Scientific Objective
The objective of this project is to prepare a flat sheet global map with contour lines representing the distance and bearing from a specific home seismic station. This map is useful in visualizing the locations of seismic events as they relate to shock wave travel times. Three-dimensional globes offer the most realistic way to locate seismic events, but these are inconvenient compared to flat sheet map projections.

Educational Objective
Understanding the geophysics of global mapping is both challenging and useful. For example it is not immediately obvious to a student accustomed with flat map projections of the globe that the most direct route from the United States to Japan leads over Alaska. Similarly, with an initial heading directly east and no adjusting of the flight path left or right, an aircraft would not reach Europe but rather pass over the western coast of Africa, the southern tip of Madagascar, and eventually the continent of Australia in the southern hemisphere. Yet another illustration of this concept shown on the figure above right is the most direct route, the great circle route, from New York to Moscow. This circumnavigated great circle route is then shown again as a sinusoidal shaped path on a flat sheet map projection below right.

From a perspective of geophysics these concepts are necessary to the understanding of bearing or direction from which a shock wave approaches a seismic station, which is a central task in seismology.

Project Description
This project relies on the mapping features of an Australian web site entitled Great Circle Mapper, which can be located by searching on that phrase. The main web page used here is pictured below. Various help screens are linked from the web site to explain its use, but what follows in this document is a brief description of how to request contour lines representing distance and bearing.

All distance and bearing contour lines must be associated with the latitude and longitude of a particular seismic station, presumably the home school. In the first map image for illustration, the home seismic station is PPNAF, Floyd Central High School in
Floyd County, Indiana, located at 38.33N 85.93W. The concentric circles represent distances of 100 and 200 miles from PPNAF. These contours are requested as shown in the user input box by this format: 100mi@38.33N 85.93W, 200mi@38.33N 85.93W, etc. The map encompassing only America shows the distance contours to appear circular.

On a larger global scale the next figure shows how stretching of the polar regions causes the distance contour “circles” to also be stretched in the polar portions. In this screen image the requested contours represent 1000, 2000, 11000, and 12000 miles from PPNAF. The antipodal position on the globe for PPNAF is located at a distance of approximately 12500 miles in the ocean area west of Australia (within the 12000 mile contour line on the screen image).

The screen image below also illustrates the request of great circle destination paths. The objective here is to request a set of destination locations at specific bearings from the home station (i.e., 30, 60, 90 degrees). To accomplish this task requires use of a separate web site which can identify the latitude and longitude of a location, say, 11000 miles from a specified home station at a bearing of, say, 30 degrees. There are several such web sites available from searches on the phrase “Vincenty Spreadsheet,” but one convenient site is linked from the Great Circle Mapper home page. Use the “Geodetic Calculations” menu link to access a downloadable spreadsheet which can accomplish the needed calculations.

Illustrated in the screen image below are the great circle paths from PPNAF to locations 11000 miles away at bearings 30 degrees and 90 degrees. To complete the great circle contour, the return path from 11000 miles back to PPNAF is also illustrated. These
bearing contours are requested as shown in the user input box with this format: 38.33N 85.93W-19.87S 83.04E, 38.33N 85.93W-35.52S 68.16E, 38.33N 85.93W-35.52S 119.98E. The KLOU input simply requested a marker be shown from the Louisville airport, which is relatively close to PPNAF from a global perspective.

The flat map that can be created in the manner described is illustrated nearby. Once the file has been created and saved, it is useful to manually add appropriate titles, labels, and a grid of latitude and longitude. This can be accomplished using any available graphics editing software such as Microsoft’s PhotoDraw.