Exercise 5 Projection Manipulation

The Arc Map software has extensive capabilities that enable manipulation of map projections. The program enables two different approaches to altering the projection of the maps that you make:

1. Use the projection manipulation capabilities of the Arc Toolbox program to create a new data layer by re-projecting an existing layer. Before you can project a layer in this way the current projection must have been identified by using the projection definition capabilities of the Toolbox. In this case you create a completely new data layer. Use this approach when you wish to achieve maximum accuracy and will be building a permanent database that requires the projection or coordinate system into which you are projecting the existing layer. This is a topic treated in detail in the introductory and advanced GIS courses.

2. Project the Data Frame. In this case, you load one or more layers into a Data Frame and then open the Data Frame Properties dialog where you can specify a coordinate system for all layers in the frame. Before you can do this you or someone else must have identified the projection or coordinate system of all of the data layers you load into the Data Frame. In this instance you do not create a new data layer, but simply project the data layers "on the fly." Use this approach if you merely wish to display the layers in the projection. This is the approach we will use here.

In this workshop you will work with two databases: one that contains a shapefile depicting the outlines of the states of the United States and another that depicts the countries of the world. In both cases you will load a map document file that depicts the cartographic data layers in global coordinates. Your task will be to use the Data Frame projection capabilities of Arc Map to create new views of the data layers . The following tables summarize the datasets with which you will be working.
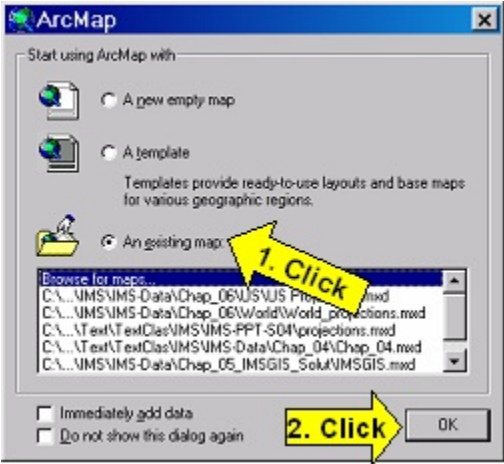
Files for US

Layer Name	Layer Type	Description
US48	Shapefile	Vector polygon file depicting the states of the contiguous United States. Also contains several attribute variables.
Latlong.shp	Shapefile	Vector line file depicting the parallels and meridians.
10 x 10 Degree Graticle.lyr	Layer file	File containing instructions for how to draw the meridians and parallels.
US Projections.mxd	Map document file	Map document file that you load to get started on the project's US maps. File defines two Data Frames, US 1 and US 2, and displays the states in global coordinates.

Files for World

Layer Name	Layer Type	Description
Countries.lyr	Layer file	Layer file containing instructions for drawing country outlines stored in country.shp
Country.shp	Shapefile	Vector data set depicting outlines of the countries of the world.
10 x 10 Degree Graticle.lyr	Layer file	File containing instructions for how to draw the meridians and parallels.
Latlong.shp	Shapefile	Vector line file depicting the parallels and meridians.
Cntrywch.dbf	DBASE file	Contains attribute data for world countries.
World_Projections.mxd	Map document file	Map file that you load to get started on the project. File defines four Data Frames, World 1, World 2, World 3 and World 4. Displays the countries in global coordinates.

Steps to Get Started with Project

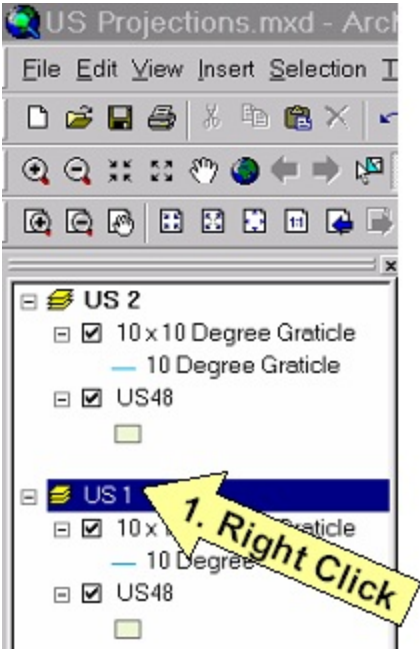| What you want to do	How to do it.	Icons & Dialogs
Run Arc Map.	Double click on the Arc Map icon, which you can find on the Desktop	
Load the Map document file.	Step 1. In the Arc Map dialog, click the "An existing map" option button and then click OK. The program will display the Open dialog.	

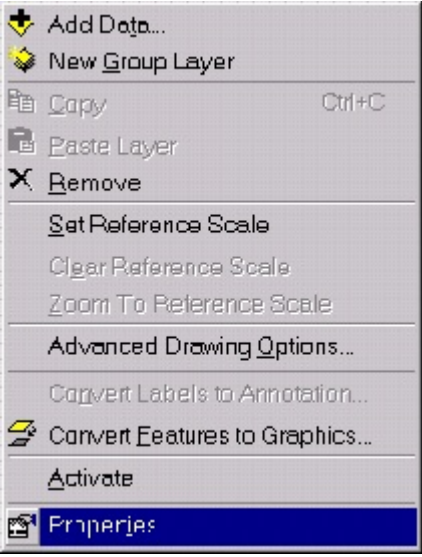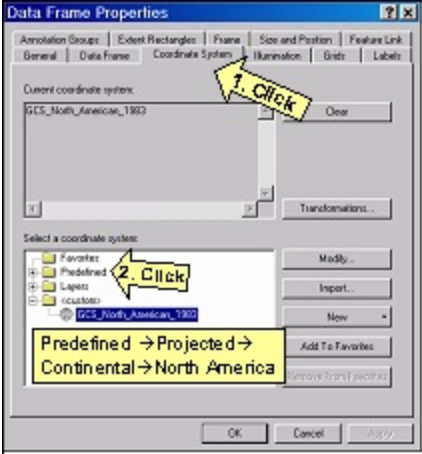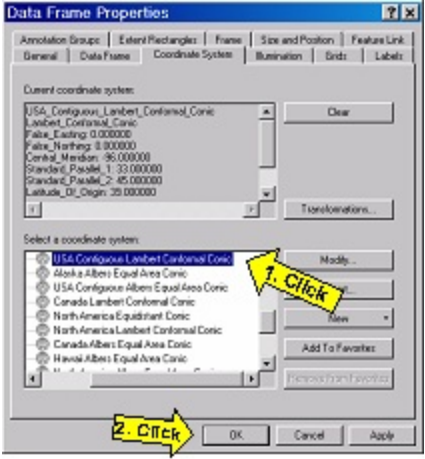| Load the Map document file.	Step 2. Navigate to the US directory of the exercise_05 folder, click to select the US Projections map document file, and then click OK. The program will load the layers.	

The illustration depicts the two Data Frames, US 1 and US 2, as they will appear after you load the map document file, US Projections. For this exercise, you can leave the program in layout display mode as you manipulate the projections of each Data Frame and make a couple of simple thematic maps of the United States.
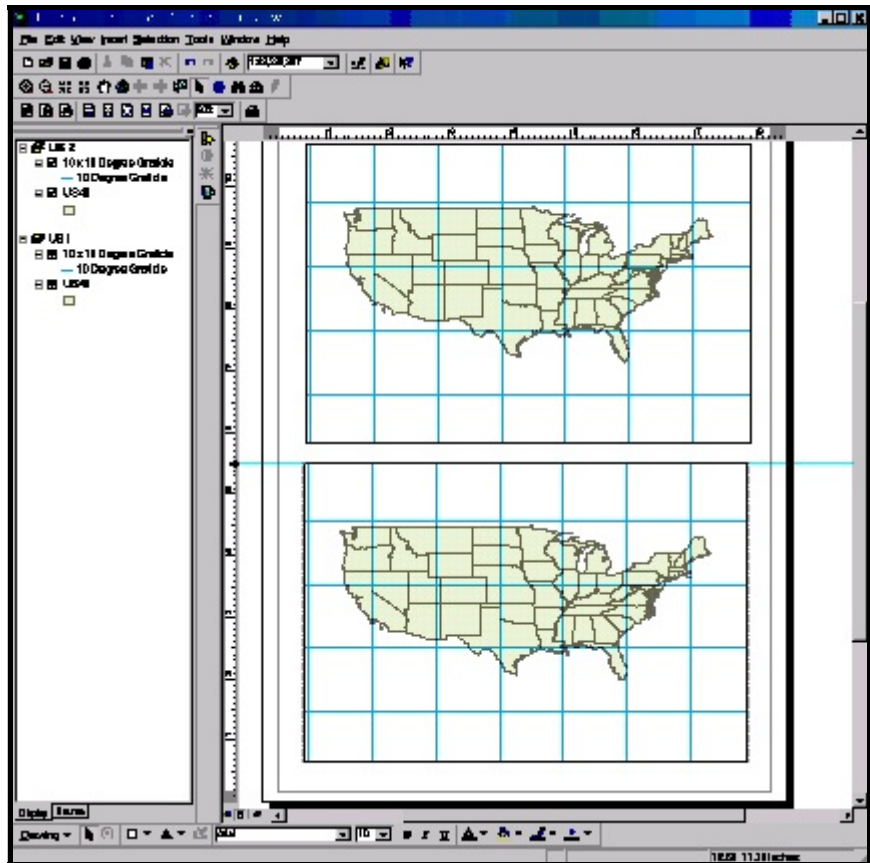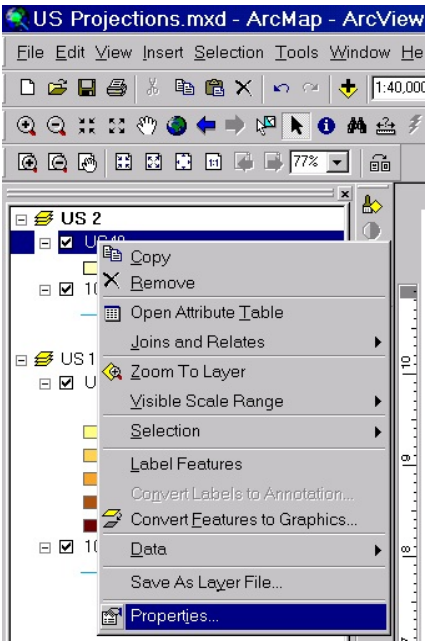
Projecting the US 1 Data Frame

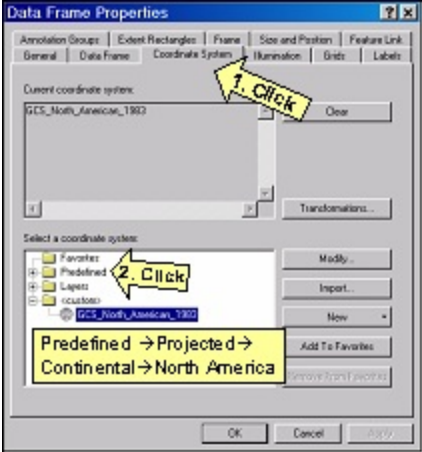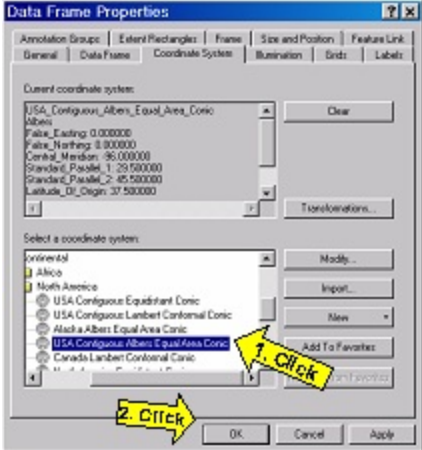| What you want to do	How to do it	Icons & dialogs
Change the projection of the Data Frame, US, 1 from global coordinates to USA Contiguous Lambert Conformal Conic.	Step 1. Right click on the US 1 Data Frame in the Table of Contents to open the drop down menu.	

Change the projection of the Data Frame, US, 1 from global coordinates to USA Contiguous Lambert Conformal Conic [continued].	Step 2. In the drop down menu, click on the Properties option. The program will open the Data Frame Properties dialog.	
Change the projection of the Data Frame, US, 1 from global coordinates to USA Contiguous Lambert Conformal Conic [continued].	Step 3. In the Data Frame Properties dialog, click the Coordinate System tab and then make the following selections: 1. Predefined 2. Projected 3. Continental 4. North America The program will present a series of projections appropriate for the North American continent.	

Change the projection of the Data Frame, US, 1 from global coordinates to USA Contiguous Lambert Conformal Conic [continued].	Step 4. Scroll until you see the USA Contiguous Lambert Conformal Conic projection. Click to highlight it and then click the OK button. The program will change the map display in the US 1 Data Frame to the projection you selected. Notice the Modify button. If you click this you will see a listing of projection parameters. You can change these to alter the standard parallels the central meridian or other projection features.	
The program displays the US states in the projection you selected. You are now going to make a thematic map of one of the available attributes. On your map include a title and a legend. There's not room for much else.	At this point, use the knowledge you have of the program to make a thematic map of one of the attribute variables. To do this begin by double clicking the layer name in the Table of Contents to open the Layer properties dialog. Select the Symbology tab then: 1. Select Quantities in the Show window. 2. Select Graduated Color as the map type. 3. By now you should know how to proceed from here.	

Projecting the US 2 Data Frame

What you want to do	How to do it	Icons & dialogs

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Change the projection of the Data Frame, US 2 from global coordinates to USA Albers Equal Area Conic.	Step 1. Right click on the US 2 Data Frame in the Table of Contents to open the drop down menu.	
Change the projection of the Data Frame, US 2 from global coordinates to USA Albers Equal Area Conic [continued].	Step 2. In the drop down menu, click on the Properties option. The program will open the Data Frame Properties dialog.	

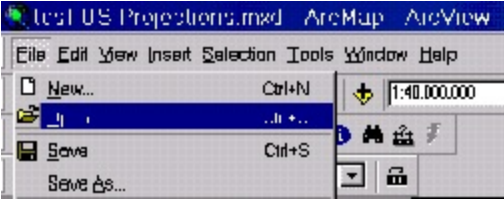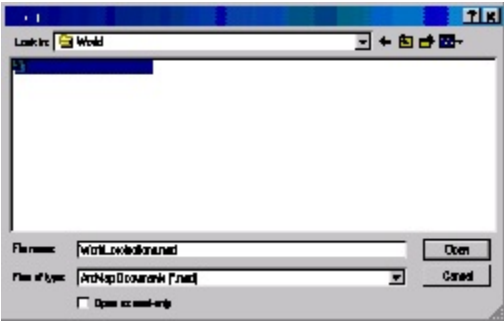|		
Change the projection of the Data Frame, US 2 from global coordinates to USA Albers Equal Area Conic [continued].	Step 3. In the Data Frame Properties dialog, click the Coordinate System tab and then make the following selections: 1. Predefined 2. Projected 3. Continental 4. North America The program will present a series of projections appropriate for the North American continent.	
Change the projection of the Data Frame, US 2 from global coordinates to USA Albers Equal Area Conic [continued].	Step 4. Scroll until you see the USA Contiguous Albers Equal Area Conic projection. Click to highlight it and then click the OK button. The program will change the map display in the US 2 Data Frame to the projection you selected. Notice the Modify button. If you click this you will see a listing of projection parameters. You can change these to alter the standard parallels the central meridian or other projection features.	
The program displays the US states in the projection you selected. You are now going to make a thematic map of one of the available attributes. On your map include a title and a legend. There's not room for much else.	At this point, use the knowledge you have of the program to make a thematic map of one of the attribute variables. To do this begin by double clicking the layer name in the Table of Contents to open the Layer properties dialog. Select the Symbology tab then: 1. Select Quantities in the Show window. 2. Select Graduated Color as the map type. 3. By now you should know how to proceed from here.	

As you can see in the following illustration, at the scale of the continental United States, even though one is equal area and the other is conformal there is not much obvious difference between the two projections. Both are conics, both are drawn secant. Both of these are projection characteristics that reduce distortion. Can you explain why?

Before ending your work with the US data, be sure to save the map document file. For that matter, as you work, save the file from time to time.
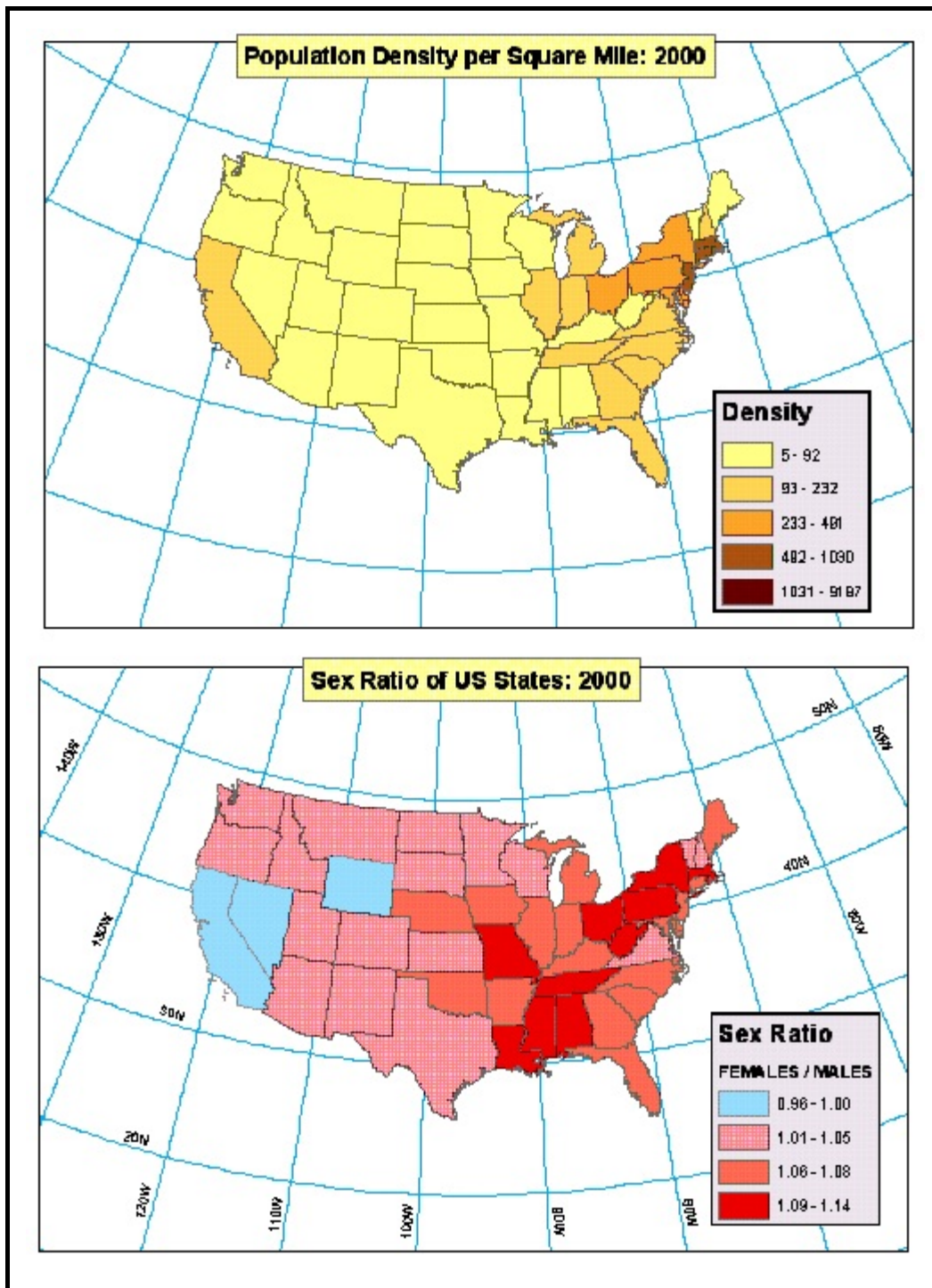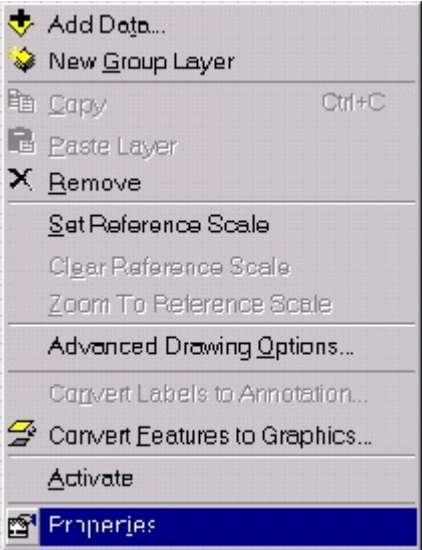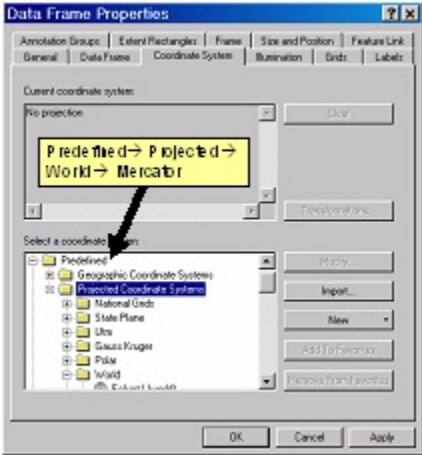
Working with the World Projection Data

Steps to Get Started with Project

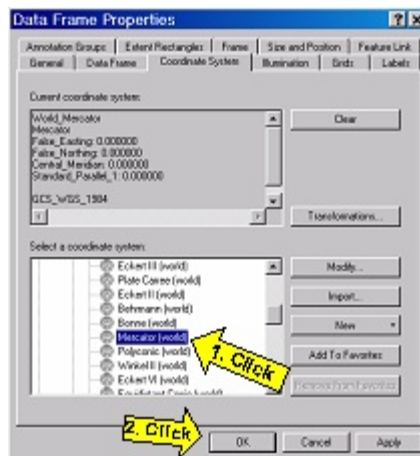| What you want to do	How to do it.	Icons & Dialogs
Open the Map Document so that you can see the world data layers.	Click on File in the Main menu and select Open from the drop down menu. The program will display the Open dialog.	
Load the Map document file.	Step 1. Navigate to the World directory of the exercise_05 folder, click to select the World_Projections map document file, and then click OK. The program will load the layers.	
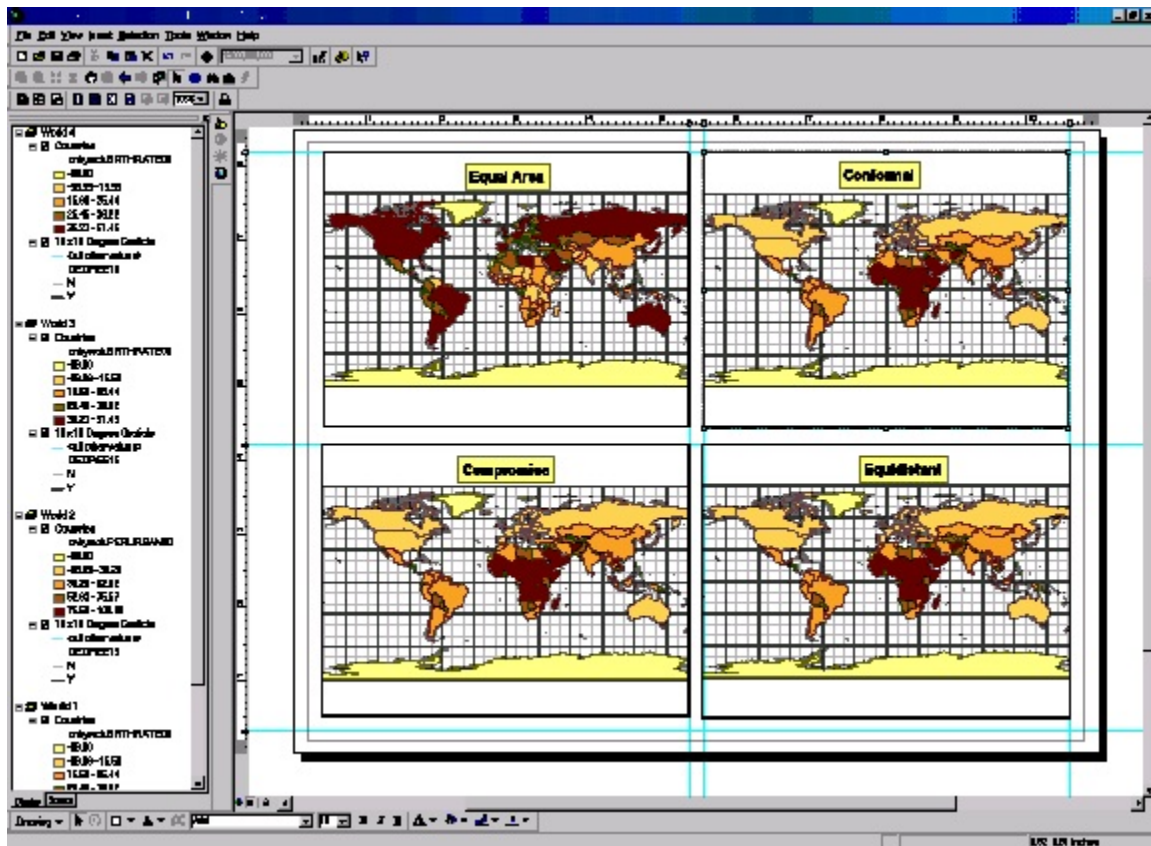
Projecting the World 1 Data Frame

What you want to do	How to do it	Icons & dialogs
Change the projection of the World 1 Data Frame, from global coordinates to Mercator Conformal.	Step 1. Right click on the World 1 Data Frame in the Table of Contents to open the drop down menu.	

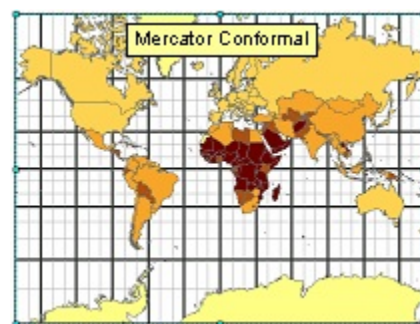|		
Change the projection of the World 1 Data Frame, from global coordinates to Mercator Conformal [continued].	Step 2. In the drop down menu, click on the Properties option. The program will open the Data Frame Properties dialog.	
Change the projection of the World 1 Data Frame, from global coordinates to Mercator Conformal [continued].	Step 3. In the Data Frame Properties dialog, click the Coordinate System tab and then make the following selections: 1. Predefined 2. Projected 3. World The program will present a series of projections appropriate for the World.	

Change the projection of the World 1 Data Frame, from global coordinates to Mercator Conformal [continued].	Step 4. Scroll until you see the Mercator world projection. Click to highlight it and then click the OK button. The program will change the map display in the World 1 Data Frame to the projection you selected. Notice the Modify button. If you click this you will see a listing of projection parameters. You can change these to alter the standard parallel the central meridian or other projection features.	
The program displays the World countries in the projection you selected.	At this point, use the knowledge you have of the program to add a text box to the Data Frame. In the text box identify the projection and its type. To do this begin by clicking Insert in the Main Menu and selecting Text from the drop down menu. By now you should know how to proceed from here.	
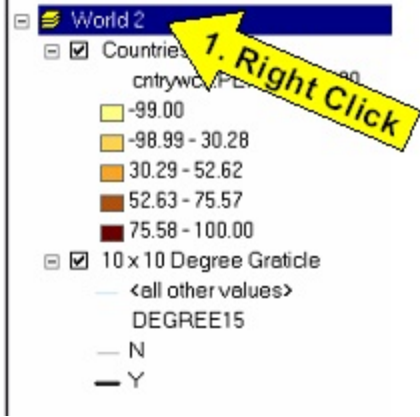
Projecting the World 2 Data Frame

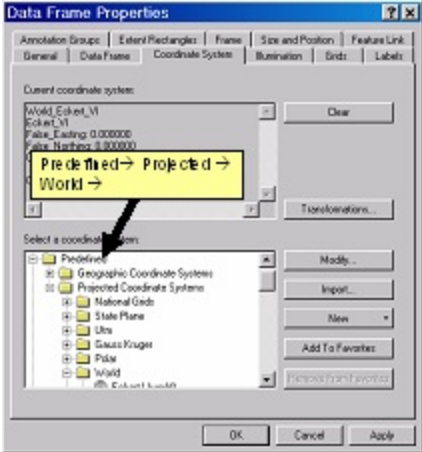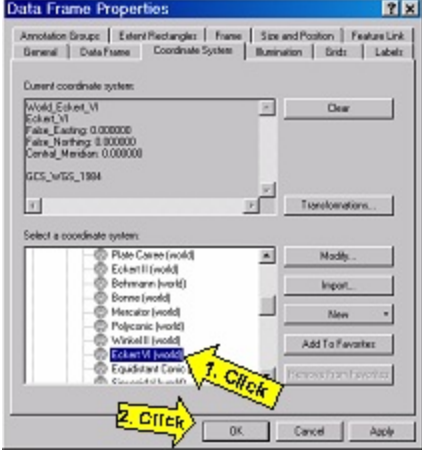| What you want to do	How to do it	Icons & dialogs
Change the projection of the World 2 Data Frame, from global coordinates to Eckert IV Equal Area.	Step 1. Right click on the World 2 Data Frame in the Table of Contents to open the drop down menu.	*(Table of Contents image showing World 2, Countries, cntrywo/PE..., -99.00, -98.99 - 30.28, 30.29 - 52.62, 52.63 - 75.57, 75.58 - 100.00, 10 x 10 Degree Graticle, <all other values>, DEGREE15, N, Y, with "1. Right Click" arrow)*
Change the projection of the World 2 Data Frame, from global coordinates to Eckert IV Equal Area [continued].	Step 2. In the drop down menu, click on the Properties option. The program will open the Data Frame Properties dialog.	*(Drop down menu image showing: Add Data..., New Group Layer, Copy Ctrl+C, Paste Layer, Remove, Set Reference Scale, Clear Reference Scale, Zoom To Reference Scale, Advanced Drawing Options..., Convert Labels to Annotation..., Convert Features to Graphics..., Activate, Properties)*

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Change the projection of the World 2 Data Frame, from global coordinates to Eckert IV Equal Area [continued].	Step 3. In the Data Frame Properties dialog, click the Coordinate System tab and then make the following selections: 1. Predefined 2. Projected 3. World The program will present a series of projections appropriate for the World.	
Change the projection of the World 2 Data Frame, from global coordinates to Eckert IV Equal Area [continued].	Step 4. Scroll until you see the Eckert IV world projection. Click to highlight it and then click the OK button. The program will change the map display in the World 2 Data Frame to the projection you selected. Notice the Modify button. If you click this you will see a listing of projection parameters. You can change these to alter the central meridian or other projection features.	
The program displays the World countries in the projection you selected.	At this point, use the knowledge you have of the program to add a text box to the Data Frame. In the text box identify the projection and its type. To do this begin by clicking Insert in the Main Menu and selecting Text from the drop down menu. By now you should know how to proceed from here.	

For the two remaining Data Frames specify projections in a similar manner:

1.   For the World 3 Data Frame draw a Robinson projection. This is a compromise projection that many

atlases and texts use for world maps. Although it is neither equal area or conformal, both shape and area distortion are small within 45˚ of the origin of the projection.

2. For the World 4 Data Frame draw a Plate-Caree projection. This projection depicts distances accurately along meridians and along two standard parallels.

When you are finished, your Data Frames should appear as in the following illustration.
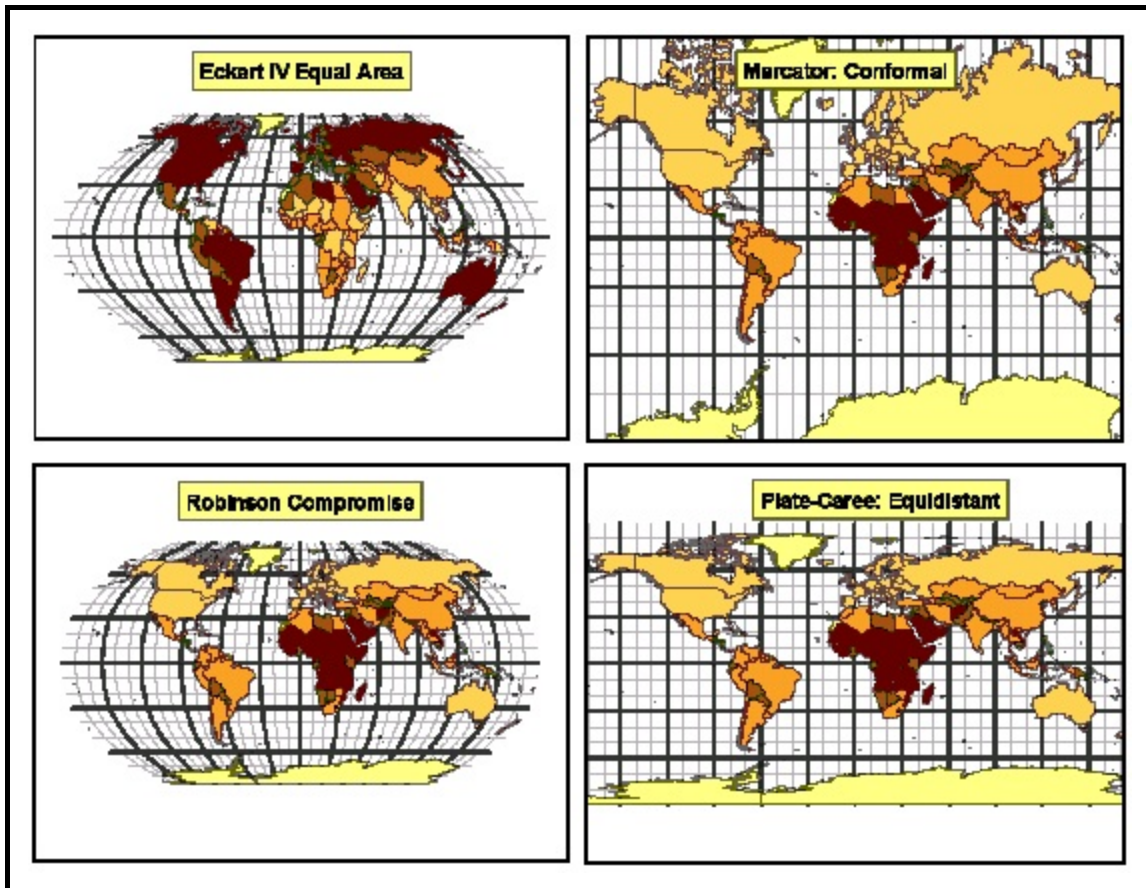
Assignment.　　　**Map 1. Print a color copy of your US layout with the two thematic maps.**

Map 2.　Print a color copy of your world projection exercise. Make sure to include a text label in each Data Frame that identifies the projection and its type.