Name _____ Section _____

Partner(s)_____ Date_____

COORDINATE SYSTEMS: THE FLAT SURFACE ISSUE...PROJECTIONS

Why would you wish to use a flat map rather than a globe to determine or display the position of a planetary feature?

It is not always convenient to use spherical globes to determine and document positions or features on a planetary body. You may have limited space to store the globe or wish to transmit the information to someone else using paper. Flat maps have been employed for thousands of years to represent geographic information. These flat maps are a **projection** of three dimensional (3D) information onto a two dimensional (2D) surface.

Look at the Earth globe and the flat map of the Earth. Can you foresee any problems with this process of displaying 3D information on a 2D surface? Explain.

There are many different projection systems for converting the spherical coordinates to a flat surface. These involve formulas for calculating the position of each point from one display to another. In the process there will be some distortion to one or more of these characteristics: scale, area, distance between points, or direction. A map maker selects a particular projection so that the characteristic(s) he or she is most interested in is distorted the least.

On page 21 are three Earth projections, the Mercator, Behrmann Cylindrical, and the Mollweide. Each of the projections shows lines of longitude and latitude with the prime meridian centered on the display. The Mercator projection is the one commonly used for maps in textbooks. Use these map projections to address the questions that follow.

1. a. On the Mercator projection look at the rectangular sections generated by the latitude and longitude lines. Are the rectangles of equal area? Explain.

b. How do they vary as you move from equator to poles? from east to west?

c. Look at Behrmann and Mollweide projections and answer questions (a) and (b) for these.

d. Look at a globe of the Earth. Are the sections generated by latitude and longitude lines the same in area? Explain.

e. Which of the projections more closely represents the globe based on relative size of sections? Explain.

f. Which projection is least accurate in representing sectioned areas? Explain.

2. On the sheet with the map projections you will note that the oceans are represented in light gray and the land masses are either white or dark gray. We will be interested in the dark gray land masses.

a. Using the globe, label the dark gray land masses on one of the projections.

b. Look at the area of the United States, India, and Australia on each of the projections. What can you say about the relative area of these land masses on the three projections?

c. Compare the areas of the United States and Russia on the three projections. How do they compare?

d. Repeat the land area comparison with the United States and Greenland and then the United States and Antarctica. How do these masses compare?

e. Which projection shows the greatest relative difference in land masses? Explain

f. Do the greatest distortions occur between land masses in the same latitude ranges (north or south) or in different latitude ranges? Explain.

g. Where are the greatest distortions in the land mass areas? Why is this so?

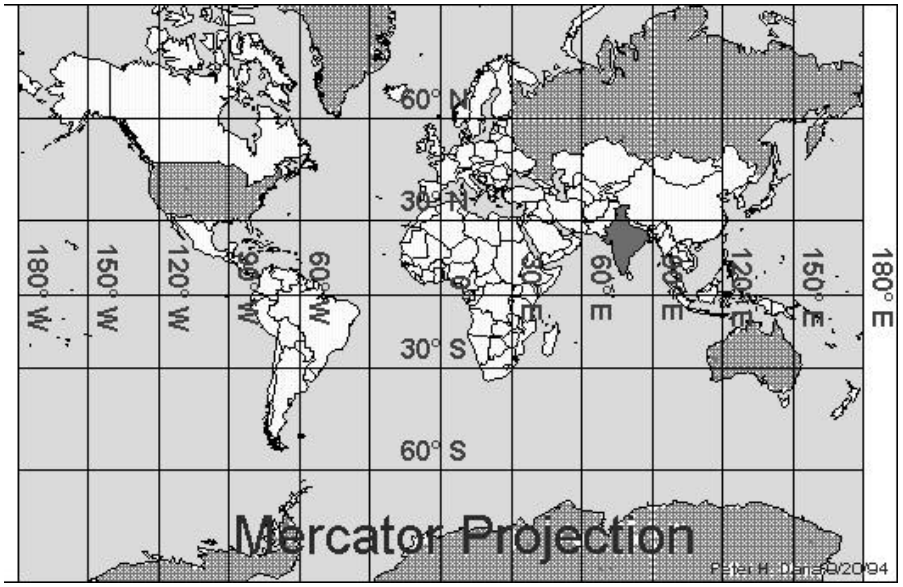
While the Mercator projection is the one you may be most familiar with, it is not an equal area projection, that is, the areas of the land masses and oceans are distorted as you move from the equator to the poles. This projection has advantages for navigation which is why it is so widely used. The Behrmann and Mollweide are equal area projections. The relative area of the land masses and oceans are preserved with these projections

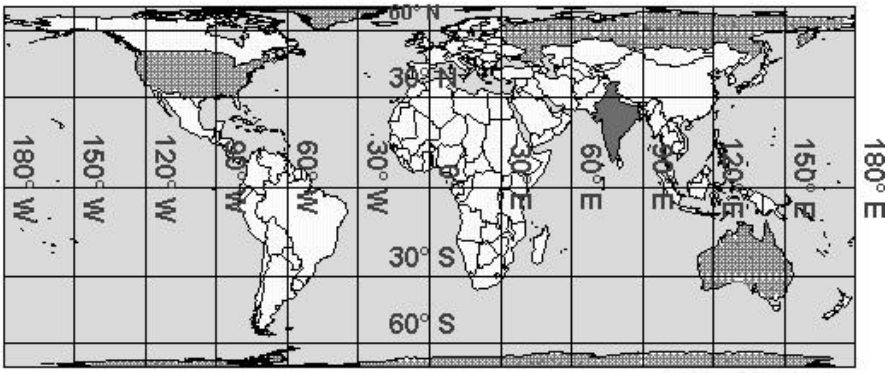
3. a. Look at the map of the Moon you used in the previous exercise. What type of projection was used to generate this map? Which properties are equal on this map (scale, area, distance, position)?

b. Repeat the procedure in (a) for the Mars map.

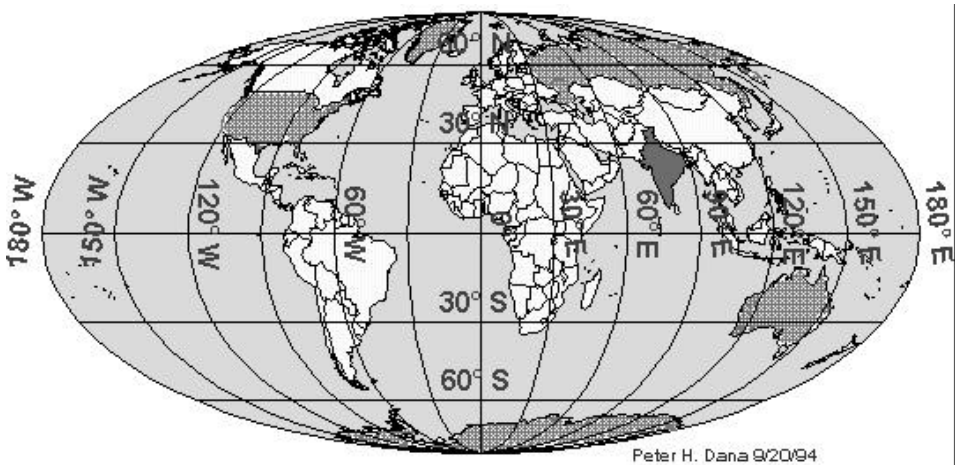
4. a. Suppose you want to make a flat map of the night sky. Based on this exercise, what problems would have to consider in constructing the map?

b. Which properties (scale, area, distance, direction) are most important to represent correctly? Explain.





Behrmann Cylindrical



Mollweide