

## **Latitude, Longitude and Map Projections in ArcGIS 9.x**

**Grade Level:** Grade 7, Grade 10, Grade 11

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### **Introduction**

The latitude and longitude coordinate system allows us to describe the locations of points anywhere on earth. The grid is composed of imaginary parallels of latitude that are measured in degrees north or south of the Equator ( $0^{\circ}$  latitude) and meridians of longitude that are measured in degrees east or west of the Prime Meridian ( $0^{\circ}$  longitude). The characteristics of the latitude – longitude grid on a globe are different from those on two-dimensional maps. These characteristics will also vary depending on the type of map projection that is used.

### **Objective**

This exercise will reinforce things you have learned about latitude and longitude. You will see the coordinate system from a global perspective while learning the location of some of the more significant lines of latitude and longitude. You will also demonstrate that the characteristics of the grid change with different map projections.

### **Required Files**

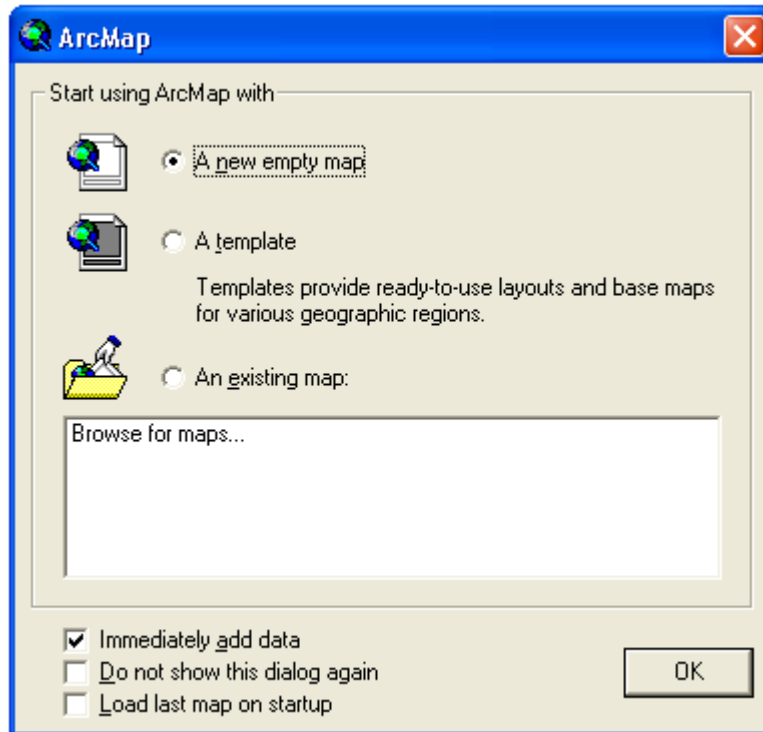
ArcCanada 3.1 Disk 3

- cntry00.shp
- Geogrid.shp
- latlong.shp

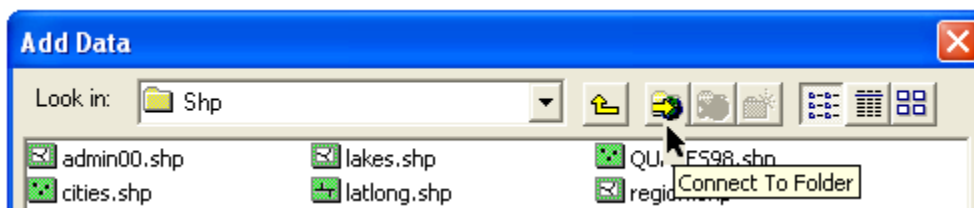
### **Instructions: Getting Started**

**Note:** When creating projects in ArcGIS, it is best to create a new folder for each project to save to. You can give the folder a name that corresponds with the nature of your project. Whenever you add or create theme layers in your project, select the corresponding folder to save your changes. Also, note that the directory paths shown in the screen shots will differ from the paths in your system. Ask your instructor if you need help creating a folder or selecting an appropriate file directory.

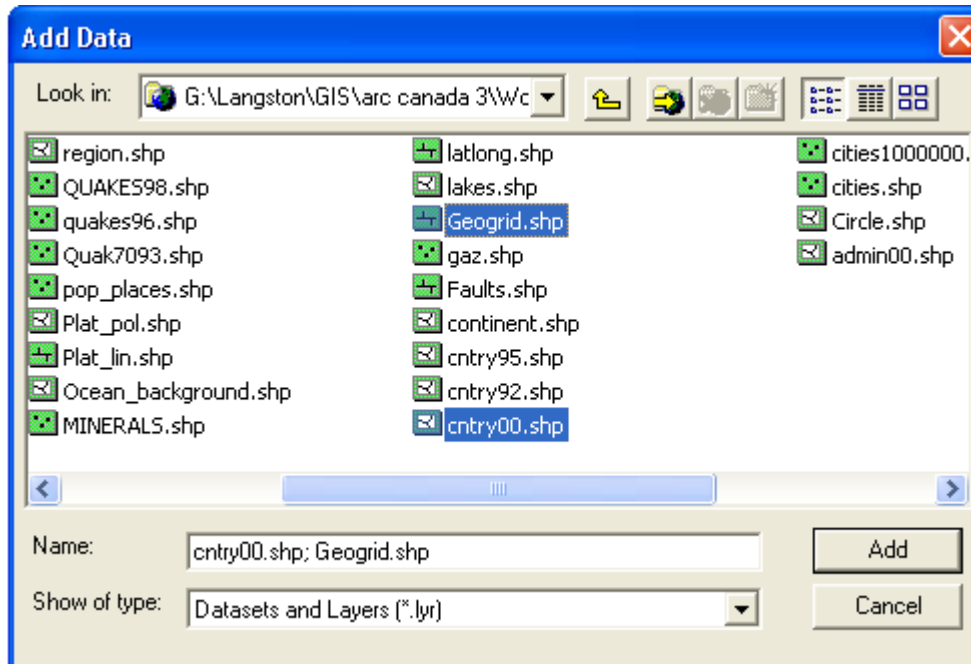
1. Launch ArcMap and when prompted, choose **A new empty map**.



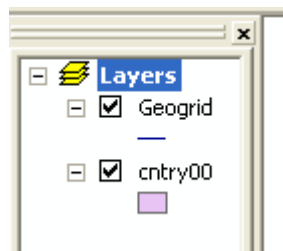
2. Use the **Connect To Folder** button to navigate to the location of **cntry00.shp** and **geogrid.shp** shapefiles. If you do not know where this data is located ask your instructor for help.



3. Use the **Add**  button to add **cntry00.shp** and **geogrid.shp** to your Data View (map).



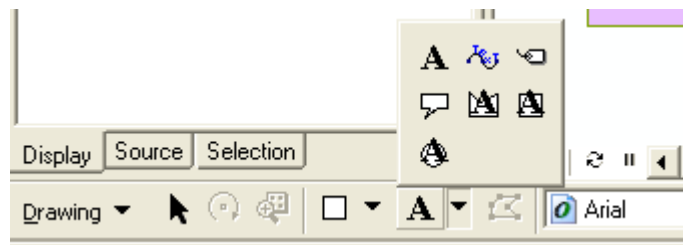
4. If the **Geogrid** is not the top layer in the table of contents, click on it and drag it so that it is above **cntry00**. This is necessary because the **cntry00** layer is a “solid” layer, while the **geogrid** is a “transparent” layer of lines.



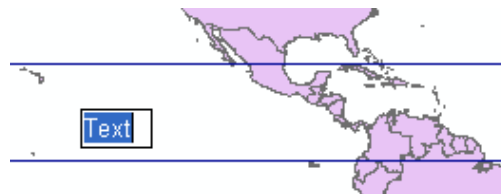
5. This is a good time to save your project. Go **File → Save As**, navigate to the folder you created for your project, create a title for your project, and select **Save**. Save your project frequently as you go along.


### Latitude and Longitude

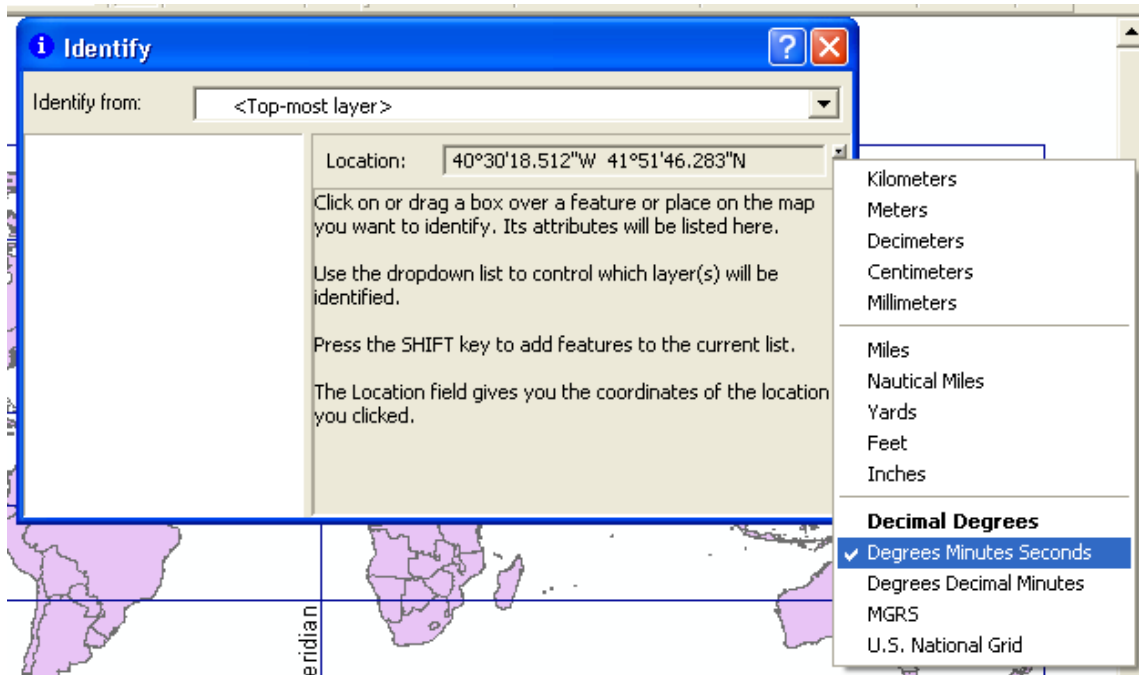
6. You will now label some features on the map related to latitude and longitude. To do this you will use the **New Text** tool found on the bottom tool bar. If you click on the drop down menu you can choose the type of labeling that you want to use.



7. With the **New Text** tool selected, click on your map where you want to label and when prompted type in the appropriate label.




8. Label the following features on your map:
  - Equator
  - Prime Meridian
  - Tropic of Cancer
  - Antarctic Circle
  - Tropic of Capricorn
  - Arctic Circle
  - North Pole
  - International Date Line
9. Using the **Identify** tool  you can determine the latitude and longitude of the various features on your map. Activate the **Identify** button and click anywhere on the map. A text dialog will appear; in the top centre you will see a bar labeled **Location**, click on the drop down menu and change the setting to **Degrees, Minutes, Seconds**.



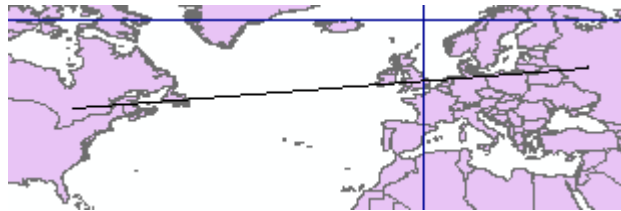
10. Each time you click the **Identify** cursor on the map, it will provide you with attribute data and the geographic coordinates (latitude and longitude) of the location you clicked. Click along various parts of the equator. What happens to the latitude and longitude as you move along the equator?
11. Move your cursor up and down the prime meridian. What happens to the latitude and longitude?
12. You can leave the labeling on your map, or you may wish to delete it as it will not be needed for the following exercise. To delete, go to **Edit** on the top toolbar, click on **Select all Elements** and hit **Delete** on your keyboard.


### Great Circle Route:

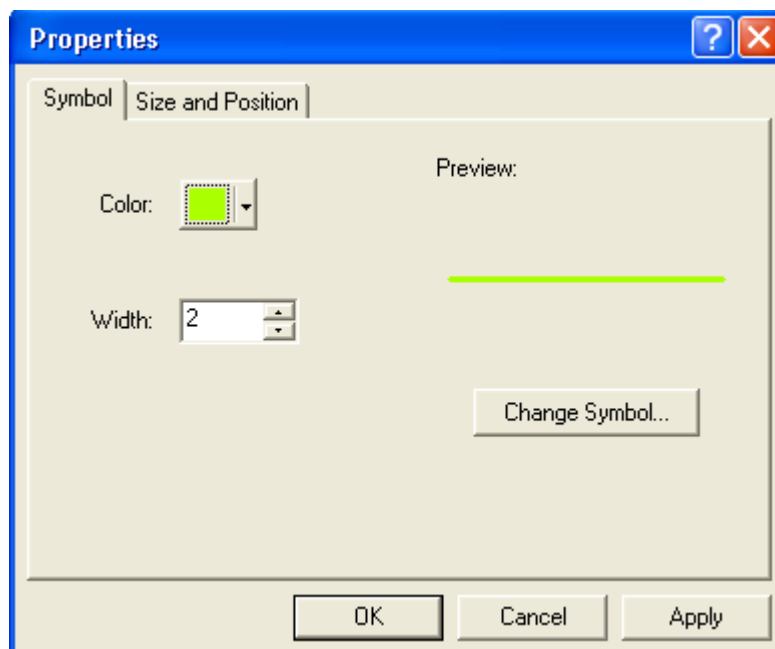
13. Now we'll take a look at the Great Circle Route and its characteristics on different map projections. Click on the **New Rectangle** button in the bottom toolbar and select the **New Line** tool  .





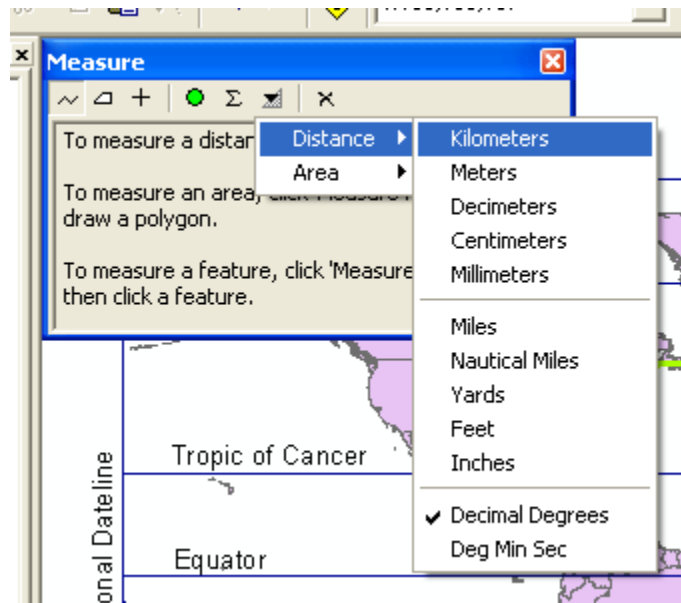
14. With the **New Line** tool selected, draw a line running from southern Ontario (approximate latitude is 45N and longitude is 83W) to western Russia (approximate latitude is 50N and longitude is 30E). To draw a line, click once where you want the line to begin and move the cursor to where you want the line to end and double click.



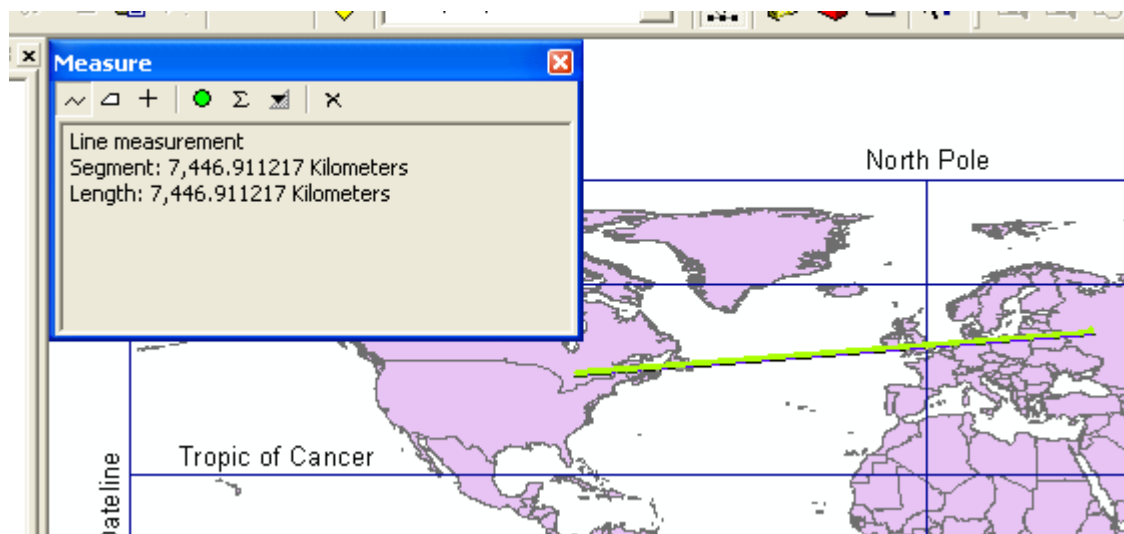
15. If the line is difficult to see, you can change the thickness and/or colour to make it more visible. Select the pointer arrow  on the top toolbar, then double click anywhere on the line and the **Properties** dialog displays. Select a colour and line thickness of your choice, then select **Apply** and **OK**.




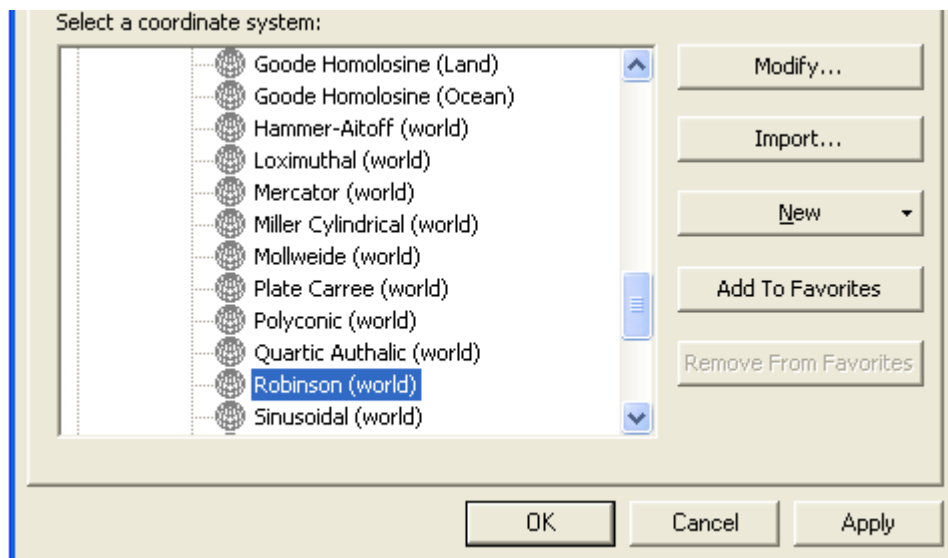
16. Now use the **Measure** tool  to measure the distance from southern Ontario to Russia represented by your line. When you activate the measure tool, the **Measure** dialog displays. Click on the **Choose Units** button , and from the drop down menu, select **Distance** and **Kilometers**.



17. Now click on one end of the line to start measuring and move the cursor to the other end of the line. The distance will be shown in the **Measure** dialog. Record the length of the line.



18. Now change the map to the **Robinson** projection to see how the characteristics of the line might change. Double click on **Layers**  in the **Table Of Contents**, then go **Coordinate System** → **Predefined** → **Projected Coordinate Systems** → **World** → **Robinson** → **Apply** → **OK**. If you get a Warning, select OK.



19. Now measure the distance again. What is the distance between southern Ontario and Russia in this projection? Why do you think the distance is different than in the previous projection (Geographic WCS-1984)?
20. Now change the map to **The World from Space** projection. If a Warning box appears, select **OK**. What has happened to the shape of the line? Why do you think this might be the case? What is the distance between the two points in this projection? (To measure a curved line, click once to change direction, then click twice to end the measurement).
21. What are some conclusions you can make about map projections based on the varying characteristics of the Great Circle Route?


### Map Projections – Country Shapes

22. Now delete the line on your map. On the top tool bar click on **Edit → Select all Elements** and on your keyboard hit **Delete**.
23. Before you change the map projection, take a look at how accurate the shape of the countries (e.g. Canada) appears to be.
24. Now change the projection to **Mercator** and select **Apply** and **OK**. If warning boxes appear click on **OK**. How has the shape of the countries (Canada) changed? Why might this have happened?
25. Now change the projection to **Sinusoidal** and look at the country shapes. Which projection do you think shows country shapes most accurately? Why?

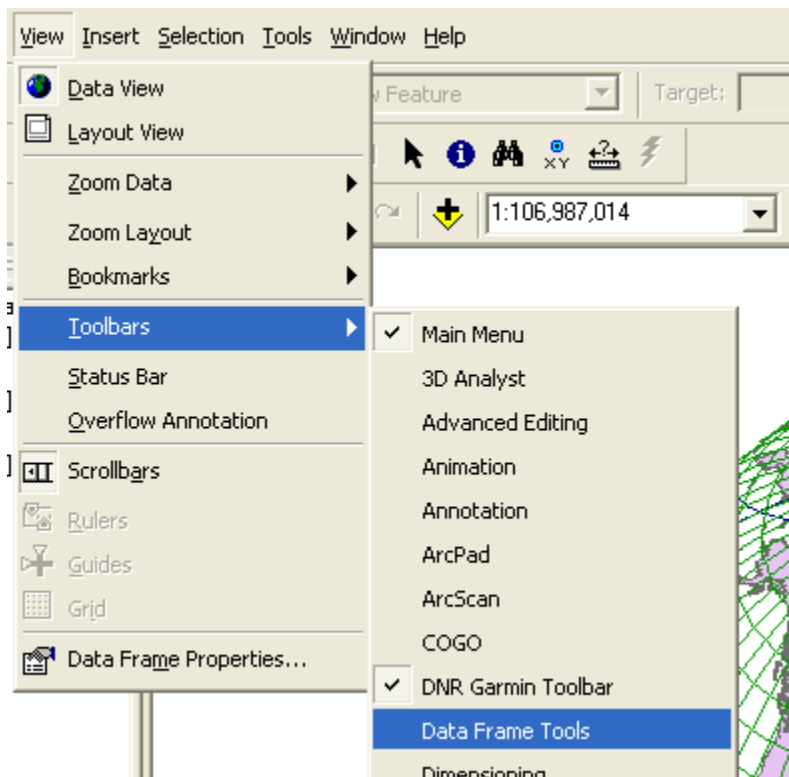


26. Now change the map projection back to **The World from Space** projection and list the advantages and disadvantages of this projection.

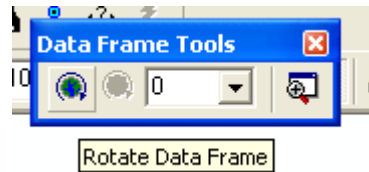
Advantages	Disadvantages

27. Now use the **Add Data** button , and navigate to **latlong.shp** located with the world data and select **Add**. If you do not know where this is ask your instructor. It may take ArcView a few minutes to load the latlong grid.

28. Now go **View** → **Toolbars** and click on **Data Frame Tools**.



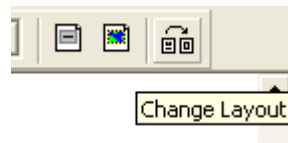
29. Select the **Rotate Data Frame** tool to rotate your map to see a variety of locations. As you rotate your map what happens to the lines of latitude? Longitude?



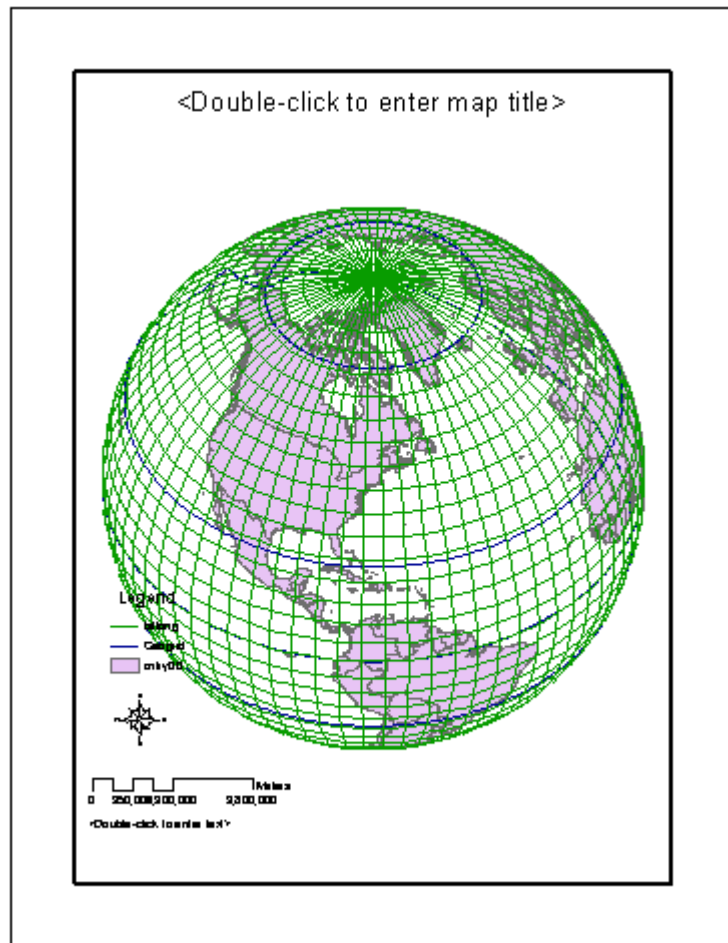
### Creating a Layout (Prepare Map for Printing)

30. It is now time to create a **layout** where all necessary map components can be added (legend, scale, north arrow, name, title and border). The easiest way to complete this is by using a map layout template. To do this, go **View → Layout View**. The default is the portrait view, however, you can change the layout by

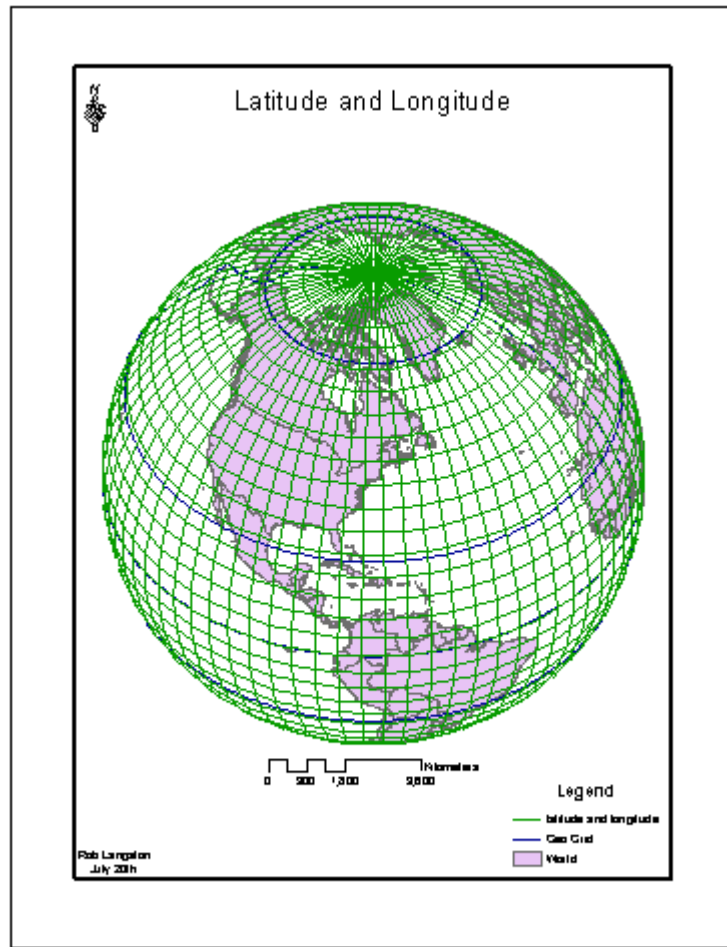
clicking on the **Change Layout** tool  found on the toolbar and then select **Letter Landscape** under the **General Tab**. We will keep the portrait default for this exercise.



31. You should now see a map with all necessary map components. (Whatever is visible in the **Data View** (map) will appear in the **Layout** view. If your map is too big or small you will have to go **View → Layout View** and zoom to the appropriate level.



32. Using the cursor, double click on the title line and add an appropriate title.
33. Using the cursor, move the north arrow and legend to a suitable location. If you want to make any changes to the legend or north arrow double click on each item and edit as required.
34. **Double click** where prompted to add your name and date.
35. **Double click** on the scale and go **Scale and Units** → **Divisional Units** and change the units to **Kilometers**.



36. Your layout is now complete and ready to show to your teacher or to print.

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