Exercise 1: An Overview of ArcMap and ArcCatalog

Introduction:
"ArcGIS is an integrated collection of GIS software products for building a complete GIS. ArcGIS enables users to deploy GIS functionality wherever it is needed—in desktops, servers, or custom applications; over the Web; or in the field." Desktop ArcGIS consists of two major components: ArcMap, which allows you to display and analyze spatial data, and ArcCatalog which allows you to manage your files.

The following exercise provides step-by-step instructions for doing basic tasks and solving simple problems in ArcGIS.

Life with ArcGIS is simpler if you keep all of your data files in one folder. I strongly recommend that you use a flash drive and create a COS120 folder on the drive, and under that a folder for each exercise and one for each two-week assignment.

Flash drive
    COS120
        Exercise 1
        Exercise 2
        etc.

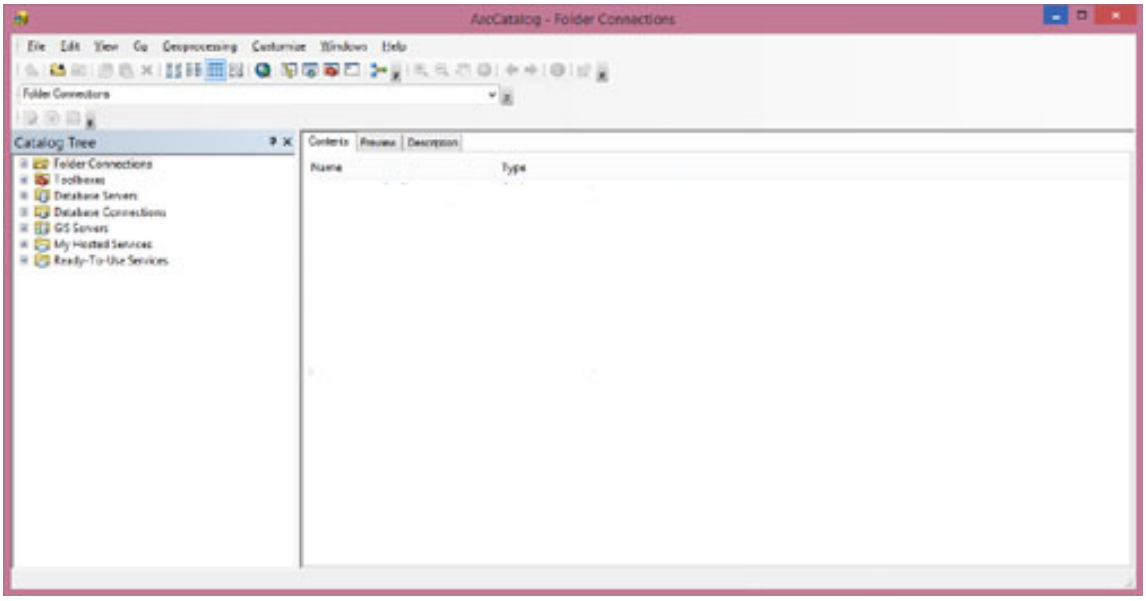
Questions will appear throughout the lab. These are intended to make you think about something important.

Procedures:
Think of ArcCatalog as a window explorer. In ArcCatalog, you can browse, organize, distribute, and document your GIS data. ArcCatalog resembles Microsoft Windows Explorer but is designed for viewing geographic databases, maps, and metadata.

1. Download and extract the data for Exercise 1 from the class website (http://umaine.edu/computingcoursesonline/cos120/).

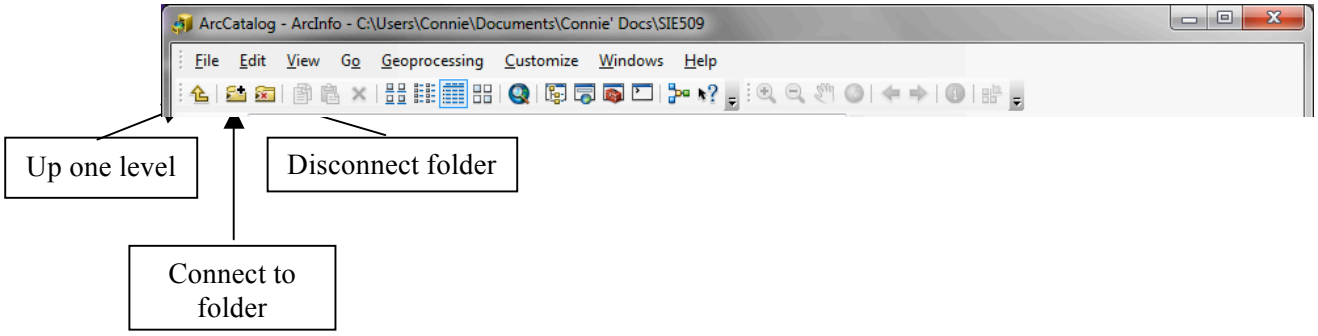
2. From the Start menu, select Programs->ArcGIS->ArcCatalog 10

   The ArcCatalog window pops up. The window is divided into two parts. The left part is the catalog tree, and lists the connections you can make. The right hand side has three tabs, Contents, Preview, Description.



Connect to a Folder:

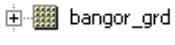
3. Find the Connect to Folder icon on the toolbar at the top. Click on this button to connect to a folder. Navigate to your COS120, Ex_1 folder and click OK in the small pop up window



3. The contents of the Ex_1 folder are displayed in the panel on the right. You can select any item here to see more information about the dataset or the content of the folder on the right side of the window, by selecting a file in the Catalog Tree and the different tabs in the right-hand panel. The information may not be complete for all files, an issue that will be addressed later in the course.

4. Explore the Ex_01 dataset, and look at the symbology in the right window. There are

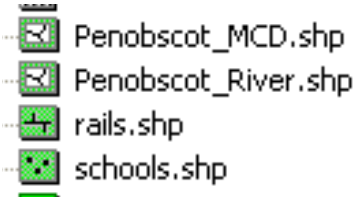
   a. ArcInfo coverages (note the folders) , 

   b. a grid file (a raster data set) 

   c. a dbf (database) file, and 

d. shapefiles.

Note the different icons for the different file types.
ArcInfo coverage are a proprietary file type, and are composed of several folders, each containing multiple files. Bocks_2000 and waterbodies are polygon files, streets is a line file and hospitals is a point file.

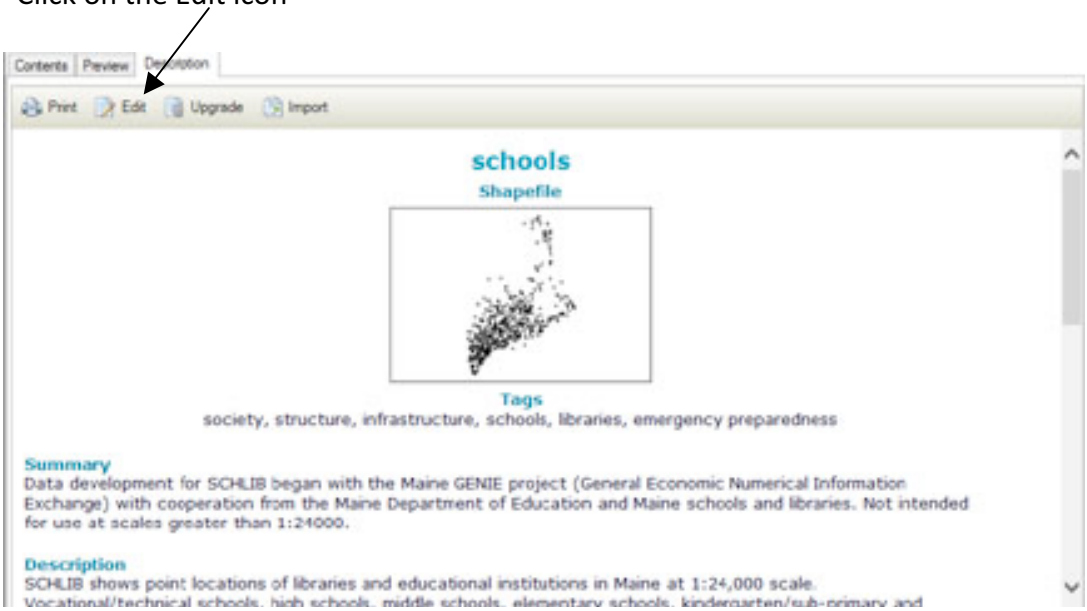


Shapefiles are a generic file type and consists of a minimum of three files, each having the same filename with a different extension. The three required extensions are: .shp (stores the geometry), .shx (a spatial index file) and .dbf. (stores the attribute tables). Penobscot_Towns and the Penobscot_River are polygon files, rails is a line file and schools is a point file

5. Click on the + sign next to the ***blocks2000*** layer. This ArcInfo coverage is composed of an arc file (line), a label file, a polygon file and a tic file (point). All coverages are composed of multiple files, and should only be manipulated (copied, moved or renamed) in ArcCatalog.

6. Next select the ***schools*** layer.
   a. Verify that the Contents tab is active. This window displays the name of the feature, its type and thumbnail if it exists.
   b. Click the Preview tab. The Preview window lets you preview the data set. If the drop down box at the bottom of the right-panel is set to Geography, you will preview the map file. If it is set to Table, you will preview the attributes of the file.
   c. Now click on the Description tab.

7. Click on the Edit icon



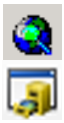
This allows you to create or alter the description. When creating a GIS project, you should enter all of the required information, to ensure the usefulness of the project over time.

8. Preview the geography of a polygon, a line and a point file type.

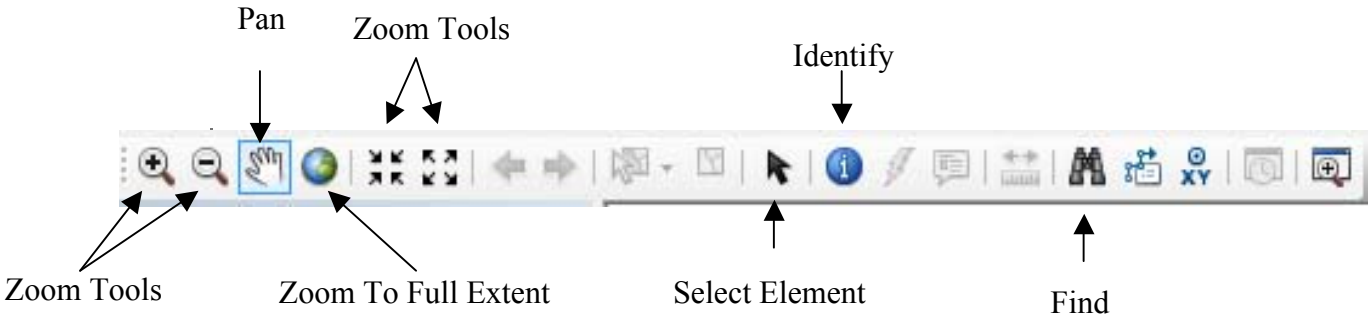
Manage data with ArcCatalog:
ArcCatalog allows you to perform data management tasks such as creating new folders and doing copy and paste operations, as well as renaming files. Although you can perform these operations on shapefiles using Windows Explorer, coverages and geodatabases **cannot** be managed outside of ArcCatalog..

1. Right-click on the Ex_01 folder in your documents folder.
2. Right-click on ***Penobscot_MCD*** (minor civil divisions) and choose Rename. Rename it as Penobscot_Towns.

Introducing ArcMap:
ArcMap is the main application for data display, data query, and data output. You can work with ArcCatalog and ArcMap together for moving data from ArcCatalog. You can launch ArcMap from the Start menu, or from the Launch ArcMap button in ArcCatalog. You can also launch ArcCatalog from within ArcMap



1. Launch ArcMap and choose "A new empty map" from the dialog box and click OK. This will display the interface of the ArcMap application. At the top part of the window is a menu bar and two toolbars. At the lower part, ArcMap comes with two parts on the screen the Table of Contents (TOC) at left and the display area at right. There are several important things to know about ArcMap:
   - First, associated with ArcMap is a toolbar, which includes such tools as Zoom in, Zoom out, Pan, Select Elements and Identify.



A toolbar can be moved by grabbing the "perforations" on the far left, an moving it to the desired position.. This is an option with all ArcMap toolbars. When you hold the

mouse point over a tool (a graphic icon), a short message called a Tool Tip appears in a floating yellow box to tell you the function of the tool.

- Second, ArcMap has two views: Data View and Layout View (the buttons for the two views are located at the bottom left of the view window). The Data view is for viewing data, whereas the Layout view is for viewing the map product for printing and plotting.

Data View | Layout View | Refresh View | Pause Drawing

- Third, ArcMap new project, there is a default data frame called Layers. Each data frame contains data sets made of shapefiles, grids, and coverages, and to spatially register them with one another, these data sets should be based on the same coordinate system. However, ArcMap has the ability to "reproject on the fly" as long as the coordinate system for the data has been defined. If one or more of the data sets in a data frame do not have projection information, ArcMap will display a warning message about the missing information and use the first available projection information for the display.
- Whenever you work with ArcMap, you are working with a map document. A map document has the .mxd file extension. This is just a text document that tells the software what to load.

Connect to Your Exercise Folder

1. Click on the Connect to Folder icon. Notice that the icon is the same as in ArcCatalog.
2. Navigate to your Ex_1 folder.

Setting the Workspace

1. In the Geoprocessing Menu select Environments->Workspace
2. Click on the Browse button and connect to your COS120_Ex_1 folder
3. Set both the Current Workspace and the Scratch Workspace to your Ex_1 folder.

This ensures that any new file you create gets saved in that folder and you won't have to "hunt for it" later. Remember to do this each time you start a new project.

Note: It is a good habit, to give your project a name and save it as soon as you start. ArcMap does automatic "saves", if the software stops working and you have to restart, it will open to the state of the last save. When you exit ArcMap, it automatically saves the project. When you reopen the project it will open to where you left off

Explore Feature Layers:

1. From the File menu, save your project with an appropriate name.

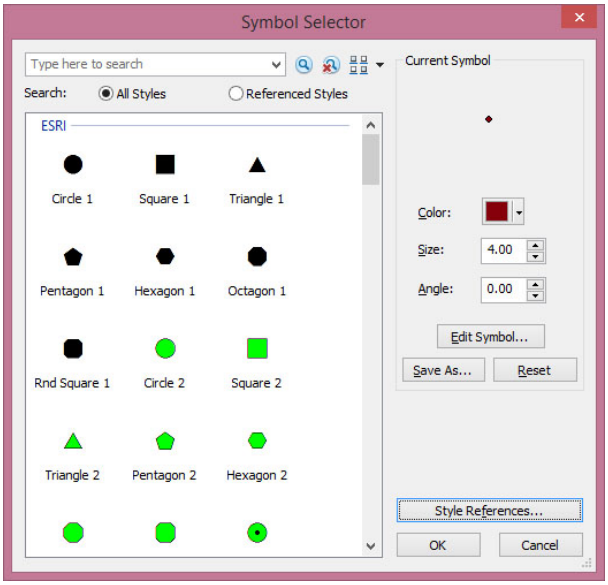
2. From the File menu, select Map Document Properties, and put a check mark next to "Store Relative Pathnames to Data Sources".

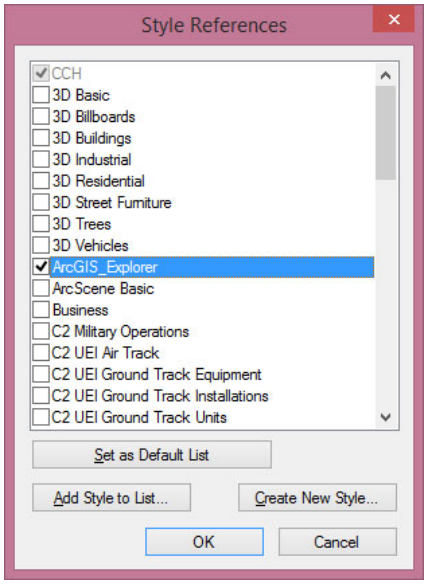
Note: ArcGIS generally provides multiple ways of accomplishing a single task. You will experience this as we add data to your project.

3. Use the Add Data tool to add the following data sets to your map (you can add them all at once, by holding down the control key as you select them):
   - Penobscot_Towns
   - Waterbodies
   - Rails
   - Streets
   - Blocks_2000
4. You can also add data by dragging and dropping from ArcCatalog. Click on the Catalog tab on the right side. Find the ***schools*** layer in ArcCatalog and drag it to the ArcMap display.
5. From the File menu, select Add Data>Add Data and select the ***hospitals*** layer. You should now have seven layers displayed in ArcMap.
6. ArcMap displays point files on top, line files in the middle, and area/polygon files on the bottom. The bottom one is drawn first, and the top one is drawn last. You can arrange the order of the layers by clicking and holding on the data layer and drag it to the place we want. Verify that the Display tab at the bottom of the TOC is active. Drag the rail layer below the street layer. Put the waterbodies below the line features, followed by Penobscot_Towns, then Blocks_2000 on the bottom. Hospitals should be on top, followed by schools.
7. Click on the check box next to the streets layer. The drawing is turned on when the box is checked, and off when it is not

Display a Layer Using Its Attributes

1. We want to display the waterbodies in a light blue color with a darker outline.
   a. To do this, left-click on the box with filled color to bring up the symbol selector window
   b. Scroll down to find "Lake Blue"
   c. We want to outline the lake with a darker blue.
      i. Click on the arrow to the right of the Outline color to reveal more color choices.
      ii. Click on dark blue.
   d. Click OK to apply these color changes.
2. Right-click on the symbol for schools.
   a. Choose Properties>Symbology.
   b. Left-click on the symbol to bring up the Symbol Selector.
   c. Click on Style References and place a checkmark on ArcGIS Explorer and click OK.



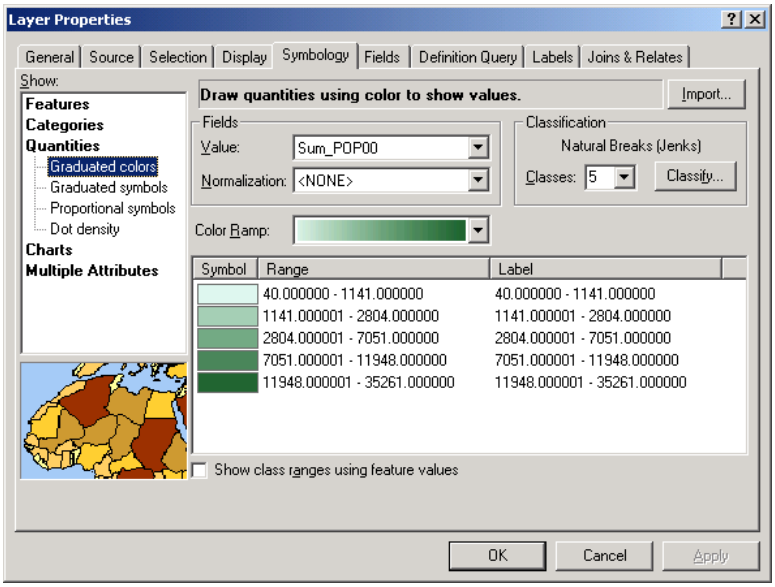


   d. Now scroll down and search for "School".
   e. Set the symbol size to 10.
   f. Click OK.

3. Click on the hospital symbol and search for hospital.
   a. Scroll down to Civic and select Hospital 1
   b. Set the size to 10.
4. Make the streets either a dark gray or black.
5. Use the a railroad symbol for rails and use the default color.

We want to display the Penobscot_Towns in a graduated color based on population.

6. Right-click on the Penobscot_Towns layer name and choose properties from the menu.
   a. Click the Symbology tab.
   b. In the box on the left (labeled Show), click Quantities->Graduated Colors.
   c. Use the drop-down Value box to choose the field SumPOP00.
   d. Use the Color Ramp drop-down box to choose a greent color ramp. Click OK to produce the map.



Identify Geographic Features

1. You can examine a particular feature's data by using the Identify tool.
2. Use the Zoom in tool and draw a box around some body of water to zoom in on it.
3. Click on the Identify tool open the Identify Results dialog box. Once the Identify Results dialog box has opened, you can switch layers by from the drop down box. Change the layer to Penobscot_Towns, and use the Identify tool on the same body of water.
4. Change the layer to Visible layers (these are the layers that are drawn on) and click on the same body of water.
5. Click on the + sign next to Penobscot_Towns.

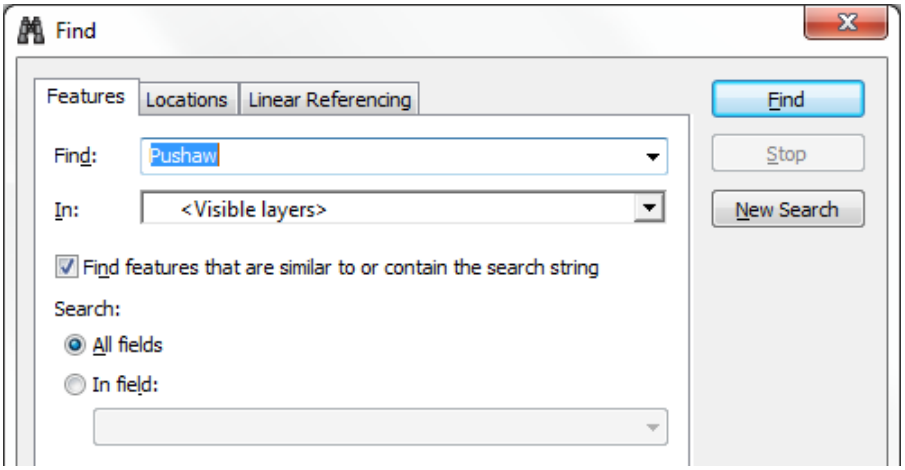
Q1. What is the advantage of choosing All Layers as opposed to a specific layer?

6. Close the Identify Results dialog box.
7. Zoom to full extent.

Finding Geographic Features

The Find tool is a handy way to seek a feature. It will look for features having a specified string across all of the layers in a map or in an individual layer. It can also search all fields or confine the search to a single field.

1. Click the Find tool to bring up the Find dialog box.



2. Make sure the Features tab is clicked so that it is active.
3. Enter the name Pushaw. Choose either All Layers (all layers will be searched) or waterbodies (only this layer will be searched).
4. Click Find.
5. When the feature has been found, choose Pushaw Lake from the list and right-click on its name and choose Select feature. Note what happens
6. Right-click again and choose Zoom to feature(s).
7. Right-click once again and choose Unselect Feature.
8. Click on the Zoom to Full Extent button to return to the previous extent.

9. Experiment with finding a couple of more features. When done, click the Cancel box to close the Find window.

Experimenting with the Zooming Buttons

1. Uncheck the streets layer so it will not be visible.
2. Click the Zoom In tool. Place the cursor in the upper left hand corner of one of the towns) in Penobscot County (Penobscot_Towns) and click and hold. Continue holding the mouse button down and drag a box around the town. When finished with the box, let go of the mouse button.

> **TIP**: If you do not like the area you have chosen, or if you make a mistake, click the Previous Extent button to return to the original extent. You can use the Next Extent to move back the other way.

3. Click on the corner of the Penobscot_Towns and notice that the view zooms in and places the point you clicked at the center. The Zoom Out toll works the same way.

4. Click on the Pan tool, then click and display inside the map window to move the map around. When you release the mouse button, the map redraws.

5. Click the Zoom Out Center button a few times to zoom out, notice that the center stays put.
6. Click the Zoom In Center button a few times to reverse the process.
7. Zoom to Full Extent.
8. Put a checkmark next to the streets layer so it will be drawn.

Bookmarks

Bookmarks provide a handy way to zoom into extents that you use frequently, or that you want others to be able to find easily.

1. Find Bangor in the Penobscot_Towns layer and zoom to the feature.
2. From the menu bar, select Bookmarks then Create.
3. Type “Bangor” in the box to name the bookmark.
4. Return to Full Extent.
5. From the menu choose Bookmarks->Bangor to use the new bookmark to zoom in.
6. Use Bookmarks->Manage to examine or remove bookmarks.

Examine other Attribute Information

1. Right-click on the Penobscot_Towns layer in the TOC, and choose Open Attribute Table. The attribute table associated with the Penobscot_Towns layer displays. Each record represents an individual feature in the Penobscot_Towns layer.

Q2. How many records/rows are there in the Penobscot_Towns layer? (Hint: Look at the bottom of the table window?)

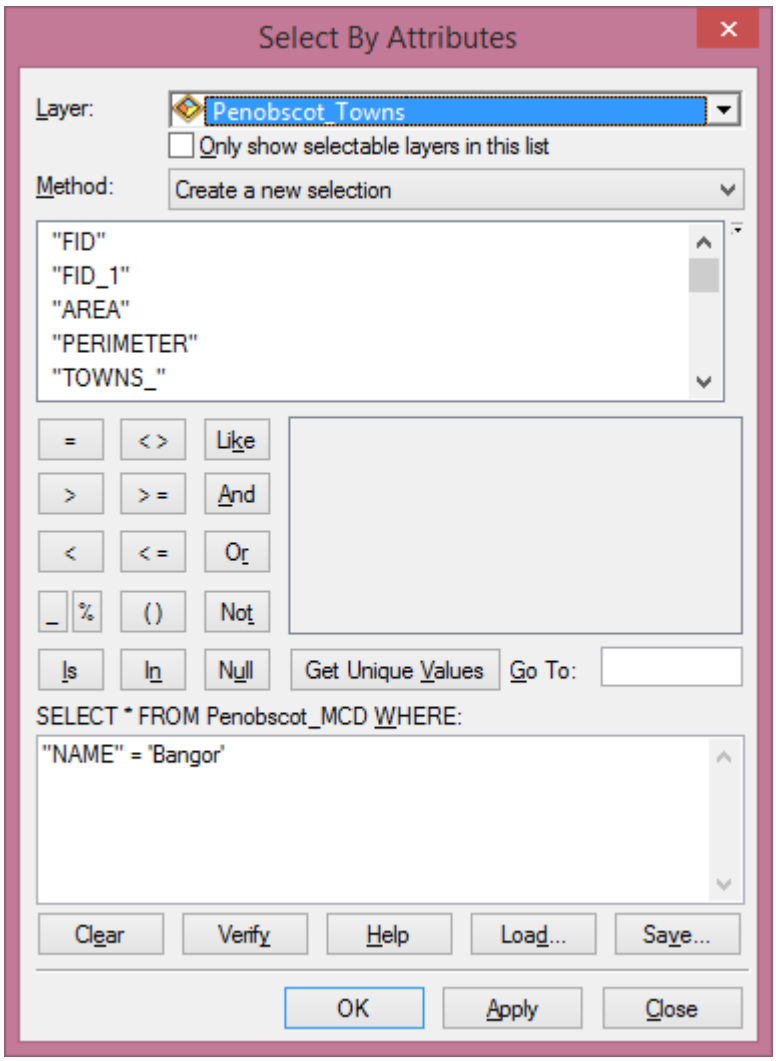
Q3. How many attributes/columns are there in the Penobscot_Town layer?

You can use the Statistics command to calculate basic statistics about all of the records (if none are selected), or of the selected records.

2. In the table, right-click on the name of the Sum_POP00 (population in 2000) field and choose Statistics from the context menu.
3. Examine the statistics and the frequency diagram.

Q4. What was the total population of Penobscot County in 2000?

4. Explore the buttons at the bottom of the attribute table. When finished, close the attribute table.
5. From the menu bar, choose Selection->Select by Attributes. Use the Query Wizard to “Create a new selection” on the “Penobscot_Towns” layer. Create the following query: "NAME" = 'Bangor', by double-clicking “NAME”, single-clicking “=” and double-clicking “Bangor”. If Bangor is not initially displayed in the list of Penobscot_Towns, click on the Get Unique Values button. Click OK. The selected Penobscot_Towns is highlighted, but depending upon where you are zoomed in, it may not be visible.



From the Selection menu, choose Zoom to Selected features, to zoom into Bangor.

6. Open the Attribute table for Penobscot_Towns. At the bottom of the table window, choose Show Selected. Only the record for Bangor will be displayed.

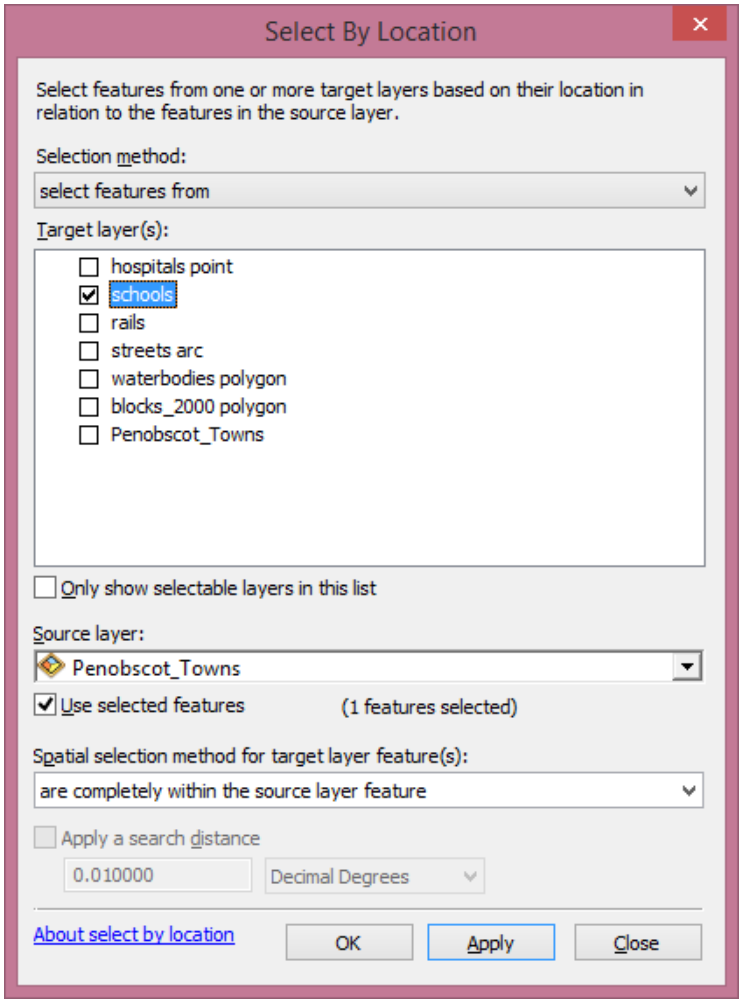
Q5. What was the population of Bangor in 2000?

7. Return to Full Extent, but leave Bangor selected for the next section.

Select features using spatial relationships (this is a Spatial Query)

We want to select all of the schools within the city of Bangor.

1. From the Selection menu choose Select by Location
   a. Select the features of Schools that are completely within the features in the Penobscot_Towns layer.



b. Check the "Use selected features box".
c. Click OK.

2. Open the schools attribute table to see how many were selected.
3. Click on the Selected button to see just the list of schools that are within Bangor.

Q6. How many schools were selected?

4. Hold the cursor over the icons at the top of the attribute table to find the Clear Selection icon. Click on it and close the attribute table.
5. Next select the Blocks_2000 that are contained within Bangor.
6. Examine the Statistics of the POP00 field of the selected records?

Q7. According to this table, what was the population of Bangor in 2000?

Q8. Why might the same information in two different tables be different?

Q9. How might you determine which value is the correct one, or if neither is correct?

7. From the Tool Bar, choose Clear Selected features to deselect Bangor and the Blocks it contains..
8. Zoom to the full extent

Label Map Features and Map Tips.

In this step we will label features on a map and add map tips. A map tip is a way to see attribute information about a feature when you put a mouse over a feature.

1. In the TOC right-click on the Penobscot_Towns and choose Properties to bring up the Layer Properties dialog box.
2. Click on the Labels tab to set labeling properties.
3. Check the Label features in this layer box.
4. Click the drop-down list in the Label Field and choose Name, the value we want to use to label the feature. Set the font size to 14.
5. However, if we label all of the Penobscot_Towns when we are zoomed to full extent, the map will be unreadable, so we will set the label to only be visible when we zoom in.
    a. Click on the Scale Range button to open the Scale Range dialog box
    b. Select "Don't show labels when zoomed"
    c. Out beyond 1:500000.
    d. Click Ok.
6. Click OK.
7. Right-click Penobscot_Towns again and choose Label Features.
8. Zoom in to the map until the labels appear.
9. If the label for Bangor is not visible, it may be necessary to change the color of the labels.
    a. Right click on Penobscot_Towns
    b. Choose Properties->Labels.
    c. Choose a different color for the symbol and click OK.

Q10. What was the scale (to the right of the Add Data button) when they became visible?

10. Zoom back out to full extent.
11. Right-click waterbodies in the TOC and choose Properties. In the Layer Properties dialog box, click the Display tab, then check the box next to Show Map Tips. Click OK.
12. Move your pointer over a lake on the associated map
13. Now that you have added Map Tips, use the Find tool again and Find North Penobscot in the Penobscot_Towns layer. Once it has been found, right-click on the name. This time choose Flash feature.

TIP: If the Show Map Tips text is dimmed in the Display Properties menu, then no spatial index exists for the data layer. Spatial indices must be created in ArcCatalog before Map Tips can be used.

Q9. What do you observe?

14. Close the dialog box.

Scale Range

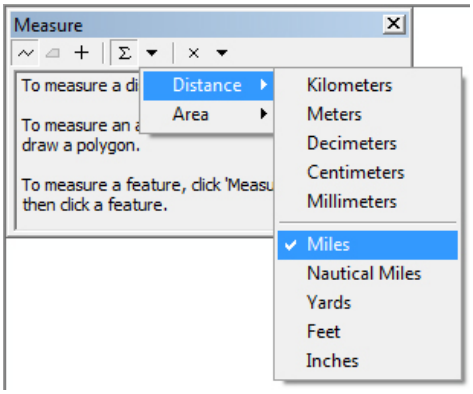
Scale Range is a layer property that allows additional control of displaying features. You have already used Scale Range to determine at what scale a label will be visible. You can also specify a range of map scales at which the map layer is drawn, to avoid cluttering the map with too much information. Try it with the Streets Layer.

1. Return to Full Extent if necessary.
2. Right-click on the Streets layer name (be sure that it is checked) and choose Properties from the menu.
3. Click the General tab if it is not already displayed.
4. Fill the button next to "Don't show layer when zoomed:" and enter the value 120000 in the box for "out beyond". Click OK.
5. Notice that the streets have disappeared from the map and the check box next to the layer has dimmed.
6. Use the Bookmark to zoom in to Bangor and the streets should reappear. If not, use the Zoom tool to zoom in until they do appear.
7. Return to full extent.

Setting data frame properties

1. Right-click on Layers and choose Properties to bring up the Data Frame Properties dialog box.
2. Click on the General tab to change the display units. The map units are in decimal degrees, so change the display units to miles.
3. Also, change the Layer name to Penobscot County.
4. Click OK.
5. Use the Measure tool to find the length of Penobscot County

6. In the Measure dialog box:
   a. Click on the Line button (1st button) and select Distance
   b. Click on the Choose Units button (4th button) and select Distance->Miles



Q11. What is the length (north to south) of Penobscot County in miles (round to the nearest whole mile?

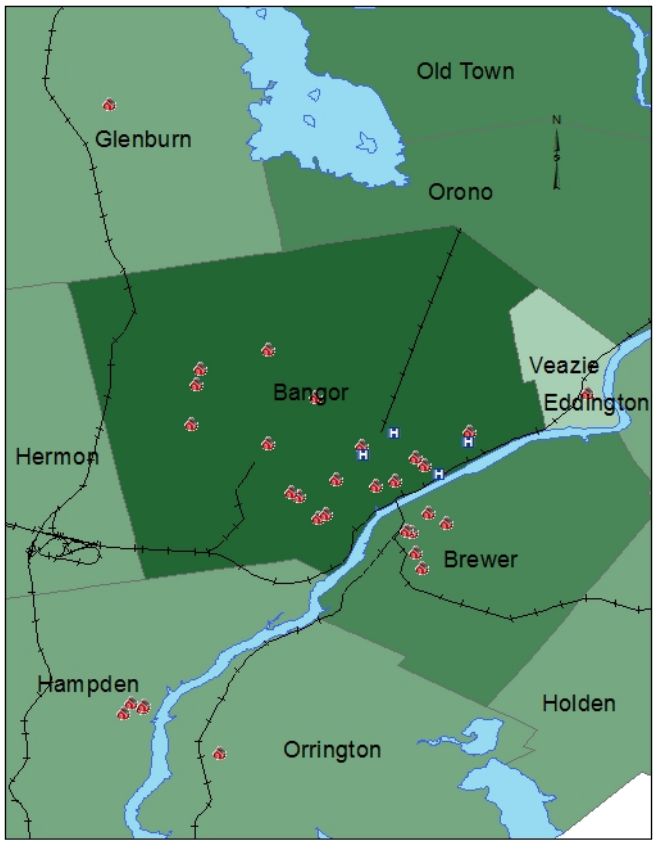
7. Double-click to stop measuring.

Creating a Layout

1. Zoom in to Bangor again.
2. From the View menu select Layout View. Change the size and placement of the map as you wish, by selecting it and dragging the handles.
3. Be sure that your map is selected. From the Insert menu select Neatline and Place around selected elements
4. Again from the Insert menu
    a. Add a Legend. Do not include Blocks_2000 in the Legend, and display your Legend in 2 columns.
    b. Add a Scale bar and North Arrow and an appropriate Title.
    c. Add your name and the date.
    d. From the File menu, choose Export Map. Export your map as a jpeg and paste it into your Report Sheet.

Your layout should be **similar** to the following.

Bangor Maine



Legend for Bangor, Maine

- hospitals point
- schools
- rails
- waterbodies polygon

Penobscot_Towns

Sum_POP00

- 40.000000 - 1141.000000
- 1141.000001 - 2804.000000
- 2804.000001 - 7051.000000
- 7051.000001 - 11948.000000
- 11948.000001 - 35261.000000

Prepared by:
Connie Holden
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