Name: ______________________ **Laboratory Section:** ______________________

Date: ______________________ **Score/Grade:** ______________________

Video
Exercise 4
Pre-Lab Video

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LAB EXERCISE 4 Map Projections, Map Reading, and Interpretation

Lab Exercise and Activities

SECTION 2

Cylindrical, Planar, and Conic Projections

This step may be done by working in groups. Your instructor will direct you.

1. Using a globe and tracing (or wax) paper—notebook paper works with an illuminated globe—trace outlines of North America, South America, and Greenland. You can do this quickly; a rough outline showing size and shape is sufficient.

Using a globe and your tracings, compare the relative sizes of North America, South America, and Greenland. Which is larger and by approximately how many times? Describe your observations.

North America is larger than Greenland by eleven times, and South America is over eight times larger than Greenland. North America is roughly 25% larger than South America.

2. Examples of two cylindrical projections are presented in Figure 4.2, the **Mercator projection** (conformal, true-shape), and Figure 4.3, the *Lambert projection* (equivalent, equal-area). These two map projections—the Mercator and the Lambert—are simply being used to examine *relative* size and shape in each portrayal of Earth.

Trace around the outlines of the same continents and island as indicated above—North America, South America, and Greenland. You might want to mark and color code the tracings according to their source (Mercator or Lambert) for future reference. Use your tracings to answer the following questions. Keep in mind that these two sets of map outlines compared to the globe you used are not at the same scale: the distance measured along their respective equators will not be equal.

a) Using the outlines from the Mercator and Lambert map projections on the next pages, make the same comparisons among North America, South America, and Greenland. Which is relatively larger and by approximately how many times? Again, describe your observations.

Mercator

approximately same size (Greenland would appear larger if all of Greenland was shown on map)

Lambert

South America; approximately 5 times larger

b) Now compare the relative shapes of Greenland, North America, and South America from the globe (shows true shape) with those from the Mercator and Lambert projections. Is there distortion in terms of shape? If so, briefly explain how they are distorted.

Mercator

poleward areas appear larger, but not greatly distorted

Lambert

N -S "flattening ," especially at poles; makes them appear flatter N -S wider E -W than on globe

3. What happens to the circles in the Mercator projection (and, therefore, to the landmasses) as latitude increases? What causes this distortion of the circles away from the equator? (*Hint:* Compare parallels and meridians with those on the globe.)

Circles become larger at higher latitudes, so landmasses appear much larger than reality. Distance between parallels and meridians becomes greater toward poles (stretching).

4. What happens to the circles in the Lambert projection (and, therefore, to the landmasses) as latitude increases? What causes this distortion of the circles away from the equator? (Once again, compare parallels and meridians.)

Circles become flatter and wider (ovals); cause N -S "shortening" and E -W "widening" in polar regions. Parallels get closer on projection and meridians become parallel.

5. Cylindrical projections such as Mercator and Lambert would best be used in mapping what areas of the globe? Why?

Best for mapping equatorial areas (low latitudes); closest to line of tangency (equator) where there is least distortion.

6. Figure 4.5a shows Earth on a *planar* projection, in which the globe is projected onto a plane. This is a **gnomonic projection** and is generated by projecting a light source at the center of a globe onto a plane that is tangent to (touching) the globe's surface. The resulting increasingly severe distortion as distance increases from the standard point prevents showing a full hemisphere on one projection.

a) Where is the projection surface tangent to (touching) the globe? (See end flap of this lab manual.)

Tangent at North Pole (at a point, not along a line)

b) What kind of distortion, if any, occurs on a planar projection, and where?

N -S stretching increases with distance from the North Pole

c) Can you show the entire Earth on a single gnomonic projection? If not, why not?

No; cannot show anything south of equator

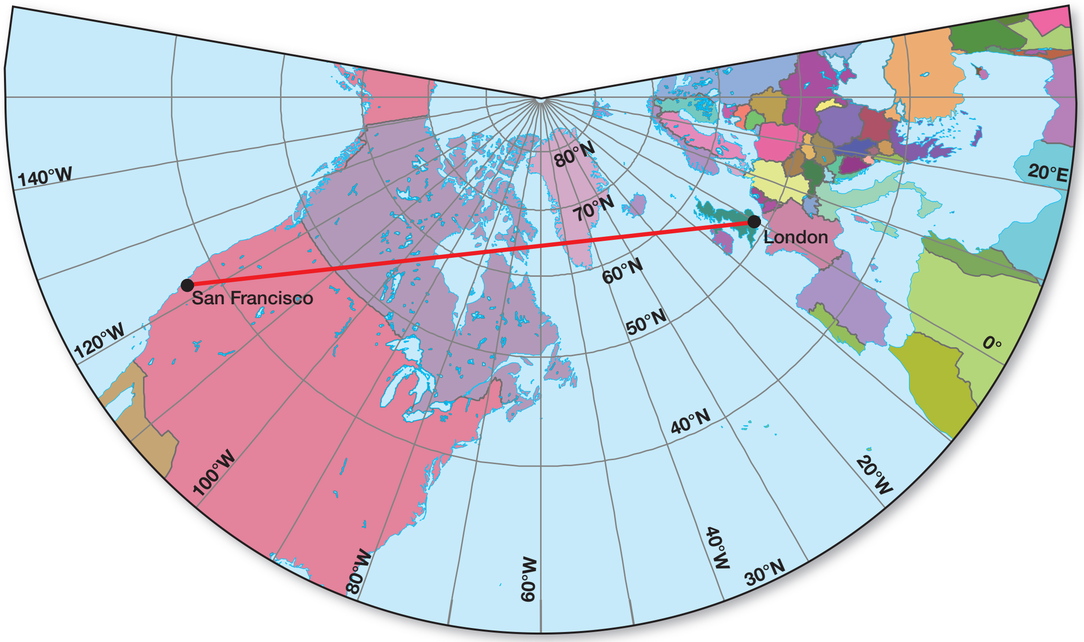
d) Which areas of the globe would likely be mapped on a planar projection, and why?

Used for high latitude/polar regions (Arctic/Antarctic); closest to point of tangency

7. Use the two maps in Figure 4.5 to plot a great circle route between San Francisco (west coast of the United States, where you can see small details of San Francisco Bay) and London (southern England at the 0° prime meridian). The straight line on the gnomonic projection will show the shortest route between the two cities. Transfer the coordinates of this route over to the Mercator map and connect with a line plot to show the route's track. Note the route arching over southern Greenland on the Mercator.

8. Assume you board a plane in San Francisco for a flight to London. Briefly describe your great-circle flight route between the two cities (plotted on the map in Figure 4.5b). What are some of the features over which you fly? Describe the landscape and water below.

Northeastward crossing Hudson Bay; east across the southern tip of Greenland; southeastward between Ireland and Scotland to London.



(a)

(b)

▲ **Figure 4.5** (a) Gnomonic/planar projection; (b) Mercator/cylindrical projection.

SECTION 3

Map Scale

Complete:

1. Several companies manufacture large world globes for display in museums, corporate lobbies, and science exhibit halls. If such a globe featured a *diameter* of 4 m (13 ft), what is the scale of this globe expressed as a representative fraction? (Show your work.) (*Hint:* Earth's equatorial diameter = 12,756 km [7926 miles].)

1:3,189,000 (4m diameter of globe, 12,756 km Earth diameter; 12,756 km ÷ 4 m = 3,189,000 m).

2. Given the large globe in Question 1 and your calculation of its representative fraction, convert the RF to a *written scale* for this globe (1 cm on the globe = ? km on Earth). (Show your work and remember that there are 100,000 cm in 1 km.)

1 cm = 31.89 km

3. Use the following topographic maps and a ruler (inches or cm) to measure the map distance between the points indicated. Noting the RF scales posted on each map, calculate the approximate ground distance (miles or kilometers). Keep in mind that there are 63,360 inches in a mile: 12 in./ft × 5280 ft/mile. Compare results with the graphic scale. (Show your work.)

   a) **Figure 20.6 Kīlauea Crater, HI, Topographic Map 1:** from the 3700-ft. contour label south of the Uēkahuna Bluff label to the Byron Ledge label on the east side of the crater.

   2.8 km, 1.7 mi 1:24,000 RF scale

   b) **Figure 25.6 Mt. Rainier National Park Topographic Map:** from Columbia Crest to McClure Rock.

   5.8 km, 3.6 mi 1:60,000 RF scale.

   c) **Figure 26.6 Death Valley Topographic Map:** from the 1000′ contour line in Trail Canyon on the west side of Death Valley to the 200′ contour line on the east side of Death Valley.

   13.9 km, 8.7 mi, 1:150,000 RF scale

4. Find three different maps or globes as follows. Briefly describe the content of each and record the scale as a representative fraction or other scale noted on each map or globe.

   a) Classroom globe ***personal answer***

   b) Map from your atlas ***personal answer***

   c) Topo map at back of this manual ***personal answer***

5. Give an example of a specific scale for each of the following:

   a) Small scale: ***personal answer***

   b) Medium scale: ***personal answer***

   c) Large scale: ***personal answer***

6. What is an appropriate scale to use in preparing a world map for a classroom (pull-down "wall" map)? Why?

Small scale is preferable (1:5,000,000 or smaller).

7. If you wanted a map to help you plan a local trip within your state or province, what scale would be best?

Large scale is preferable (1:62,500 or larger).

8. If you were helping to plan the painting of a world map on a local school playground that is approximately 10 meters along the equator, what scale would be best?

   RF: ***1:407,500***

   Written scale: ***1 cm = 4.075 km***

9. Using the metric-to-English conversion chart on the inside of the fold-out back flap of this manual, what would be the approximate length of the equator, in feet?

32.81 ft

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SECTION 4

Township and Range Survey System

Questions and analysis about the township and range system.

1. Complete the fill-ins presented in Figure 4.8 on the next page.

2. Using Figure 4.7 as your guide, which meridian and base line pair would be used to survey the area you are in?

   personal answer

3. As mentioned in the introduction to this section, California uses three different base lines and meridians. List the other states that use more than one base line and meridian pair.

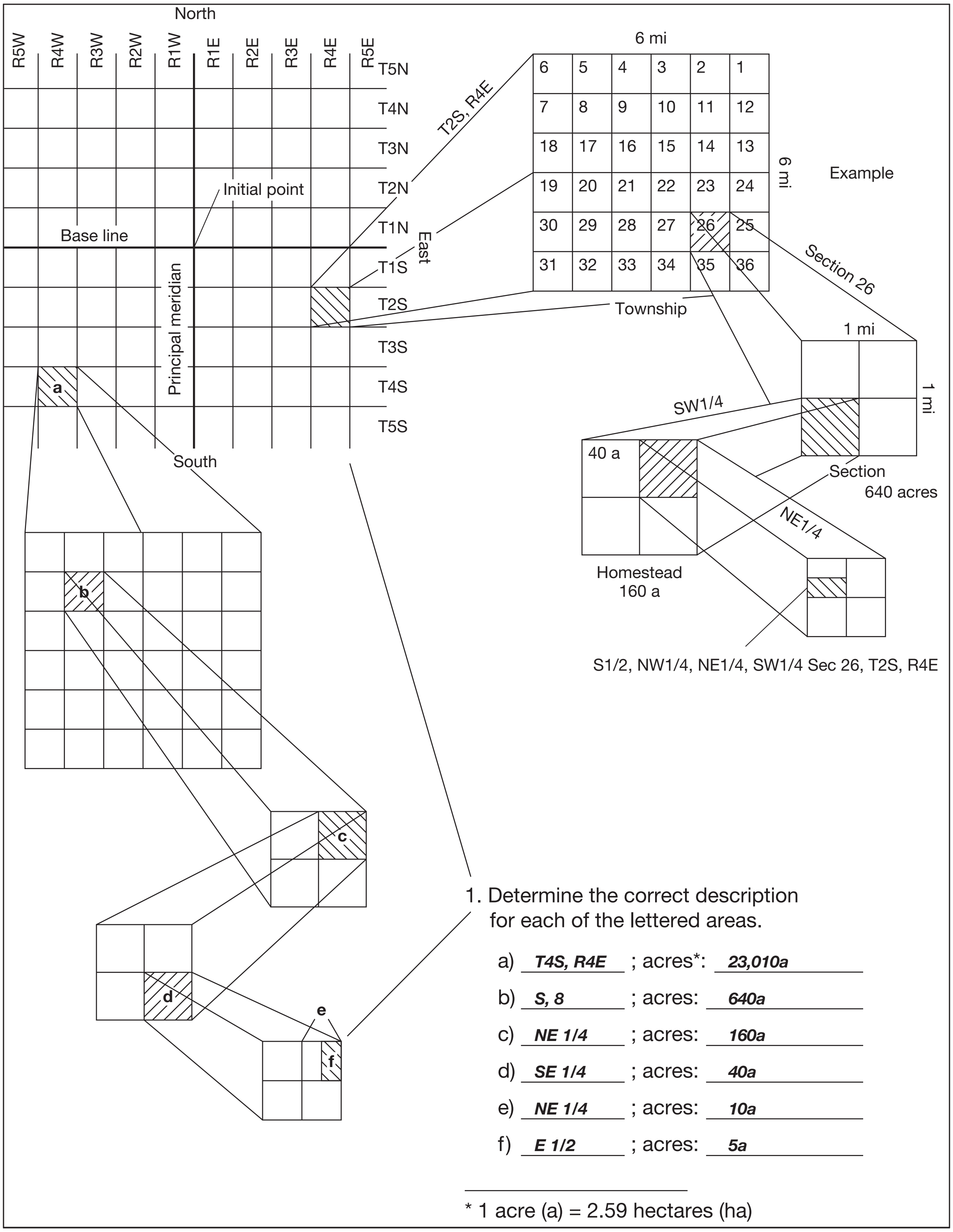
   Alabama, Illinois, Ohio, Pennsylvania, Mississippi

4. If your campus was surveyed using the public-lands system, give a full description of the campus in standard township and range format (consult a topographic map for your campus area).

   personal answer

5. If the state or region where your campus is located was surveyed under a different system (for example, parts of Texas, the original 13 colonies), describe it relative to this system.

   personal answer



▲ **Figure 4.8** Township and range rectangular survey grid system illustrating a parcel of land at S1/2, NW1/4, NE1/4, SW1/4, Sec 26, T2S, R4E