Module - Introduction to ESRI ARCGIS

Exercise # 1 - Creating a Simple Map in ArcMap

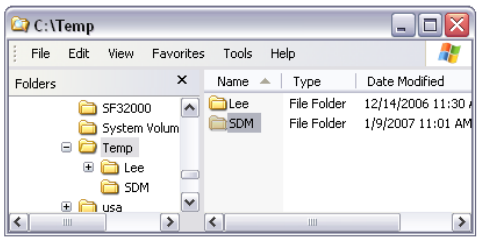
In this exercise you are introduced to the ArcMap interface and some of the basic skills necessary to create simple maps. Once you have successfully completed this part of the tutorial, you will know:

- How to open ArcMap with a new empty Map Document
- How to personalize the ArcMap interface and add new toolbars
- How to add spatial data to your Map Document
- How to set relative pathnames to allow you to move and share your Map Projects
- The difference between Data View and Layout View
- How to change Map Feature transparencies
- How to label Map Features
- How to alter Map Feature Symbology
- How to add essential Map Elements (North Arrow, Legend, etc…) for effective map creation
- How to export your map to PDF and JPG

Preparing For the Tutorial

1) ***Navigate*** to the **http://www.lakhankar.com/gis/Module1Data.zip** and download the data.

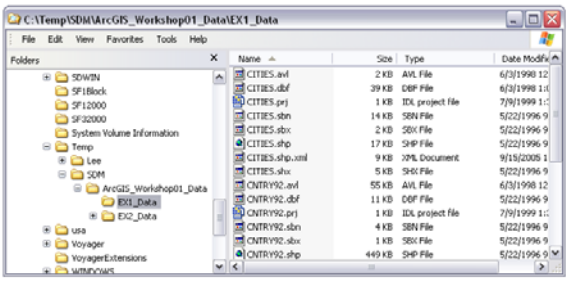
2) ***Make*** a **New Folder** using your **initials** as the name of the **New Folder**. For example, if your name is John Jacob Jinglehymer-Smith, you would make a new folder called **C:\Temp\JJJ**



3) Copy the ***Downloaded data***

file to your **C:\Temp*your_intials*** folder.

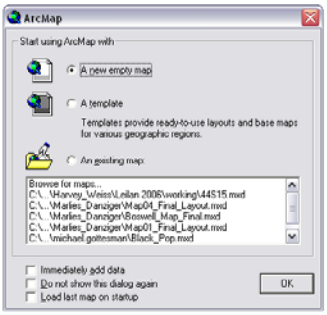
if you are using this tutorial as part of a live workshop.



4) ***Unzip*** the **dataset** to your initials folder (You should be able to simply ***right-click*** on the file and ***select*** **Extract Here…**). This file contains the datasets we will use for the exercises that follow.

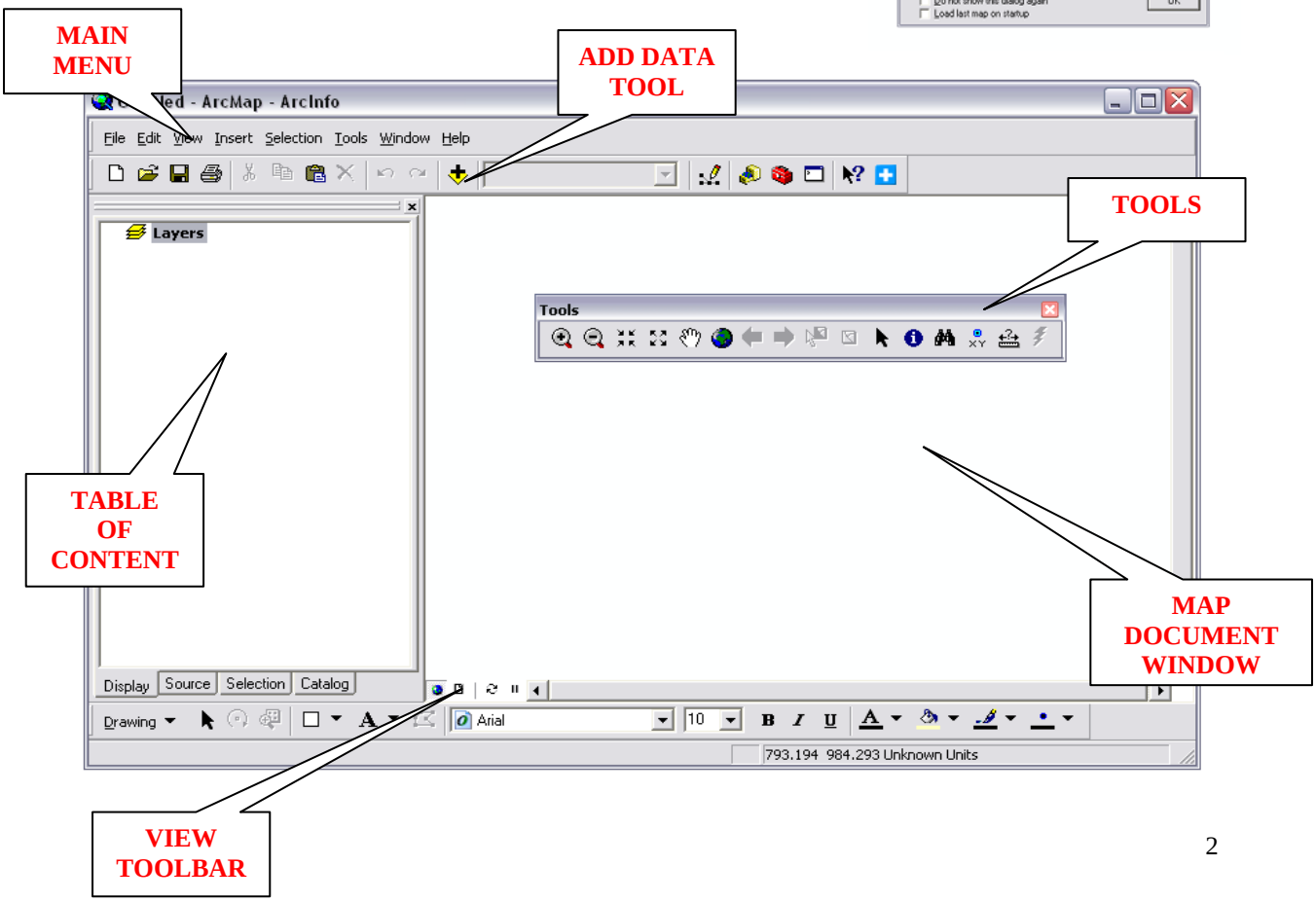
5) ***Browse*** into the **C:\Temp*your_initials*\Module1Data\ folder** where you extracted the dataset and take a ***look*** at the files in the **EX1_Data folder.** Note that there are many files in this folder, some of which have the same name, but different file extensions.

Starting ArcMap and Getting the Interface Ready to Use



1) ***Start*** **ArcMap** (which should be under **Start>Programs>ArcGIS>ArcMap**).

2) When prompted, ***Select*** the "**with a new empty map**" option. You will be presented with something like what you see below:



- The **Main Menu** should be familiar to anyone who uses Microsoft Windows software. It is where you perform basic file and document editing functions.

- The **Table of Contents** is the area where your data layers will be listed and where you can interact with and alter the properties of individual layers.

- The **Add Data button** is located on the "Standard" Toolbar and opens a dilog box that allows new layers to be added to the Table of Contents and Map Document. It should not be confused with the Open Document button, which is located on the same toolbar, but is not unique to ArcMap.

- The **Map Document Window** is the area where your map data will be displayed.

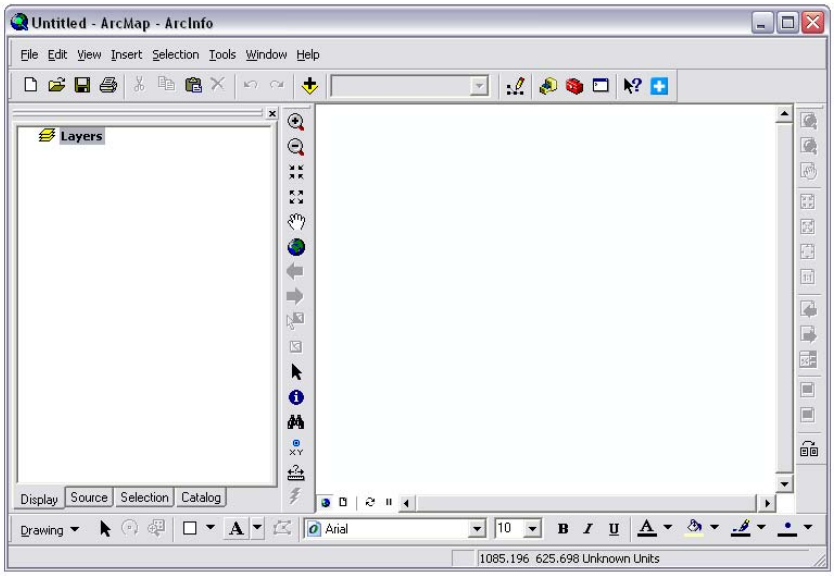
- The **Tools toolbar** contains a series of tools that operate on the data displayed in the Map Document Window.

- The **View Toolbar** changes between the Data View and Layout View of the Map Document.

3) ***Click-and-hold*** on the **Tools toolbar** and ***drag & drop*** it between the **Table of Contents** and the **Map Document Window**.

4) On the **Main Menu**, ***go to*** **View>Toolbars>Layout** to ***Activate*** the **Layout Toolbar**.

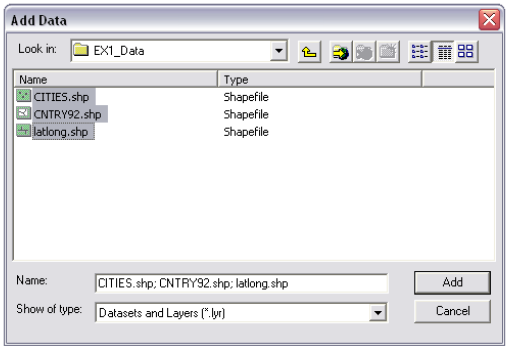
5) ***Click-and-hold*** the on the **Layout toolbar** and ***drag & drop*** it on the margin to the right of the **Map Document Window**.



Adding Data to your Map Document & Saving

1) ***Click*** the **Add Data button**  , which will open an '**Add Data**' **Explorer Window**.

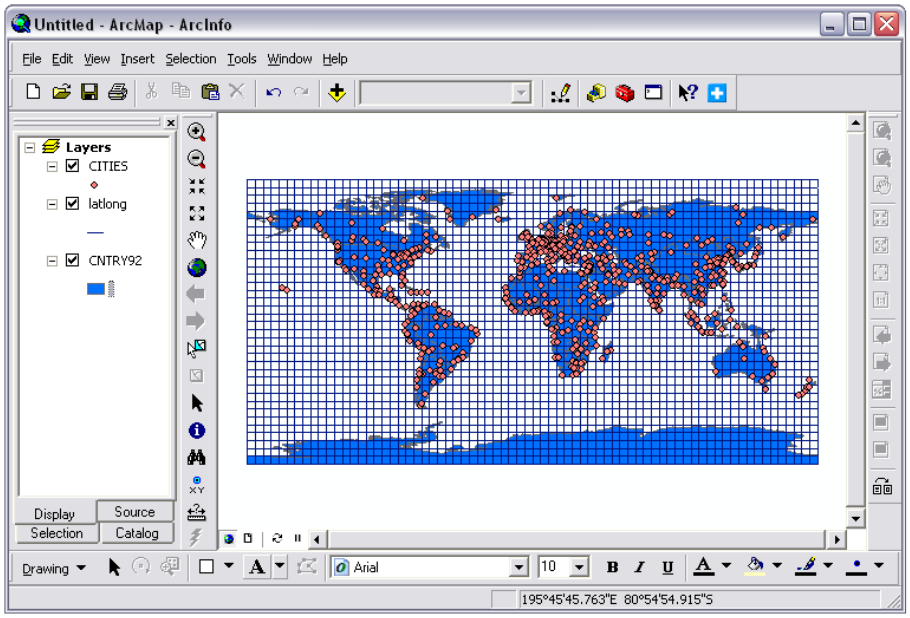
2) ***Browse*** to the **C:\Temp*your_initials*\Module1Data\EX1_Data folder**.



3) ***Hold down*** your **Ctrl key** to ***highlight*** the **CNTRY92, CITIES**, and **latlong** datasets.

4) ***Click*** the **Add button** to insert the data layers into **ArcMap**.

These data files are in "shapefile" format, which is one of the most common formats for specifically spatial data. Notice that they appear different in the Add Data Explorer Window than they appeared in Windows Explorer. While you saw dozens of files in the folder when you used Windows Explorer, ArcMap "knows" that a shapefile is actually a "collection" of files, rather than a single file, and so it only shows you a single icon to save confusion. You will encounter other types of data in the second exercise, but for now we'll keep it simple.



5) On the **Main Menu**, go to **File>Map Document Properties** to ***open*** the **Dialog box**.

Check the "**Store relative path names to data sources**" **checkbox**.

On the **Main Menu**, ***go to*** **File>Save As** and ***save*** your **Map Document** to your **C:\Temp*your_initials*\Module1Data\ folder** with the title **Ex01.mxd.**

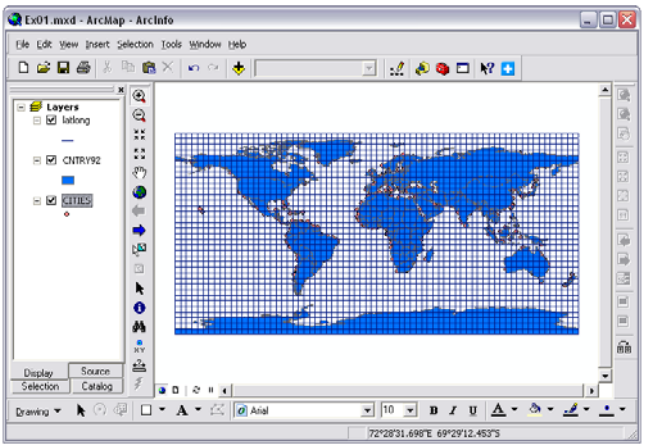
The MXD file is the "Map Document," in much the same way that the DOC file is the "Word Document" in Microsoft Word. One important distinction between MXD and DOC files is that, while DOC files actually "contain" all of the text, images and objects you insert into them, the MXD document only "refers" to the location of your data, and instructs the software in how to display it. That means that, while you can move a DOC file and preserve the contents, you cannot move an MXD file and preserve the contents, since the links to the data will no longer be correct. To get around this problem, we have instructed the software to refer to its data using relative pathnames, which record the paths to the data sources relative to the place where the MXD document is saved. This means that if you put your save your data in the same folder as your MXD document (or in a subfolder of the folder your MXD document is in, you can now move the entire project and preserve the location of the data relative to the MXD document.

Exploring the Map Document Window

1) ***Click*** on the **checkbox** next to the CITIES layer in the **Table of Contents** window. Notice that it turns the layer off.

2) ***Click*** on the **checkbox** next to the CITIES layer in the **Table of Contents** window to turn it back on.

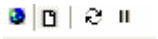
3) Now ***Click*** and hold the CITIES layer name and drag it below the CNTRY92 layer, in the **Table of Contents**.

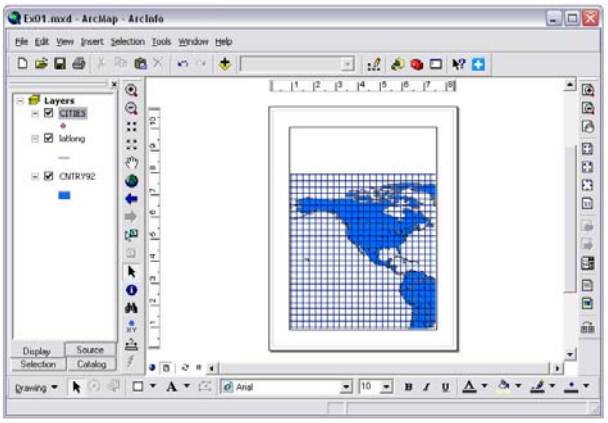


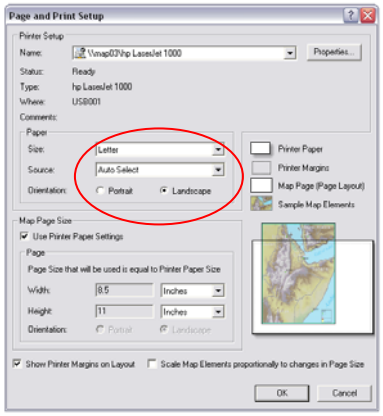
Note that the order that layers are displayed in the **Table of Contents** is the order that they are displayed in the **Map Document**.

4) ***Drag*** the CITIES layer back to the top of the **Table of Contents**.

5) ***Select*** the **Zoom Button**  and ***Zoom*** into North America by dragging a box from Alaska to Puerto Rico.

6) ***Find*** the **View Toolbar**…  (At the bottom left corner of the **Map Document Window**). ***Select*** the button that looks like a page. This will ***change*** your view to **Layout**.

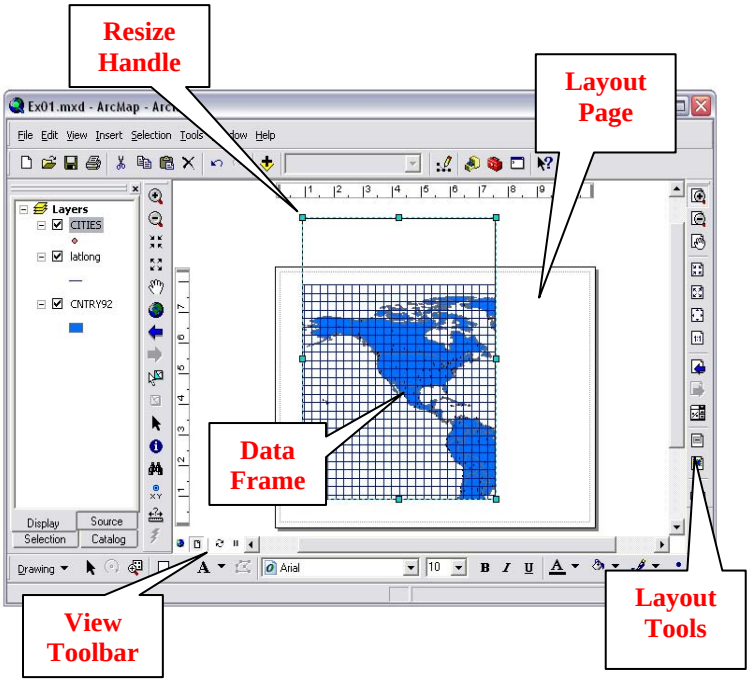




7) On the **Main Menu**, ***go to*** **File > Page and Print Setup**. ***Change*** your **Paper Orientation** to **Landscape**. Note the difference between **Portrait** and **Landscape** mode in the example image?

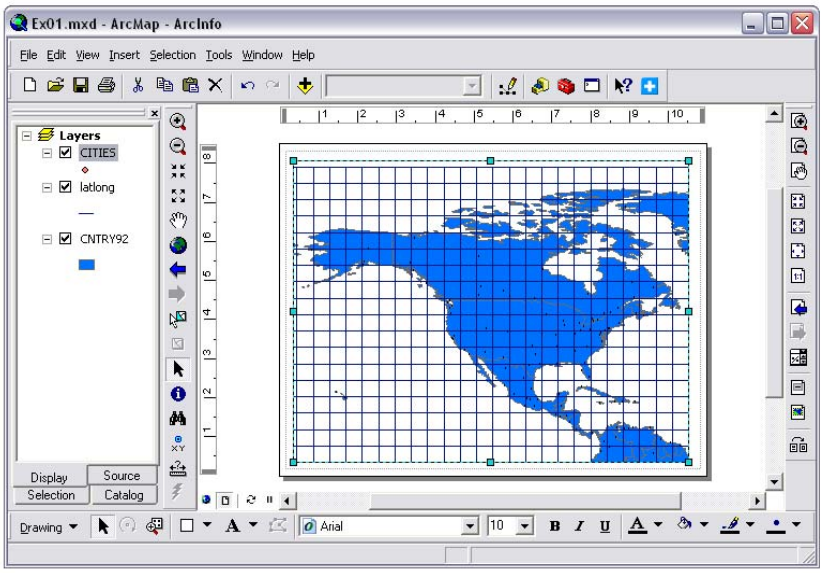
8) *Close* the **Page & Print Setup Dialog Box**.

9) *Select* the **Layout Zoom Out** tool (you placed the **Layout Toolbar** on the right side of the **Map Document Window** earlier in the tutorial) and ***click once-at-a-time*** in the center of the **Layout Page** until you can see the entire data frame extending beyond your page border.



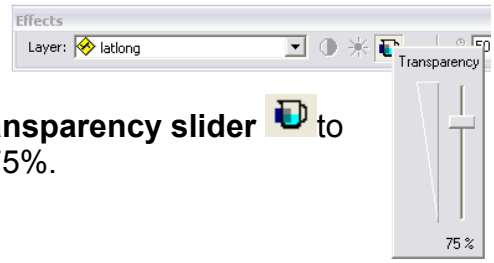
10) ***Click once*** in the **Data Frame** using the **Select Element Tool** (It's back on the **Tools Toolbar**, to the left side of the Map Document Window) to ***select*** your **Data Frame.**

11) Using the **blue Resize Handles**, ***resize*** the **Data Frame** to fit within your page border.



Adjusting Layer Transparency Using the Effects Toolbar

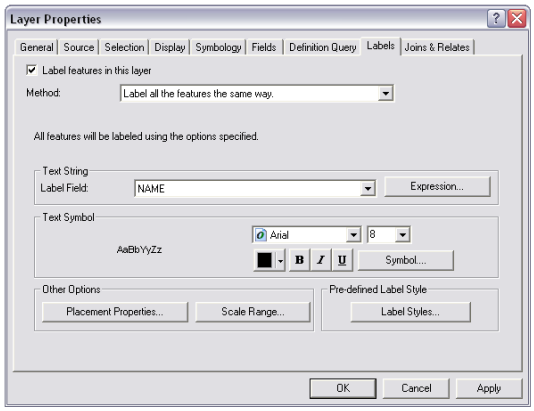
1) On the **Main Menu**, ***go to*** **View > Toolbars** and ***turn on*** the **Effects Toolbar**.



2) ***Choose*** the **latlong shapefile** and use the **Transparency slider** to alter its display. Use a transparency of about 75%.

Using Properties to Label Map Data

1) ***Right-Click*** on the **cities shapefile** and ***open*** the **Properties Dialog** box.



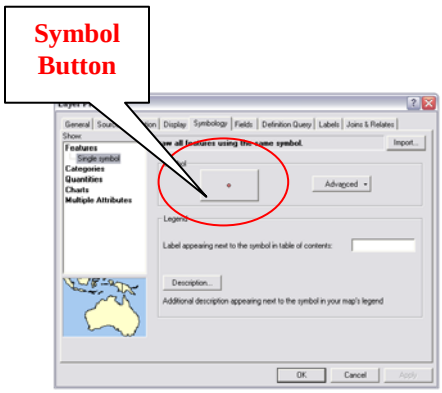
2) ***Select*** the **Labels Tab** and make sure that **NAME** is selected as the **Label Field**.

3) ***Check*** the "**Label features in this layer" radio button** and click **OK**.

4) Right-click on the cities layer name in the **Table of Contents** and select **Label Features**. Note that your labels turn off. Do the same to turn them back on.

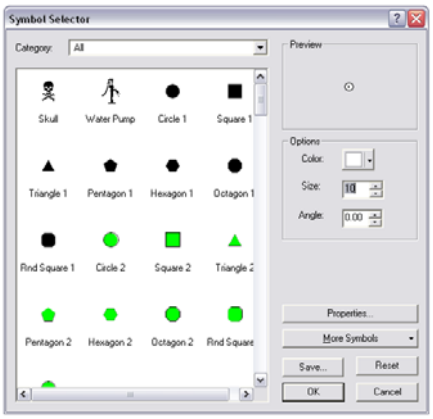
5) ***Save*** your work.

Using Properties to Change Symbology



1) ***Right-Click*** on the **cities shapefile** and ***open*** the **Properties Dialog** box.

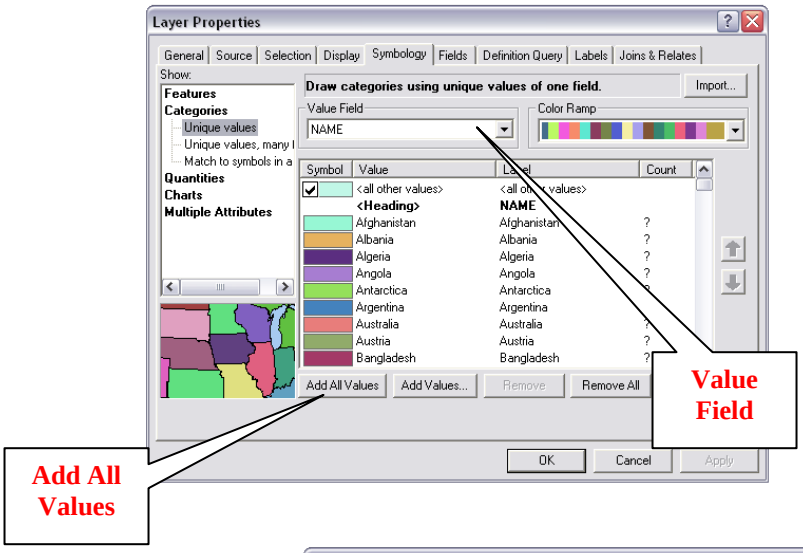
2) ***Select*** the **Symbology Tab**, ***click once*** on the point symbol button.



3) Use the **Symbol Selector** dialog box to change the symbol for your cities layer. ***Reduce*** the **Size** of the symbol to **10 points**. ***Click*** **OK** twice to apply the changes.

4) ***Right-Click*** on the **CNTRY92 shapefile** and ***open*** the **Properties Dialog** box.

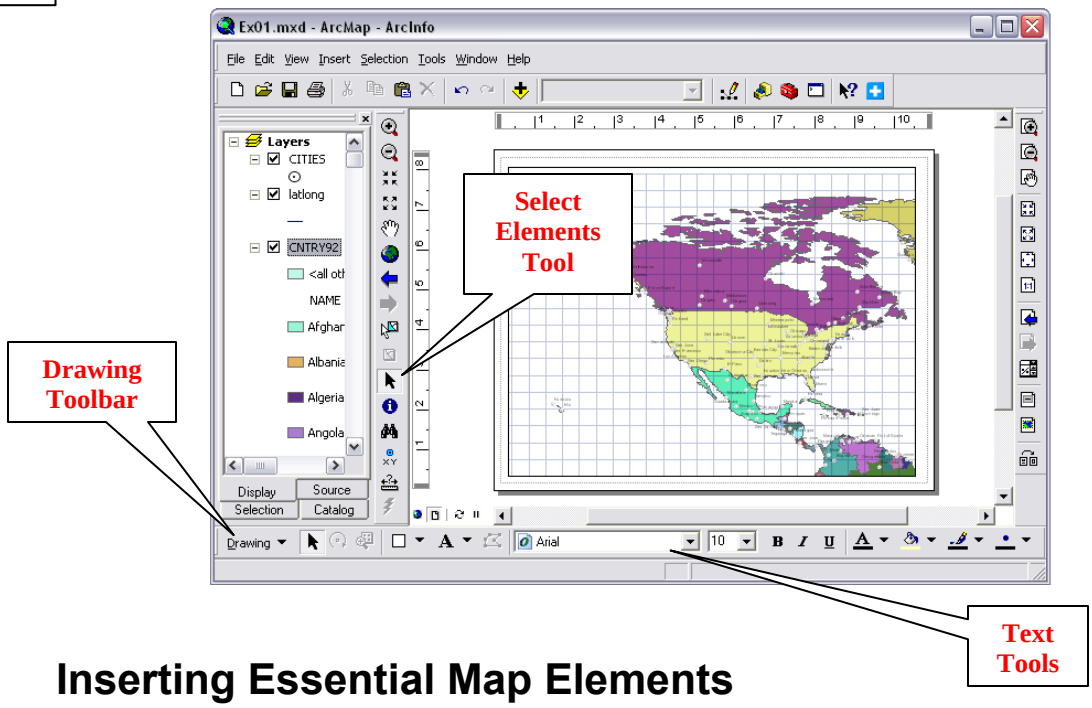
5) ***Select*** the **Symbology Tab** and ***click*** on the **Categories item** in on the right side of the window.



6) **Unique Values** will be the default. Use the **Value Field drop-down** to ***select*** **NAME**.

7) ***Click*** on the **Add All Values button** at the bottom of the window.

8) You can ***change*** the **Color Ramp**, if desired. ***Click*** **OK** to apply the change.



Inserting Essential Map Elements

1) On the **Main Menu,** ***go to*** **Insert > Title.** A highlighted **textbox** will be inserted into your **Map Layout**.

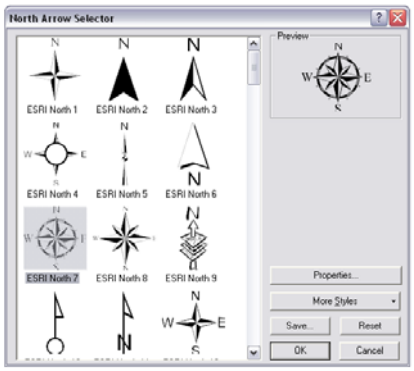
2) ***Change*** the **text** in the **Title Textbox** to "**North America**" and ***click outside*** the **textbox** using the **Select Elements Tool**. This will make the

text change and highlight the textbox with a blue dashed box.

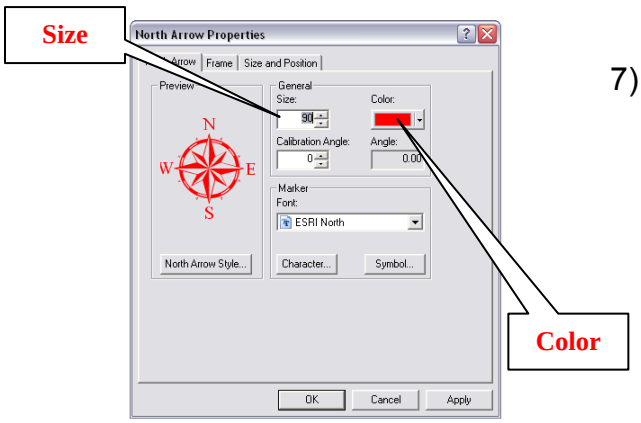
3) At the Bottom of the **ArcMap Window**, on the **Drawing Toolbar**, ***change*** the **text size dropdown** from **18** to **24** and ***click*** on the **Bold Text button**.

4) You can ***reposition*** the **text**, if desired, using the **Select Elements Tool.**

5) On the Main Menu, go to Insert > **North Arrow**. Use the North Arrow Selector to select an appropriate North Arrow and click OK to insert it into your Map Layout.

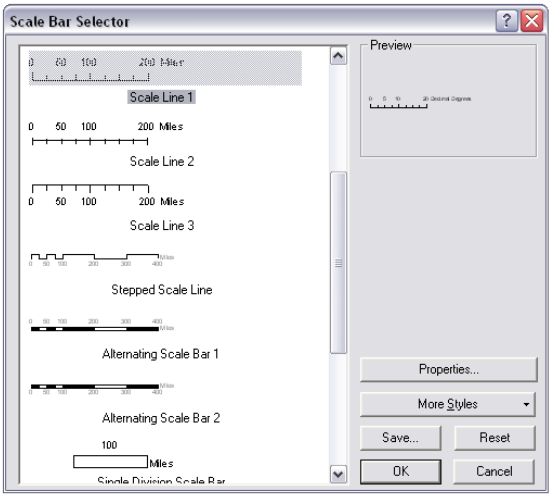


6) ***Position*** the **North Arrow** and ***Resize*** it appropriately using the **Select Elements** tool.



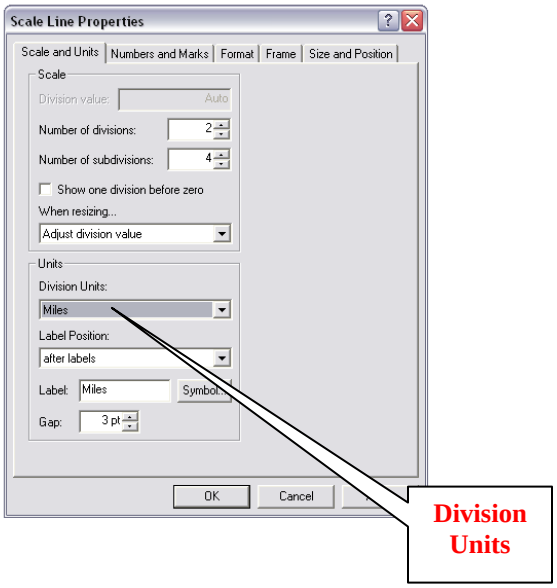
7) Using your **Select Elements tool**, select and right click on your **North Arrow** and choose **Properties**. Change the **Color** of your North Arrow to Red, and the **Size** to 86 points. Click **OK**.

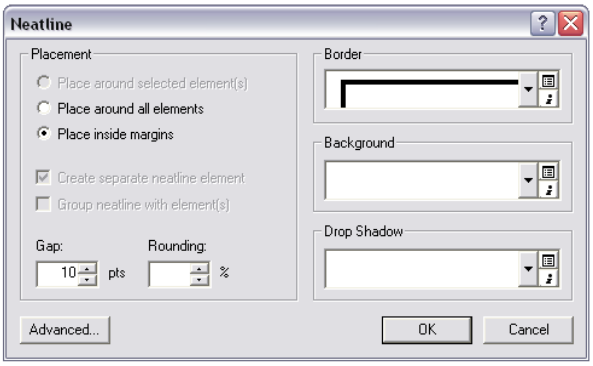
8) On the **Main Menu**, ***go to*** **Insert > Scale Bar**. ***Use*** the **Scale Bar Selector** to select a **Scalebar** and ***click*** **OK** to ***insert*** it into your **Map Layout.**



9) Again using the ***Select* Elements tool**, ***select*** and ***right-click*** on your **Scalebar** and open the properties dialog box.

10) ***Select*** the **Scale and Units** tab and change the **Division Units** from **Decimal Degrees** to **Miles**. ***Click* OK**.





11) On the **Main Menu**, ***go to* Insert>Neatline**, ***choose*** "**Place Inside Margins**" and ***select*** an appropriate **border thickness** from the.

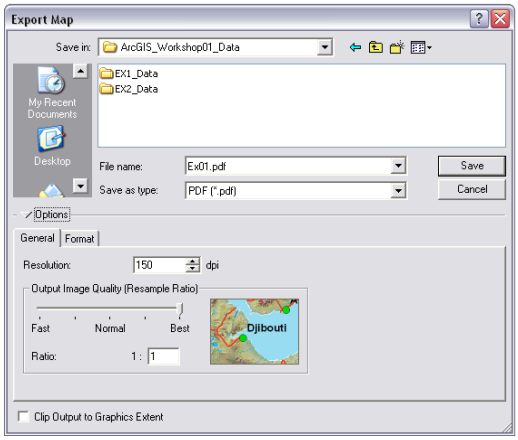
12) ***Save*** your work.

Exporting Your Map for Distribution in PDF Format

1) On the **Main Menu**, ***go to* File > Export Map.** Note the options you have when **Exporting** a **Map**.

2) ***Choose* "PDF *.pdf"** (Adobe Acrobat file) from **the Save File as Type dropdown**.

3) ***Browse*** to your **C:\Temp*your_initials*\Module1Data\ folder** and name your file **Ex01.pdf**.



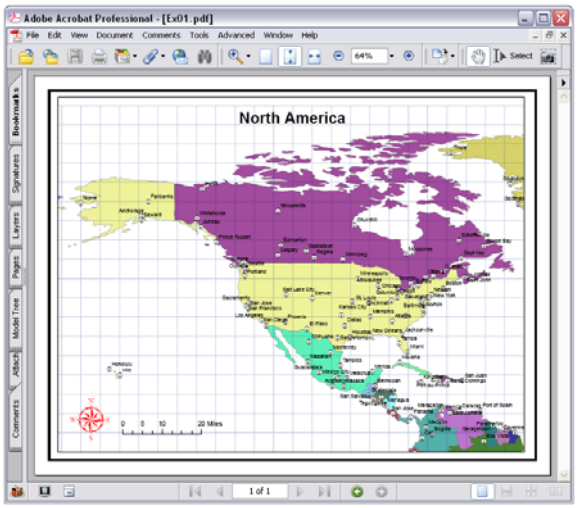
4) If the **Options** window at the bottom of the Export Dialog is not opened, open it using the 

button.

5) ***Set*** the **Resolution** to **150 dpi**.

6) ***Click*** on the **Format tab** and ***uncheck*** "**Compress Vector Graphics**." ***Click*** **Save**.

7) ***Browse*** to the folder you saved the **Ex01.pdf** file into and ***open*** it to see the final product.



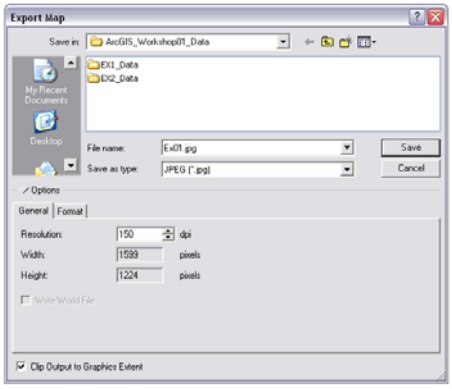
Exporting for Use in Microsoft Word or PowerPoint

1. ***Go to*** **File>Export Map** to ***open*** the **Export Map Dialog**.

2. ***Change*** the **Type** to **JPEG (*.jpg)** and note the available options.

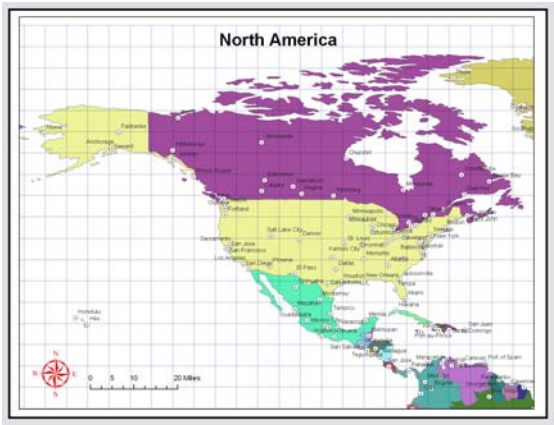
3. Set the **Resolution** to **150dpi** and

4. ***Check*** the **"Clip Output to Graphics Extent"** checkbox.



5. ***Click*** on the **Format Tab** and ***make sure*** the **Color Mode** is set to **24-bit True Color**. Changing the Color Mode to 8-bit Grayscale will produce a Grayscale Image, suitable for Black & White printing.

6. ***Browse*** to your **C:\Temp*your_initials*\Module1Data\ folder** and ***name*** your file **Ex01.jpg.** ***Click*** **Save.**



7. **Browse** to the folder you saved your **JPG** image in and ***double-click*** to view it in the default image viewer on your machine.

Congratulations!

You have just created a piece of custom cartography using ArcMap.

Module #1 - Introduction to ArcMap

Exercise #2 – Working with Spatial Data

The first exercise in the tutorial introduced you to the ArcMap interface and gave you the skill you need to create simple maps. Now you will learn how to manage and work with datasets in ArcMap. Once you have successfully completed this part of the tutorial, you will know:

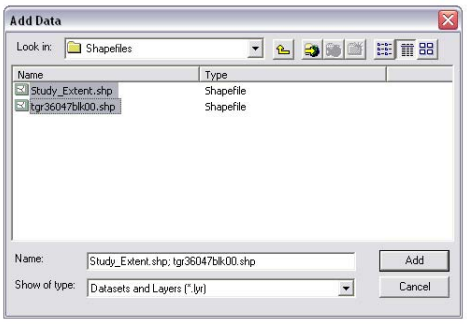
- How to tabular data to a Map Document
- How to display Coordinate Data from a table
- How to convert displayed coordinate data to a new shapefile
- How to select features by location and export to a new shapefile
- How to find
- How to use ArcToolbox Geoprocessing tools, specifically to clip one shapefile to the extent of another
- How to Join tabular data to a Boundary File
- How to add a new attribute field and calculate its value from other attribute fields
- Add a Legend to a Map Layout and alter its appearance

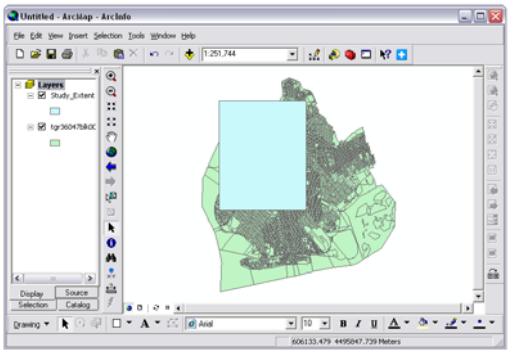
Creating a New Map Document and Adding Data.

8. ***Save*** your work from **Exercise 1** and ***Click*** on the **New Map File Button**  , on the **Tools toolbar**.

9. ***Make sure*** that you are in the **Data View**, rather than the **Layout View**.

10. ***Use*** the **Add Data**  **Button** to ***open*** the **Add Data Dialog**.





11. ***Browse*** to the **C:\Temp\SDM\Module1Data\ EX2_Data folder** containing the data for this exercise and ***Browse*** into the \Shapefiles **folder**. ***Hold down*** the **Ctrl button** and select and **Add** the following files:
    - **Tgr36047blk00.shp**
    - **Study_Extent.shp**

12. ***Use*** the **Add Data**  **Button** to open the **Add Data Dialog**.

13. ***Browse*** to the **C:\Temp\SDM\Module1Data\EX2_Data folder** containing the data for this exercise and look for the **\Tabular_Data** folder. ***Select*** and **Add** the **Kings_County_GNIS.csv** file.

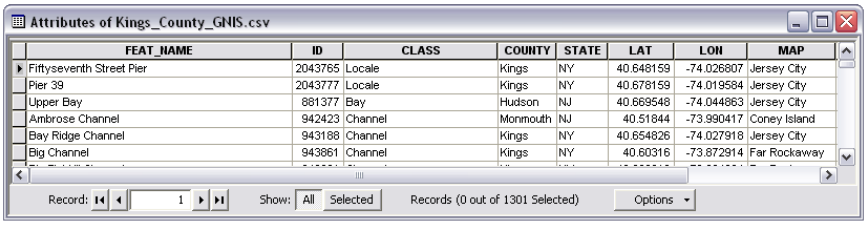
> Note that the **Source Tab** in the **Table of Contents** is now active, and this new data layer is visible there, but there has been no change in the **Map Document** window. This is because the data you have added is a table, rather than a shapefile and it does not yet have an explicit geographic display.

14. ***Go to*** **File>Save** As, and save your **Map Document** as **EX02.mxd**.

How to Display Latitude/Longitude Data from a Table

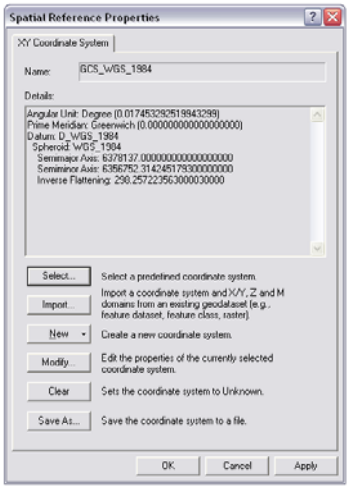
Many times your data will not be obtained in a format that is directly readable in ArcMap. GPS data, EPA toxic release site data and other types of data you might be interested are often found in tabular form, with geographic coordinates (Latitude/Longitude) for data points recorded as a field associated with the other attributes for each record. Here, you will create a GIS layer from a table of geographic coordinates and attributes obtained from the **USGS GNIS (Geographic Names Information System)** which contains information for geographic features in the United States. The procedure used here is essentially the same that you would use for creating GIS layers from other tabular data with geographic coordinates.

1. ***Right-Click*** the **Kings_County_GNIS.csv** file and ***select*** **Open** to open the **Attribute Table**.



FEAT_NAME	ID	CLASS	COUNTY	STATE	LAT	LON	MAP
Fiftyseventh Street Pier	2043765	Locale	Kings	NY	40.648159	-74.026807	Jersey City
Pier 39	2043777	Locale	Kings	NY	40.678159	-74.019584	Jersey City
Upper Bay	881377	Bay	Hudson	NJ	40.669548	-74.044863	Jersey City
Ambrose Channel	942423	Channel	Monmouth	NJ	40.51844	-73.990417	Coney Island
Bay Ridge Channel	943188	Channel	Kings	NY	40.654826	-74.027918	Jersey City
Big Channel	943861	Channel	Kings	NY	40.60316	-73.872914	Far Rockaway

2. ***Note*** that this file contains **Geographic Coordinates (**the **LAT** & **LON** Fields**),** as well as attributes associated with each record.

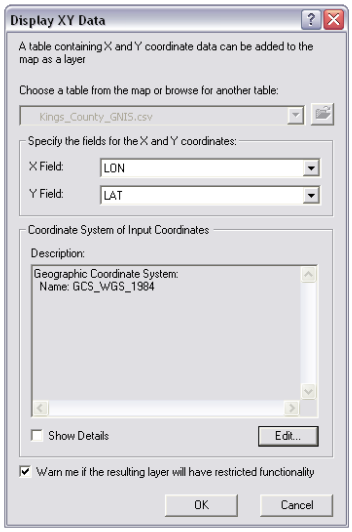


3. ***Close*** the **Attribute Table**.

4. **Right-Click** the **Kings_County_GNIS.csv** file and select **Display XY Data** to open the **Display XY Data Dialog Box.**

5. The correct **X Field (LON)** and **Y Field (LAT)** should be selected by default (although this will not always be the case).

6. Under the **Coordinate System item**, ***click*** on the **Edit Button** to ***open*** the **Spatial Reference Properties** dialog.



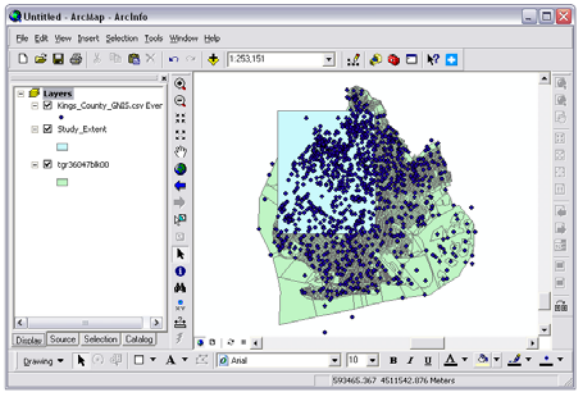
7. ***Click*** on the **Select button** and ***Browse*** to **Geographic Coordinate Systems>World>WGS 1984.prj** and ***click*** **Add**.

8. ***Click*** **OK** to apply the **Spatial Reference**.

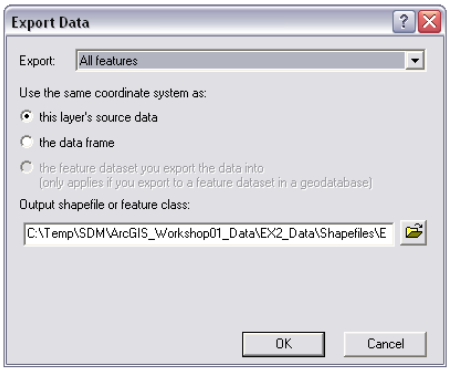
9. ***Click*** **OK** in the **Display XY Data dialog** and you should see a new layer of points added to your **Map Document** Window, as well as a *new layer name* called **Kings_County_GNIS.csv Events** in the **Table of Contents Source Tab**.

10. Click on the **Display Tab** to change the view of the **Table of Contents.**

*The **Events Layer** that you just created is not an actual file, but simply the display of the coordinates contained in the table. To perform many of the **Geoprocessing** tasks that are involved in any GIS analysis, we will want to turn this **events layer** into a **Shapefile**, which is the most common type of GIS data layer.*



11. To create a **Shapefile** from this layer, **Right-Click** on the layer and select **Data>Export Data.**



12. ***Use*** the **"Output Shapefile…" Dialog** to ***browse*** to your **EX2_Data\Shapefiles** folder and name your file something meaningful, like **Kings_County_GNIS.shp.**

13. ***Click*** **Save,** then **OK.**

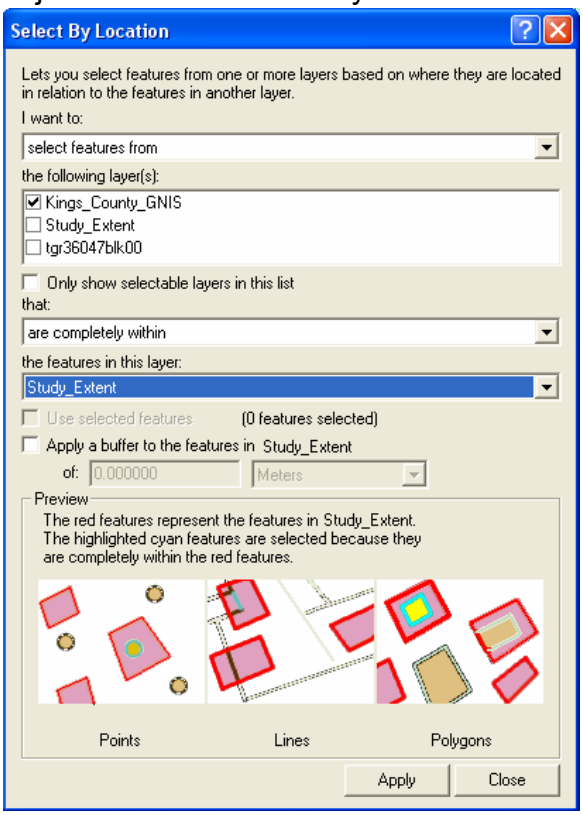
14. ***Select*** **Yes** when asked if you want to add the exported data as a layer.

15. You can ***Right-Click*** on the original **Kings_County_GNIS.csv Layer** and ***Remove*** it.

16. ***Save*** your work.

How to Select Geographic Features by Location

Notice that the points in the **shapefile** that we just created extend beyond the **Study_Extent** layer in our **map document**. Many times you would like to create a ***subset*** of a data layer based upon the **feature locations** of another layer. Here, we will use **Select by Location** to create a **subset** of the **GNIS** layer that only contains points that fall within our area of interest.



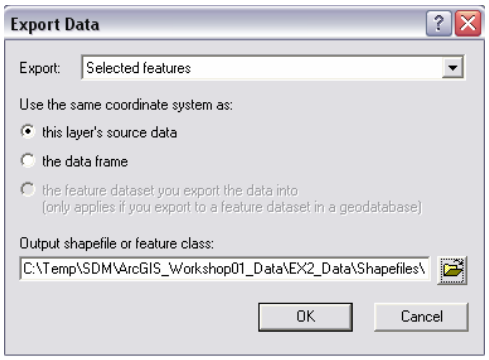
1. On the **Main Menu**, ***Go to*** **Selection>Select by Location** to ***open*** the **dialog box**.

2. ***Select*** the options as shown below to:

   - ***select*** **features** from the **Kings_County_GNIS layer**…

   - …that are **completely within** the **Study_Extent layer**.

3. ***Click*** **Apply** and **Close** to see that the points within the **Study_Area** layer are now **highlighted**.

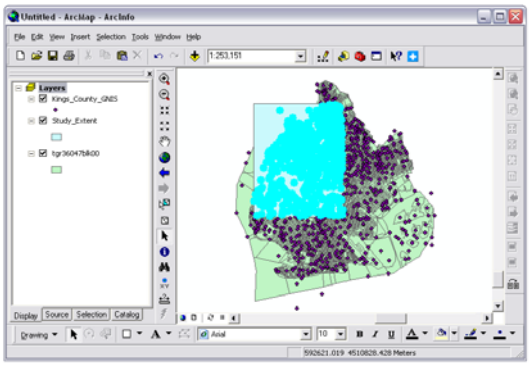


4. **Right-Click** on the **King_County_GNIS** Layer in the **Table of Contents** and select **Data>Export Data.**

5. Note that "**Selected features**" is the default **Export Option**, since you have an active selection for this layer. ***Accept*** this default and ***Browse*** to your **Data folder** and ***name*** your file something meaningful (**Red_Hook_GNIS.shp**). Click **Save.**

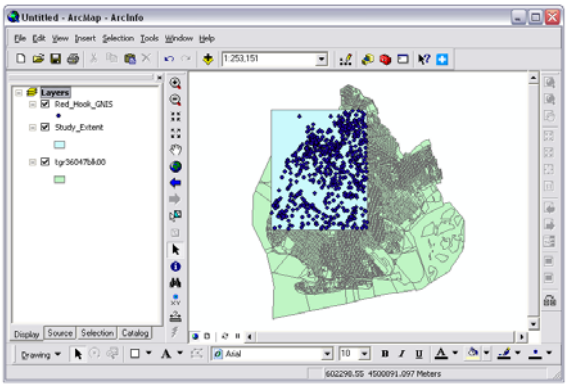
6. ***Click*** **OK** to ***Export*** the selection to a new shapefile.

7. ***Select*** **Yes** when asked if you want to add the exported data as a layer.



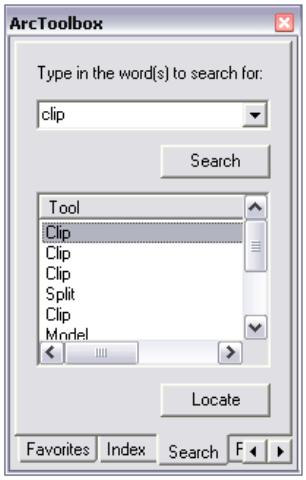
8. You can ***Right-Click*** on the **Kings_County_GNIS Layer** and ***Remove*** it.

9. ***Save*** your work.



Using a Tool in ArcToolbox: Clipping One Layer to Another

If your area of interest is a single county, but your data layers are all statewide, you might want to limit the extent of your data layers to the shape of the county you are interested in. When working with point files, this is easy enough to do using **Select by Location** as we have done above. Many times the features that make up one layer do not lie "neatly" within the boundaries of the features of another. In these cases, you might want to **"Clip"** your data layers to the shape of your area of interest. This not only helps create a "cleaner" map document, it can significantly reduce the demand upon your computer processor when doing analysis. Here we will use one of the many tools in **ArcToolbox** to clip the **Tiger Census Block Boundary** file for Kings County to the **Study_Area** layer.



1. Use the **ArcToolbox Button**  to ***open*** the **ArcToolbox** window in **ArcMap**.

2. Note that it, like the **Table of Contents Window**, has three tabs at the bottom of the window.

3. ***Select*** the **Search Tab**, enter "**Clip**" into the **search box** and click **Search**. You should be presented with a list of tools.

4. The first **Tool** in the list should be the **Clip Tool** from the **Analysis Tools** group (Tools are grouped by type).

5. ***Double-Click*** on this **Tool** to ***open*** its **Dialog Box**.

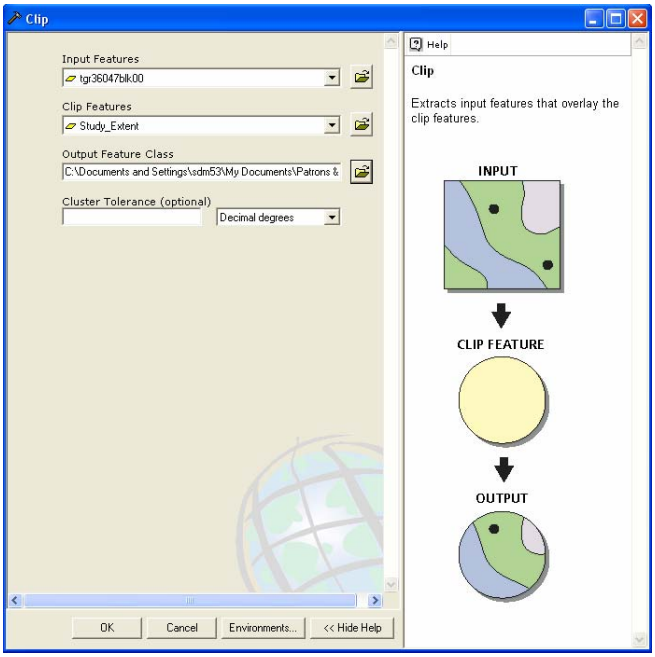
6. ***Select*** the **tgr36047blk00 layer** as your **Input Features.**

7. ***Select*** the **Study_Extent** as your **Clip Features.**

8. ***Browse*** to your **Data\Shapefiles** folder to save the layer as **Red_Hook_Census_Blocks_2000**.

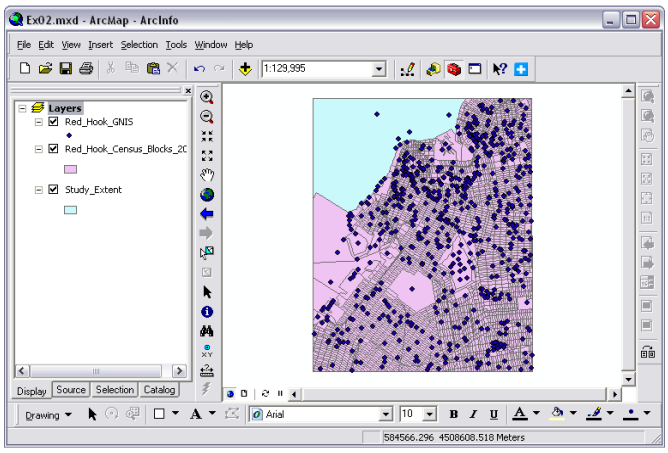
9. ***Leave*** the remaining items as their **default values.**

10. ***Click*** **OK** to apply the **Clip Tool**.



11. ***Right-Click*** on the **tgr36047blk00 layer** and ***Remove*** it.

12. ***Click*** the **Full Extent Button**  to ***zoom*** to the new extent of your data.

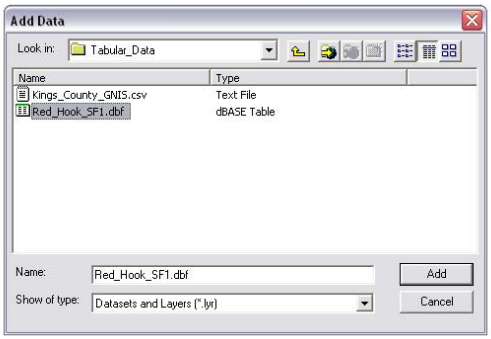


Joining Tabular Data to a Geographic Layer

Many times, attribute data is contained in tabular form, separate from the Geographic boundary files that are used by GIS software. This is particularly the case with Census Data. This is because the number of attributes available for some GIS data is so large that including the files together creates prohibitively large layer files. In most cases, a researcher only needs a limited number of attributes for analysis. **ArcMap** allows you to "**Join**" a tabular attribute file to its corresponding Geographic File. Here we will use a **"key field,"** present in both the attribute table and the geographic boundary file for the Census data for Red Hook, to "**Join**" those two files.

1. ***Right-click*** on the **Red_Hook_Census_Blocks_2000 layer** and **Open** its **Attribute Table**. Note that the only available attributes are identifiers, and that there are no demographic variables included in this file.

2. ***Close*** the **attribute table**.

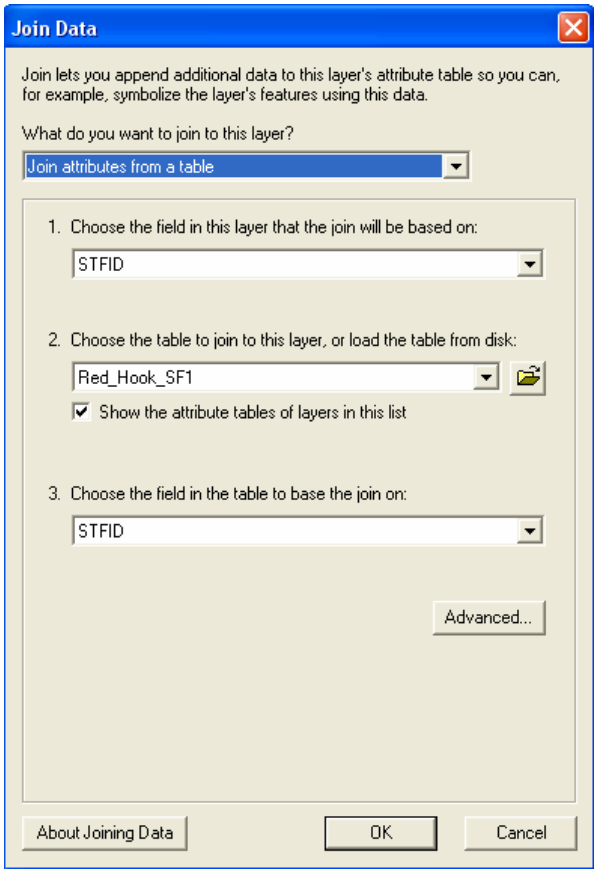


3. ***Click*** the **Add Data**  **Button** to open the **Add Data Dialog**.

4. Browse to the **C:\Temp\SDM\Module1Data\EX2_Data folder** and look for the **\Tabular_Data** folder.

5. ***Add*** the **Red_Hook_SF1.dbf file**.

You will note that the **Source Tab** of the **Table of Contents** again becomes the active tab.



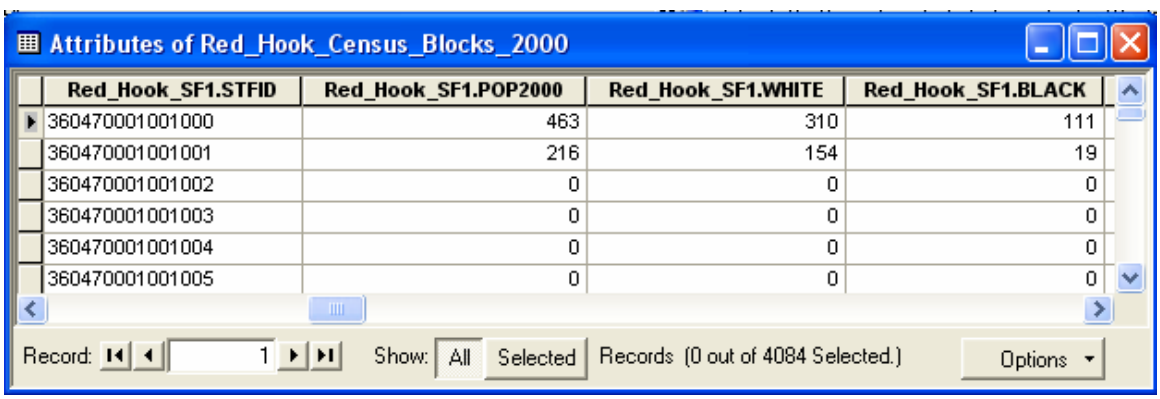
6. **Right-Click** on the **Red_Hook_Census_Blocks_2000** Layer and select **Joins and Relates>Join** to open the dialog box**.**

7. Enter the **Join Options** as shown on the right and click **OK** to apply the **Join.**

8. Now **Right-Click** on the **Red_Hook_Census_Blocks_2000** Layer and select **Open Attribute Table.**

9. Scroll across the table and note that the **fieldnames** are now **prefixed** with the name of the table they are original to. For example, the field **POP2000**, from the **Red_Hook_SF1.dbf** is now **Red_Hook_SF1.POP2000.**

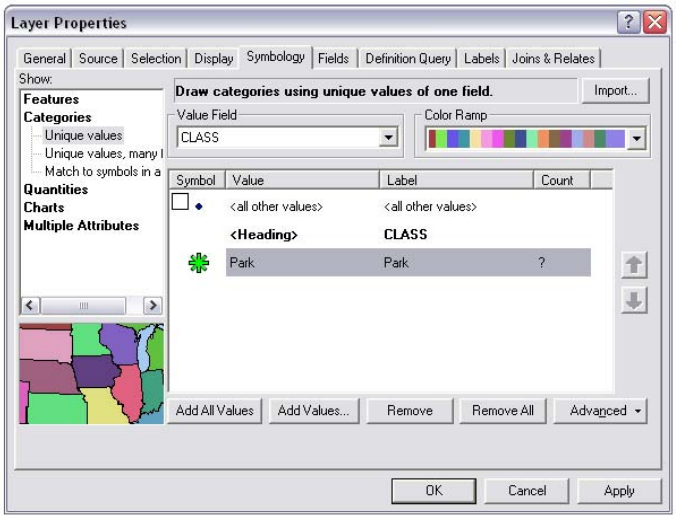
10. **Close** the **Attribute Table.**



Red_Hook_SF1.STFID	Red_Hook_SF1.POP2000	Red_Hook_SF1.WHITE	Red_Hook_SF1.BLACK
360470001001000	463	310	111
360470001001001	216	154	19
360470001001002	0	0	0
360470001001003	0	0	0
360470001001004	0	0	0
360470001001005	0	0	0

*It is important to note that a "**Join**" does not actually create a new dataset, but creates a relationship between two datasets.*

11. **Right-Click** on the **Red_Hook_Census_Blocks_2000** layer and go to **Data>Export Data**.



12. **Export** the layer as **Red_Hook_Census_Blocks _2000_with_SF1.shp,** adding it to the **Map Document** when prompted.

13. ***Open*** the **Attribute Table** and note that the **Fieldnames** are no longer **prefixed**, but that duplicate fieldnames (such as **SFID**) have been **suffixed** with **_1.** The new file contains all of the fields from the "**Join**."

14. Close the Attribute Table.

15. ***Remove*** the original **Red_Hook_Census_Blocks_2000** layer (the one without the SF1 data).

16. **Save your work.**

Applying Symbology to Create a Simple Thematic Map

Ultimately, the goal of any geographic analysis is to present results to an audience. Here we will use the layers created in the previous steps to create a simple thematic map from the two data layers we have created.

1. If you have not already, ***make*** **Display** the active **Tab** in the **Table of Contents**.

2. ***Right-Click*** the **Red_Hook_GNIS** layer and **Open** the **Properties Dialog Box**.

3. ***Click*** on the **Symbology Tab** and in the left "**Show**" window select **Categories>Unique values**.

4. Change the **Value Field** to **CLASS**.

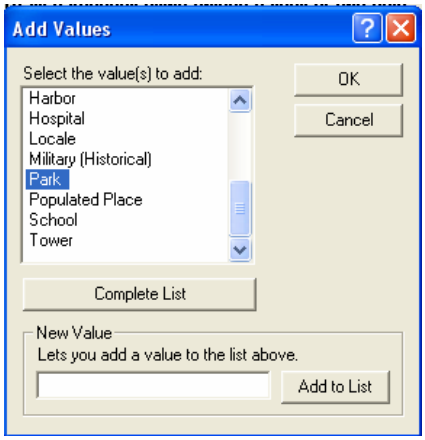
5. Click on the **Add Values Button** 

6. Scroll through the list to find the **Park** item and **Highlight Park** and **Click OK**.

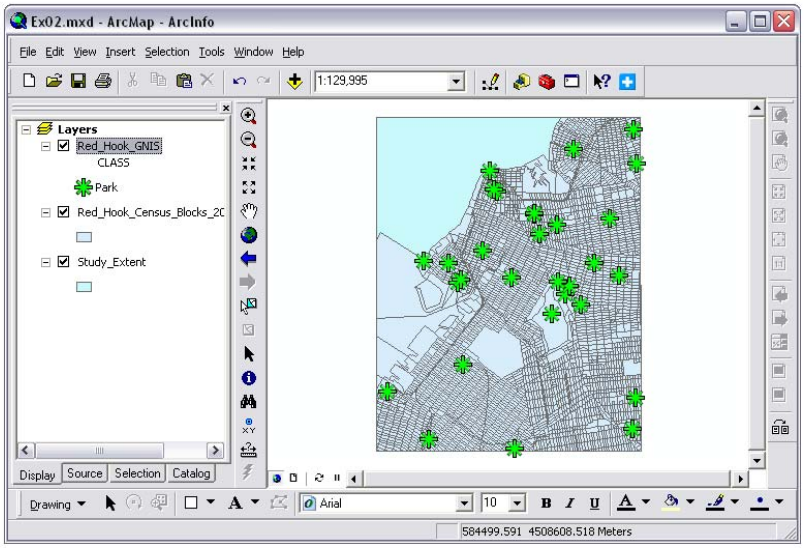
7. **Uncheck** the **Checkbox** next to the **Value**: **<all other values>** (this turns off the visibility of all features other than Parks).

8. **Double-Click** on the point symbol next to the **Value: Park** to open the **Symbol Selector Window**.

9. Scroll through the choices and pick a symbol you think represents the idea of a **Park** (I chose **asterisk #2**).

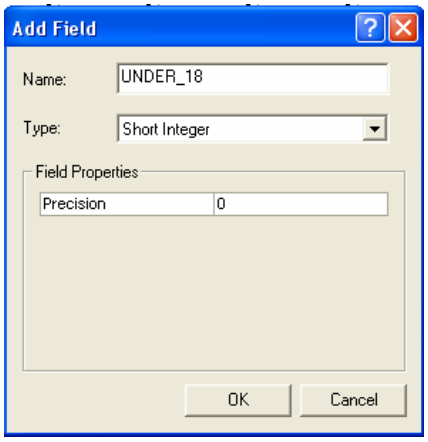


10. Click **OK** twice to exit the **Symbol Selector** and apply the symbol change. Note that all but the points representing **Parks** have disappeared.



Creating a New Field in the Attribute Table and Calculating a Value Based Upon Other Fields.

Now we would like to symbolize the Census Blocks according to the number of children Under 18 in each Block. However, we do not have a field with this value! We **DO** have two fields (**AGE_UNDER5** & **AGE_5_17**) from which we can calculate this value. Here, we will create a new field in the attribute table and calculate its value based upon these two fields.



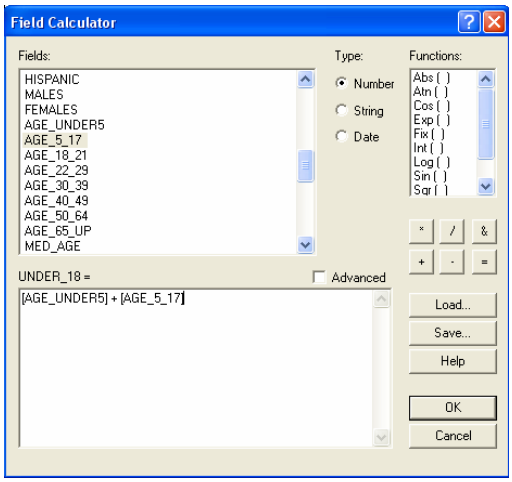
1. ***Right_Click*** on the **Red_Hook_Census_Blocks_with_SF1** Layer

and **Open the Attribute Table**.

2. ***Click*** the **Options Button**  and select **Add Field**.

3. ***Name*** your new field **UNDER_18** and make sure that the field **Type** is set to **Short Integer**. Click **OK** to add the field.

4. If you scroll to the far right of your **Attribute Table**, you should see the new field, populated with a value of **0**.



5. **Right-Click** on the **UNDER_18** fieldname and select **Calculate Values** to open the **Field Calculator**.

6. In the **Fields: window**, scroll down to find the **AGE_UNDER5** and **AGE_5_17** fieldnames.

7. **Double-Click** on the **AGE_UNDER5** fieldname to place it in the **Calculator Window**.

8. Click on the **Plus Button**  to add the **addition operator** to the argument.

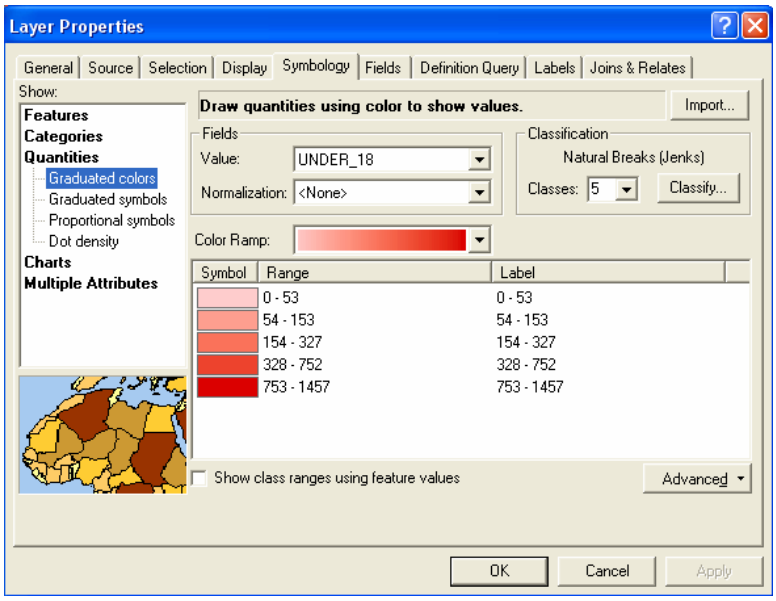
9. Now, **Double-Click** the **AGE_5_17** fieldname to add it to the argument. Your Field Calculator argument should look like the one below:

[AGE_UNDER5] + [AGE_5_17]

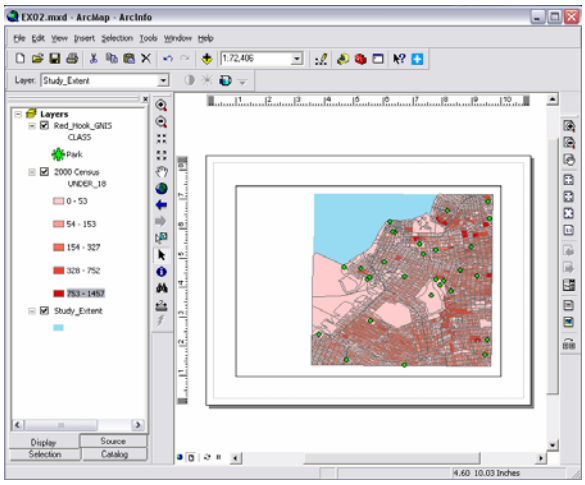
10. Click **OK** to apply the calculation. Note that your **UNDER_18** field now contains the number of children under 18 for each of the Census Blocks.

11. You can now close the **Attribute Table**.

12. **Right-Click** on the **Red_Hook_Census_Block**



s_2000_with_SF1 layer, open the **Properties**



13. Click the **Symbology Tab**.

14. Select the **Quantities** option, and **Graduated** colors.

15. Set the **Field Value** to **UNDER_18**.

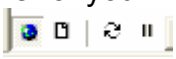
16. Choose an appropriate **Color Ramp** (I chose a pink to red ramp).

17. Leave the **Classification** as the default **Natural Breaks**, with **5 Classes**.

18. Click **OK** to apply the **Symbology**.

Adding a Legend to a Map Layout

Now that you have created new data layers, calculated attributes and symbolized them, you would like to create a map layout to present your work to your intended audience. Here, you will learn to create a printable map layout and add essential map elements like Title, Legend, North Arrow, Scale Bar and descriptive text.

1. In the lower-left corner of your **Map Document Window**, you will find the **Map View Toolbar**  . Click on the **Layout View Button**  to change the Layout view. You should now see your Map Document superimposed on paper page.

2. Activate the **Pan Tool**  and use it to position your data to the right side of the Data Frame.

3. Activate the **Select Elements Tool**  .

4. **Click** once on the **Study_Extent Symbol Color Patch**, in the **Table of Contents**, to open the **Symbol Selector** and change the color to **Blue**.

5. In the **Main Menu**, go to **Insert>Legend** to open the **Legend Wizard**.

6. In the **Legend Items** list, highlight the **Study_Extent** item and use the **Remove Item Button**  to remove that layer from the legend.

7. **Click Next** twice.

8. Choose a **Border** and **Background Color** and then accept the defaults for the remainder of the **Legend Wizard**.

Since the name of the **Red_Hook_Census_Blocks_2000_with_SF1** is so long, it creates an oddly shaped **Legend**.

9. Select the layer's name in the **Table of Contents**, pause and click the name again to make it available for renaming. Rename the layer something shorter, like **"2000 Census"**.

Note that when you rename the layer in the **Table of Contents**, it is updated in the **Legend**, as well. Also note that any text displayed in the **Table of Contents** can be altered to be more meaningful.

Module #1 - Introduction to ArcMap

Exercise #3

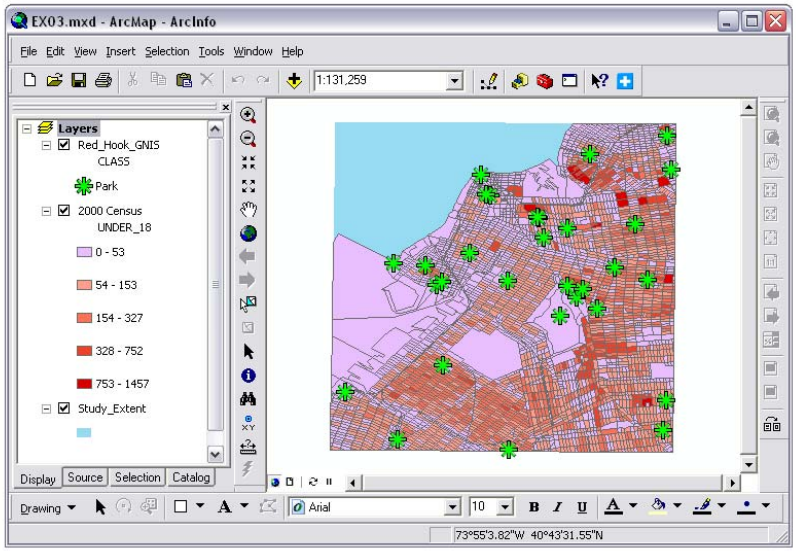
In this exercise, you will explore several tasks that are common to GIS analysis. Here, you will be interested in assessing the number of children served by each of the Parks, identified in the second exercise. To do this, you will have to create several new types of data layer, derived from our original layers. Using ArcToolbox, you will learn to

- How to convert one data type (Polygons) to another (points).
- How to convert between data file formats (shapefile to coverage)
- How to create Theissen Polygons
- How to Join one layer to another based upon spatial location in order to extract its attributes.
- How to aggregate an variable from a layers attribute table based on another field in order to summarize that variable.

Creating "Centroids" from a Polygon Layer

1. ***Browse*** to the **C:\Temp*your_initials*\Module1Data\EX3_Data folder**.

2. ***Open*** the **EX3.mxd** found in that **folder**.

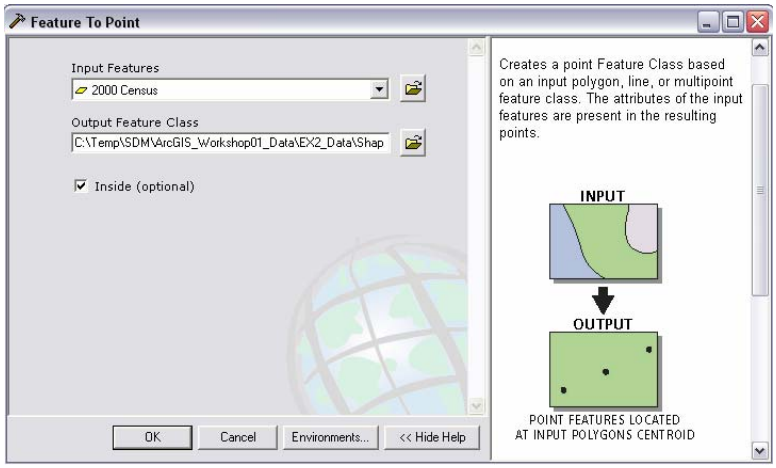


3. ***Use*** the **ArcToolbox button**  to ***open*** **ArcToolbox** again, and ***click*** on the **Search Tab**.

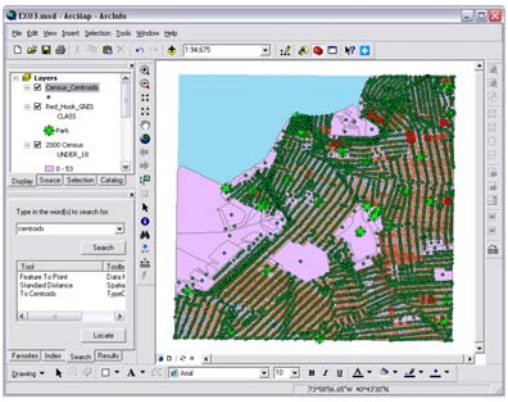
4. ***Search*** on the term "**centroid**," and look for the **Feature to Point Tool** in the results.

5. ***Double click*** on the **Feature to Point Tool** name to ***open*** it.

6. ***Select*** your **2000 Census Layer** as your **Input Features layer.**



7. ***Name*** your **Output Feature Class** as **Census_Centroids.shp,** and ***save*** it to your **C:\Temp*your_initials*\Module1Data\EX3_Data \Shapefiles folder**.



8. ***Check*** the **Inside Option checkbox** *(this ensures that the center points of irregularly shaped features will still lie within the feature*)**.**

9. ***Click*** **OK** to create the new file.

10. ***Right-Click*** on the new **Census_Centroids layer** and ***Open*** the **Attribute Table** to see that the attributes from your census block have been transferred to this new file.

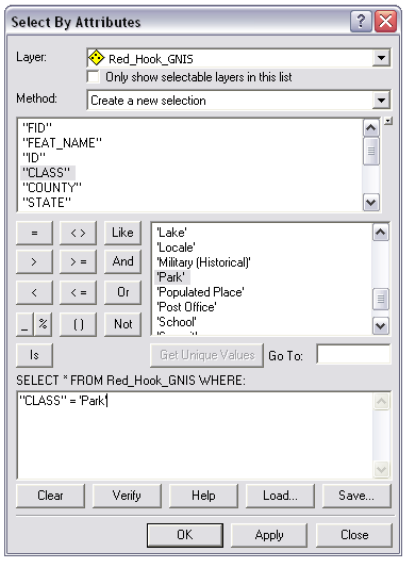
11. ***Close*** the **Attribute table** and ***uncheck*** the **checkbox** next to the **Census_Centroids layer** in the **Table of Contents** to turn the **layer visibility** off.

Creating Voronoi Polygons

What we want to do now is create what are called Voronoi, or Thiessen Polygons. Voronoi polygons are created so that every location within a polygon is closer to the sample point in that polygon than any other sample point. For some reason, the tool that creates these polygons in ArcMap is only available to operate on what are called "coverages." Coverages are a

legacy data file format from the days when ArcGIS was UNIX based. We need to convert our Parks Layer to coverage. First, you need to select all of the Parks in our **Red_Hook_GNIS** layer, so that they are the only ones in our resulting coverage (most tools in **ArcToolBox** work so that if you have an active selection in a layer, the selected features are the only ones the tool is run on).

Converting to Coverage Format



1. On the **Main Menu**, ***go to*** **Selection>Select by Attributes**

2. ***Enter*** the necessary settings to select all of the features in **Red_Hook_GNIS**, whose **"Class" = 'Park'**.

3. ***Click*** **OK** to ***select*** the **Parks** and ***close*** the **Selection Dialog** window.

4. ***Return*** to the **Search Tab** in **ArcToolbox**, ***enter*** the term "**Feature Class to Coverage**," and ***click*** **Search**.

5. ***Open*** the **Feature Class to Coverage** tool.

6. ***Select*** the **Red_Hook_GNIS layer** as your **Input Feature Class**

7. ***Browse*** to your **C:\Temp*your_initials*\Module1Data\EX3_Data\Shapefiles folder** to save your **Output Coverage** as **RH_Parks** (coverage names can only be 13 characters or less in length).

8. Leave the rest of the **Options** as their **default** and ***click*** **OK** to ***apply*** the conversion.

9. **ArcToolbox** does not add the **coverage layer**, by default, but we don't really need the layer in our **Map Document** anyway, so this is not of concern for us now.

Creating the Voronoi Map Using the Theissen Polygon Tool

1. ***Return*** to the **ArcToolbox Search Tab** and **Search** for "**Voronoi**."

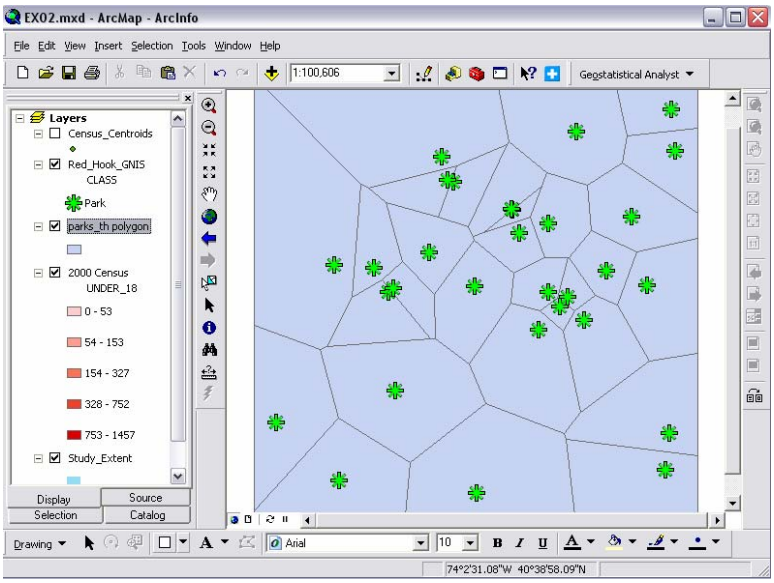
2. The **Theissen Tool** should be returned, ***Double-Click*** it to **Open** the **Theissen Tool**.

3. ***Browse*** to your **C:\Temp*your_initials*\Module1Data\EX3_Data \Shapefiles folder** and ***select*** the **rh_parks coverage** as your **Input Coverage**.

4. ***Save*** the **Output Coverage** as **parks_th**, in the same **C:\Temp*your_initials*\Module1Data\EX3_Data\Shapefiles folder**.

5. ***Click*** **OK** to create the **new coverage**.

6. Since the tool does not add the layer to your **Table of Contents**, ***use*** the **Add Data Button**  to ***browse*** to you **C:\Temp*your_initials*\Module1Data\EX3_Data \Shapefiles folder** and ***add*** the **parks_th coverage** (note the difference in the icon style) to your **Map Document**.



Spatial Joins and Summary Statistics

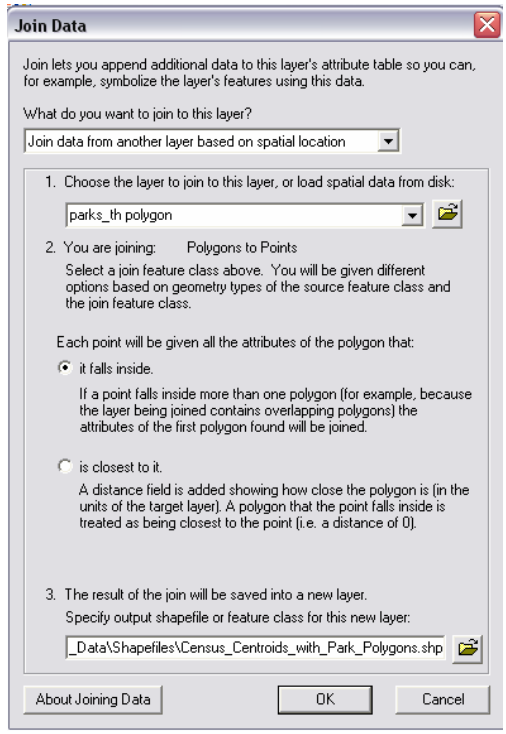
Now we would like to summarize the Under_18 field in our Census 2000 layer to determine the number of children allocated to each park, using our **Voronoi** Polygons. First, we need to be able to determine what **Park** every one of our **Census_Centroids** is nearest to. To do this, we will do a "**Spatial Join**."

1. ***Right-Click*** on the **Census_Centroids** and ***go to*** **Joins and Relates>Join**.

2. We will "**Join data from another layer based on spatial location.**"

3. In this case, we are ***joining*** to the **parks_th polygon** layer, giving each point all of the attributes of each polygon that "**it falls inside**," as shown on the right:

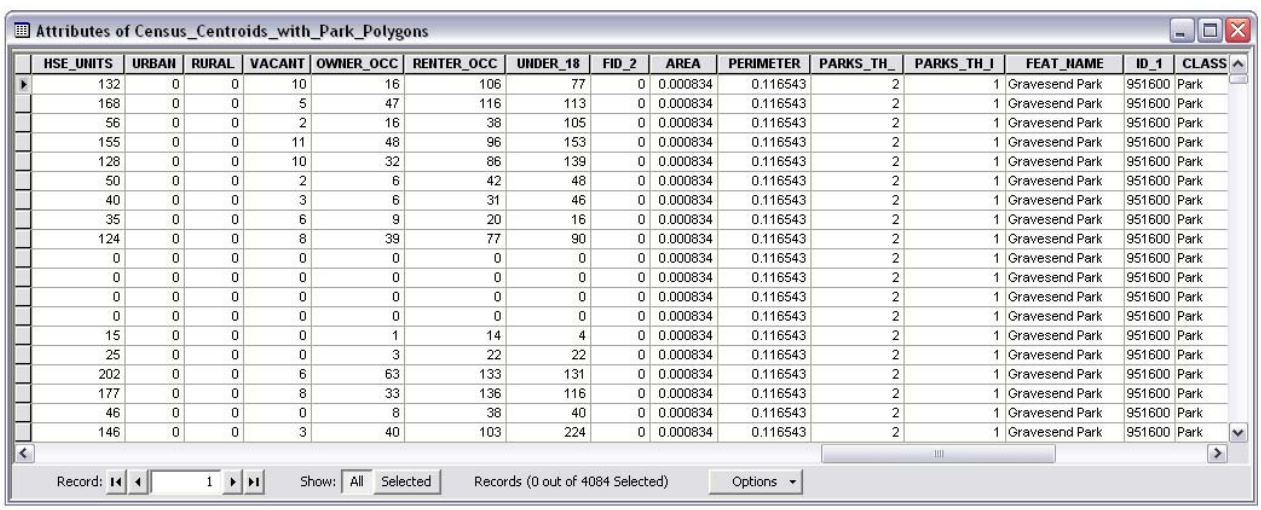
4. ***Name*** the **Output Layer** **Census_Centroids_with_Park_Polygons.shp** and ***save*** it to your **C:\Temp*your_initials*\Module1Data\EX3_Data \Shapefiles folder**.



5. ***Click*** **OK** to create the new joined layer.

6. ***Right-Click*** on the **new layer** and **Open the Attribute Table**.

7. ***Scroll*** to the right and note that the points now have the **Census Attributes**, as well as the **attributes** of the **Park** that they are nearest to.



Attributes of Census_Centroids_with_Park_Polygons

HSE_UNITS	URBAN	RURAL	VACANT	OWNER_OCC	RENTER_OCC	UNDER_18	FID_2	AREA	PERIMETER	PARKS_TH_	PARKS_TH_I	FEAT_NAME	ID_1	CLASS
132	0	0	10	16	106	77	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
168	0	0	5	47	116	113	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
56	0	0	2	16	38	105	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
155	0	0	11	48	96	153	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
128	0	0	10	32	86	139	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
50	0	0	2	6	42	48	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
40	0	0	3	6	31	46	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
35	0	0	6	9	20	16	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
124	0	0	8	39	77	90	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
0	0	0	0	0	0	0	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
0	0	0	0	0	0	0	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
0	0	0	0	0	0	0	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
0	0	0	0	0	0	0	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
15	0	0	0	1	14	4	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
25	0	0	0	3	22	22	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
202	0	0	6	63	133	131	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
177	0	0	8	33	136	116	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
46	0	0	0	8	38	40	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park
146	0	0	3	40	103	224	0	0.000834	0.116543	2	1	Gravesend Park	951600	Park

Record: 1 Show: All Selected Records (0 out of 4084 Selected) Options

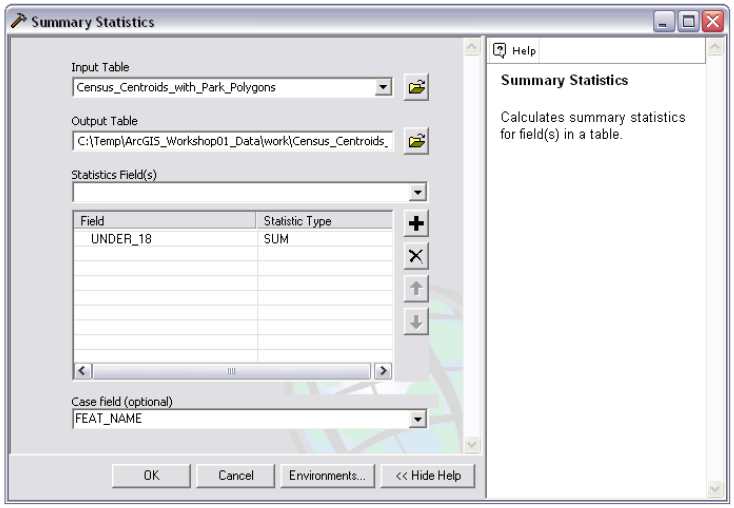
Creating Summary Statistics

1. ***Return*** to the **ArcToolbox Search Tab** and ***Search*** on the term "**Summary**."

2. ***Look*** for the **Summary Statistics Tool** in the results and ***Double-Click*** it to ***Open*** the **Summary Statistics Tool**.

3. ***Select*** your **Census_Centroids_with_Park_Polygons layer** as your **Input Table**.

4. ***Save*** the results to your **C:\Temp*your_initials*\Module1Data\EX3_Data\Tabular_Data folder** as **Children_per_Park.dbf**.



5. ***Choose*** the **UNDER_18 Field** under **Statistics Field**.

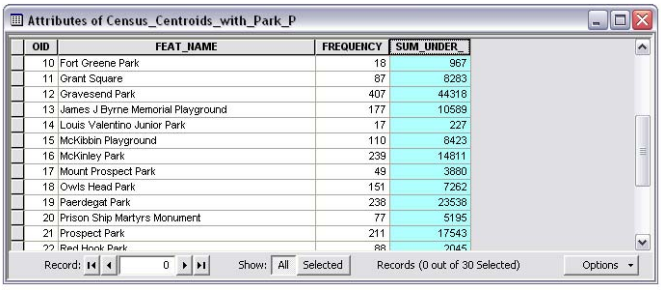
6. ***Select*** **SUM** as the **Statistic Type**.

7. Under **Case Field**, ***Select*** **FEAT_NAME.**

8. ***Use*** the **Add Data button** to ***browse*** to the **C:\Temp*your_initials*\Module1Data\EX3_Data\Tabular_Data folder** and ***add*** the **Children_per_Park table** to your **Map Document**.

9. Your **Table of Contents** view will change to **Source**, because the table you have added *does not have an explicit geographic display*.

10. ***Right-Click*** on the **Children_per_Park table** and ***Open*** it. Note that we now have a table that describes the number of children served (in terms of proximity) by each of our parks.



OID	FEAT_NAME	FREQUENCY	SUM_UNDER_
10	Fort Greene Park	18	967
11	Grant Square	87	8283
12	Gravesend Park	407	44318
13	James J Byrne Memorial Playground	177	10589
14	Louis Valentino Junior Park	17	227
15	McKibbin Playground	110	8423
16	McKinley Park	239	14811
17	Mount Prospect Park	49	3880
18	Owls Head Park	151	7262
19	Paerdegat Park	238	23538
20	Prison Ship Martyrs Monument	77	5195
21	Prospect Park	211	17543
22	Red Hook Park	88	2045

11. ***Save*** your work and ***leave*** **ArcMap** ***open***.

Module #1 - Introduction to ArcMap

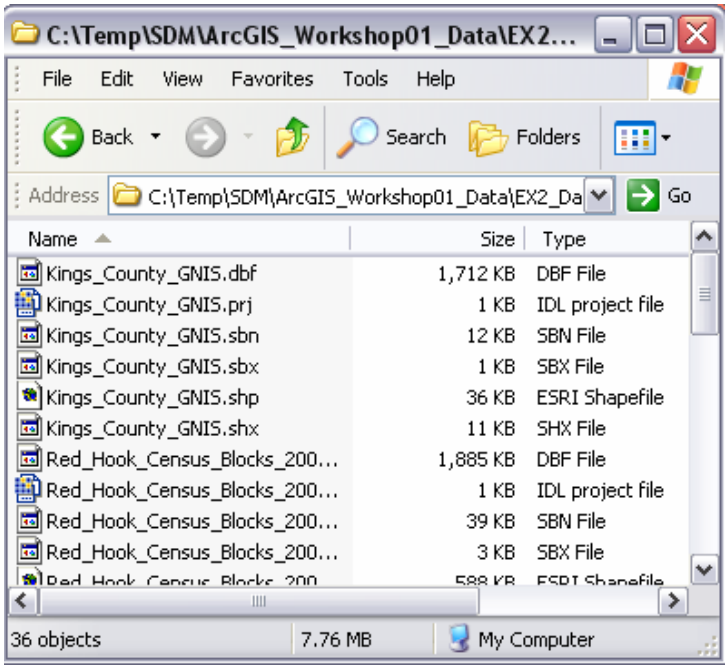
Exercise #4 – Management of ArcMap Projects

Now we want to familiarize ourselves with some of the file management issues you will have to deal with when working with ArcGIS. This section will introduce you to **ArcCatalog**, and will provide you with skills that will make managing your GIS projects easier.

Windows Explorer vs. ArcCatalog

1. ***Open*** a **Windows Explorer** window (you can start with **My Computer**, if you like), and **browse** to the **EX2_Data folder** you unzipped to your initials directory. You should find your **EX02.mxd Map Document file**, as well as three folders (**Documentation, Shapefiles and Tabular_Data**) that contain the data we have been using in the previous exercise.

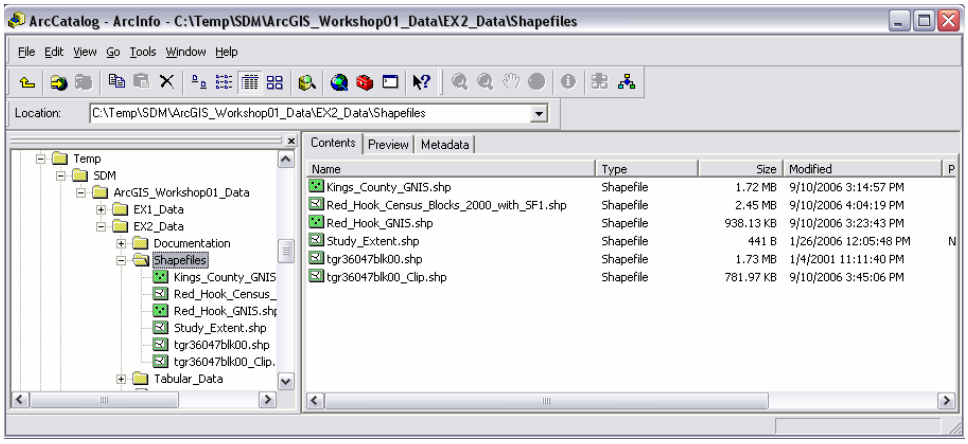
2. ***Open*** the **Shapefiles** folder, and take a look at the files stored there. You should see many filenames that look somewhat familiar, but with file extensions like **.dbf, .sbx, .prj, .shp** and so on. It isn't really important to know what each of these separate files contains at this point.



3. Now ***look*** for the **ArcCatalog** icon  on the **main toolbar** of your **ArcMap Window** and ***Click*** on it to **Open ArcCatalog**.

4. Once **ArcCatalog** has opened, ***browse*** to the same **Shapefiles folder** you looked at in **Windows Explorer**, using the **Catalog Tree**, which is the left side of the **ArcCatalog** application.

5. Note that where you saw many files, with the same names but different file extensions, in **Windows Explorer**, you now see only one file, with the file



extension .**shp**. Shapefiles are actually made up of many different file (the ones you saw in **Windows Explorer**), each of which contains a specific type of data necessary to create the shapefile, as a whole.

6. ***Right-Click*** on one of the **shapefiles** in your **ArcCatalog** Contents Window. Note that there are a number of options available for copying, exporting and exploring properties.

   The important thing to recognize here is that ArcCatalog "knows" that each Shapefile is actually made up of several files. ArcCatalog helps prevent damage to shapefiles through inadvertent loss of one of its component files by showing you the array of files as a single item. In most cases, you should use ArcCatalog to copy, paste, and move your GIS data files from one place to another to avoid accidentally "breaking" your data layers.

Viewing, Editing and Creating Metadata

Metadata is "data about data," and maintaining it is an essential part of any GIS analysis project. Maintaining good Metadata allows examination of your methodological process and increases the repeatability of your analysis. Metadata also allows you to maintain essential information about coordinate systems, projections and the processing that went into creating individual layers. ArcCatalog maintains much of the Metadata itself. Here, you will learn to

examine the metadata for your data, and to edit and create new metadata that contains relevant information about how the data was created.

1. In the **Catalog Tree** on the left side of the **ArcCatalog** window, ***select*** the **Census_Centroids.shp layer**.

2. In the **View Window**, ***Select*** the **Metadata Tab**. Explore some of the **Metadata** items available

3. In an empty area of the **ArcCatalog Toolbar** area, ***Right-Click*** and ***enable*** the **Metadata Toolbar** if it is not already enabled.

4. Set the Stylesheet to FGDC ESRI, and ***Click*** on the **Edit Metadata Button**  .

5. ***Write*** a short abstract of this dataset. You can explore the various metadata fields available later.

6. ***Note*** that many fields are labeled as "**REQUIRED**," in red. *These are fields that you should become familiar with, and maintain, when creating data that will be used by others.*

7. ***Click*** **Save**. ***Note*** that the **Abstract** item has been ***updated***.

More Tips to Make Your ArcMap Experience Less Stressful:

- Create a main **Project Folder** for your GIS analysis project. Under this main folder, create a Data folder, under which you should create a series of subfolders for each type of data you are using, or creating in your project (**shapefile, raster, image, tables, etc…**). For complex projects, you may even find it helpful to create further divisions (**original, working, final, etc…**) within each of your data subfolders to contain the multiple versions of data files that can accumulate during the course of a GIS project.

- By setting "**Relative Pathnames**" in the **Map Properties>Data Source Options**, you can move your ArcMap Project Folder as a single unit, preserving the location of your data files relative to your **MXD document**, without breaking the internal links to the datasets. You can also Zip the folder and send it through the email to colleagues.

- MXD Map Documents are very small! You can save many versions of a project by saving multiple Map Documents. This allows you to save several layout versions of the same data without using a great deal of disk space.

- ArcMap supports long filenames for MXD Document, table and shapefile names. Use this to your advantage by giving these files very specifically descriptive names. Coverage and raster filenames are limited to 13 characters.

Congratulations! You are now ready to explore ArcMap on your own! If you are interested in additional training materials, or just need help with a specific GIS related issue, feel free to contact us !