Getting Started with ArcGIS
## Integrating Different Data Sources, Creating Maps

INTRODUCTION

In the first lesson of this module you learned how to connect to data locations on your computer, how to add data to a map, and how to symbolize that map. In this lesson you will link an external data set to the same data you worked with in the first lesson as well as learn how to take your symbolized (classified) map and make it complete (adding a scale bar, north arrow/compass rose, a legend, etc. Before you get started you will need a new file available from the S4 Training Page located under Module 1.

Navigate to http://www.s4.brown.edu/S4/about.htm, select "teaching and training" from the menu bar on the left. This page consists of several tutorials; for each tutorial there are accompanying data files, readings, and links necessary for completing each. Under the Getting Started with ArcGIS2 tutorial you should see a data file called **EconomyCLASS.dbf, download it and unzip it to a location on your computer** (it can be a network or local location).

To get started you can **open ArcMap and ArcCatalog and add the "cntry00.shp" data to your map in ArcMAP** (same data you used in the Getting Started with ArcGIS 1.

Once you have this map file open **right click on the layer name and view the drop-down window (see two images below). You will select "properties" next.**
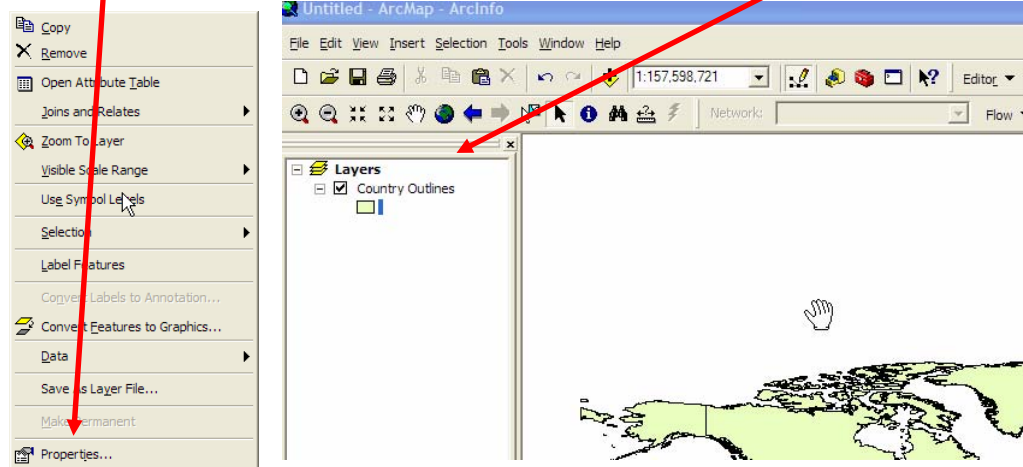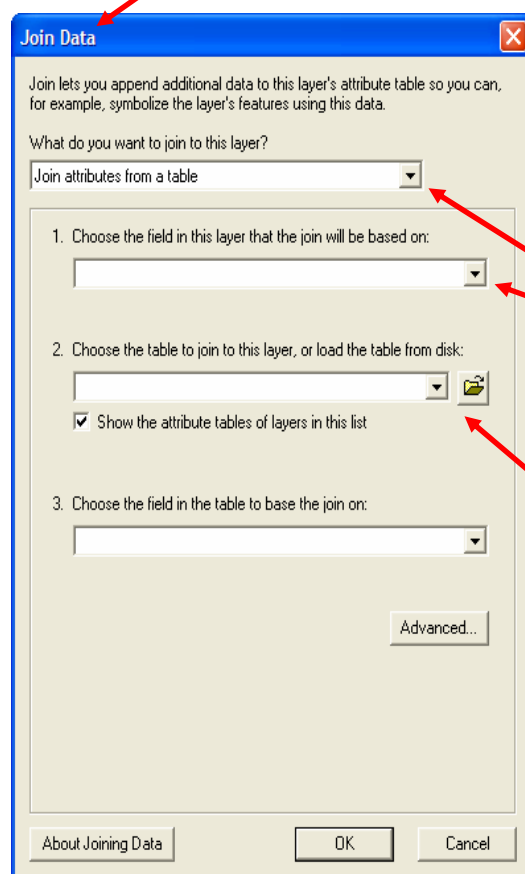

Remember from lesson one that this drop-down window contains several useful tools; in lesson one you used the "properties" component to color (symbolize) your map. In this tutorial you will join an outside data set to your world map (as was suggested in lesson one).

Click on "Joins and Relates" and select "Join…" This will bring up a new window in which you will establish the relationship between your world map and a data file. The data file we are using is a list of world countries (fewer than in the map file) with an associated economic developed classification. The original data came from the World Bank (link below) and can be downloaded from that location as well, the excel data must be converted to Dbase 4 format for joining (that step has already been complete for you). Each country has been assigned to one of four classes (high income, Upper-Mid, Lower-Mid, and Lower Income, additional information on the classification scheme can be found at the following World Bank site).

http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458
~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html

In addition to what you are learning in this lesson there are several other approaches to linking outside data to maps in ArcMap. Here is a link to a file created by ESRI Inc., the company that develops and publishes the ArcGIS software.

http://www.esri.com/news/arcuser/0104/files/excel.pdf#search=%22join%20a%20csv%20
file%20arcgis%22

When setting up a join between your current map and an external data file there are a couple of required elements. The external file must be in an acceptable format, either text (comma separated values or .csv, specifically) or Dbase (.dbf) version 4. There are ways to link excel files and other formats and these are covered in the above ESRI file, but the process is quite complicated and requires changing database setting associated with the excel file. Second, the external database file and the map fill (check the attribute table) must have a column in common; they must share a variable with a similar range of values. The heading of the column doesn't need to be the same, but the contents must be the same (format, spelling, etc.). *In this lab we are using a 3 character country code, not country name, although it's there.*

In order to establish the join **you will need to specify the file to be joined (EconomyCLASS.dbf), and the "Field" (column, variable, attribute, etc.) in both the map file and the data file.** If you open the attribute table of the map file and the Dbase file (you can use excel) you will see a couple of variables that have potential for joining, country names might seem the most intuitive. Unfortunately it presents some potential problems, including multiple spellings, misspellings, and different versions of a country's name. Therefore, **you should use the 3 character code ("ISO_3digit" in the map file and "code" in the dbase file).** These codes represent the ISO 3166-1 alpha-3 codes for each country; they are unique and are more likely to result in a successful join. Once you've filled in these boxes click "OK," click yes if you are asked if you want to create an index for the join.

MAPPING THE NEW VARIABLES

Now that the data files have been joined to the attribute table you can **view the new column by right clicking the "cntry00" layer and selecting "open attribute table."** As you scan from the left to the right you will notice that the columns associated with the Dbase file have column headings that are different from the map file columns. Each column name is preceded by the name of the dbase file (EconomyCLASS). You will also see "<null>" entries sprinkled throughout the table that are associated with entries in the map file (countries) that were not part of the EconomyCLASS data file. These include possessions of other countries (Falkland Islands, Pitcairn Island, etc.), multi-national geographic entities (Antarctica), and other places that might not be relevant or reasonable to include in the World Bank database.

Close the attribute table and right click on the "**country outlines" layer again and select "properties" (at the bottom), then select the "symbology" tab.** You're going to map the development categories associated with the World Bank data and give each category a unique color (value). **In the far left of the symbology window click "Categories" and select "Unique values."** Because you are mapping unique values you don't have to worry about a classification scheme. After selecting "Unique values" you have to select the correct variable to map: **in the "Value Field" pull down menu select "EconomyCLASS.INCOME.GRO"** this is the development index from the World Bank. **Once selected you will have to click on "Add All Values" at the bottom of this window.**
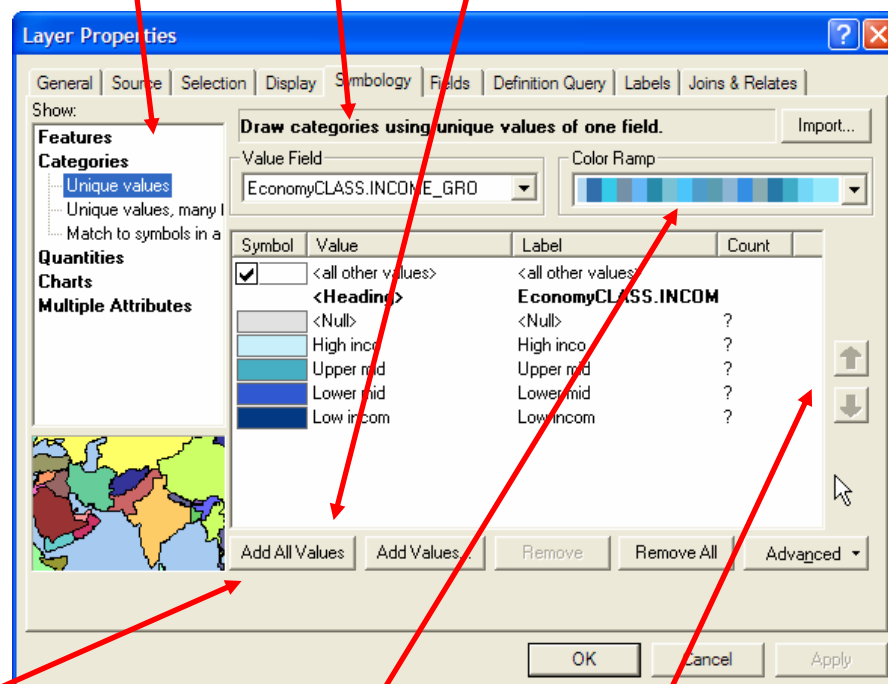

"Add all values" will add all possible values for the variable you want to map. You can also **select a color scheme ("Color Ramp") and/customize the**

colors, if you like. For now just be sure that something associated with your color selection is related to the variable you are mapping. In this case, the variable represents relatively higher and lower economic development, so something in the color sequence should match this relationship. In the example above as the color blue gets darker relative development decreases (or lighter means higher). One thing to note is that the order of the variable levels in the symbology window will be the order on the map and in the legend, you can use the UP and DOWN arrows to move selected items up and down (for this map you should move "Low income" and "Lower mid" to the bottom), then manipulate your colors.

Now you might have something that looks like this:
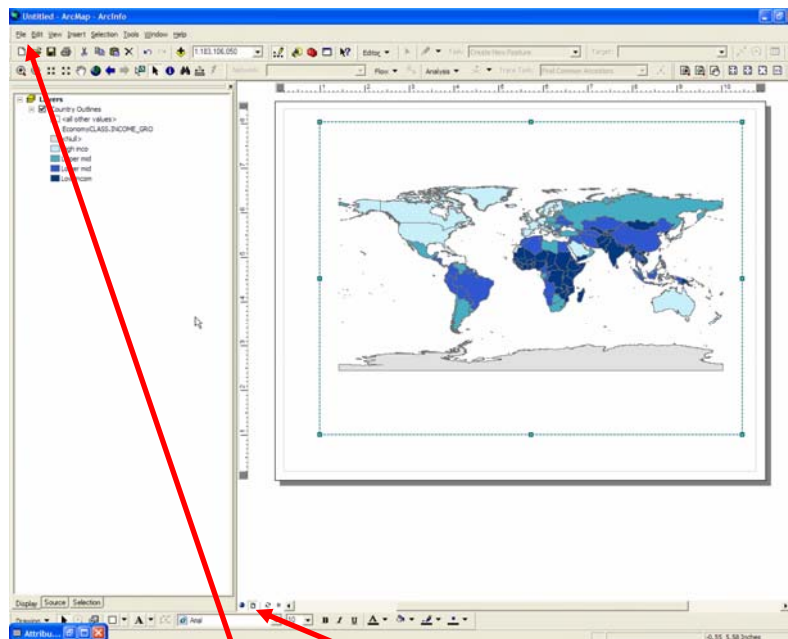
In order to make this look more "map-like" you're going to switch over to Layout view, which can be done from the bottom left of the view window (the little Earth is the data view and the page is the layout view).
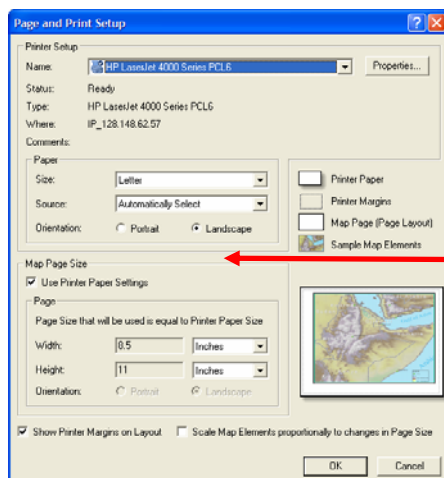
If your map isn't in an orientation that you like (portrait vs. landscape) you can change orientation just like you change page properties in most windows programs; from the File Menu select "Page and Print Setup." In the "Paper" section there are two buttons, one for portrait and one for landscape, make your selection here.

There are several other useful options here that you should check out, although we won't be dealing with them in this lesson. You can set your paper size (map size), which is often overlooked but is an important part of map-making.

MAKING A MAP

What does a map need to be legitimate? There are lots of elements that play an important role in making a map useful. This is the ultimate goal in creating any map for an outside audience (as opposed to a map intended for analysis and probably targeted to a single user, often the map maker, or a small group), it must clearly communicate the mapmaker's message. The following section summarizes some of the more common map elements, it is important to think about each individual element that is to be added to a map; everything that is added has the potential to add to the maps ability to communicate your message, at the same time it has the potential to distract from the map's central focus.

Some of the elements that a map can include are:

Title

The title of a map is usually one of its most essential features. As such, it should receive very careful attention so as to match the needs of the theme and audience. A short title might suffice if readers can be assumed to be familiar with the theme being presented; more information is needed for less experienced readers. The content of the title should also be measured against other lettering applied to the map, for example in the legend or annotations. Sometimes, legends and annotations supplant much of the content of a title. Also, be aware that captions usually take the place of titles for maps appearing in publications such as books and journals.

Distance or scale

Scale must always be indicated or implied, unless the audience is so familiar with the map area or distance of such little relative importance that it can be assumed by the audience. Distance and scale can be indicated in a variety of ways on a map in verbal, numeric, or graphic form. When using computer systems, the graphic form of representing scale is often preferred. With computers, maps are often drafted at different scales than they are printed. In using verbal or numeric scales, the cartographer must be certain that the map is printed at precisely the scale indicated. If a graphic scale is inserted in a digital map, it will always maintain its relative size with respect to the digital map no matter how it is printed. Remember, scale varies significantly across the area of some maps. If this is true of yours, be sure to note the adjustments required.

Direction (Orientation, North Arrow, Compass Rose)

The question of what is north can be an issue on some maps. On the earth, true north (the direction to the North Pole) differs from magnetic north, and the magnetic north pole moves due to changing geophysical conditions of the earth's crust and core. Many reference maps indicate both. Most maps we compose are oriented to true north, even though compass readings in the field are angled to the magnetic pole. Adjustments for these compass deviations are made routinely.

Legend

The legend lists the symbols used on a map and what they depict. These symbols should appear in the legend exactly as they are found in the body of the map and be described clearly and fully. Do not treat the legend as an afterthought; it should receive careful attention. Be aware, however, that not all maps require legends. Sometimes the

necessary information is put in a caption, or subsumed by textual annotations placed directly on the body of the map.

Neatlines

Neatlines or clipping lines are used to frame a map and to indicate exactly where the area of a map begins and ends. The outer neatline of a map—its border--helps to frame the entire map composition to draw the reader's attention to the various elements of information. Neatlines are also used to "clip" the area of the body of the map and of locator, inset, and index maps. Neatlines are not always needed to trim the body of the map, some geographic areas can, so to speak, be suspended in space without a neatline. In other cases, the areal extent of a map can be made apparent in other ways.

Sources of information and how processed

Unless it is absolutely clear from the context in which a map appears, readers will need to know about the sources from which the map was derived. You must identify your sources so that the reader could, if needed, track them down to check your information and interpretation. Often the age, accuracy, and reliability of sources is critical to the interpretation of a map and should be noted. Sometimes it is also important to indicate how the data was processed, grouped, generalized, or categorized.

Locator maps

Some maps portray areas whose locations may be unfamiliar to readers. In such cases, the cartographer adds a "helper" or locator map that places the body of the map within a larger geographical context with which the reader can be expected to be familiar. A detailed map of troop movements on the first day of the Battle of Gettysburg may require, for example, a locator map indicating Gettysburg's position within the road network of south central Pennsylvania and northern Maryland in 1863.

Inset maps

Sometimes observations and data are so densely clustered in small sections of a larger map that the cartographer must provide the reader with additional close-up, "zoomed-in" maps of these smaller areas. Otherwise the data will obscure itself. These close-up detailed maps are called insets.

Index maps

There are limits to the amount of information that can be placed effectively in the body of a map, even though this information is useful to readers. Sometimes labels and other information can be moved to an index map.
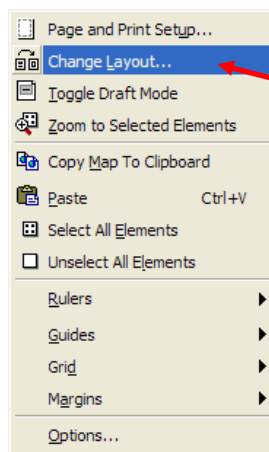
In ArcMap (Layout view) most of these map elements can be added from the "Insert" pull down menu on the main menu. From the Data view you can still select this menu option but most of the items are "grayed out" and not available. **You can also right-click on the layout (outside the neatlines of the map) and select "Change Layout..."** which will bring up a window that offers several predetermined layout. While these layout can be easily applied they often don't work with individual maps and need to be altered. Initially it is a good practice to create your own layout to develop your map making skills.

In addition, ArcMap makes a set of simple drawing tools available on a drawing toolbar. ***Toolbars can be turned on and off from the "View" menu item on the main menu, click on "View" and scroll down to "toolbars;" there are many toolbars to choose from.*** You can use the drawing tools to block out parts of the map, to add textboxes, arrows, and other incidental objects that enhance your map. For instance if you don't like the title of your legend, or the name of one of your legend items you can add a text box and fill it with the text you like and have it overlay the unwanted legend item. Of course you can also change legend items through ArcMap by editing your attribute table or creating an alias for your fields in the properties window.

New Data
An additional zip file, extension.zip is available on the S4 training site. It contains a shapefile of the United States. The shapefile State1990.shp is the state map of the United States with demographic data from Census 1990. There are fifty-one records in the file, which contains the following variables:

Variable name	Variable label
STATE_NAME	state name
STATE_FIPS	state FIPS code
SUB_REGION	division code
STATE_ABBR	state abbreviation
POP1990	population 1990
HOUSEHOLDS	number of households 1990
MALES	number of males
FEMALES	number of females
WHITE	non-Hispanic white population
BLACK	non-Hispanic black population
ASIAN_PI	Asian population
HISPANIC	Hispanic population
AGE_UNDER5	age below 5
AGE_5_17	age 5-17
AGE_18_29	age 18-29
AGE_30_49	age 30-49
AGE_50_64	age 50-64
AGE_65_UP	age 65 and above
NEVERMARRY	never married
MARRIED	married
SEPARATED	separated
WIDOWED	widowed
DIVORCED	divorced
HSEHLD_1_M	number of Male-headed households
HSEHLD_1_F	number of Female-headed households
HSE_UNITS	total housing units
VACANT	total vacant housing units
OWNER_OCC	number of owner occupied housing units
RENTER_OCC	number of renter occupied housing units
MEDIAN_VAL	median housing value

Using what you have learned so far in ArcGIS use this data to explore demographic patterns in the United States. Create a single map that answers a specific research question.

Think first about your research question in relation to the data that is available, feel free to explore the data and make a view maps of the variables in which you are interested. This will give you a sense of what is possible and what question you might want to pose.