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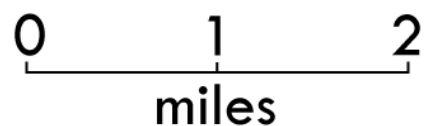
This scale makes it even easier to visualize because, well it does the visualizing for you. The map user can easily use a ruler, piece of paper, string, or pipe cleaner to measure a distance on the map and then hold it up to the scale to see the represented distance.

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."
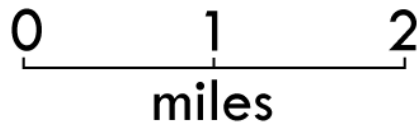
FRACTIONAL   1:63,360

VERBAL   1 inch = 1 mile

GRAPHIC   0   1   2
                     miles

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.
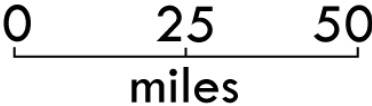
4.4. Converting scales

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.
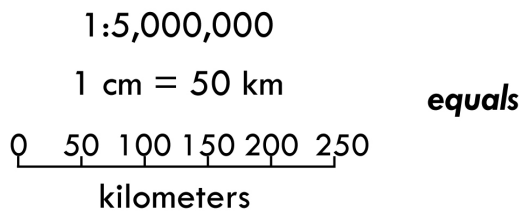
Fractional:
Verbal:
Graphic:

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?*

<div align="center">

1:5,000,000

1 cm = 50 km   *equals*

0   50 100 150 200 250

kilometers

</div>

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		
	1 cm = 40 km	
		0 10 20 30 40 50 kilometers

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.
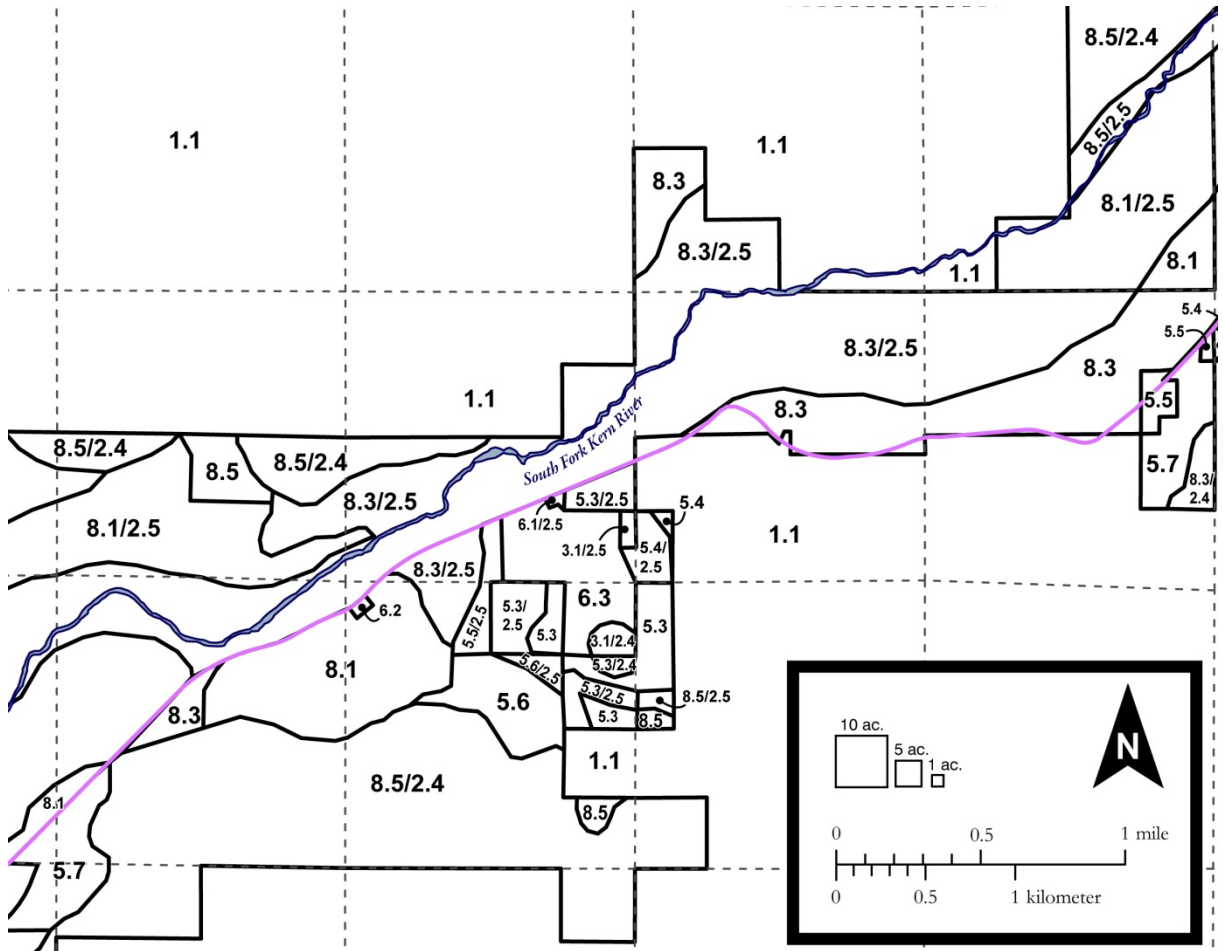
4.7. Understanding Scale

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 $\frac{1}{8}$ of an inch.
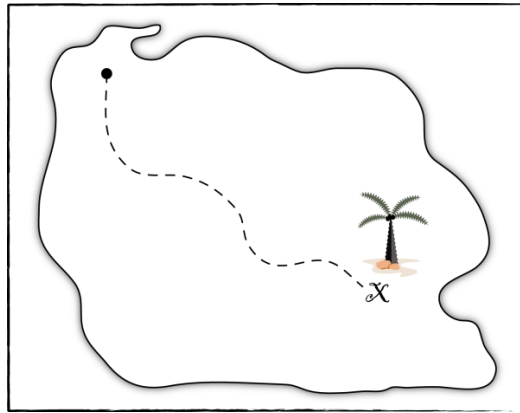
If the map is drawn with a scale of 1:5,000, how much area would the X cover?

Step 1.If 1 inch = 5,000 inches, how many inches would $\frac{1}{8}$ of an inch cover? Convert $\frac{1}{8}$ 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