Minerals

COR Objective 8

7.1. Introduction

One part of being a physical geographer is having a basic knowledge of the rocks around us. In this lab you will get experience handling rock and mineral samples. You will look for specific characteristics in each sample and by the end of the lab you should have a good idea as to how rocks form.

7.2. Minerals

Minerals are the building blocks of the rocks and crust around us. Rocks are typically made up of multiple minerals

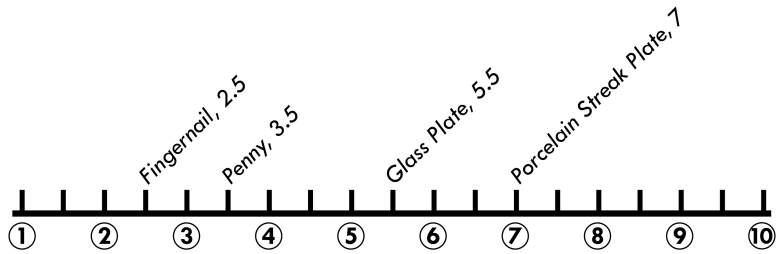
1. According to your physical geography textbook what is the definition of a mineral?

2. According to your physical geography textbook, what are the most abundant elements in the Earth's crust?

In this section of the lab, you will examine some of the mineral samples your instructor has set out. The ability to describe minerals is straightforward. You will need to identify the color, luster, crystals, and hardness of each type of mineral.

- Color is rather simple; just look at your sample and describe the color.
- Luster refers to how a mineral reflects light. Is it vitreous (glassy) or dull? Other luster types include: metallic, adamantine (brilliant like a diamond), resinous, pearly, and waxy
- Crystals are not present on every mineral sample we have in the lab, but every mineral has a specific crystalline structure. If you see a crystal on your sample describe its shape. Is it cubic, hexagonal, etc?
- To test the hardness of a mineral we use the Mohs Scale, developed by the German mineralogist Frederick Mohs. It ranges from 1-10 with 1 being the

softest mineral and 10 being the hardest. Below you will see the Mohs ranking of common objects. For example, your fingernail is a 2.5. If you can scratch a mineral with your fingernail that means the mineral is less than 2.5. If you cannot scratch it, it is greater than 2.5.



Mohs Hardness Scale

The Silicates

3. *Quartz*

   Color:
   Luster:
   Crystals:
   Hardness:

4. *Feldspar*

   Color:
   Luster:
   Crystals:
   Hardness:

The Oxides

5. *Gypsum*

   Color:
   Luster:
   Crystals:
   Hardness:

6. *Hematite*

   Color:
   Luster:
   Crystals:
   Hardness:

The Carbonates

7. *Calcite*

    Color:
    Luster:
    Crystals:
    Hardness:

7.3. Rocks

In this section you will start examining rocks, which are different from minerals.

8. According to your physical geography textbook, what is the definition of a rock?

Rocks fall into three separate classes: Igneous, Sedimentary, and Metamorphic. The classes refer to how the rock was formed.

- Igneous rocks are those formed from the cooling of molten rock. The way in which molten rock cools and the minerals inside it determine what rock will form when it solidifies.
    - Intrusive igneous rocks cool inside the Earth's crust. Because they cool under the surface they cool slowly. This slow cooling allows the molten minerals time to crystallize and gives these rocks a coarse-grained appearance. *Granite* is a good example.
    - Extrusive igneous rocks cool outside of the crust. When lava leaves a volcano it cools quickly, which causes these rocks to be fine-grained. *Basalt* is a good example. A rock like *obsidian* is an example of lava cooling so quickly that the minerals don't have time to differentiate leaving a shiny volcanic glass.

- Sedimentary rocks are those formed from little bits of other rock.
    - Clastic sedimentary rocks form from small pieces of rock being eroded, deposited, and cemented. *Sandstone* is simply grains of sand getting glued into rocks. Shale is finer grained clay cementing together. Often this can trap deceased creatures and form fossils.
    - Chemically precipitated sedimentary rocks form when the hard parts or organisms (e.g. shell) or mineral compounds that separate out of water solutions. *Limestone* is an example of this. Hydrochloric acid (HCl) can be used to test for limestone. It reacts with the cemented shell and releases carbon dioxide while also dissolving the rock. A weaker version of this acid

    is found in rainwater and slowly dissolves large amounts of limestone creating underground caverns.

- Metamorphic rocks were once igneous or sedimentary rocks that were subjected to extreme heat and/or pressure. They recrystallize and become totally different rocks. Limestone turns to marble, sandstone turns to quartzite, and granite turns to gneiss.
    - Foliation refers to when the minerals of a metamorphic rock align in a specific direction. Any color or structural pattern you see in the metamorphic rock samples in the lab can be described as foliation.

Using the rock samples provided by your instructor, study and describe two of each class of rock. Be thorough and think carefully about what you see in each sample.

Igneous Rocks

Rock Sample 1.

Color:
Luster:
Structure:
Likely Formation Process:

Rock class and subclass:
Rock name:

Rock Sample 2.

Color:
Luster:
Structure:
Likely Formation Process:

Rock class and subclass:
Rock name:

Metamorphic Rocks

Rock Sample 3.

Color:

Luster:

Structure:

Likely Formation Process:

Rock class and subclass:

Rock name:

Rock Sample 4

Color:

Luster:

Structure:

Likely Formation Process:

Rock class and subclass:

Rock name:

Sedimentary Rocks

Rock Sample 5

Color:

Luster:

Structure:

Likely Formation Process:

Rock class and subclass:

Rock name:

Rock Sample 6

Color:

Luster:

Structure:

Likely Formation Process:

Rock class and subclass:

Rock name:

7.4. Mystery Rocks

Now you will be tested to see if you have been paying attention. At the back of the lab you will find three mystery rocks. Using what you have learned in this lab, you should be able to find the clues in each rock to determine their class and name.

Rock Sample 7.

Color:
Luster:
Structure:
Likely Formation Process:

Rock class and subclass:
Rock name:

Rock Sample 8.

Color:
Luster:
Structure:
Likely Formation Process:

Rock class and subclass:
Rock name:

Rock Sample 9.

Color:
Luster:
Structure:
Likely Formation Process:

Rock class and subclass:
Rock name:

End of Lab 7

Name______________________

Physical Geography
Lab Activity #08

Due date___________

Using a compass

COR Objective 4

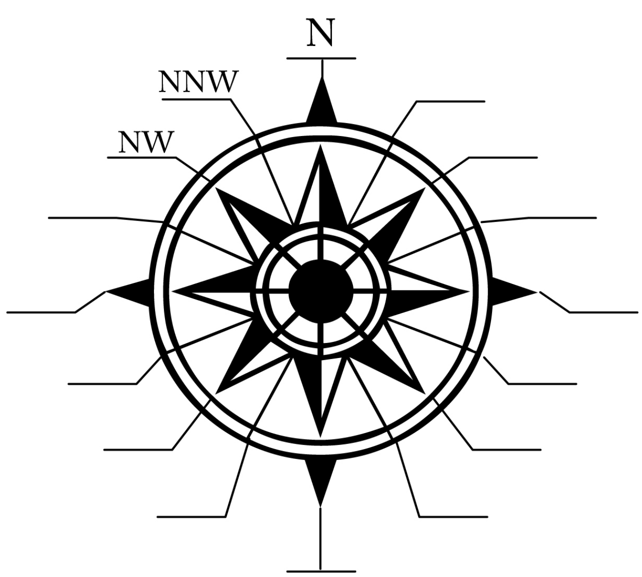
8.1. Introduction

The compass is undeniably a valuable tool in finding your way, but it is also useless if you don't know how to actually use it. A needle pointing to north is only one tool in successfully finding your way out of the wilderness. This lab will introduce you to using the compass in the real world.

8.2. Cardinal Direction and Azimuth

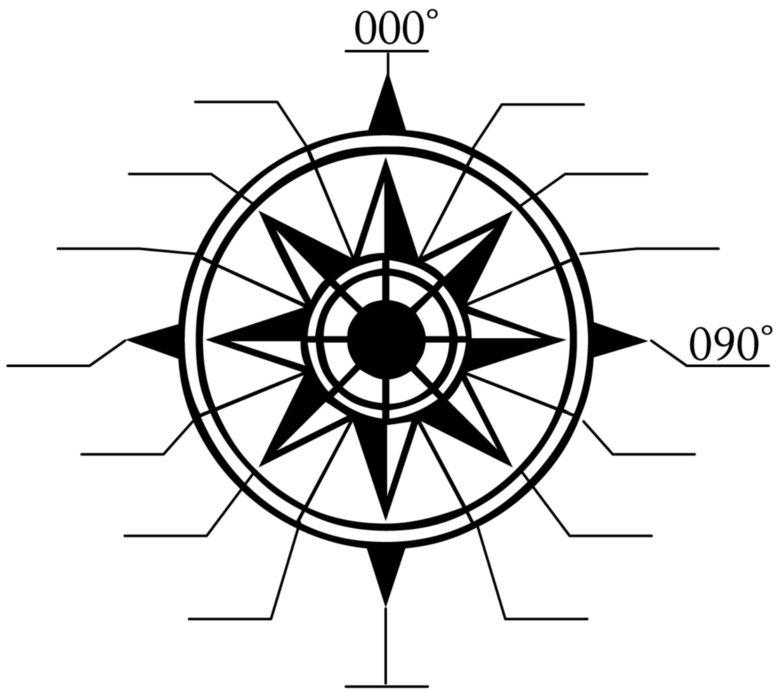
We know that the compass points north, but cardinal direction is more than the letter "N". We divide the round compass rose into sixteen different directions. North is at the top, east points to the right, south to the bottom, and west to the left. In between two main directions like north and west, we have northwest (NW). In between NW and west we have west-northwest (WNW) and in between NW and N we have north-northwest (NNW).

1. Fill in the missing directions on the compass rose below:



Azimuth is similar to cardinal direction, but way more useful in applying to navigation with a map and compass. Rather than use north, south, etc. azimuth relies on degrees. North corresponds with 0°, east is 90°, south is 180°, and so on. When reporting azimuth we always use three digits. Add two zeroes to the front if the number is below ten and one zero if it is below 100 (e.g. 15° would be 015°).

2. Fill in the missing azimuths on the compass rose below:



8.3. Pacing

You now understand direction, but the other crucial component in using a compass is distance. Measuring long distances in the field is not easy. Knowing your pacing distance will allow you to have a pretty good idea of how far you've gone without having to stretch a tape measure over rocky terrain. Pacing distance is the distance between every other step.

1. Walk at a normal pace for a distance of 100 feet. Count every other step.
2. Write down the number you counted here. _______________
3. Do it again. Write the number here. _____________
4. Do it one more time. Write the number here. ____________

5. Take the average of the three numbers from above. Your pace is _________ paces per 100ft

6. Now divide 100ft/______ paces. Your pace is _______ ft/pace. *This final number will be very important for this and other labs. Commit it to memory.*

8.4. Practicing with the compass

To use a compass to find an azimuth you simply do the following:

- Chose a specific object or landmark that is at least twenty feet away.
- Hold the compass flat in your hand. Any tilting can cause the needle to drag and give you the wrong direction. Also make sure you aren't wearing any jewelry or electronics that could cause the magnetic needle to be pulled away from north.
- Point the front of the compass at the object.
- Twist the compass housing (the part with the numbers) until the red arrow outline is directly underneath the red needle
- Read the number that is now lined up with the front of the compass. That is the azimuth of the object or landmark you are pointed towards.

It sounds easy enough, but using a compass with confidence takes practice. That is what you will do now.

7. Find an object on campus that you can shoot an azimuth for. Write it here __________

8. Now walk to the object and shoot an azimuth back to where you were first standing. Write that new azimuth here ______________.

9. Subtract the larger azimuth from the smaller _____________. *If you are using the compass properly, you should get a difference of exactly 180. Being off by a degree or two isn't a big deal, but if you are off by more than five degrees you need to try it again.*

10. Repeat this with four more objects
    a. Azimuth __________, Back azimuth _________, Difference _________
    b. Azimuth __________, Back azimuth _________, Difference _________
    c. Azimuth __________, Back azimuth _________, Difference _________
    d. Azimuth __________, Back azimuth _________, Difference _________

8.5. Declination

Declination refers to the difference between the geographic north pole, or true north, which is the one at the top of the globe, and the magnetic north pole which is where the north end of the magnetic field actually is. You need to correct for declination because the needle on your compass aligns with magnetic north and not the north arrow on your map. Not doing so can get you horribly lost when travelling over long distances.

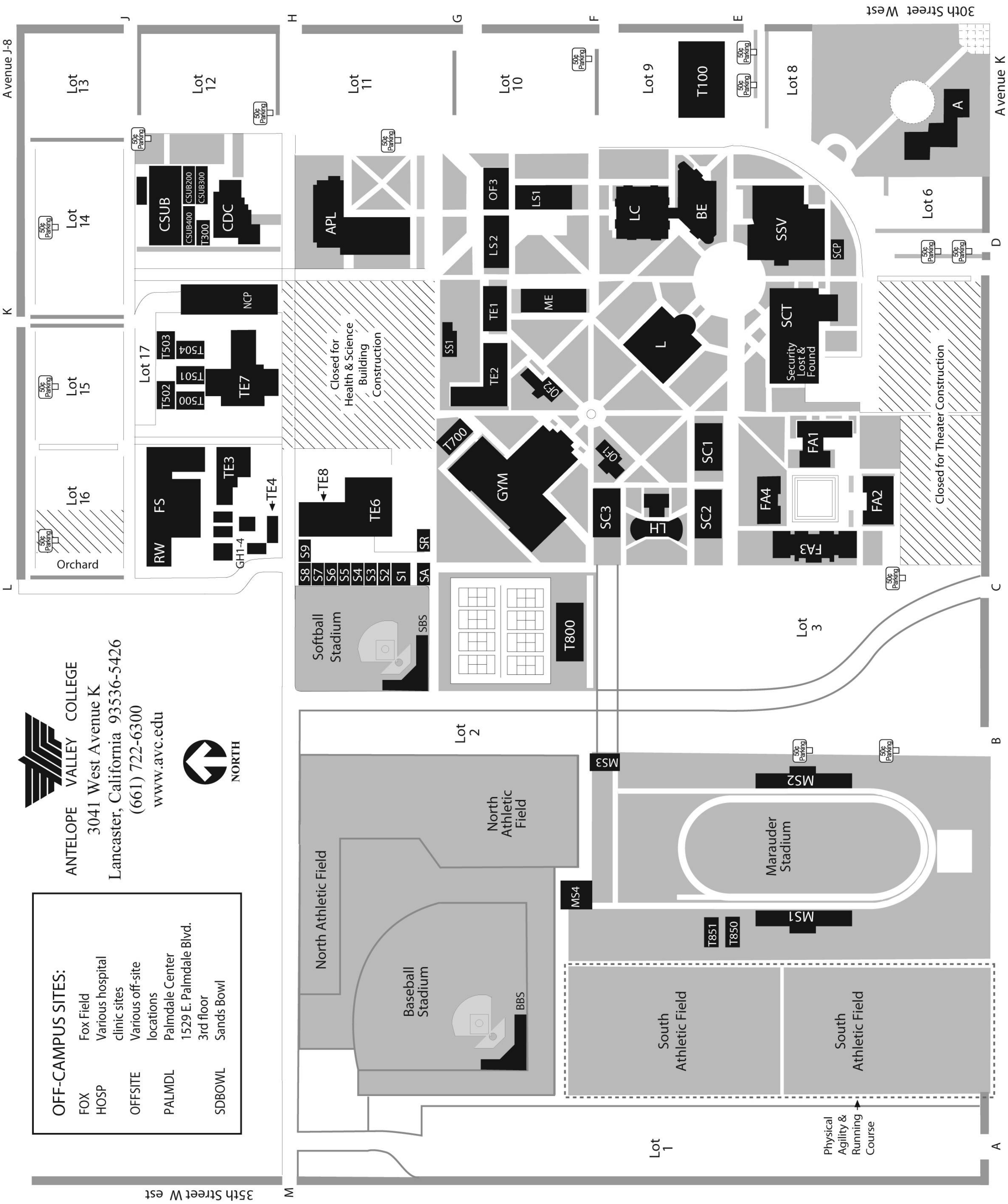
One way to check for magnetic declination is to compare a linear feature on the map with its magnetic azimuth.

11. Using your attached campus map find a nearby linear feature running north-south. A sidewalk could work just fine.

12. Find the magnetic azimuth for that same feature with your compass. If the azimuth is to the west of north subtract that number from 360. If your azimuth is to the east of north, simply write down that number. *Be sure to add the direction to your declination.*

13. **The declination on campus is _____________.**

If you are using a declinated compass you can adjust the dial to correct for the local declination. The convenience of this is that you never have to think about declination again. If you are using a simple base plate compass you will need to make mathematic corrections to every azimuth you take.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Lot 6
Lot 8
Lot 9
Lot 10
Lot 11
Lot 12
Lot 13
Lot 14
Lot 15
Lot 16
Lot 17
Orchard
50¢ Parking
CSUB
CSUB400
CSUB200
CSUB300
T300
CDC
NCP
T503
T504
T501
T502
T500
TE7
FS
RW
TE3
TE4
GH1-4
TE8
TE6
SR
S9
S8
S7
S6
S5
S4
S3
S2
S1
SA
SBS
Softball Stadium
T800
Closed for Health & Science Building Construction
APL
OF3
LS1
LS2
TE1
ME
SS1
TE2
OF2
T700
GYM
OF1
SC3
LH
SC1
SC2
LC
BE
SSV
SCP
L
SCT
Security Lost & Found
FA1
FA4
FA2
FA3
Closed for Theater Construction
T100
A
MS3
MS2
MS4
MS1
North Athletic Field
Marauder Stadium
T851
T850
Baseball Stadium
BBS
South Athletic Field
Physical Agility & Running Course

8.6. Charting a compass course

With your compass and knowledge of your pacing distance, you should be able to record a route that others can follow. Working in groups, first look at your campus map and try to visualize a twelve point course. Walk the course and record the azimuth, distance, and description of the objects you visit below.

14. Starting point: ______________________________

Azimuth	Number of Paces	Distance (ft)	Description

15. Final point: ______________________________

8.7. Following a compass course

Have one member of your group rewrite the final course below, but do not write down the descriptions or the final point. Give this sheet to another group in your class. Each group will try to follow the other's routes and make it to the final point. When you are following another group's course, make sure to write down where you think the final point is. When you finish the course give this paper back to the original group. Did you make it to the right final point? If not, what went wrong?

16. Starting point:____

Azimuth	Distance (ft)	Number of Paces

17. Final point:____

End of Lab 8

Name____________________

Physical Geography

Lab Activity #09

Due date__________

Sketch Maps, Part I

COR Objective 1, 2, 4, & 6, SLO 1, 2, & 4

9.1. Introduction

Geographers have jobs that take them outside of the office and into the field. In fact, that's why most of us become geographers. When something significant is found out in the wilderness, often we need to construct sketch maps for later analysis. The maps must be as accurate as possible, while only being created with a compass and knowledge of one's pacing distance. In this lab you will learn the basics of drawing a sketch map with the data provided below.

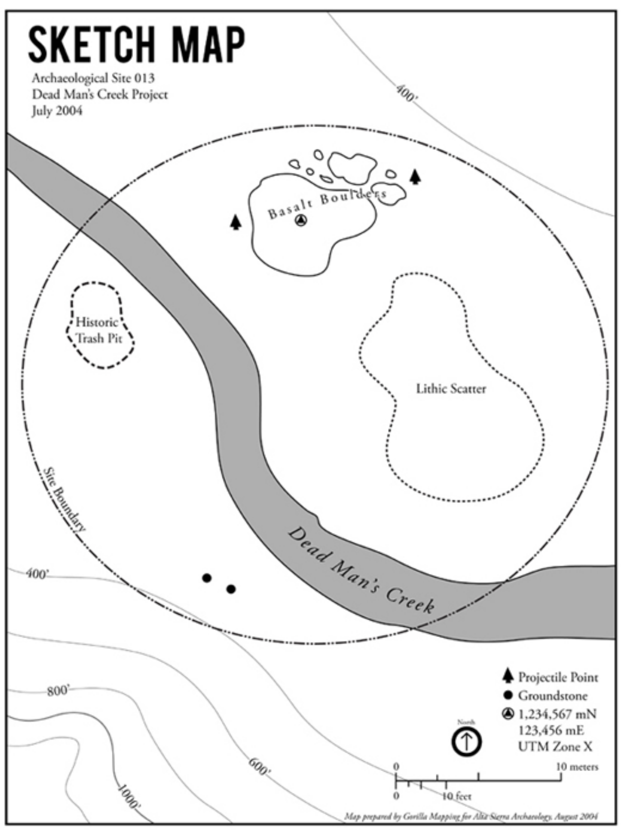

Figure 9.1.Example of an archaeological sketch map.

9.2. The concept

A sketch map is drawn from data taken from compass readings and pacing distances. If you know the direction and distance of everything as it relates to your starting point you can quickly draw a scaled map.

Your first step is to determine the orientation of your map. North is typically set at the top of your map, but should the top be one of the 8.5" sides or one of the 11" sides? This of course depends on the shape of the thing you are trying to map.

Next you will need a scale. Since your map will be on an 8.5"x11" sheet of paper, you must calculate the map's scale so it will completely fit on the paper. Assume you have 7"x10" on which to draw. That means that the longest dimension of your map must fit within 10" of space. For example, if the longest dimension is 275' in reality, 10" must equal 275'. If we simplify it (divide each side of the equation by 10) we get 1" = 27.5'. If we convert the feet to inches we get a fractional scale of 10:3,300 or simplified: 1:330.

Let's say the other dimension of your map is 175'. That means that 7" = 175'. Divide each side by 7 and you get 1" = 25' or 1:300. The scales are close, but you will need to pick one. To be safe you should always pick the smaller scale of the two, which means the larger number on the right of the colon (in this example, 330 is larger than 300 so you would use a scale of 1:330).

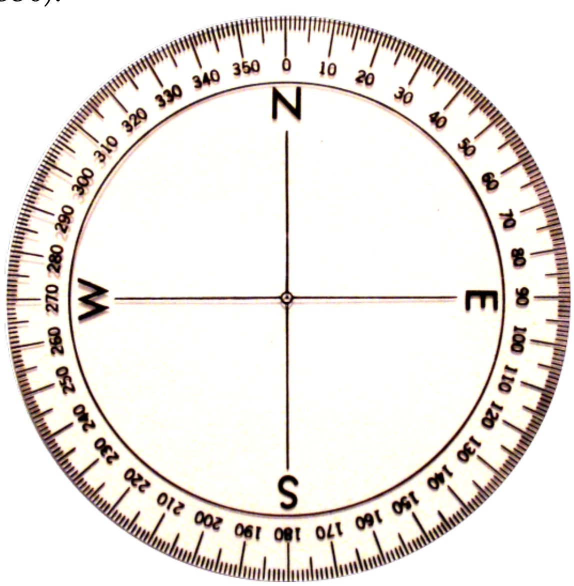

Figure 9.2.360° Protractor.

Once you have your scale, locate the first point or "datum" and begin drawing the boundary of your site. To do so you will need a 360° protractor (figure 9.2). Align 0° with North on your map and make a temporary mark in the direction of the next boundary point. Using a ruler and your map's scale draw a line in the proper direction at the exact length it should be. Continue this until you have your complete site boundary. Then using the azimuth information you will triangulate the items inside the site. You are given two azimuths for each item. When properly drawn, the two azimuths should intersect exactly where the item exists in space.

Figure 9.3 shows an example sketch map to help you format your own. Be as accurate as possible and make your map as neat and legible as you can.

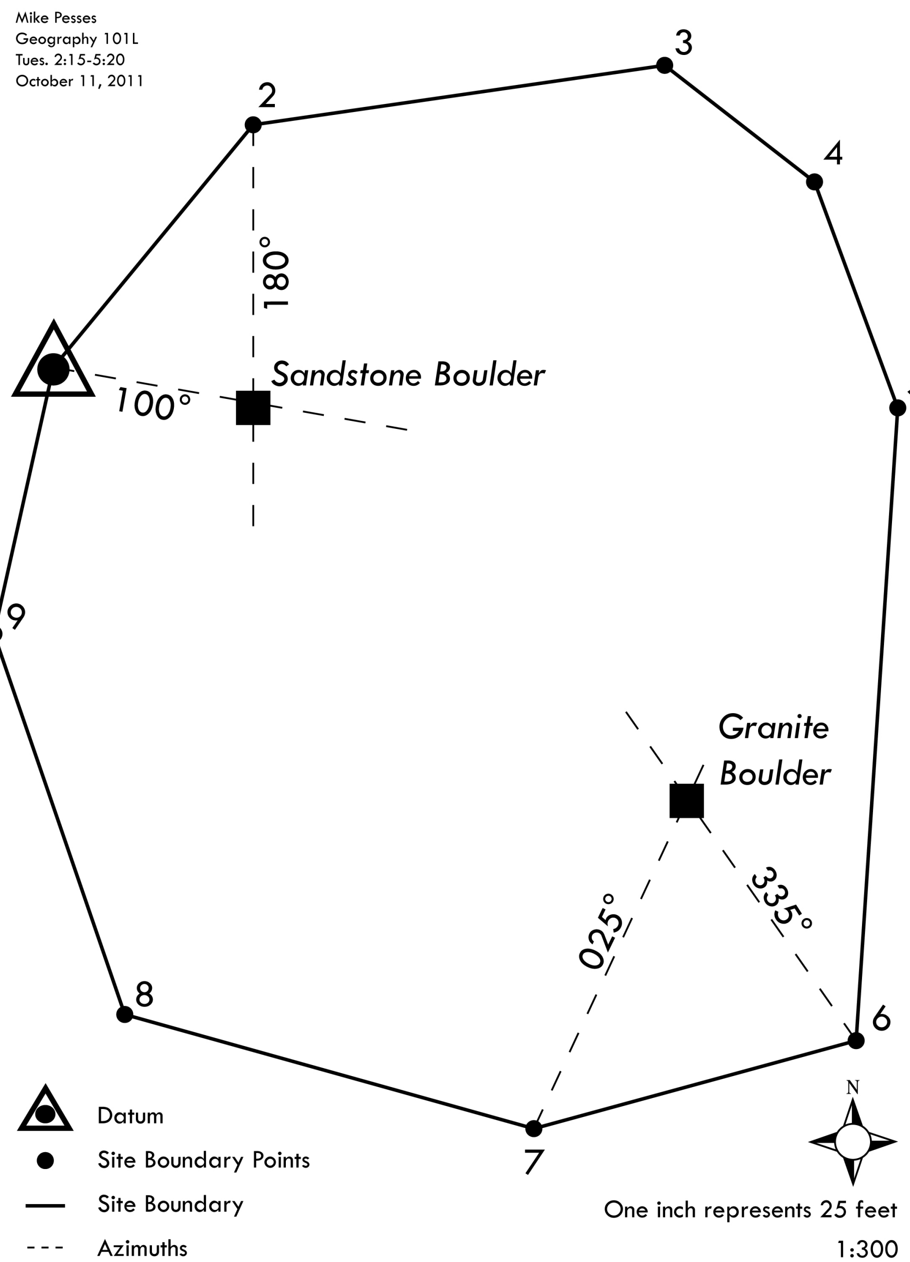

Figure 9.3. Example Sketch Map

9.3. Map 1 – Plane crash

You are part of a team responsible for locating and mapping the remains of a plane crash that took place in the Mojave Desert. While hiking transects, your team finds a portion of the wreckage in an area roughly spanning 250' from east to west by 175' from north to south. You find a tall Joshua tree near the southeast corner of the site to use as a datum, which is roughly two miles, at 065° from the intersection of County Line Road and Cypress Road. *From there you create a site boundary using the following trees in the area:*

- Joshua Tree 2 (from tallest tree): 015°, 56.25 ft
- Joshua Tree 3: 030°, 28.125 ft
- Joshua Tree 4: 355°, 50 ft
- Joshua Tree 5: 246°, 31.25 ft
- Joshua Tree 6: 281°, 75 ft
- Joshua Tree 7: 259°, 100 ft
- Joshua Tree 8: 220°, 37.5 ft
- Joshua Tree 9: 120°, 43.75 ft
- Joshua Tree 10: 200°, 75 ft
- Joshua Tree 11: 090°, 150 ft
- Back to datum: 070°, 37.5 ft

Within this site boundary you found the following pieces of wreckage:

- Metal from fuselage at 020° from J. Tree 9, 090° from J. Tree 8
- Metal from fuselage at 046° from J. Tree 10, 304° from J. Tree 11
- Engine component at 225° from J. Tree 5, 172° from J. Tree 6
- Portion of vertical stabilizer 023° from J. Tree 11, 270° from J. Tree 2
- Computer debris at 094° from J. Tree 8, 050° from J. Tree 9
- Electrical wiring at 102° from J. Tree 9, 188° from J. Tree 6

Your final map should show all of these points in their exact locations, use different symbology for the different elements, indicate the location of the nearest roads, and contain a legend, scale bar, representative fraction scale, verbal scale, north arrow, a title, and your name.

9.4. Map 2 – archaeological site

You got fired from your airplane wreckage job (for stealing compasses), but luckily found work as a field archaeologist. You are out with a team surveying a wilderness area outside of Fall River Mills in Northern California for potentially important prehistoric sites. You discover a lithic scatter with some faunal remains. The site runs approximately 100 ft from north to south by 70 ft from east to west. You select a large granite boulder as your datum, which rests in the northwest of your site. According to your topo map, the coordinates appear to be 615,050 mE, 4,558,420 mN, UTM Zone 10. *From there you map the following site boundary:*

- To Point 2 – Pine tree: 180°, 20 ft
- To Point 3 – Oak tree: 144°, 12.5 ft
- To Point 4 – Oak tree: 210°, 20 ft
- To Point 5 – Oak tree: 175°, 15 ft
- To Point 6 – Granite boulder: 168°, 27.5 ft
- To Point 7 – Basalt boulder: 103°, 21.25 ft
- To Point 8 – Pine tree: 028°, 25 ft
- To Point 9 – Pine tree: 049°, 27.5 ft
- To Point 10 – Basalt boulder: 003°, 32.5 ft
- To Point 11 – Rhyolite boulder: 331°, 20 ft
- To Point 12 – Pine tree: 279°, 25 ft
- Back to Datum – 271°, 25 ft

Within the site you find the following artifacts:

- Debitage (stone tool debris) at 209° from point 11, 269° from point 10
- Small mammal bones at 327° from point 7, 058° from point 6
- Obsidian biface (double-edged blade) at 097° from point 5, 136° from point 4
- Obsidian conical flake core (big hunk of obsidian used for tool making material) at 247° from point 10, 308° from point 9
- Three obsidian flake blanks (raw materials for bifaces) at 176° from point 12, 127° from datum
- Round cobble hammerstone (used to modify obsidian) at 045° from point 2, 156° from datum
- Elk antler tip (for pressure flaking of stone tools) at 075° from point 3, 113° from point 2
- Broken obsidian projectile point at 353° from point 8, 266° from point 9

Your final map should show all of these points in their exact locations, use different symbology for the different elements, indicate the UTM coordinates of your datum, and contain a legend, scale bar, representative fraction scale, verbal scale, north arrow, a title, and your name.

End of Lab 9

Name____________________

Physical Geography
Lab Activity #10

Due date___________

Sketch Maps, Part II

COR Objective 1, 2, 4, & 6, SLO 1, 2, & 4

10.1. Introduction

In Lab 9 you were introduced to the concept of drawing sketch maps in the field, but you worked on preexisting data. This lab will take you out of the classroom and into the field to practice drawing a sketch map from data you obtain. You will work in groups and draw a map of one of the buildings on campus.

10.2. Field work

Field work is an art. You need to be detailed while still working quickly to get back to the lab as soon as possible. When in doubt take extra notes and draw plenty of sketches or take pictures to help you remember what you saw in the field. Luckily you will be working closely to the classroom so you can always run back outside if you forgot a detail or made a mistake.

Here is what you will be doing:

- Once you have a group and know which building you will be mapping walk the length and width of the building to get a general idea of the size of the area you will be mapping. Record it on your Sketch Map Field Data Form (below).
- Next start mapping a site boundary around the building. Start at a tree, lamppost, etc. that will be your datum, or origin point, and get the azimuth and distance to the next object. Make sure to record the general location of your datum (SW corner, N of building, etc. Take careful notes on the Field Data Form and continue mapping until you reach the datum again.
- Then map the corners of the building using the concept of triangulation as explained in Lab 9. Using the roof line usually makes this easier. Remember, you don't need the distance from the site boundary points to the corner, only two azimuths from different site boundary points.

Sketch Map Field Data Form

Project: **Date:**

Crew Chief: **Team Members:**

General Site Location: **Datum Location:**

General Site Dimensions (length and width):

Azimuth to Point 2: ________ Paces to Point 2 _________ Distance to Point 2 __________
Azimuth to Point 3: ________ Paces to Point 3 _________ Distance to Point 3 __________
Azimuth to Point 4: ________ Paces to Point 4 _________ Distance to Point 4 __________
Azimuth to Point 5: ________ Paces to Point 5 _________ Distance to Point 5 __________
Azimuth to Point 6: ________ Paces to Point 6 _________ Distance to Point 6 __________
Azimuth to Point 7: ________ Paces to Point 7 _________ Distance to Point 7 __________
Azimuth to Point 8: ________ Paces to Point 8 _________ Distance to Point 8 __________
Azimuth to Point 9: ________ Paces to Point 9 _________ Distance to Point 9 __________
Azimuth to Point 10: ________ Paces to Point 10 ________ Distance to Point 10 _________
Azimuth to Point 11: ________ Paces to Point 11 ________ Distance to Point 11 _________
Azimuth to Point 12: ________ Paces to Point 12 ________ Distance to Point 12 _________

Triangulation Items:

Corner Name:
1. Azimuth:________, from Point ______
2. Azimuth:________, from Point ______

Corner Name:
1. Azimuth:________, from Point ______
2. Azimuth:________, from Point ______

Corner Name:
1. Azimuth:________, from Point ______
2. Azimuth:________, from Point ______

Corner Name:
1. Azimuth:________, from Point ______
2. Azimuth:________, from Point ______

Corner Name:
1. Azimuth:________, from Point ______
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Corner Name:
1. Azimuth:________, from Point ______
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Corner Name:
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Corner Name:
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Corner Name:
1. Azimuth:________, from Point ______
2. Azimuth:________, from Point ______

Corner Name:
1. Azimuth:________, from Point ______
2. Azimuth:________, from Point ______

10.3. Lab work

Once you have gathered this data and are sure it is as accurate as can be return to the lab to begin drawing your map. The directions to draw a sketch map detailed in Lab 9 are reprinted here for your convenience.

Your first step is to determine the orientation of your map. North is typically set at the top of your map, but should the top be one of the 8.5" sides or one of the 11" sides? This of course depends on the shape of the thing you are trying to map.

Next you will need a scale. Since your map will be on an 8.5"x11" sheet of paper, you must calculate the map's scale so it will completely fit on the paper. Assume you have 7"x10" on which to draw. That means that the longest dimension of your map must fit within 10" of space. For example, if the longest dimension is 275' in reality, 10" must equal 275'. If we simplify it (divide each side of the equation by 10) we get 1" = 27.5'. If we convert the feet to inches we get a fractional scale of 10:3,300 or simplified: 1:330.

Let's say the other dimension of your map is 175'. That means that 7" = 175'. Divide each side by 7 and you get 1" = 25' or 1:300. The scales are close, but you will need to pick one. To be safe you should always pick the smaller scale of the two, which means the larger number on the right of the colon (in this example, 330 is larger than 300 so you would use a scale of 1:330).

Once you have your scale, locate the first point or "datum" and begin drawing the boundary of your site. To do so you will need a 360° protractor (figure 10.1). Align 0° with North on your map and make a temporary mark in the direction of the next boundary point. Using a ruler and your map's scale draw a line in the proper direction at the exact length it should be. Continue this until you have your complete site boundary.

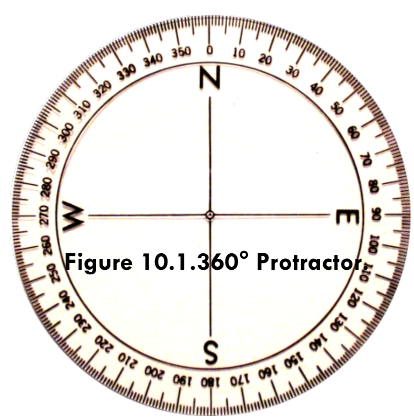


Figure 10.1. 360° Protractor

Then using the azimuth information you will triangulate the items inside the site. You are given two azimuths for each item. When properly drawn, the two azimuths should intersect exactly where the item exists in space.

Figure 10.2 shows an example sketch map to help you format your own. Be as accurate as possible and make your map as neat and legible as you can.

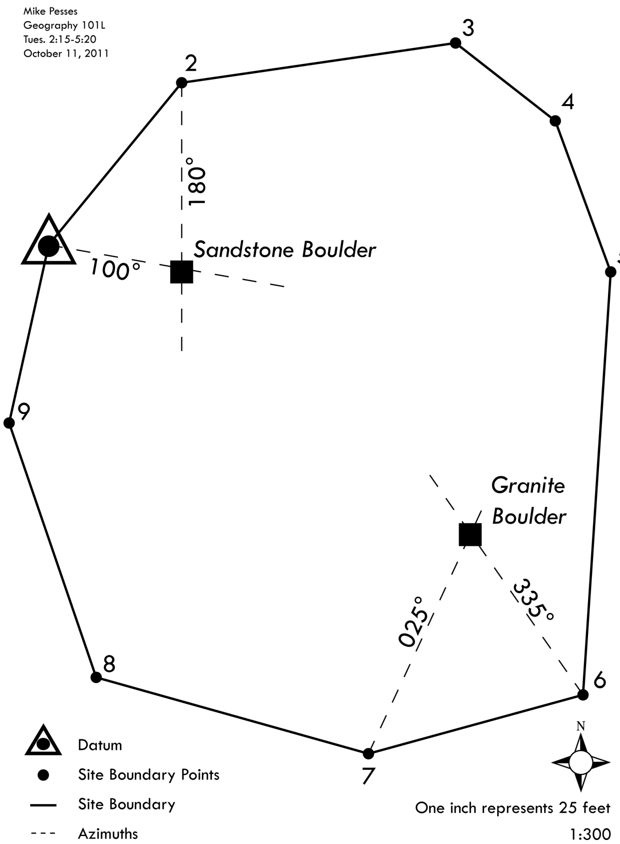


Figure 10.2. Example Sketch Map

Make sure your final sketch map is clearly drawn, has a verbal and fractional scale, a legend, a title, a north arrow, and your name.

End of Lab 10

Name______________________

Physical Geography

Lab Activity #11

Due date___________

Topographic Maps

COR Objective 3, SLO 3

11.1. Introduction

Not all maps are created equally. As we've seen with scale, having the wrong map can make your job a lot more difficult. If you need to do something in the wilderness or rural parts of the country, be it hiking, hunting, fighting wildfires, or looking for a rare animal species, a simple road map won't do you much good. You would want a topographic map.

Topographic maps are those that show elevation (relief) of the Earth's surface along with natural and cultural features. We will specifically be using maps from the United States Geological Survey (USGS). The USGS was created by an act of Congress in 1879 which made the agency responsible for "classification of the public lands, and examination of the geological structure, mineral resources, and products of the natural domain." Part of their mission involved mapping the relief features of the country and creating the predecessors of the maps we'll use today. The topographic maps have several other names: topo maps, quad maps, and quadrangles. They all refer to the same thing.

11.2. Accuracy

The maps have evolved over the years. Standards have been maintained, especially when it comes to accuracy. For the 7 ½ Minute Quadrangles:

Horizontal: No more than 10% of the well defined map points may be more than 40 feet from their true position.

Vertical: No more than 10% of the elevations derived from contour lines may be more than ½ contour interval off. That means that 90% of elevations in the mountains must be with 20 feet of their actual height, and 90% within flatter regions must be within 5 feet.

Now these standards are great for elevation, but keep in mind that cultural features on the map may be horribly inaccurate, or at least out of date. For example, the Lancaster West quadrangle that we will use quite a bit was last updated in 1974. Topography hasn't changed much over the last few decades, but the housing developments, roads, and buildings certainly have.

11.3. Symbology

All modern USGS topographic maps are drawn using a standardized symbology, i.e. the same pictures and colors mean the same things on every topographic map. Roads, buildings, rivers, etc. are always drawn the same way.

Look at one or more of the quadrangles in the lab to answer the following questions. You can also visit http://pubs.usgs.gov/gip/TopographicMapSymbols/topomapsymbols.pdf for more help.

1. What is shown in black ink?

2. What is shown in blue ink?

3. What is shown in brown ink?

4. What is shown in green ink?

5. What is shown in red/pink ink?

6. What is shown in purple ink?

11.4. The Map Collar

Some of the most important information on a topographic map isn't on the map itself, but on the Map Collar the area between the neatline and edge of the paper. Select a topographic map to answer the following questions.

7. The map title is located in the upper right of the map. USGS maps are typically named for the largest town or city shown on the map itself. What is the title of the map you are using?

8. The minute series refers to how much longitude and latitude is covered on the map.
    a. What is the latitude (to the minute and second) at the bottom of the map?
    b. What is the latitude at the top of the map?
    c. What is the difference between the two?
9. Now do the same with the longitude
    a. What is the longitude on the west side of the map?
    b. What is the longitude on the east side of the map?
    c. What is the difference between the two?
10. The map you are using covers _______ minutes of latitude and longitude.
    a. This would make it a ________ minute series map.
11. The topographic maps we are using are either 7.5 minute or 15 minute series. How many 7.5 minutes does it take to cover the area shown on a 15 minute series map? *And no, it's not two…*

The bottom left corner of the map collar has specific details about how the map was made and the information was collected. This information is crucial if you are using multiple maps from different sources. You'll learn more about this data when you sign up for Geography 205 (you know you want to).

12. Who published this map?
13. Who provided the controls?
14. What projection was used to make this map?
15. What datum was used to make this map?
16. What years were the aerial photos taken?
17. Was data field checked? If so, when?

Another useful piece of information in the map collar is the north arrow, which displays three separate north values. The line with the star represents geographic, or true, north. GN stands for grid north which follows the UTM coordinate system, and MN stands for magnetic north which points toward the north pole of Earth's magnetic field. The magnetic declination for the area depicted in the map is labeled in degrees. The "mils" number refers to a military system of navigation.

18. What is the declination of the map you are currently using? Be sure to include direction (east or west of true north).

19. Should you trust this declination? Why or why not?

11.5. Contour Lines

The USGS uses contour lines to depict a 3D landscape on a 2D map. A contour line is drawn on the map to connect places with the *same* elevation. So wherever a contour line labeled "2000 feet" touches is at 2,000 feet above sea level. They are also drawn with specific conventions to depict slopes and valleys (more on that to come).

Every topographic map has a unique contour interval so it is important to find in the map collar before using your map. By contour interval we mean that there is a specific distance between each contour line. This means that when contour lines are spread out they represent a flat area and when they are close together they represent steep terrain.

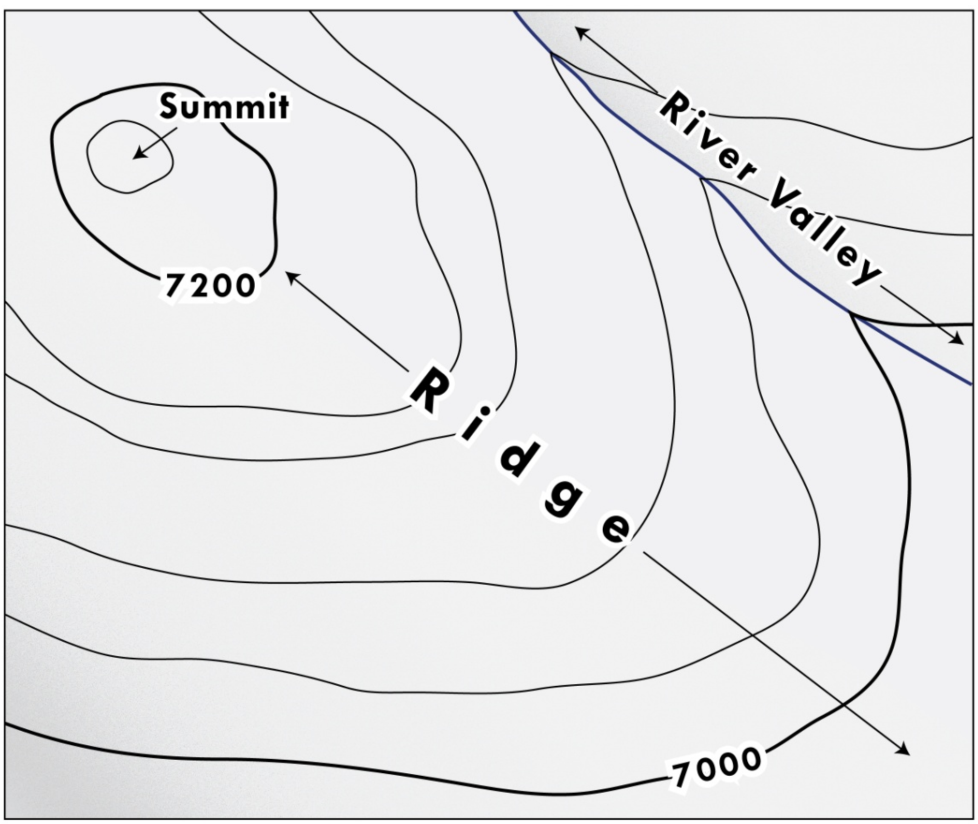


Figure 11.2. Sample contour lines for summit, ridge, and valley (40 foot contour interval).

Figure 11.2 illustrates how contour lines are used to represent three topographic features: a summit (the peak, or highest point, of a hill or mountain), a ridge, and a river valley.*Summits* are drawn using closed, irregular circles. They also typically have a brown "X" indicating the exact highest point. *Ridges* are drawn with contour lines in "U" shaped patterns with the base of the "U" pointed downhill. *River valleys and drainages* (i.e. channels carved by water repeatedly flowing through them) are drawn with "V" shaped contour lines. The points of the "V" point uphill.

20. **Draw in three dimensions the terrain represented in figure 11.2 here:**

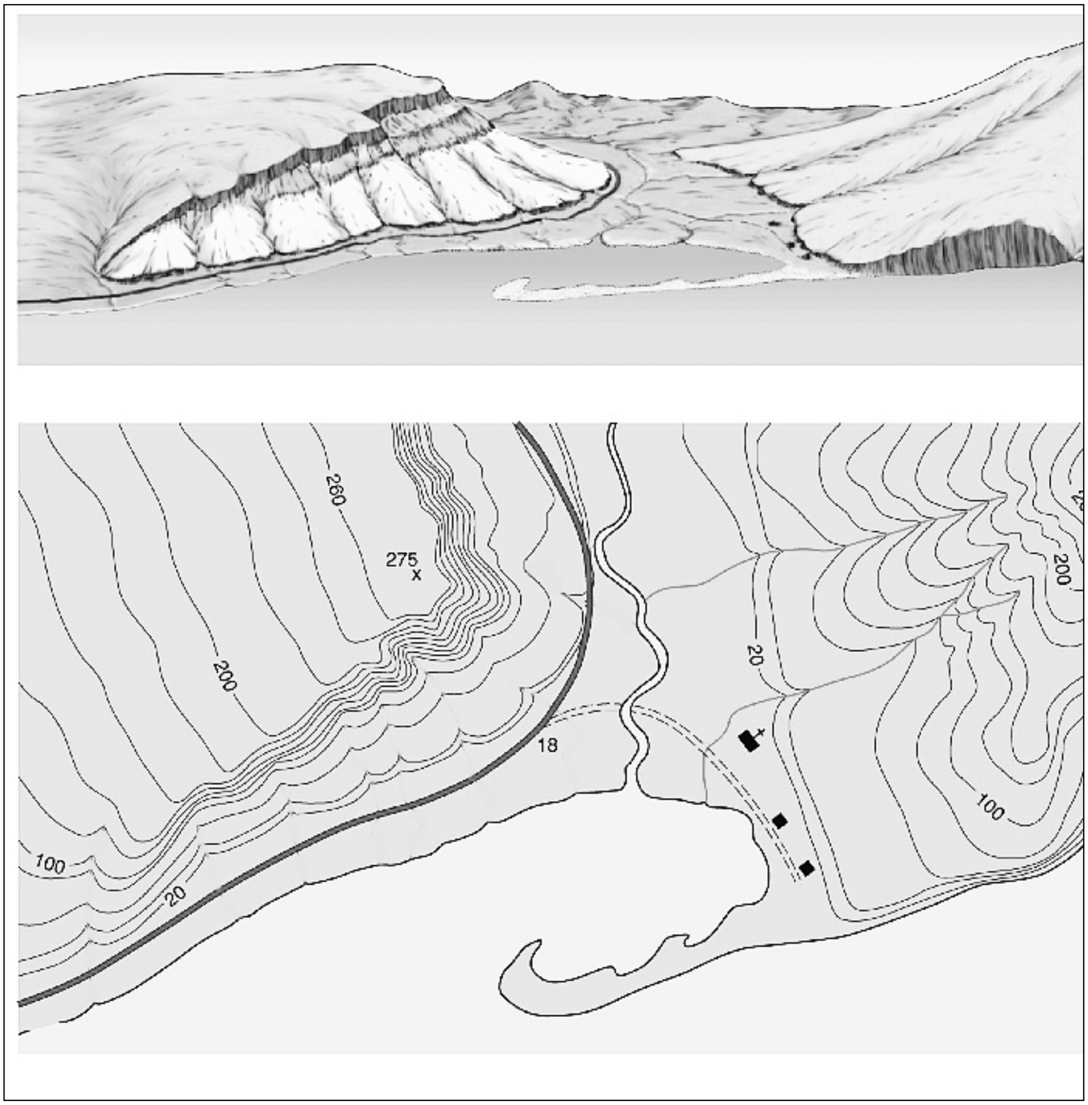
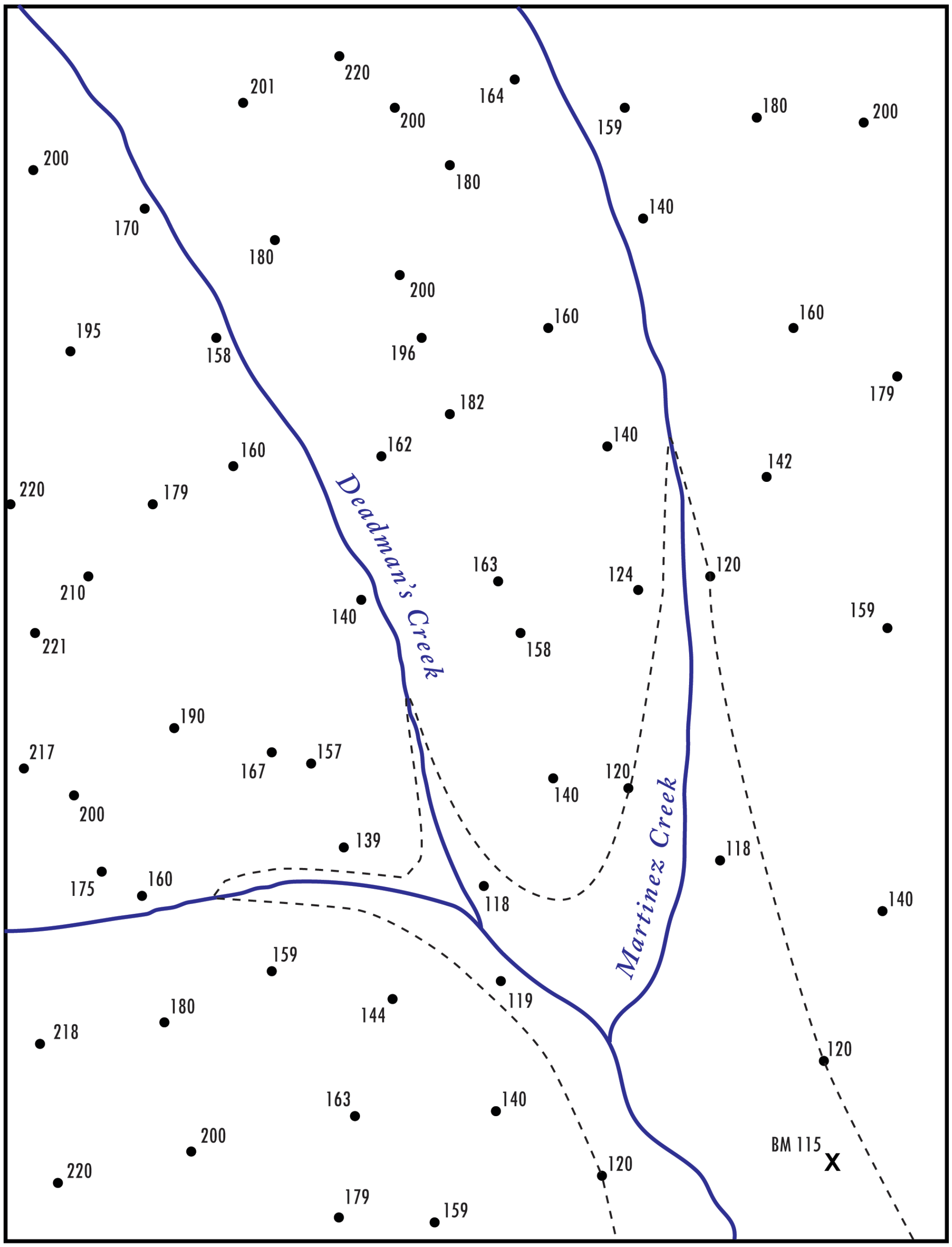


Figure 11.3. Terrain and contour representation

Figure 11.3 shows both the terrain of a seaside place and a topographic map of the same location.

21. Draw a circle around the church on both pictures
22. Draw an arrow on the topographic map pointing to the ocean-side cliff.
23. Circle the stream running into the main river.
24. With its contour lines the topographic map reveals multiple drainages. Draw them in to the map above (*hint: there are nine total*)
25. Assume you are in charge of planning a hike for people with really bad knees from the church up to the spot elevation of 275'. Draw the best route for such a hike.

26. Using the information given in figure 11.4 below, sketch in the missing contour lines using 20 foot intervals. *Remember that contour lines never cross, and you need to use the conventions for representing ridges and river valleys. Use pencil and do your best to make an attractive and smooth topographic map.*



Contour Interval 20 Feet

End of Lab 11

Name______________________

Physical Geography

Lab Activity #12

Due date___________

Geomorphology from above

COR Objective 6,7, SLO 3

12.1. Introduction

In this lab you will practice picking out geomorphological features from aerial photos and topographic maps using stereographic glasses (figure 12.1). If you overlap two copies of the same aerial photo, stereographic glasses create a 3D representation of a singular image. It takes a little practice, but in adding a third dimension the landforms come to life.

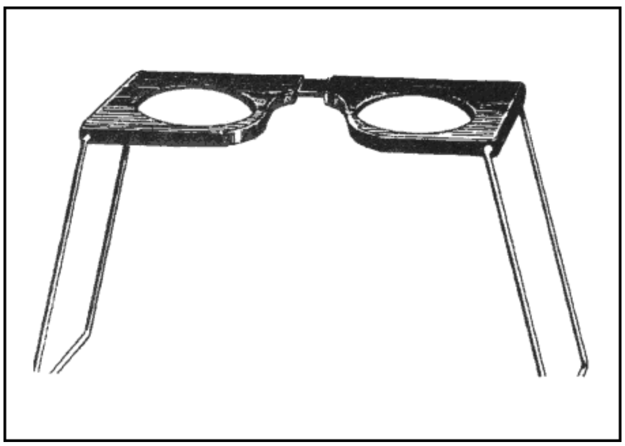


Figure 12.1.Stereographic glasses.

You will need to use a copy of Wanless' *Aerial Stereo Photographs*, De Blij et al's *Physical Geography*, and your lecture notes to answer the following.

12.2. Weathering & Mass wasting

1. Describe what you see in Wanless, on pg. 4:

2. What is the term we use for landscapes of this weathered rock? What weathering process led to its creation?

3. Describe what you see in Wanless, pg. 8:

4. How does something like this occur?

12.3. Fluvial processes

5. Wanless, pg. 34, describe the process that led to the formation of Horseshoe Lake

6. Wanless, pg. 44, what do we call a stream that has been elevated like the one shown here?

12.4. Aeolian processes/arid lanscapes

7. Wanless, pg. 25, Describe what you see

8. How were the features at the mouth of the canyons formed?

9. Wanless, pg. 26, Describe what you see

10. What other desert region does the scene on page 26 remind you of?

12.5. Glacial processes

11. Wanless, pg. 10, Describe what you see

12. The above glacier will carve out what?

13. Wanless, pg. 15, Describe what you see

14. What famous granite valley in California was sculpted this way?

15. Wanless, pg. 16, Describe what you see

16. What is the weathering process that gave the mountain at C.0-2.0 its general round shape? How does it work?

17. Wanless, pg. 17, Describe what you see

18. How are the features on Wanless, pg. 20 formed? Do they come from alpine or continental glaciers?

12.6. Coastal Processes

19. Are the majority of the coastal landforms on Wanless, page 28 the result of erosional or depositional processes? How can you tell?

20. Explain what the continued warping or refraction of waves will do to the headlands and what the coastline will ultimately look like.

End of Lab 12

Name______________________

Physical Geography
Lab Activity #13

Due date___________

Slopes and Profiles

COR Objective 7, SLO 3

Slope refers to a change in elevation from one point to another. The steepness of a slope can be a big deal. Forest fires burn quicker up a steep slope. The angle of repose refers to the maximum angle a slope can be before it is no longer stable; a useful concept when building homes in mountainous regions.

13.1. Calculating Slope

Slope means rise over run, i.e. how much vertical distance you climb for every unit of horizontal distance you travel (Figure 13.1). Slope can be expressed multiple ways, which you will practice calculating in this lab.

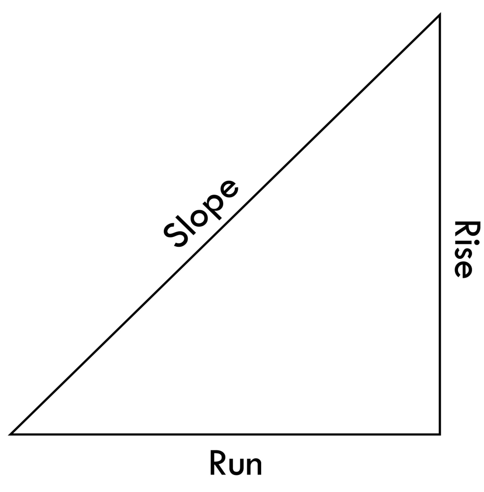


Figure 13.1. Conceptualizing slope

In order to calculate slope from a map we need to find two variables: the vertical distance traveled (v) and the horizontal distance traveled (h). Look at the map in figure 13.2.

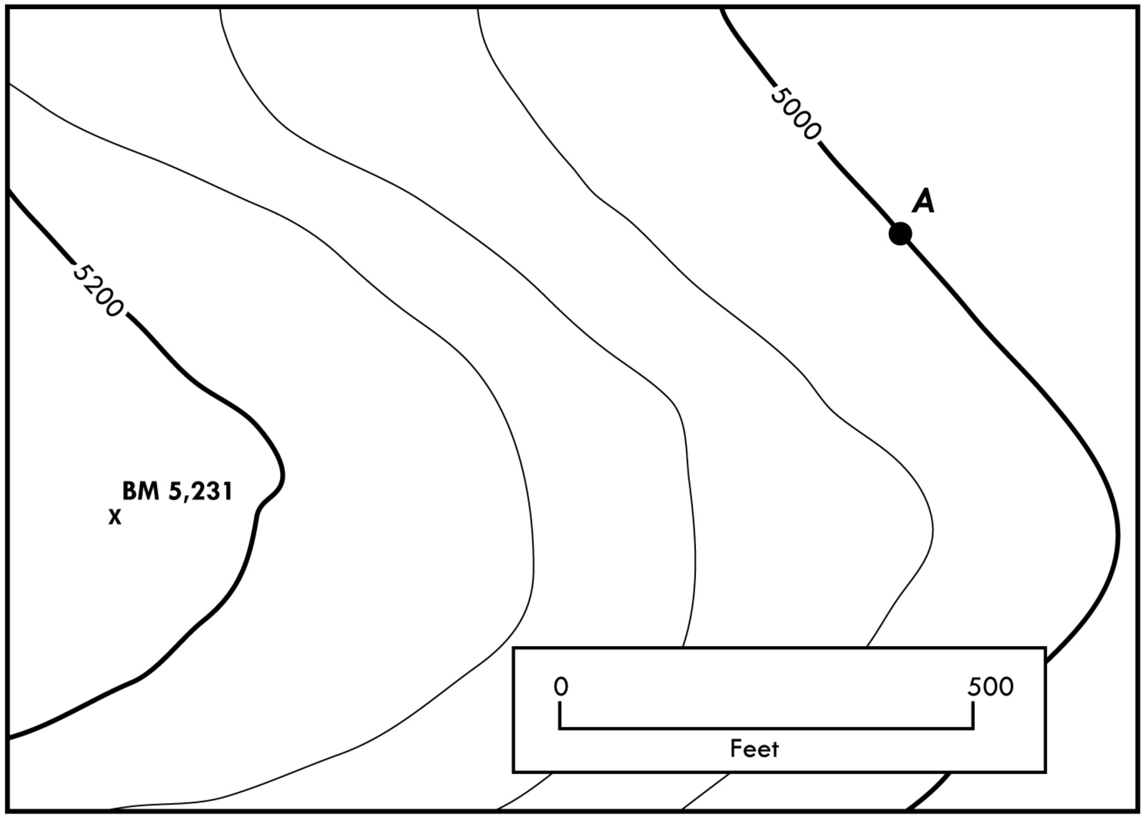


Figure 13.2.Topographic map example.

Let's imagine we want to know the slope from Point A to Benchmark (BM) 5,231. The number following "BM" is the specific elevation in feet above sea level at the X. We can find the elevation of Point A by using the contour line it intersects. Our variable *v* can be found by subtracting the smaller elevation from the larger one. We can then find *h* by using the graphic scale to measure the distance between our two points.

1. What is *v* for figure 13.2.?

2. What is *h* for figure 13.2.?

Now that we know *v* and *h* we can find the ratio, percent, and degree of our slope. We'll look at ratio first, which tells us how long it takes us to go up or down one foot. We calculate the ratio slope by using the formula

Ratio = *h*/v : 1

For example, if h = 10,000 feet and v = 600 feet, our ratio scale would be 17:1, meaning for every 17 feet you travel horizontally you climb one foot in elevation.

3. Using our values from questions 1 and 2, what is the ratio slope for figure 13.2.?

The next way to express a slope is as a percent. A percent slope or "grade" is often used in transportation to show how steep a road is. We calculate it using the same v and h variables, but in a different formula

Percent slope = (v/h) 100

4. Using our values from questions 1 and 2, what is the percent slope for figure 13.2.?

Finally, we can express a slope in terms of degrees. Using simple trigonometry and our h and v values, we can easily calculate the angle at which the slope heads up. The formula is

Degree of slope = arctan (v/h)

The "arctan" feature is often depicted as $\tan^{-1}$on scientific calculators.

5. Using our values from questions 1 and 2, what is the degree of slope, or slope angle for figure 13.2.?

You now know how to express the same slope three different ways. These numbers may not mean much to you at first, but they can make more sense when you begin to compare different slopes. For example, heading south from Antelope Valley College on 30th Street West to Marie Kerr Park would take you up a slope of 1% or 87:1. That's a slope you wouldn't notice in a car, but could feel if you were riding a bike. Conversely, driving south from Avenue K on 70th Street West to the California Aqueduct would take you up an average slope of 3% or 30:1. The steep last section of road that splits off of 70th to the Aqueduct has a slope of 8% or 13:1.

13.2. Finding slopes on topographic maps

Calculate the slopes for each of the locations listed below. Express the slope as a ratio, percent grade, and angle.

Use the Lancaster West quadrangle for the following questions.

6. What is the slope from the top of Quartz Hill (the hill itself, not the town) to BM 2471?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

7. What is the slope from the administration building at Antelope Valley College to the oil well located at NW ¼, SE ¼, Sec. 26, T 7 N, R 13 W?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

Use the Ship Rock, New Mexico Quadrangle for the following questions.

8. What is the slope of the north face of Ship Rock, (measure from the peak to 5,500')?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

9. What is the slope from BM 8840 at the top of Beautiful Mountains to BM 6345 (found to the NE)?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

10. What is the slope from the peak of Ship Rock to the end of its southern ridge?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

Use the Charleston Peak, Nevada Quadrangle for the following questions.

11. What is the slope from the Cold Creek Field Station (Sec. 6, T. 18 S, R. 56 E) to the highest peak on Indian Ridge?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

12. What is the slope of Hwy 52 from McWilliams Campground (Sec. 10, T. 19 S, R. 56 E) to the eastern edge of the map?
    a. v =
    b. h =
    c. Ratio =
    d. Percent Grade =
    e. Degree =

13.3. Contour Profiles

A contour profile adds a 3rd dimension to our 2 dimensional topographic maps. It is a systematic way of representing the relief (i.e. elevation changes) over a specific route on a map. Figure 13.3 shows how the concept works. Imagine you are hiking from point A to point B. The contour profile at the bottom of the figure shows the type of terrain you would encounter.

Typically contour profiles are drawn with a certain amount of vertical exaggeration. This means the vertical scale (the real world distance covered when travelling an inch up the profile) is greater than the horizontal scale (the real world distance covered when travelling an inch along the line from point A to Point B). We do this so we can actually visualize the relief on our contour profiles.

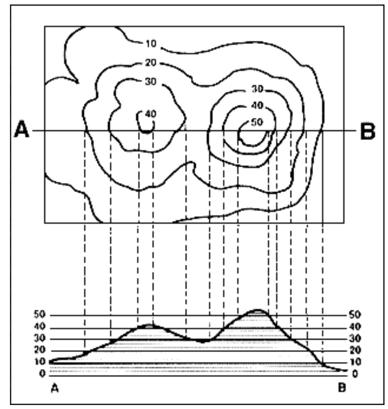


Figure 13.3. Contour profile (courtesy USGS)

13. Let's say a contour profile has a horizontal scale of 1 inch = 1,000 feet. What would its fractional scale be?

 1: ________________

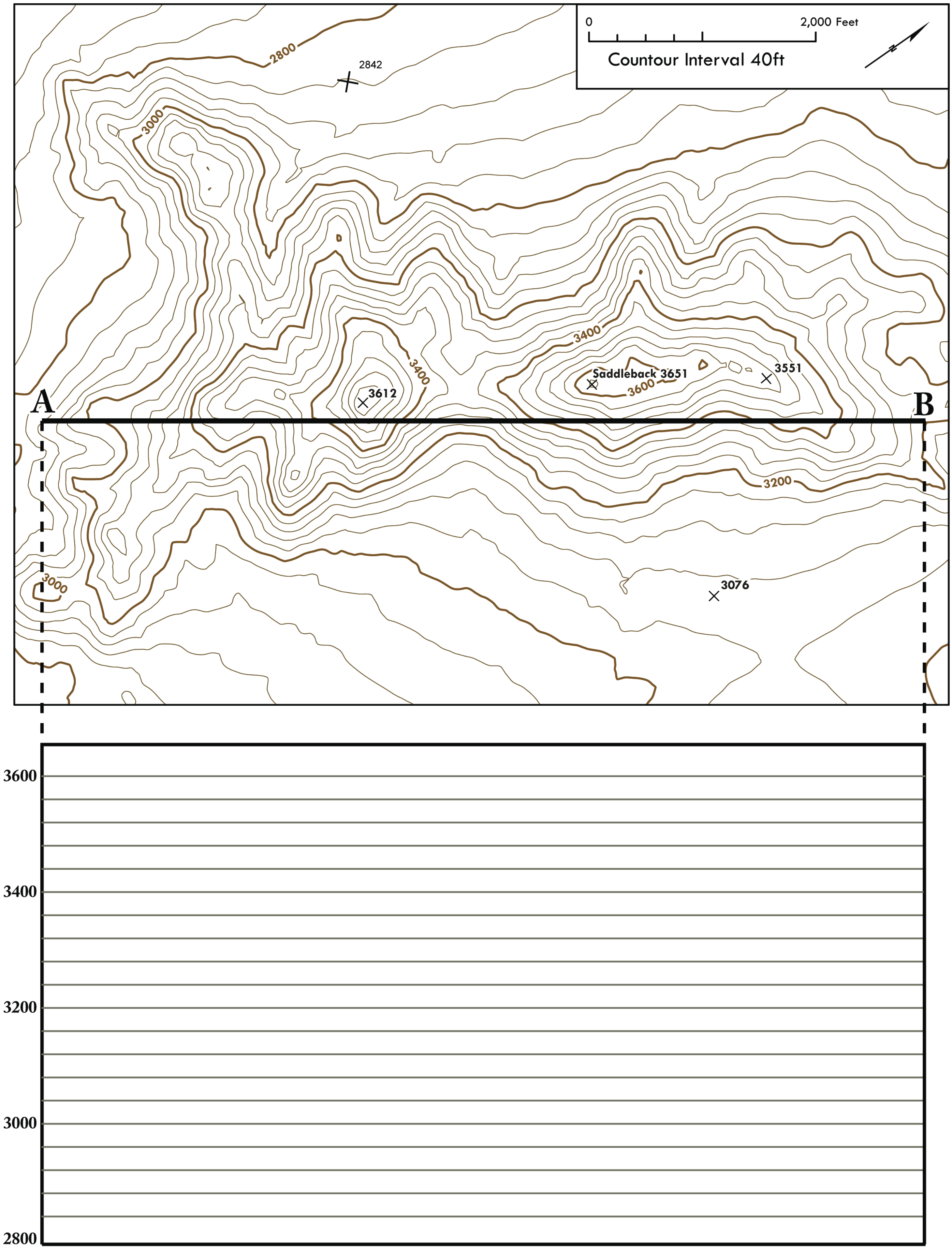
14. Using the same scale for the vertical would result in a flat profile. If we use a vertical scale of 1 inch = 100 feet, what would the fractional vertical scale be?

 1: ________________

You can calculate the vertical exaggeration of a profile by taking the fractional scale value of the horizontal scale and divide by the fractional scale value of the vertical scale.

15. What is the vertical exaggeration of this profile?

16. On the following page construct a contour profile for the topographic map of Saddleback Butte, California. Every time the line running from A to B crosses a contour line, draw a point on the graph directly below on the proper elevation line. When you have all your points, connect them to see the profile of Saddleback Butte.


0
2,000 Feet
Countour Interval 40ft
2800
2842
3000
3400
3612
Saddleback 3651
3600
3551
3200
3076
A
B
3600
3400
3200
3000
2800

Name____________________

Physical Geography

Lab Activity #14

Due date__________

Geographic Research

COR Objective 6, SLO 3

14.1. Introduction

One of the most important college skills is the ability to conduct research. Academia exists to learn more about the world in a meaningful and often scientific way. This exercise will introduce you to concepts like a literature review, annotated bibliography, and how to formulate spatial questions. As you are working through this lab remember that every piece of writing you do in college should *say* something. A college paper should never be a regurgitation of known facts, but rather your own unique perspective on a topic.

This lab does not require a paper to actually be written. Rather, it is designed to introduce you to how to properly begin to write for other classes you will take in the future.

14.2. Spatial Thinking

Any good research paper requires a lot of work before you even begin to write the paper itself. You will need to focus your effort to a specific topic and ultimately a specific thesis statement to ensure your paper is not a rambling collection of facts. In this section you will work to formulate a thesis statement for an imaginary research paper for a Geography 101 class.

1. Think of the subjects that have interested you in your Geography 101 lecture class. Write down three general topics that were covered or will be covered.
    a.
    b.
    c.

A simple topic like "volcanoes" is much too broad a topic for a research paper. You need to focus your topic by selecting a region or point in time. For example, I could change my broad "volcanoes" topic to "stratovolcanoes in Northern California."

2. Choose your favorite topic of the above three and limit it to a point in time or a place in the world.

14.3. Thinking about your subject

The best way to quickly generate information on your subject is to conduct a few general Internet searches. In this section you will visit a few search engines to gather information that can help you develop your thesis statement.

First go to Google (http://www.google.com). Below, write down a series of key words to enter into the search engine. Then enter them into Google and take notes on any useful websites you find. You should be looking for websites that can trigger ideas regarding your thesis. Wikipedia is fine for this step of your research, but you should also be finding scientifically valid information from other trusted organizations.

3. Keywords:
    a. Notes:

4. Keywords:
    b. Notes:

5. Keywords:
    c. Notes:

6. Keywords:
    d. Notes:

7. Now visit (http://www.bing.com) and enter the same key words. Do you find any new websites that Google did not show you before?

You have found a handful of websites, but the biggest trick is determining if the information they provide is actually valid. Anyone can post a website using any content he or she feels like. Think about the things that make a website seem valid and write down five clues that will help you determine if the websites you found are worth using

8.
9.

10.
11.
12.

14.4. Crafting a thesis

A thesis statement is what guides your research paper. It is the main point you are trying to make with your paper and it helps you to focus your writing and supporting arguments. It may be difficult for you to write a definitive thesis until you conduct more research. A thesis statement can change as more information is gained from researching a subject. At this point forming a broadthesis is acceptable. For example, my thesis could simply be: I want to explore the relationship between stratovolcanoes and where people live in Northern California. As I conduct research on the subject, I can then formulate a specific thesis for my paper.

13. Using your own topic and place or region from Question 2, write your own thesis statement here:

14. What are three maps you could use to support your thesis statement?

14.5. The Literature Review

A college level paper should use both classic works and the latest research to ensure the thesis and arguments are well informed. No bit of academic work starts in a vacuum. We build off of the work that has come before and hopefully contribute to academic literature with everything we produce. To begin this process you conduct a literature review.

A literature review is a survey of existing academic work in order to see what other researchers have done on your topic. The best way to do this is to utilize an electronic database through your college or university. The Antelope Valley College library subscribes to EBSCOhost, a collection of online databases that catalog thousands of articles from academic journals. If you were to search for these articles through Google, you would have to pay the publisher a fee in order to download them. EBSCOhost allows you to do this for free.

15. You will need to find at least four full length articles that will help support your thesis. To use EBSCOhost, do the following:
    - Login to your MyAVC account.

- Click on the Academics tab.
- In the Library Channel you will see a link to EBSCOhost. You will also see the username and password you need to access the database from off campus.
- Click on the EBSCOhost link.
- Enter the username and password when prompted by EBSCOhost.
- Click on Research Databases.
- Select Academic Search Premier and hit continue.
- Click on Advanced Search before entering your keywords.
- Check the boxes next to Full Text and Scholarly (Peer Reviewed) Journals.
- Enter your keyword(s) and click Search.

If you have any trouble with off-campus access, you can call the Reference Desk at 661-722-6300 ext. 6276.

Be sure to save the articles you will use to your computer. You will be reading them and using them to complete the final part of this lab.

14.6. Digital Books

A new tool in conducting a literature review is Google Books (http://books.google.com), which houses millions of digital scans of books from publishers and library stacks. Journal articles found through EBSCOhost are valuable for reading the latest in research, but scholarly books typically contain the foundations of a scientific field.

16. Go to http://books.google.com
17. Type in your keyword(s) and click Search Books

You will probably get a lot of results. When looking for a book that can help you with your literature review you want one that is neither a textbook nor an unscientific work and one that has a "preview" within Google Books.

18. Experiment with your keywords and find two books that will work for your thesis. *If you cannot find anything, you can also <gasp> go into the AVC library…*

14.7. Finishing your thesis

Now it is time to finalize your thesis statement. Remember that a thesis statement is the guiding message of your paper. It tells your reader what he or she can expect from your paper and it helps you focus as you are researching and writing. Now that you have done more research you should be able to come up with a definitive statement you want to make with your *imaginary* paper.

In a geography paper you always want your thesis to have a spatial component. This means your paper will tie in with a location or region. A good way to check this is to think about how you could use maps to support your argument. Using my example from above, I could come up with the following thesis statement: *The presence of stratovolcanoes has not deterred human settlement patterns in Northern California.*

19. Write your specific thesis statement here:

20. How could maps be used to support your thesis?

14.8. Annotated Bibliography

To finish this lab you will create an annotated bibliography of your six best sources you discovered in this lab. Remember, four of these sources must be journal articles from EBSCOhost and two must be books from books.google.com or the AVC library.

An annotated bibliography is like a work cited page at the end of a paper, but with descriptive paragraphs under each entry. This will make you think about the sources you chose and how they fit in with your thesis. Your annotated bibliography must follow the Chicago Manual of Style author-date system, which is the style of choice in geography. If you are not familiar with this system of citation, you can find a good overview at http://library.osu.edu/help/research-strategies/cite-references/chicago-author-date.

Your bibliography will be in alphabetical order by author and have a paragraph under each entry explaining what the article or book is about and how it ties in with your thesis. Type and attach your annotated bibliography to this lab.

End of Lab 14

Name______________________

Physical Geography
Lab Activity #15

Due date___________

Choropleth Maps

COR Objective 1 & 7, SLOs 1 & 3

15.1. Introduction

Up until this point we have used maps to find locations on the Earth. While they are in fact great for such a task, maps have many other uses. They are graphic representations of the Earth, and as such can show location and topography as well as patterns across space. In this lab you will make a series of choropleth maps. A choropleth map is a map that uses fixed boundaries and a consistent symbology to illustrate facts about the places mapped. For example, Figure 15.1 shows the population density, or number of people per square kilometer, of Europe.

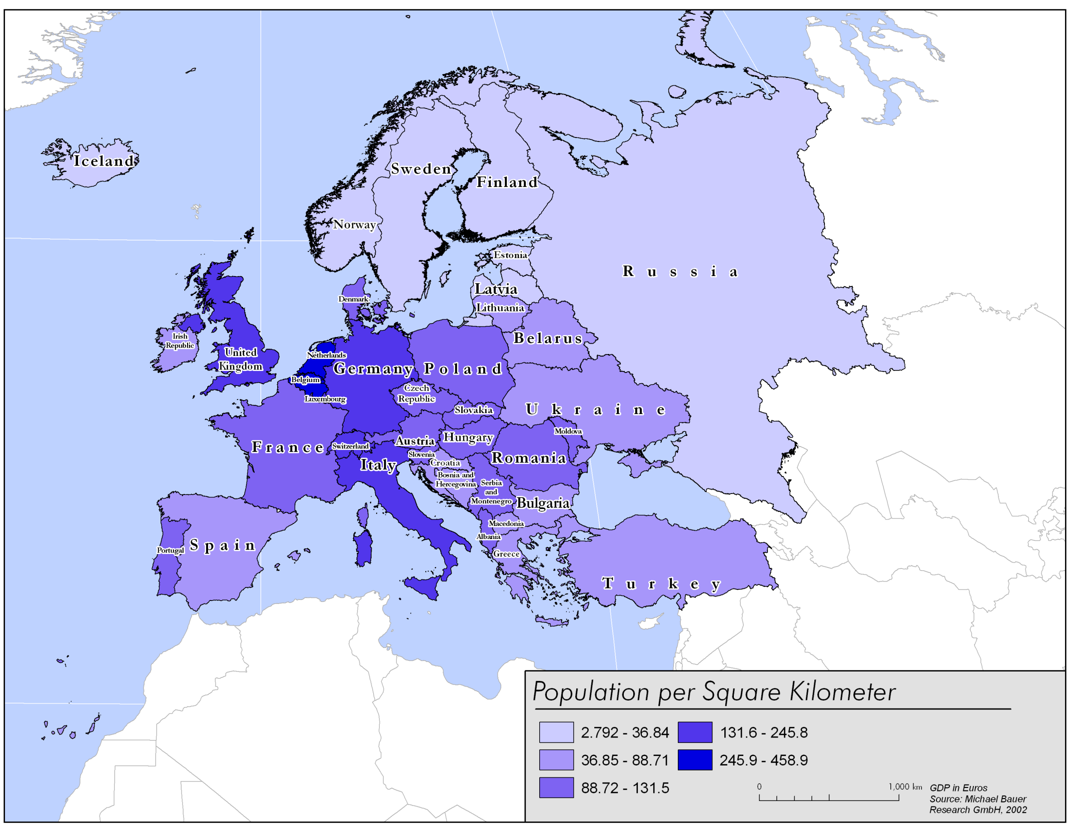


Figure 15.1.Choropleth map of Europe's population density.

15.2. Mapping population statistics in the Middle East

For this lab you will make a series of three choropleth maps illustrating population counts in the Middle East. Your first map will show the population growth of each country in the region. The second map will show children aged 14 and under as a percentage of the total population. The third map will show seniors aged 65 and above as a percentage of the total population.

Before you begin to color in countries on the maps below, you will need to think about the information you are trying to present to determine the best way to visualize it.

First you need to look at your data. All of the data you will need for this lab is provided in figure 15.3. Your first map will be showing the population growth rate in the Middle East, and of course, those values filled out in the table. You'll have to do some work before your data is ready to map.

Population growth can be found with the formula

$$\textbf{Growth Rate (\%)} = \left(\frac{\textbf{(Population at end of time period - pop. at start)}}{\textbf{Population at start of time period}} \right) \times 100$$

1. Use this formula to fill in the missing values in figure 16.2.

Now that you have all of your data you can begin to sort out the values and have a good idea as to how you will make your first map.

2. Which country has the highest amount of population growth? What is it?

3. Which country has the lowest amount? What is it?

Mapping every single value of population growth with a unique color would make for an incomprehensible map. Instead of mapping unique values, a choropleth map places each value into a classification. For example, data values ranging from 0-25% could be placed into one classification, 25.1-50% into another, and so on. Such a map should have no fewer than four and no more than six classifications. Using fewer classifications will present too simple of a picture and using more than six will make the map difficult to read. Typically we use a statistical method like *Jenks Natural Breaks* to properly classify data, but you will simply come up with a classification scheme that seems to fit the data.

4. Looking at your data values for population growth, create 4-6 classifications that you think would make a meaningful map. *Keep your high and low values in mind; if your high value is 72%, you would not need to have a classification go any higher*. Write your classification scheme here.

Now that you have a classification scheme you will need to come up with the symbology you will use to map it. Since a choropleth map is designed to convey a story with the data, you want to choose a symbology that best fits the data. Figure 15.2 shows three different symbology schemes that can be used for choropleth maps.

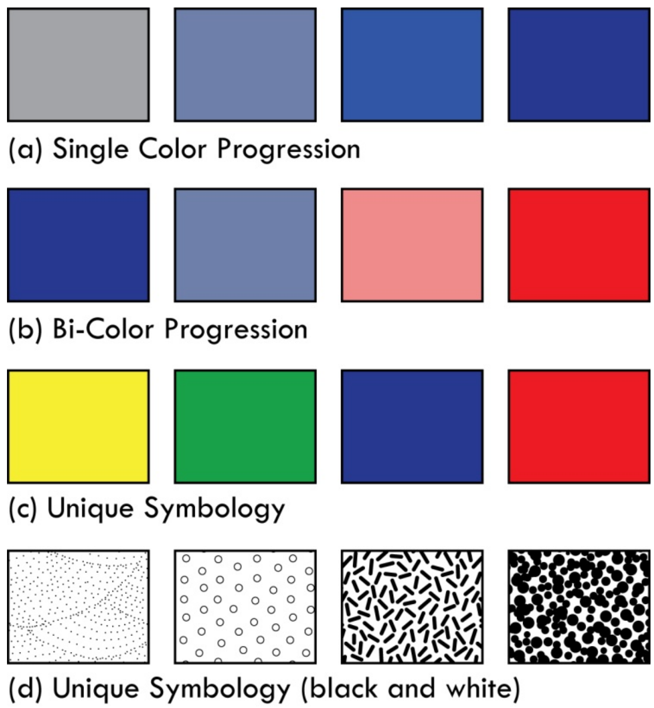


Figure 15.2.Symbology schemes for choropleth maps.

The single color progression uses lighter to darker shades of a color to indicate more or less of a certain thing. The bi-color progression is typically used to highlight both high and low values of a phenomenon. Unique symbology is used to show classifications that are unique of each other and do not necessarily indicate a high or low value.

5. Based on the population growth data, which symbology scheme would be best for your data? Why?

6. Draw and color the symbology as it relates to your data classification:

You now have a classification scheme and symbology for your map. Using the first blank map of the Middle East provided, create your map of the population growth in the region. Give the map a title and a legend for the symbology in the blank rectangle in the lower left of the map. Then begin going through your data and symbolizing each country based on their growth. *Use your atlas if you have any doubts as to the exact boundaries of a country.*

Use the steps above to make two more maps, one for the children aged 14 and under as a percentage of the total population and one for seniors aged 65 and above as a percentage of the total population.

Once your three maps are complete, answer the following questions.

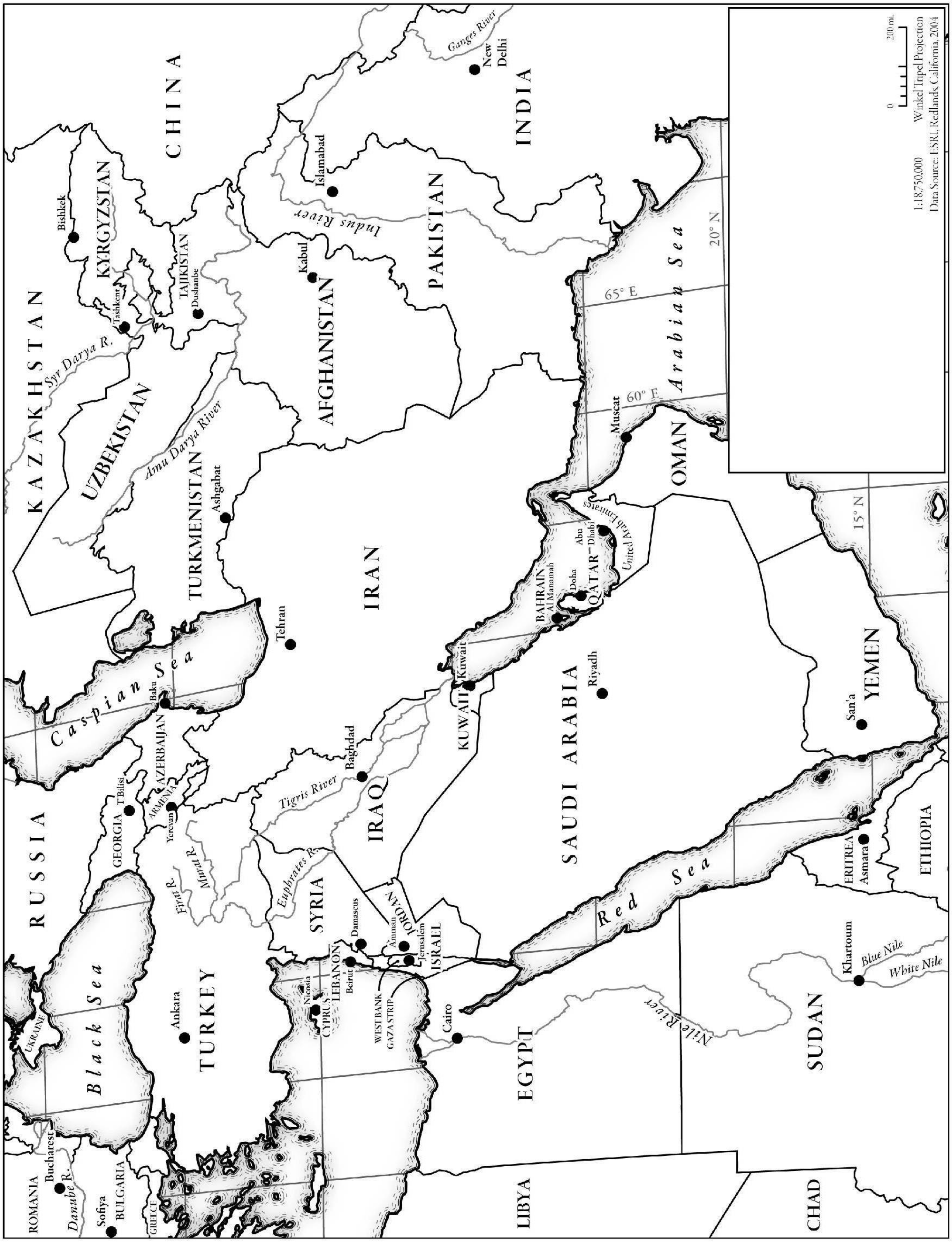
7. What do maps of the amount of children and seniors in a country tell you about a place?

8. What interesting trends do you notice when comparing your three maps?

Country Name	Total pop., 2000	Total pop., 2009	Population Growth	Pop. Ages 0-14 %, 2009	Pop. Ages 65+ %, 2009
World	6,084,959,036	6,775,235,741	11.34%	27	8
Afghanistan	23,630,320	29,802,724		46	2
Armenia	3,075,811	3,082,951		20	11
Azerbaijan	8,048,535	8,781,100		24	7
Bahrain	650,012	791,473		26	2
Eritrea	3,657,325	5,073,279		42	2
Ethiopia	65,514,626	82,824,732		44	3
Georgia	4,744,750	4,260,333		17	14
Iran	63,938,646	72,903,921		24	5
Iraq	25,108,525	31,494,287		41	3
Israel	6,289,000	7,441,700		28	10
Jordan	4,797,500	5,951,000		34	4
Kazakhstan	14,883,600	15,888,000		24	7
Kuwait	2,190,000	2,794,706		23	2
Kyrgyzstan	4,915,300	5,321,355		29	5
Lebanon	3,772,283	4,223,553		25	7
Oman	2,402,184	2,845,415		31	3
Pakistan	138,080,000	169,708,303		37	4
Qatar	616,817	1,409,423		16	1
Saudi Arabia	20,644,121	25,391,100		32	3
Syria	16,510,861	21,092,262		35	3
Tajikistan	6,172,891	6,952,223		37	4
Turkey	66,459,578	74,815,703		27	6
Turkmenistan	4,501,727	5,109,881		29	4
United Arab Emirates	3,238,054	4,598,600		19	1
Uzbekistan	24,650,000	27,767,100		29	4
West Bank & Gaza	3,004,150	4,043,218		45	3
Yemen	18,181,733	23,580,220		44	2

Source: World Bank, 2011

Figure 15.3.Population data for the Middle East.



KAZAKHSTAN
KYRGYZSTAN
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Tashkent
TAJIKISTAN
Dushanbe
Syr Darya R.
Amu Darya River
TURKMENISTAN
Ashgabat
AFGHANISTAN
Kabul
Islamabad
Indus River
PAKISTAN
INDIA
New Delhi
Ganges River
RUSSIA
GEORGIA
T'Bilisi
ARMENIA
Yerevan
AZERBAIJAN
Baku
Caspian Sea
Tehran
IRAN
Tigris River
Baghdad
IRAQ
Murat R.
Firat R.
Euphrates R.
SYRIA
Damascus
LEBANON
Beirut
JORDAN
Amman
Jerusalem
ISRAEL
WEST BANK
GAZA STRIP
CYPRUS
Nicosia
TURKEY
Ankara
Black Sea
UKRAINE
ROMANIA
Bucharest
Danube R.
BULGARIA
Sofiya
GREECE
LIBYA
EGYPT
Cairo
Nile River
SUDAN
Khartoum
Blue Nile
White Nile
CHAD
ETHIOPIA
ERITREA
Asmara
Red Sea
SAUDI ARABIA
Riyadh
KUWAIT
Kuwait
BAHRAIN
Al Manamah
QATAR
Doha
Abu Dhabi
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Data Source: ESRI, Redlands, California, 2004
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Yerevan
AZERBAIJAN
Baku
Caspian Sea
KAZAKHSTAN
Syr Darya R.
UZBEKISTAN
Amu Darya River
TURKMENISTAN
Ashgabat
Bishkek
KYRGYZSTAN
Tashkent
TAJIKISTAN
Dushanbe
CHINA
Ankara
TURKEY
Firat R.
Murat R.
Euphrates R.
Tigris River
Nicosia
CYPRUS
LEBANON
Beirut
SYRIA
Damascus
WEST BANK
GAZA STRIP
Amman
JORDAN
Jerusalem
ISRAEL
IRAQ
Baghdad
Tehran
IRAN
Kabul
AFGHANISTAN
Indus River
Islamabad
PAKISTAN
New Delhi
Ganges River
INDIA
Cairo
LIBYA
EGYPT
KUWAIT
Kuwait
BAHRAIN
Al Manamah
Doha
QATAR
Abu Dhabi
United Arab Emirates
SAUDI ARABIA
Riyadh
Muscat
OMAN
60° E
65° E
Arabian Sea
20° N
Red Sea
Nile River
CHAD
SUDAN
Khartoum
Blue Nile
White Nile
ERITREA
Asmara
ETHIOPIA
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YEMEN
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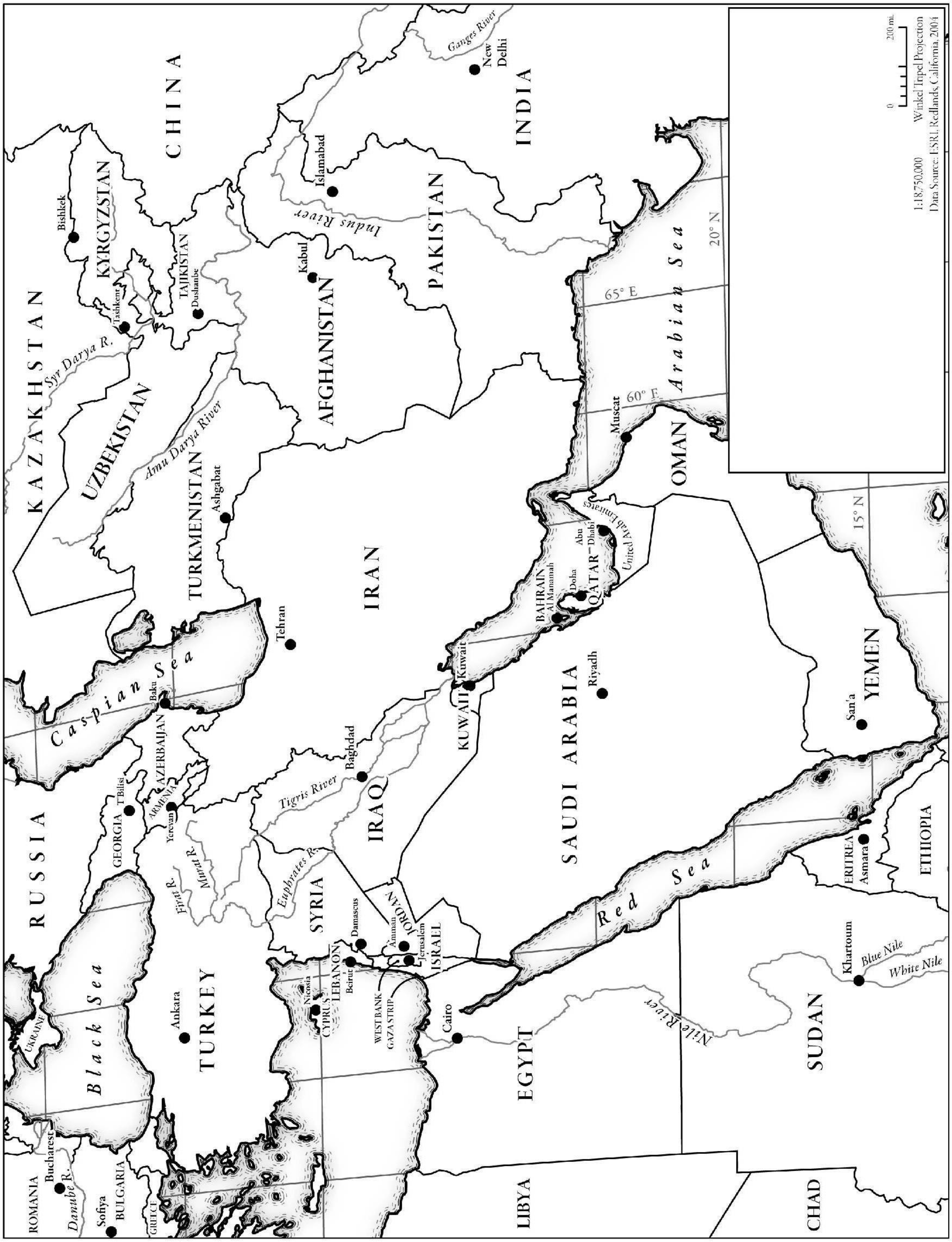
1:18,750,000
Winkel Tripel Projection
Data Source: ESRI, Redlands, California, 2004



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KYRGYZSTAN
Bishkek
UZBEKISTAN
Tashkent
TAJIKISTAN
Dushanbe
Syr Darya R.
Amu Darya River
TURKMENISTAN
Ashgabat
AFGHANISTAN
Kabul
PAKISTAN
Islamabad
Indus River
INDIA
New Delhi
Ganges River
Caspian Sea
Baku
AZERBAIJAN
ARMENIA
Yerevan
GEORGIA
T'Bilisi
IRAN
Tehran
IRAQ
Baghdad
Tigris River
Euphrates R.
Murat R.
Firat R.
TURKEY
Ankara
Black Sea
UKRAINE
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Danube R.
BULGARIA
Sofiya
GREECE
SYRIA
Damascus
LEBANON
Beirut
CYPRUS
Nicosia
JORDAN
Amman
Jerusalem
ISRAEL
WEST BANK
GAZA STRIP
EGYPT
Cairo
Nile River
LIBYA
CHAD
SUDAN
Khartoum
Blue Nile
White Nile
ERITREA
Asmara
ETHIOPIA
Red Sea
SAUDI ARABIA
Riyadh
KUWAIT
Kuwait
BAHRAIN
Al Manamah
QATAR
Doha
Abu Dhabi
United Arab Emirates
OMAN
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YEMEN
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Winkel Tripel Projection
Data Source: ESRI, Redlands, California, 2004

Name____________________

Physical Geography
Lab Activity #16

Due date__________

California Climate Classification

COR Objective 6, SLO 3

16.1. Introduction

One of the most important factors in the physical geography of a place is its climate. Weather is what happens in terms of temperature and moisture in the atmosphere on a day to day basis. Climate is the long term average of weather events in a place. By studying the climate of a place we can begin to deduce what flora, fauna, soil type, and weathering processes will be found within it.

Use Units 14-17 of DeBlij et al's Physical Geography *to answer the following questions.*

1. Name the two types of data the Köppen system uses to map climate regions.

2. Explain the differences between tropical, mid-latitude, and polar locations.

16.2. Köppen's Climate Classification

Vladimir Köppen was a German climatologist who came up with a simple climate classification system based on a place's temperature and precipitation. While not perfect, it can provide a quick idea as to what weather a place experiences throughout the year. Every location in the world can be given a three letter classification based on annual weather data. Sacramento, California is a Csa climate. Bishop, California is a BWk climate.

World climates are placed into one of six major classifications:

A = Tropical climates
C = Mesothermal(mild mid-latitude) climates
D = Microthermal(cold mid-latitude) climates

E = Polar climates
B = Dry climates
H = Highland climates

3. Based on what you know about California geography and descriptions in *Units 14-17 of DeBlij et al's* Physical Geography, which major climate classifications will you not see in California? Why not?

Every location that falls into one of the first four climate classifications (A, C, D, and E) also has two lowercase letters following the main classification. The second letter in these climates refers to when precipitation occurs.

f = precipitation falls all year
w = winter dry, summer wet
s = summer dry, winter wet

The third letter tells you about the average monthly temperature extremes.

a = hot summers, warmest month above 72° F
b = warmest month below 72° and four months or more above 50°
c = warmest month below 72° and three months above 50°
d = coldest month below -35°
e = warmest month below 50°

As mentioned above, Sacramento, California is a Csa climate. The "C" means it is a Mesothermal climate. The "s" means rain falls during the winter and not the summer and the "a" means that it has hot summers.

Climates that fall into the "B" classification are treated differently. A climate that falls into this category is either an arid or semiarid climate. Arid means that the annual precipitation is less than ½ of the annual evapotranspiration. These climates are given a "W" after the B. Semiarid climates have annual precipitation greater than ½ but still less than the annual evapotranspiration. They are given an "S". The third letter for these climates refers to annual average temperatures. A lowercase "h" means the mean annual temperature is above 65° F and a lowercase "k" means the mean annual temperature is below 65° F.

As mentioned above, Bishop, California is a BWk climate, meaning it is an arid desert with cold winters.

16.3 Applying Köppen's System

To determine which climate classification a place falls into, you first want to create a climograph. A climograph is a useful visualization of the temperatures and precipitation of a place. An example is below under question 4. The blue points and line show the normal daily temperatures averaged for each month. The red bar graph shows the normal precipitation for each month. This climograph is for Palmdale, California and was filled in using the climate data in the table just below it.

Once your climograph is complete, use the following flow chart to determine the classification.

Step 1 – Find the Major Climate Group

Climate Group	Description
A – Tropical	Wet; low latitudes
B – Dry	Not latitude specific; evaporation exceeds precipitation; typically in California, areas with less than 38 cm (15 in.) of rain per year
C – Mesothermal	Mild winters, warm or hot summers
D – Microthermal	Very cold winters
E – Polar	High latitude; very cold
H - Highland	This can be difficult to determine without contextual data, so for this lab, Highland is defined as any location above 3,000ft in elevation.

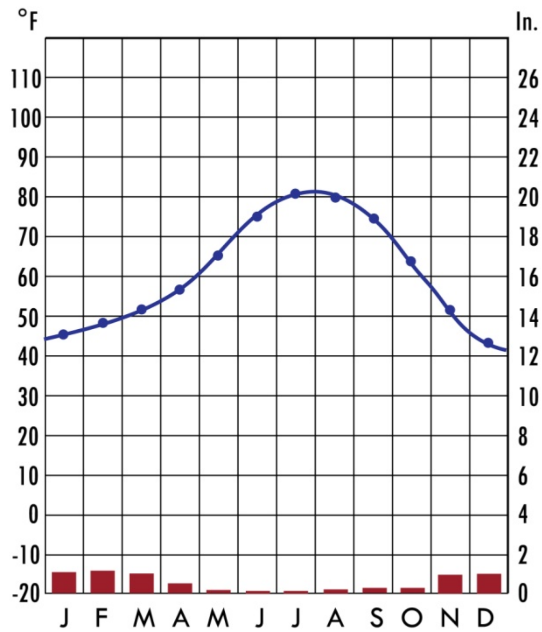
Step 2 – Identify the precipitation patterns

If climate group is…	The second letter is…
A, C, or D	f = wet year round; typically over 100 cm (40in.) of rain per year m = monsoonal precipitation (extremely wet summers) w = dry in winter, rains in summer s = dry in summer, rains in winter
B	W = arid desert; in California typically less than 25 cm (10in.) of rain per year S = semiarid steppe; in California typically greater than 25 cm (10 in.), but less than 38 cm (15 in.) of rain per year
E	T = tundra; warmest month between 0°C (32°F) – 10°C (50°F) F = ice cap; no monthly average above 0°C (32°F)
H	Highland climates do not get a second or third letter, so you're done

Step 3 – Identify temperature distinctions

If climate group is…	The third letter is…
A, C, or D	a = hot summers; warmest month above 22°C (72°F) b = warm summers; warmest month below 22°C (72°F)and four or more months above 10°C (50°F) c = cool summers; warmest month below 22°C (72°F)and three months above 10°C (50°F) d = very cold winters; coldest month below -37°C (-35°F)
B	h = hot desert or steppe; average annual temperature above 18°C (65°F) k = cold desert or steppe; average annual temperature below 18°C (65°F)

4. Use the table to fill in the blank fields to the right of the climograph and use the Köppen system to classify Palmdale's climate.



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

Wettest Month/Amount:

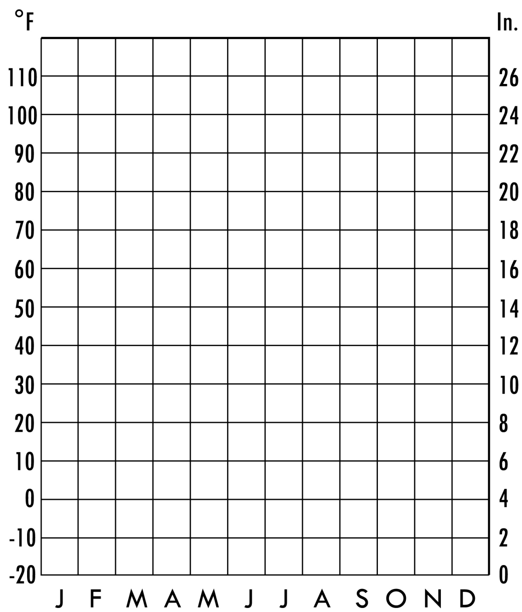
Dryest Month/Amount:

Köppen Classification:

Palmdale, Calif. | Elevation 2,596' | 34° 35' N, 118° 06' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	31.9	35.4	38.5	42.9	50.3	57.7	64.3	63.3	56.6	47.6	38.0	31.5	46.5
Normal Max.	58.2	62.8	66.4	73.1	81.3	90.5	97.1	96.1	89.9	79.8	66.3	57.8	76.6
Normal Daily	45.1	49.1	52.5	58.0	65.8	74.1	80.7	79.7	73.3	63.7	52.2	44.7	61.6
Normal Precip.	1.23	1.29	1.13	0.41	0.13	0.06	0.05	0.18	0.25	0.23	0.95	1.01	6.92

5. Complete the following climographs and classifications:



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

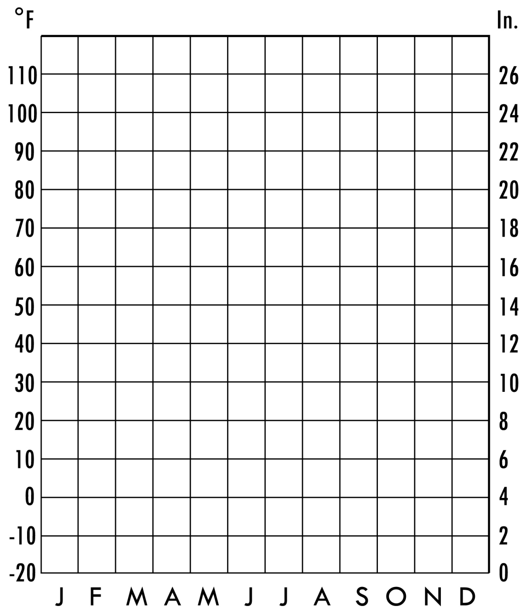
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Bakersfield, Calif. | Elevation 495' | 35° 25' N, 119° 03' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	38.6	42.6	45.8	50.1	57.3	64.0	69.6	68.5	63.5	54.8	44.7	38.3	53.2
Normal Max.	56.9	63.9	68.9	75.9	84.6	92.4	98.5	96.6	90.1	80.7	66.8	56.5	77.7
Normal Daily	47.8	53.3	57.4	63.0	71.0	78.2	84.1	82.6	76.8	67.8	55.8	47.5	65.4
Normal Precip.	0.86	1.06	1.04	0.57	0.20	0.10	0.01	0.09	0.17	0.29	0.70	0.63	5.72



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

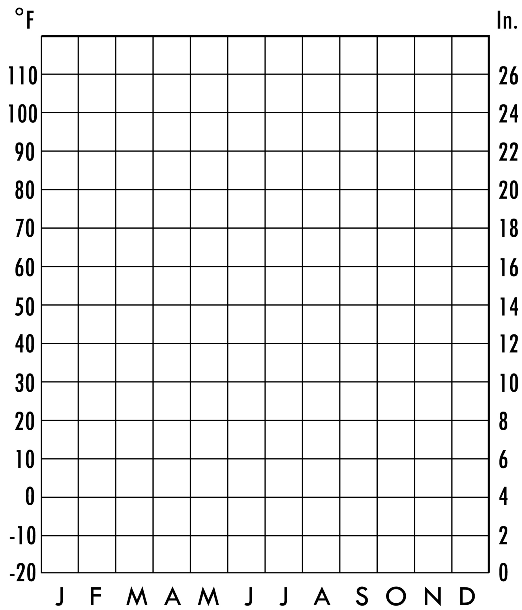
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Berkeley, Calif. | Elevation 345' | 37° 52' N, 122° 15' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	43.3	46.2	46.8	48.2	50.6	53.3	54.2	55.3	55.9	53.4	48.7	43.8	50.0
Normal Max.	56.4	59.7	60.9	63.8	66.2	69.0	70.0	70.0	71.7	69.6	62.5	56.6	64.7
Normal Daily	49.9	53.0	53.9	56.0	58.4	61.2	62.1	62.7	63.8	61.5	55.6	50.2	57.4
Normal Precip.	5.03	3.75	3.71	1.82	0.33	0.15	0.07	0.10	0.37	1.48	3.74	3.75	24.30



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

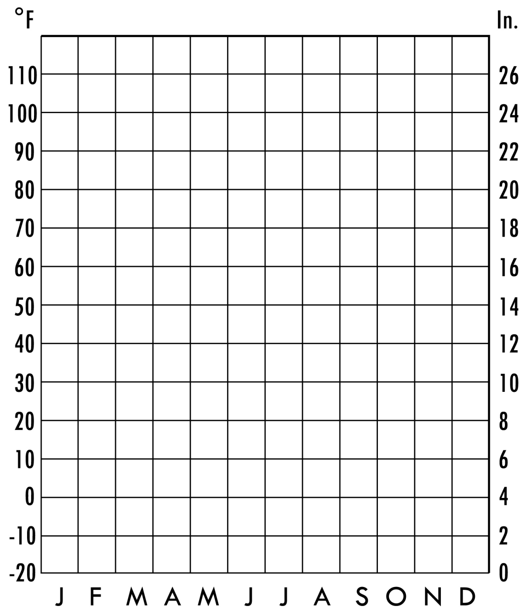
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Big Bear Lake, Calif. | Elevation 6,790' | 34° 15' N, 116° 53' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	18.9	21.1	23.2	27.5	33.5	40.3	46.7	45.9	39.7	31.4	24.8	19.9	31.1
Normal Max.	47.4	48.5	50.4	57.0	65.6	75.2	80.3	78.8	73.4	65.2	54.3	48.1	62.0
Normal Daily	33.2	34.8	36.8	42.2	49.6	57.8	63.5	62.4	56.6	48.3	39.6	34.1	46.6
Normal Precip.	4.01	3.75	3.53	1.53	0.58	0.12	0.82	0.99	0.62	0.68	2.54	3.48	22.65



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

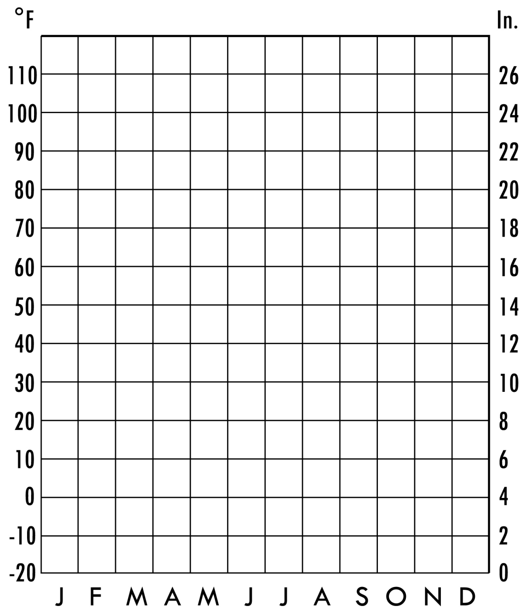
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Crescent City, Calif. | Elevation 40' | 41° 46' N, 124° 12' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	40.0	41.5	41.7	42.6	45.6	49.1	50.8	51.8	50.1	47.0	44.0	40.4	45.4
Normal Max.	55.2	56.2	56.3	57.9	60.8	63.6	65.6	66.2	66.8	63.8	58.3	55.3	60.5
Normal Daily	47.6	48.9	49.0	50.3	53.2	56.4	58.2	59.0	58.5	55.4	51.1	47.9	53.0
Normal Precip.	9.88	8.36	8.93	4.60	2.94	1.33	0.39	0.96	1.75	4.85	10.61	10.61	65.21



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

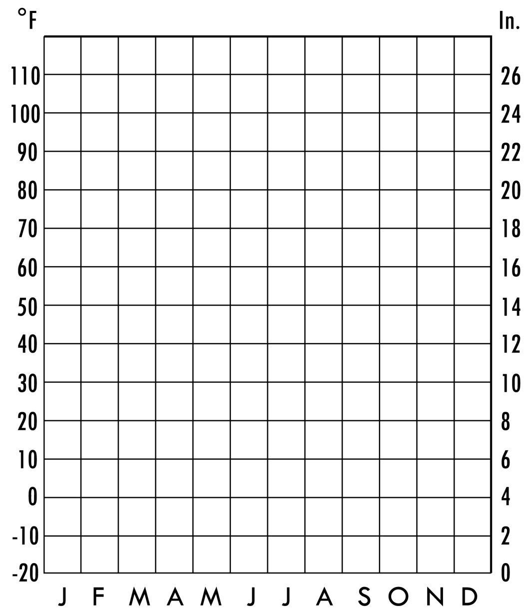
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Death Valley, Calif. | Elevation -194' | 36° 28' N, 116° 52' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	38.5	45.7	53.5	61.7	71.5	81.0	87.4	85.5	75.5	61.7	48.2	37.8	62.3
Normal Max.	64.9	72.7	79.6	88.1	98.0	108.1	114.3	112.1	104.4	91.7	75.6	63.8	89.4
Normal Daily	51.7	59.2	66.6	74.9	84.8	94.6	100.8	98.8	90.0	76.7	61.9	50.8	75.9
Normal Precip.	0.24	0.41	0.31	0.15	0.08	0.04	0.15	0.18	0.17	0.11	0.23	0.21	2.28



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

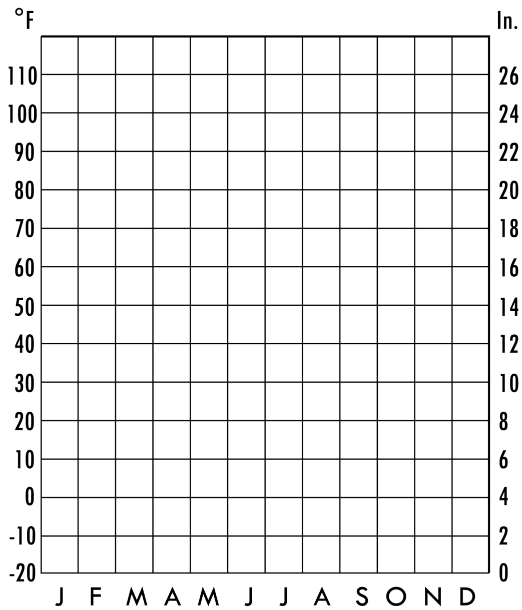
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Fresno, Calif. | Elevation 328' | 36° 46' N, 119° 43' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	37.4	40.5	43.4	47.3	53.7	60.4	65.1	63.8	58.8	50.7	42.5	37.1	50.1
Normal Max.	54.1	61.7	66.6	75.1	84.2	92.7	98.6	96.7	90.1	79.7	64.7	53.7	76.5
Normal Daily	45.7	51.2	55.1	61.2	69.0	76.6	81.9	80.3	74.5	65.2	53.6	45.4	63.3
Normal Precip.	1.96	1.80	1.89	0.97	0.30	0.08	0.01	0.03	0.24	0.53	1.37	1.42	10.60



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

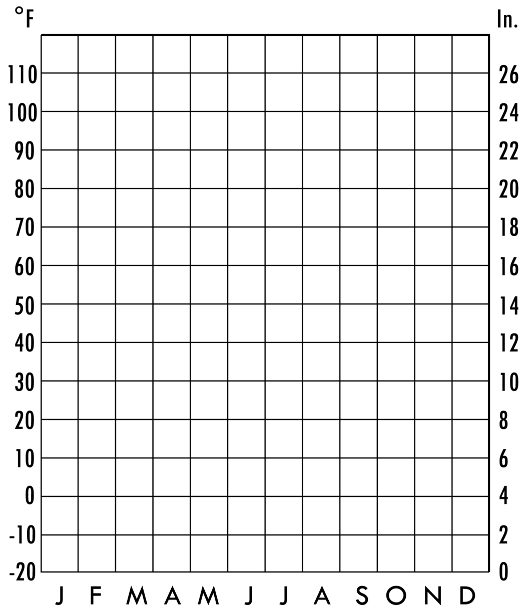
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Redding, Calif. | Elevation 502' | 40° 30' N, 122° 18' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	35.7	40.0	41.7	46.0	52.3	61.8	64.7	63.1	58.8	49.2	41.4	35.2	49.2
Normal Max.	55.3	61.3	62.5	69.9	80.5	90.4	98.3	95.7	89.3	77.6	62.1	54.7	74.8
Normal Daily	45.5	50.7	52.2	58.0	66.4	76.1	81.5	79.5	74.1	63.5	51.8	45.0	62.0
Normal Precip.	6.06	4.45	4.38	2.08	1.27	0.56	0.17	0.46	0.91	2.24	5.21	5.51	33.30



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

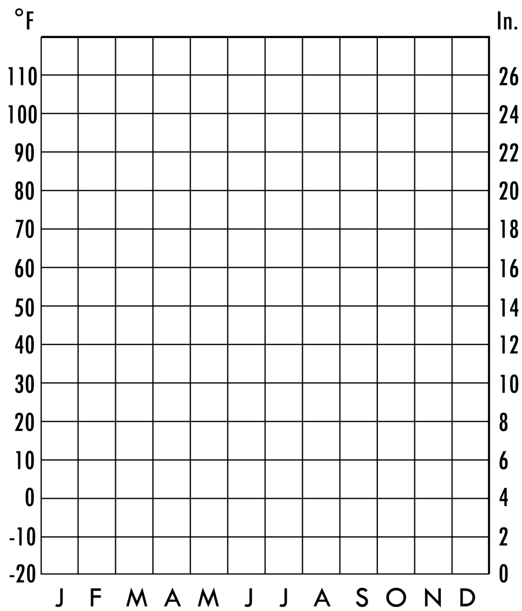
Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Santa Barbara, Calif. | Elevation 5' | 34° 25' N, 119° 41' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	43.4	45.4	47.0	49.0	51.8	55.0	57.8	59.2	57.7	53.9	48.5	43.6	51.0
Normal Max.	65.0	65.7	66.4	68.6	69.4	71.7	75.3	77.0	75.8	74.2	69.1	65.6	70.3
Normal Daily	54.2	55.6	56.7	58.9	60.6	63.4	66.6	68.1	66.8	64.1	58.8	54.6	60.7
Normal Precip.	3.57	3.75	2.75	1.27	0.20	0.07	0.01	0.05	0.31	0.33	2.18	2.49	16.98



Place:

Lat./Long.:

Elevation:

Temperatures

Warmest Month/Mean:

Coldest Month/Mean:

Precipitation

Annual Total:

Wettest Month/Amount:

Dryest Month/Amount:

Köppen Classification:

Twentynine Palms, Calif. | Elevation 1,975' | 34° 08' N, 116° 02' W

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave./Total
Normal Min.	35.3	38.8	42.5	48.3	56.2	64.3	71.0	69.9	62.8	52.3	41.6	35.0	51.5
Normal Max.	63.3	68.6	73.8	81.7	90.8	100.6	105.5	103.1	96.4	85.5	71.4	62.9	83.6
Normal Daily	49.3	53.7	58.2	65.0	73.6	82.5	88.3	86.5	79.6	69.0	56.5	49.0	67.6
Normal Precip.	0.38	0.33	0.40	0.10	0.11	0.01	0.66	0.82	0.47	0.26	0.28	0.43	4.25

6.4. Mapping Climate

Use the following map of California to map each of the places given climate classifications in this lab (including Sacramento and Bishop). Refer to your atlas if you are unsure as to the exact locations.

6. What generalizations can you make about California climates?

End of Lab 16

Name____________________

Physical Geography

Lab Activity #17

Due date___________

Planning a Hike

COR Objective 1, 3, & 7, SLOs 1, 2, & 3

17.1. Introduction

You have been charged with planning a hiking trip using the "Desolation Wilderness" maps provided by your instructor. Read the following items you will need to include in your route and then plan your hike.

17.2. Criteria

The following criteria must be met in your planned hike:

- Your hike must start outside of Desolation Wilderness boundaries and end (place your campsite) inside the wilderness area
- The hike in must be at least 7 miles
- The hike must be on a designated trail
- The hike must end at a lake

17.3. Hike description

1. Title of map:

2. Published by:

3. Date of publication:

4. Projection:

5. Horizontal datum:

6. Trailhead location in PLSS coordinates (to nearest ¼ section):

7. Azimuth and distances of at least 5 points along your hike:

8. The name of the trail(s) used:

9. In narrative form, describe any physical or geographic features you will pass along the trail:

10. The exact location of where you will camp at the end of your hike (again using PLSS coordinates to the ¼ section)

11. The azimuth of the nearest mountain peak from your campsite
12. Sketch a map showing the trailhead, the trail itself, the campsite location, and any terrain changes or named features along the way. Be sure to include a north arrow and map scale.

End of Lab 17

Name______________________

Physical Geography
Lab Activity #18

Due date___________

Building Streams

COR Objective 6,7, SLO 3

18.1. Youthful Streams

Using the stream table in the lab, your brilliant instructor will construct a "youthful" stream, meaning it represents one that just formed in nature. Draw the approximate shape of the stream in the space below:

Head **Mouth**

Using a ruler, fill in the following chart:

Location	Width (cm)	Depth (cm)	Form Ratio (Depth/Width)
Head			
Center			
Mouth			
Stream Average			

18.2. Mature Streams

Next we will run the water for a bit to represent a river entering maturity, meaning it has been around for a few years. Draw the overhead profile again

Head **Mouth**

Using a ruler, fill in the following chart:

Location	Width (cm)	Depth (cm)	Form Ratio (Depth/Width)
Head			
Center			
Mouth			
Stream Average			

1. Did the stream change its form ratio at all places at the same rate? Might it be possible for the lower regions of a stream to be in a different stage of development from the upper regions? Explain.

2. From your observation of the stream table, which stage of development in the life history of a stream is the shortest? Why?

3. Why does the stream begin to meander in early maturity?

4. If looking on a topographic map, how would you distinguish a youthful stream from a mature one?

5. What is the lowest level (base level) to which this stream can cut?

6. Why do most youthful streams have a V-shaped valley?

18.3. Old Streams

The next stage in stream development is full maturity or old age. To save time, your charming instructor will carve the full meanders into the sand. Once it is done, draw the new stream below and fill in the first row of the chart:

Head **Mouth**

Using a ruler, fill in the following chart:

	Width (cm)	Depth (cm)	Length (cm)	Valley Side Angle
Before Starting				
After 2 minutes				
After Cutoff				

7. Rivers are often used as political boundaries. Based on what you have seen, how can this be problematic? Explain.

8. Explain why, in times of flooding, the safest spot may be on the very banks of the river.

9. If you were going to buy property and two identical lots were offered, one on the inside of a meander and one on the outside, which would you invest you money in? Why?

10. Explain why a cutoff occurs. What does it do to the length of the river?

11. Where was the meandering stream's water moving fastest? Where was it the slowest? How does this affect the growth of the meanders?

12. Why are old aged rivers very rare in nature?

13. After the stream has reached maturity, what conditions might again produce active downward cutting of the channel?

End of Lab 18

Name____________________

Physical Geography

Lab Activity #19

Due date___________

Monitoring geographic events

COR Objective 6

19.1. Introduction

Every day events pertaining to the geographic subjects we have discussed in class are occurring somewhere in the world. This lab will require you to track down fifteen of them that occurred this semester. *You will write a brief description in the space below and then map each event on the attached maps.* You may use any media (Internet, newspaper, television, etc.) as long as you clearly cite the source. When describing the events be sure to fully explain the who, what, when, where, and why. Only use events from this current semester.

1. Date:_______________Event:____
   ____
   ____
   ____
   ____
   ____
   Source: ____
2. Date:_______________Event:____
   ____
   ____
   ____
   ____
   ____
   Source: ____
3. Date:_______________Event:____
   ____
   ____
   ____
   ____
   ____
   Source: ____

4. Date:_______________Event:____

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Source: ____

5. Date:_______________Event:____

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Source: ____

6. Date:_______________Event:____

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Source: ____

7. Date:_______________Event:____

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Source: ____

8. Date:_______________Event:____

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Source: ____

9. Date:_______________Event:____

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Source: ____

10. Date:______________Event:____

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Source: ____

11. Date:______________Event:____

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Source: ____

12. Date:______________Event:____

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Source: ____

13. Date:______________Event:____

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Source: ____

14. Date:______________Event:____

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Source: ____

15. Date:______________Event:____

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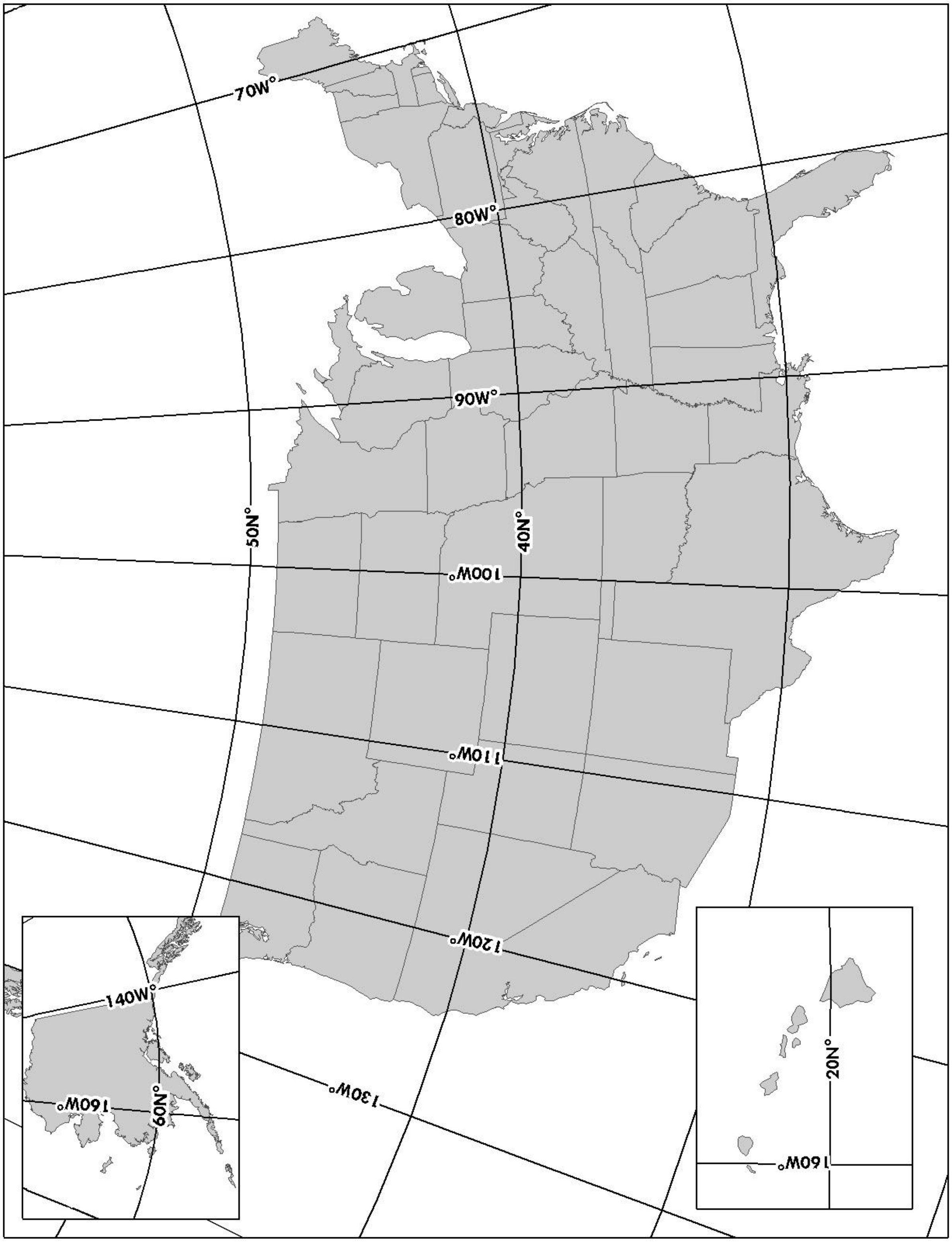
Source: ____


70W°
80W°
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110W°
120W°
130W°
140W°
160W°
60N°
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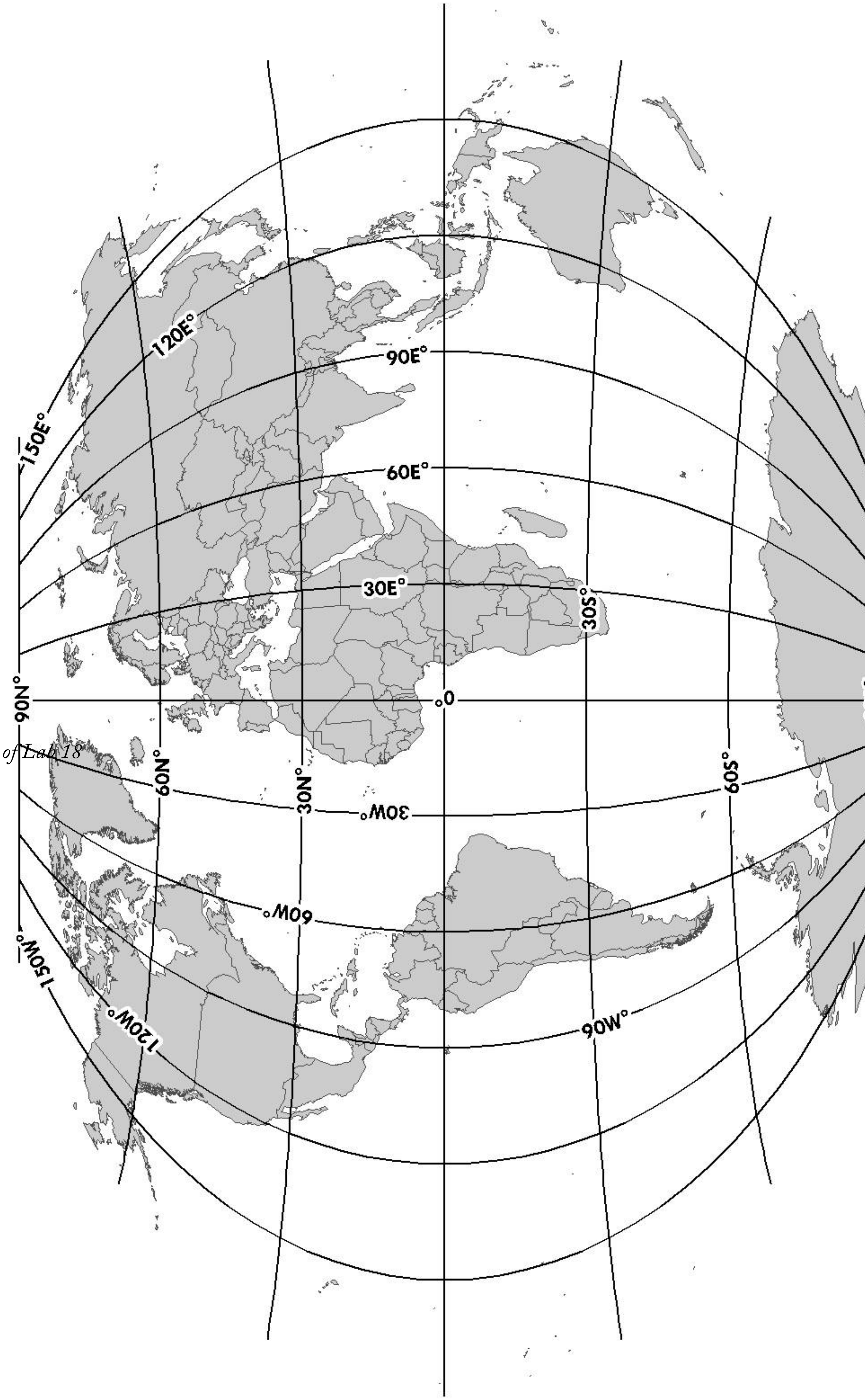
150E°
120E°
90E°
60E°
30E°
0
30W°
60W°
90W°
120W°
150W°
90N°
60N°
30N°
30S°
60S°
90S°

End of Lab 18

Physical Geography
Lab Activity #20

Focusing on geographic methods

COR Objective 9, SLO 4

20.1. Introduction:

We've covered a variety of geographic methods and topics over the semester. Now it's time for you to select one aspect of the geosciences and directly related fields to research further and then report your findings to the class.

20.2. List of topics:

Geodesy	Soil Science
Global Positioning System (GPS) & satellite navigation	Hydrology
Geographic Information Systems (GIS)	Atmospheric Science
Photogrammetry	Oceanography
Remote Sensing	Archaeology
Cartography	Paleontology
Seismology	Forestry
Geophysics	Biogeography
Physical Geology	Wilderness guiding
Historical Geology	Crime analysis
Mineralogy	Wildfire mapping
Engineering geology	Emergency preparedness planning
Geochemistry	Urban & rural planning
Volcanology	
Geomorphology	

20.3. The Process

Once you have a topic you will need to begin researching. A simple *Google* search can provide a variety of pages that will help to explain what your subject is all about. Be sure to consult a variety of sources to ensure your report is well informed.

When you feel you have gathered enough information you will *type* a 2-3 page report on your findings. Your report should answer the following questions:

- Define your topic. What is its main area of focus? Why is its existence necessary? How does it benefit humanity? How does it relate to topics discussed in Geography 101?
- Can someone make a living in this field? If so, what education, training, and experience are needed?
- What special technology or equipment does this field use?
- Are there any national or international organizations to which people working in the field belong? Where is the next meeting or conference being held?
- Can you find any current job openings in this field? If so, what is the job description and what does it require? Is a salary listed?

You do not need to adhere to a particular style (MLA, Chicago, etc.). Simply make sure you use a standard 12 point font, double space, and have 1” margins. You should also clearly list your sources to avoid any chance of plagiarism. *Papers that are not properly formatted and/or spell/grammar checked will be docked 20%.*

You will be required to present your findings to the class. Check with your instructor for time limits and any required visual aids.

End of Lab 20

Physical Geography
Appendix A – Reporting Coordinates

Coordinates must be written correctly and consistently to ensure that they are both accurate and useful. The following will be the standards used in the class. **You must conform to these standards to receive full credit on quizzes, labs, and exams!**

Degrees Minutes Seconds (DMS)

- Report the latitude first, then longitude.
- Degrees should be have the ° symbol after the number
- Minutes should have the ' symbol after the number
- Seconds should have the " symbol after the number
- The direction must be given after the latitude and longitude (N, E, S, W)

Decimal Degrees (DD)

- Report the latitude first, then longitude
- Coordinates south of the equator and west of the prime meridian must have a negative symbol (-)
- Round the number to five decimal places

Universal Transverse Mercator (UTM)

- Report the easting first, then northing (over, then up)
- Write "mE" after the easting and "mN" after the northing

Public Land Survey System (PLSS)

- PLSS coordinates must be reported from smallest to largest.
  - Give the aliquot divisions, then the section, then the township, then the range, and finally the baseline and meridian.
- For quarter sections and other aliquot divisions, give the locational reference first, then the fraction (e.g. SW ¼, N ½, etc.)
- The following abbreviations may be used:
  - The southwest quarter of the northeast quarter of section 14, township 7 north, range 13 west = SW ¼, NE ¼, Sec. 14, T. 7 N, R. 13 W

Reporting azimuth

- Azimuth is always reported with three digits, using a zero in front if the number is less than 100 and two zeroes if less than 10.

Example: 90° should be written as 090° when reporting an azimuth