Working with ArcVoyager:
A Jump Start Lesson

Exploring U.S. landforms and relationships

Background: The United States is a nation of many physical contrasts. From gentle coastal plains to rugged mountain terrains, the country contains much diversity. The lay of the land affects physical systems in the environment, such as the flow of water. It also affects the human component of the United States. For instance, the location of large population settlements is aided, constricted, and directed by the physical features of the continent.

Using *ArcVoyager's United States Reference Map* project (*Designing Global Adventures: Point Me*), students will:

> **Task 1.** Add a landform image layer for the contiguous 48 states to the existing project and make observations about the physical makeup of the country.
> **Task 2.** Add new thematic layers and make observations about relationships among these features.

Failsafe: If you have a technical problem with an ArcVoyager project, don't panic. Simply use the QUIT button (or if need be, the EXIT feature in the FILE menu) to quit out of that session of ArcVoyager and reopen a fresh copy of the appropriate project from the ArcVoyager Guide.

Critical step! ArcVoyager (ArcView) skills already in place? This exercise assumes that you are familiar with a few key ArcVoyager (ArcView) operations. These include: turning themes on and off, making a theme active, reordering themes in the table of contents, using the identify tool, navigating within a view, and working with the legend editor. If these are not familiar, review the *How to Use the Atlas* section of the ArcVoyager Guide and practice these operations using the World Atlas. If you would like more practice, work with the exercise *Exploring Earthquakes and Related Processes* prior to this lesson. It will help you learn basics of legend editing.

Detailed help also can be found in the ArcView online Help system. To open the ArcView help, click the HELP TOPICS menu. Pay particular attention to the topic CREATING AND USING MAPS. (To see a listing of topics, click on the CONTENTS tab.)

Procedures for Task 1: Add a landform image layer for the contiguous 48 states to the existing project.

1-1.   Open the *ArcVoyager United States Reference Map* project.

1-2.   Observe and describe what the map display (the VIEW) currently shows. Note the theme names in the legend (the TABLE OF CONTENTS) and identify which currently are "turned on" in the map. To see the full list, scroll down the themes in the TABLE OF CONTENTS. Explore the contents of this project.

   Can't read the entire name in the TABLE OF CONTENTS? You can adjust the width of the TABLE OF CONTENTS. To do this, drag the cursor slowly across the border between the map display portion of the window and the gray TABLE OF CONTENTS box. When the cursor becomes a double-arrowed pointer, click, hold, and drag the TABLE OF CONTENTS frame to the right. Let go.

1-3.   Add a new layer to the project from the ArcVoyager databases. (**Note:** If file navigation is new to you, be patient. You will need to open and close directories/folders to find specific data files. This is similar to how you would find a specific document in a file cabinet, possibly moving from one file drawer to another.)

A. Click the ADD THEME button.

B. In the ADD THEME dialog box, the current directory selected should be VOYAGER. If not, navigate to the VOYAGER directory location on your hard drive (e.g., C:\VOYAGER).

C. Open the DATA directory inside VOYAGER with either a double click on its name or a single click on the name and then a click on OK. (C:\VOYAGER\DATA\). Next, open the IMAGE subdirectory (C:\VOYAGER\DATA\IMAGE\).

D. Select IMAGE DATA SOURCE from the list of data source types. This will present a listing of image files (TIF files) from which to choose.

E. Select the last image in the list, USA.TIF, which is a low-resolution version of the U.S. Geological Survey's Shaded Relief map for the contiguous 48 states. Click OK.

    Concept alert: The USA.TIF is equivalent to a photograph made up of individual pixels. There are no points, lines, or polygons. This means that there is no data base associated with it and tools like the IDENTIFY tool will not work.

    Concept alert: The image is in a particular map projection, ALBERS EQUAL-AREA. This projection and its settings match those of the VIEW in general. If the VIEW projection is changed, the layers will not display correctly. The correct settings are Central Meridian= -96.00, Reference Latitude=23.00, Standard Parallel 1=29.5, Standard Parallel 2=45.00, False Easting= 00.00 and False Northing=00.00.

1-4. Notice that this new theme appears at the top of the TABLE OF CONTENTS. If it is turned on in this location, it will mask all the layers below it. To prevent this, move USA.TIF to a new location near the bottom of the list. The easiest way to do this is to click, hold, and drag the layer down towards the end of the list. This will put USA.TIF beneath the other themes.

1-5. Scroll to the bottom of the TABLE OF CONTENTS. Move USA.TIF just above the OCEAN layer. It may take a couple of attempts to recognize how ArcView handles the location of themes in the listing.

1-6. Rather than calling this layer USA.TIF, rename it to SHADED RELIEF - U.S. 48. With USA.TIF as the ACTIVE THEME ("raised"), open the THEME menu, select RENAME, and type in the new text. Click OK.

1-7. In the TABLE OF CONTENTS, find the layer called UNITED STATES. Move it below the theme SHADED RELIEF - U.S. 48 (USA.TIF) in the listing.

1-8. Turn on SHADED RELIEF - U.S. 48 and watch how the layers display. With SHADED RELIEF - U.S. 48 at this location in the TABLE OF CONTENTS, Mexico and Canada as well as the rivers and lakes should display directly on top of SHADED RELIEF - U.S. 48.

1-9. To help provide a political geographic context for the land form image, scroll to the top of the TABLE OF CONTENTS and make sure that the top layer, STATE OUTLINES is turned on. The outlines display in black.

    Presentation tip: If the state outlines seem too dark, double click on the name, STATE OUTLINES. This will bring up the LEGEND EDITOR. Double click on the black outline symbol. This will open the FILL PALETTE. Click on the PAINT BRUSH icon. In the COLOR pull-down menu, select OUTLINE. Choose a

brighter color such as LIGHT RED. Close the FILL PALETTE. Click the APPLY button in the LEGEND EDITOR. Close the LEGEND EDITOR. The map should redraw with LIGHT RED state outlines.

Can't see your legend in the TABLE OF CONTENTS? Click on the HIDE/SHOW LEGEND button in the user interface or select it in the THEME menu. To hide a legend, click HIDE/SHOW LEGEND again.

Can't find a button or tool or wondering what each one does? Without clicking, slowly move your cursor across the button and tool icons. A brief description of each is displayed in the STATUS BAR. (On a Windows machine, this is at the bottom of the ArcVoyager window. For a Macintosh, it is the line below the ArcVoyager tools.)

1-10. Use the ZOOM and PAN tools to zero in on the mountain states of Utah, Wyoming, and Colorado. Note the VIEW's current scale. The SHADED RELIEF - U.S. 48 layer is best viewed between the scales of 1:10,000,000 and 1:40,000,000.

Lost on the map? With a U.S. STATE or COUNTY layer as the ACTIVE THEME ("raised"), click the ZOOM TO ACTIVE THEME(S) button to get to a full U.S. view. To just see the 48 contiguous states, make SHADED RELIEF - U.S. 48 the ACTIVE THEME and zoom to it. Also the ZOOM PREVIOUS button will display up to five previous map extents.

1-11. Spend time observing the map. What is visible? Notice features like the mountain chains in Colorado and Wyoming or the Basin and Range province of Utah and Nevada. Notice the extent and location of rivers. What other observations can be made? What relationships are apparent?

1-12. Investigate other parts of the country and make similar observations. Eventually, focus in on Colorado, Utah, and Wyoming using any combination of ZOOM, PAN, and other navigation tools.

Procedures for Task 2: Add new thematic layers (continental divide and mountain peaks) to the project.

2-1. Look at the rivers. It is evident that there are starting/stopping points in the western mountain region. Why might this be? To study this, add another theme, the Continental Divide.

A. Click the ADD THEME button and navigate to the VOYAGER\\DATA\GEO\US subdirectory. If file navigation still feels new to you, follow the steps outlined below.

** In the ADD THEME dialog box, the current directory should be VOYAGER\DATA\ \IMAGE. However, the data item needed is not in the IMAGE subdirectory. It is inside a GEO subdirectory.

1. To open a different DATA subdirectory, double click on the DATA folder in the list (or click once its name and then click OK).

2. The GEO folder should be visible in the list as well as the IMAGE and TABLE folders.

3. Open the GEO folder with either a double click on its name or a single click on the name and then click OK. Follow this by opening the US subdirectory.

B. Select FEATURE DATA SOURCE from the list of data source types. This will present a listing of themes (SHP or shape files) from which to choose. (Come back to some of these as you explore more.)

C. Select US48_DIV.SHP, which is the Continental Divide in the contiguous 48 states. Click OK.

D. The theme US48_DIV.SHP has been added at the top of the TABLE OF CONTENTS list. Turn it on.

Presentation tip: You may wish to change the color and width of the line displayed. Do this with the LEGEND EDITOR. See Step 1-9 for more information. Experiment with the PEN (e.g., use a DASHED SIZE 2 line) and the COLOR palettes (e.g., use a bright orange). Also, change its name from US48_DIV.SHP to Continental Divide. See Step 1-6 for help.

Presentation tip: You may wish to change the color and/or width of the line displaying the rivers to a brighter, thicker blue. Remember, the MAJOR RIVERS theme must be the ACTIVE THEME in order to make these changes.

2-2. Notice the pattern of the Continental Divide and the location of the rivers. Also, notice the basin in the southern portion of Wyoming. What does its presence mean for streams within its boundaries? What are some of the rivers falling on either side of the divide? Use the IDENTIFY tool to get information about specific rivers. Do this by first clicking once on the name MAJOR RIVERS to make it the ACTIVE THEME. Click the IDENTIFY tool and then click on a river to identify its name.

Where did parts of some rivers go? Notice that you may not see all of a river in this theme, for instance the Snake between Washington and Idaho. It just sort of disappears. Why? Look at the order of the themes in the TABLE OF CONTENTS. One layer is masking the rivers--STATE OUTLINES. Unless you have reordered the layers, it probably is above the Rivers layer. Change the order to aid your viewing.

2-3. The Continental Divide is associated with elevated places. Are the highest places in the contiguous U.S. associated with this area? To see this, add another thematic layer from the VOYAGER\DATA\GEO\US directory US14PEAK.SHP. Use Step 2.1 as your guide. This layer will display the 92 mountain peaks in the United States of 14,000 feet or more.

A. Once added, change the color and symbol as needed and turn the layer on. See Step 1-9 for help.

B. Change the NAME of the theme US14PEAK.SHP to HIGHEST PEAKS. Open the THEME MENU. Select THEME PROPERTIES. Rename this layer HIGHEST PEAKS. Also check the box to the left of USE SUFFIX. (Why? This will allow you to see in the TABLE OF CONTENTS what characteristic of the theme is being mapped in Step 2-9.) Click OK.

2-4. A large number of these mountain peaks are visible in Colorado. What are they? Making sure that HIGHEST PEAKS is the ACTIVE THEME, use the IDENTIFY tool to learn more about some of these elevated locations. The data displayed includes the peak's name, the county(ies) and state of its location, its elevation in feet, the USGS topographical map on which it is found, its designation as a summit, and its latitude and longitude (in decimal degrees). When done, close the IDENTIFY RESULTS window.

2-5 There are many peaks in Colorado. How many are there and what are their names? To investigate this, use the SELECT tools and the data TABLE.

A. Make sure that HIGHEST PEAKS is the ACTIVE THEME by clicking one time on its name.

B. Click and hold the SELECT FEATURE tool. It opens a pull-down set of five geometric icons. Pick the SELECT BY RECTANGLE tool.

C. Move your cursor back on to the map. At a spot northwest of Colorado, click, hold, and drag a box around all of Colorado's mountain peaks. When selected, they will appear in YELLOW. If you missed some, simply draw the box again.

D. To find out which peaks these are, click the OPEN TABLE button.

   Wait a minute, something's changed! Notice that the menus, buttons, and tools now are different. By clicking the OPEN TABLE button, you have left the map area (VIEWS) and have now opened the data base area (TABLES). Notice that the TITLE BAR for the map is "grayed out." A TABLE called ATTRIBUTES OF HIGHEST PEAKS (the TABLE of information about the mountain peaks) is now the ACTIVE WINDOW.

   Tip: Moving between windows. To toggle between the map and table, open the WINDOW menu. In the list near the bottom, select UNITED STATES--BASE MAP. The map is now the ACTIVE WINDOW. To return to the table, click the WINDOW menu again and select ATTRIBUTES OF HIGHEST PEAKS. The table is in front and active again.

E. On the left end of the tool bar, notice the two gray boxes with numbers inside and some text to the right of each. They should read 56 OF 92 SELECTED, meaning that 56 mountain peaks are selected from the 92 records in the database. If you change the selection or perform a query, the count of selected features is updated automatically.

   Safety tip! Do not click your cursor on a record inside the data table unless you want to change the items selected. With the SELECT tool (cursor) engaged, an errant click will change the selected set and wipe out your current selection.

F. In the table, scroll down through the table using the SLIDER BAR on the right. You will eventually see a group of records in yellow. These are the same features that are in yellow on the map. Move the SLIDER BAR back to the top when done. Likewise, explore the table contents going across using the SLIDER BAR along the bottom of the table. Note that the fields are the same ones you saw when using the IDENTIFY tool in Step 2-4.

G. To see an alphabetic listing of the highest peaks in Colorado, use the PROMOTE and SORT buttons.

   1. For an alphabetic listing of peak names, click once on the field name, PEAK_NAM. It darkens.

   2. Click the SORT ASCENDING button. This will put the list in alphabetic sequence.

   3. Click the PROMOTE button. This keeps the alphabetic sequence but pushes the 56 selected peaks to the top. The first Colorado peak should be Blanca Peak.

H. Among the Colorado peaks, which is the highest? Is it the highest mountain peak in the United States?

   1. Scroll across the table and find the field named ELEV_FT. This is elevation in feet. Click on the name ELEV_FT to make it the ACTIVE FIELD (darkened).

   2. Click the SORT DESCENDING button. Mount McKinley in Alaska should be at the top and Mount Elbert in Colorado should be the 19th name in the list.

3. When finished exploring, Close the ATTRIBUTES OF HIGHEST PEAKS table window. The map again will be the active window.

2-6. Display the location of all 92 mountain peaks in your VIEW window.

A. First, make sure that HIGHEST PEAKS is still the ACTIVE THEME (by clicking once on its name in the TABLE OF CONTENTS) and clear the selected group of mountain peaks by clicking the SELECT NONE button.

B. Click the ZOOM TO ACTIVE THEMES button. Alaska and the western U.S. should be visible.

2-7. Map the peaks by elevation.

A. Double-click on the name HIGHEST PEAKS to open the LEGEND EDITOR.

B. Click the box labeled LEGEND TYPE and select GRADUATED SYMBOL.

C. For the CLASSIFICATION FIELD, select ELEV_FT. The data are grouped automatically into 4 classes. Click the CLASSIFY button and change the number of classes to 4. Leave the TYPE as NATURAL BREAKS (but come back to this area later and experiment with the other classification types.) Click OK.

D. Double click on the SYMBOL (the box in the lower left corner) to open the SYMBOL PALETTE. Select the TRIANGLE symbol with the black outline.

E. Click the PAINT BRUSH icon to open the COLOR PALETTE. Select a FOREGROUND color. Try pink and close the MARKER PALETTE.

F. Back in the LEGEND EDITOR, click the down arrow in the SIZE RANGE window marked 12. Scroll down the list and select size 20. Click the down arrow in the window marked 4, scroll down the list and select size 6. APPLY and exit. (**Note:** Before applying, ask the students to hypothesize on elevation patterns based on their explorations in the data table.)

2-8. What does the map show? A general observation is that the highest peaks appear to be in Alaska. Is this true? Are there any mountain peaks of 15,000 feet or higher in the 48 contiguous states? Build a GIS question that selects the peaks that are greater than 15,000 feet.

A. With HIGHEST PEAKS as the ACTIVE THEME, click the QUERY BUILDER button. You may want to position the QUERY BUILDER dialog box in such a way that you can see it and the map at the same time. (To move the QUERY BUILDER, click and hold on the TITLE BAR, and drag the window to a new location.)

B. Double click on the field name ELEV_FT. Notice a statement is being created in the STATEMENT BOX below the field names.

C. Click once on the GREATER THAN OR EQUAL TO symbol.

D.   Insert the cursor to the right of the GREATER THAN OR EQUAL TO symbol in the STATEMENT BOX and type in 15000 (no commas). The statement should read:

([Elev_ft] >= 15000)

E.   Click NEW SET and close the QUERY BUILDER.

F.   A set of YELLOW symbols appear seemingly only in Alaska. Is this true? Click the ZOOM TO SELECTED button. The map focuses on southeastern Alaska. Open the data table and click the PROMOTE button to be certain. Examine the list. When done, click the SELECT NONE button and close the data table.

Going further and reinforcing concepts.

3-1.   To broaden the focus, add another theme (Step 2-1) from the VOYAGER\DATA\ GEO\US directory, US_HIGH.SHP, the highest point in each state.

A.   Experiment with renaming the theme (Step 2-3), sorting the data table on various field parameters (Step 2-5), display all the points (Step 2-6), and map the theme by elevation (Step 2-7).

B.   Experiment with the ZOOM tools to see better the various points in reference to the landforms surrounding them.

3-2.   Examine the landform image in relation to the location of major U.S. cities.

A.   The major U.S. cities theme is already in the existing project. Find MAJOR CITIES (U.S.) BY POP1990. The theme is mapping 1990 city population for large cities. Turn it on.

Presentation tip: It will be helpful to turn off unnecessary themes including peaks, major rivers, state outlines, and state capitals.

B.   While there are a number of major cities in Alaska and Hawaii, focus attention on the 48 contiguous states. To see this area, either draw a box using the ZOOM tool or make SHADED RELIEF - U.S. 48 (the shaded relief image) the ACTIVE THEME and click the ZOOM TO ACTIVE THEMES button. What do you see?

C.   Open the data table for this theme to see more information. How many cities are represented in the table and on the map? 555 cities. Notice the different fields of data that can be mapped thematically and/or analyzed in a tabular form.

D.   Remember that this theme is named MAJOR CITIES (U.S.) - it is showing the major cities but not all of the cities in the U.S. It is displaying only cities of 50,000 population or greater because a special query has been constructed for this layer to select and display only the largest cities. The original shapefile contains data for all places of 10,000 persons or more. Let's copy the existing theme, remove the restriction from the copy, and map an additional 2,600 places.

1.   Turn off the theme MAJOR CITIES (U.S.) BY POP1990.

2. Go to the EDIT menu. Select COPY THEMES. Click again on the EDIT menu. Select PASTE. A new copy of the theme MAJOR CITIES (U.S.) is inserted at the top of the TABLE OF CONTENTS.

3. Make the new MAJOR CITIES (U.S.) BY POP1990 theme the ACTIVE THEME ("raised") by clicking once on its name.

4. Click the THEME menu and select PROPERTIES. In the dialog box, notice the definition by the QUERY BUILDER icon, ([POP1990] >= 50000). (**Note:** Building queries in this area allows you to remove those that don't match the condition from the display and from the table. This only affects the display. It does not remove them permanently from the shapefile or database. When you are ready, come back and experiment with the THEME PROPERTIES.)

5. Click the CLEAR button and then OK. This wipes out the special condition.

E. Back in the TABLE OF CONTENTS, double click on the MAJOR CITIES (U.S.) BY POP1990 theme at the top. This opens the LEGEND EDITOR.

F. For the moment, rather than mapping this theme by any characteristic, display just the location of the cities. To do this, select SINGLE SYMBOL as the LEGEND TYPE.

G. Change the color and size of this symbol to a SIZE 4 WHITE CIRCLE. See Step 1-9 for help.

H. In the map, notice the arrangement of these places in relation to major landforms. For instance, notice the cities in the Willamette River Valley and those along the Front Range of Colorado and Wasatch Range of Utah.

I. Turn on other layers such as MAJOR HIGHWAYS (U.S.) and STATE OUTLINES to aid in your investigation.

J. Map the new MAJOR CITIES (U.S.) layer as a GRADUATED SYMBOL (Step 2-7); experiment with several different fields as the CLASSIFICATION FIELD.

3-3. Examine the landforms in relation to the locations of Federal Lands (land owned by the federal government).

A. The Federal Lands theme already exists in the project. Find FEDERAL LANDS (NON-BLM). The theme shows six major categories of federal lands in the 48 contiguous states.

B. ZOOM to the extent of the active theme and turn it on. What do you see? After some general observations, use the ZOOM tool to zero in on areas of interest. What relationship is visible between the presence of federal lands (e.g., forests and parks) and rugged terrain? Use the PAN tool to move around the map at a set scale. Areas of note are the mountain west, especially the Basin and Range Province, the Cascades, the Rockies, the Ozark-Ouachita Plateau, and the Appalachian Range.

C. To see the landforms behind the federal lands polygons, change the opaque patterns to transparent patterns.

1. Open the LEGEND EDITOR. Double-click on the symbol for INDIAN RESERVATION to open the FILL PALETTE. Select a thin diagonal line pattern. Click the PAINT BRUSH icon to open the

COLOR PALETTE. Click the box labeled COLOR and select BACKGROUND. Select the white box with the X through it (this is clear, not white). Close the SYMBOL PALETTE. In the LEGEND EDITOR, click APPLY and close the editor. Check out the change to the map by zooming on the Four Corners area. If this pattern does not look good, try another pattern (e.g., horizontal lines or dots).

2. When you are satisfied with the fill pattern, go back to the LEGEND EDITOR and change the remaining five categories. To change them all at once, hold the SHIFT key on your keyboard and click on the first and the last symbols. Keep holding the SHIFT key down and double click the last symbol to open the FILL PALETTE. Select a fill pattern, change the background color to clear, and then close the FILL PALETTE. Click APPLY and then close the LEGEND EDITOR.

D. Use the Theme Properties QUERY BUILDER described in the Step 3-2 to display only particular types of federal lands (such as TYPE = "NATIONAL FOREST OR GRASSLAND").

3-4 To find out more about the file USA.TIF (SHADED RELIEF - U.S. 48 theme) and other data layers included with ArcVoyager, explore the data dictionary in the VOYAGER/DOCUMNTS directory. These documents are not accessed from the ArcVoyager interface. They are viewed using an Adobe Acrobat Reader. The reader is included on the CD you used to install ArcVoyager (or go to http://www.adobe.com to download a free copy). The Reader must be installed before you can read the various informational documents about ArcVoyager.

Launch the Adobe Acrobat Reader. Click the FILE menu, click OPEN, and navigate to where you have ArcVoyager installed (e.g., C:\ VOYAGER\...). Open the DOCUMNTS directory and then open the REFERNCS directory. Select the file FILE_NDX.PDF. This opens a 3-page listing of the data sets and images found in ArcVoyager. Print this listing as a handy reference. Close the document.

To see the full dictionary of data files, open the file DICTNARY.PDF (Click the FILE menu again, click OPEN, and select DICTNARY.PDF in the same directory.) This opens a 145-page document that describes in detail all of the data sets, the attribute fields in each data set, and all of the images. Go to page 3 of the dictionary. This is the same index you just printed but it includes hypertext links from each data set entry to the detailed descriptions. For instance, clicking the RED BOX at the end of the FEDLAND.SHP entry will take you to its description. You can also use the SEARCH tool (the binoculars) to find items by name. For instance, to find out about the shaded relief image, click the BINOCULARS and type USA.TIF in the FIND window. Click the FIND button. This takes you to the first instance of USA.TIF in this 145-page document (if you started your search from page 1 of the dictionary). Click the BINOCULARS and click the button FIND AGAIN. This shows the next instance of USA.TIF in the dictionary, which provides a short description of this layer. For the most complete description, click the BINOCULARS and click the button FIND AGAIN one more time. To zoom in more closely on this text, use the Adobe Acrobat ZOOM tool. Print pages as needed. When finished exploring, close the dictionary and the Reader.