



Working with ArcVoyager: A Jump Start Lesson

Exploring earthquakes and related processes

Background: Earth is a dynamic planet. Physical processes are constantly changing its face. Some of these agents of change are earthquakes, volcanoes, faults, and tectonic plates. Where do these occur? How are they related?

Using the *World--Physical Geography* project in the section *Designing Global Adventures: Point Me*, you will:

Task 1. Display locations of recent earthquakes and make observations about global patterns.

Task 2. Add related physical geographic themes of volcanoes, fault lines, and major tectonic plate boundaries to the map and make observations about relationships among these phenomena.

General note: Tasks 1 and 2 can be accomplished with either *Viewing World Snapshots: Show Me* or the *World--Physical Geography* project in *Designing Global Adventures: Point Me*. The steps below are written for use with the *World--Physical Geography* project.

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/QUIT feature in the FILE menu) to quit out of that session of ArcVoyager and reopen a fresh copy of the 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, and navigating within a view. 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.

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: Display recent earthquake locations around the world.

- 1-1. Open the *ArcVoyager World--Physical Geography* project.
- 1-2. Observe and describe what the map display (the VIEW) is currently showing. At the same time, note the theme names in the legend (the TABLE OF CONTENTS) and identify which are currently "turned on" in the map. Scroll down the themes in the TABLE OF CONTENTS.
- 1-3. Find the theme MAJOR EARTHQUAKES, 1970-93. Before turning this layer on, predict what you think you will see in the map.

Can't read the entire name in the TABLE OF CONTENTS? You can adjust the width of the TABLE OF CONTENTS. To accomplish 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.

- 1-4. Display the theme by clicking the check box to the left of the theme name.

Wondering what each button and tool 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 screen. For a Macintosh, it is a line just below the ArcVoyager tools.)

- 1-5. Describe what the map shows. Are there global patterns? Do they match your predictions?
- 1-6. With thousands of earthquake events being displayed, it is difficult to see clearly the level of activity in some parts of the world. Use the EXTENTS menu to zoom quickly to continental areas, e.g. Latin America. Also, experiment with the use of the various ZOOM and navigation buttons/tools and the SCALE tool to move around the map.



Lost on the map? Use the ZOOM TO FULL EXTENT button to quickly get back to a global view. Also the ZOOM TO PREVIOUS button will display up to five previous map extents.



- 1-7. With MAJOR EARTHQUAKES, 1970-93 as the ACTIVE THEME, experiment with the IDENTIFY tool. As you click the IDENTIFY tool on an earthquake point, the IDENTIFY RESULTS box will open. It provides information about an earthquake event(s) including MAGNITUDE (Richter scale), DEPTH (in kilometers), YEAR, MONTH, and DAY. Do you find any global patterns in the magnitude or the depth of earthquakes?



Computer alert: The IDENTIFY RESULTS window operates in a way that may catch novice users off guard. In a Macintosh environment, the window exists until closed by clicking the upper left corner, but it may be *sent to the back* (thus potentially hidden) by clicking anywhere outside of the IDENTIFY RESULTS window. In the Windows environment, if the IDENTIFY RESULTS window is minimized, using the IDENTIFY tool again does not reopen the window; the window must be reopened manually (by double clicking its icon in Windows 3.1 or by clicking its Taskbar tag in Windows 95/NT) in order to see newly identified items. **Moral of the story:** When finished with the IDENTIFY RESULTS window, close the window rather than minimize it.

- 1-8. Because the data table includes information about the earthquakes' magnitude and depth, the points can be mapped by those characteristics.



- A. To begin this process, get back to a global view by using the ZOOM TO FULL EXTENT button.
- B. Double click on the theme name MAJOR EARTHQUAKES, 1970-93. This will open the LEGEND EDITOR.

(Note: You can move the LEGEND EDITOR and other windows by clicking and holding on the TITLE BAR and then simply dragging the box to where you want it.)

- C. For practice, change the color of the earthquake points from magenta squares to gray circles.

1. To do this, double click on the magenta symbol. This brings up the MARKER PALETTE.
2. In the MARKER PALETTE, select the green circle with a black outline. Also, experiment with the SIZE of the symbol. Select size 4.
3. Click the PAINT BRUSH icon to select a FOREGROUND color. Click the dark gray box next to black and exit the MARKER PALETTE dialog box.
4. In the LEGEND EDITOR, click the APPLY button and close the dialog box. This will change the earthquake symbol and color.



D. Map the earthquakes by magnitude.

1. Double-click on MAJOR EARTHQUAKES, 1970-93 to open the LEGEND EDITOR.
2. For the LEGEND TYPE, select GRADUATED SYMBOL.
3. For the CLASSIFICATION FIELD, select MAGNITUDE. The software defaults to five classes.
4. Double-click on the SYMBOL in the small box at the bottom of the LEGEND EDITOR to open the SYMBOL PALETTE. Select the green circle with the black outline.



5. Click the PAINT BRUSH icon to select a FOREGROUND color. Select gray and close the MARKER PALETTE.
6. In the LEGEND EDITOR, click the down arrow in the SIZE RANGE window marked 12. Click down the list and select size 16. Before you apply this change to the map, predict what the patterns of earthquake magnitude will be. For example, where do you think the largest earthquakes will be? Do you think there will be clusters of earthquakes? Where will the clusters be? Click APPLY and close the LEGEND EDITOR. Does the pattern match your predictions?

E. To see in the TABLE OF CONTENTS what characteristic of the theme is being mapped, do the following.

1. Click the THEME menu and select PROPERTIES.
2. Click the check box by USE SUFFIX (which means, “Yes, display the theme’s field name that I am mapping.”), and click OK.
3. In the TABLE OF CONTENTS, note that this theme is now labeled MAJOR EARTHQUAKES 1970-93 BY MAGNITUDE.

Can’t read it all? If you can’t read everything in the TABLE OF CONTENTS, change its size by using the procedure described in Step 1-3 or rename the THEME (clicking the THEME menu, selecting RENAME, type in a different name (such as QUAKES 70-93), and click OK.

F. Map the same theme by DEPTH (kilometers) of earthquake using a copy of the theme MAJOR EARTHQUAKES 1970-93 (use a copy so you do not to lose the magnitude map).

1. Turn off the MAJOR EARTHQUAKES 1970-93 theme. Make sure it is the ACTIVE THEME (“raised up” by clicking once on its name). Click the EDIT menu and select COPY THEMES. Click again on the EDIT menu. Select PASTE.
2. The new COPY of the MAJOR EARTHQUAKES 1970-93 theme will appear at the top of the TABLE OF CONTENTS.
3. Double click on the theme name. This will open the LEGEND EDITOR.
4. For the CLASSIFICATION FIELD, select DEPTH.
5. Double click the SYMBOL in the small box near the bottom of the LEGEND EDITOR. This opens the SYMBOL PALETTE. Click the PAINT BRUSH to open the COLOR PALETTE. Select a medium green as FOREGROUND color. Close the SYMBOL PALETTE.
6. In the LEGEND EDITOR, click the down arrow in the SIZE RANGE window marked 12. Select 16. Click APPLY and close the LEGEND EDITOR.
7. Note that the new theme at the top of the TABLE OF CONTENTS is ready to map earthquakes by depth. Before turning this layer on (clicking the CHECK BOX to the left of its name), predict where the deepest and most shallow earthquakes on the planet occur.



- G. Is there any visible relationship between earthquake depth and magnitude? Leave the DEPTH layer on and turn on the MAGNITUDE layer. Explore differences around the planet, e.g., North and South America.

Procedures for Task 2: Add volcanoes, fault lines, and major tectonic plate boundaries.

- 2-1. Using the map displayed at the end of Task 1, turn off the MAJOR EARTHQUAKES 1970-93 BY DEPTH layer and click the ZOOM TO FULL EXTENT button. This will take you back to a global view of the 1970-93 earthquakes.



- 2-2. Scroll down the TABLE OF CONTENTS to identify other layers you think are related to earthquakes (faults, volcanoes, tectonic plates). Hypothesize about the relationship of these themes to earthquake activity and location.
- 2-3. Display the VOLCANOES. Do this by repeating Steps 1-3, 1-4, and 1-5.
- 2-4. Discuss and explore the patterns visible. Again, does the map match your hunches? To get a closer view in various areas (e.g. Asia, Latin America, the Rift Valley of Africa), use ZOOM and navigation tools.
- 2-5. Experiment with the IDENTIFY tool (see Step 1-8 for help). Information available for volcanoes includes NAME, ELEV (elevation in meters), TYPE (active, potentially active, and solfatara stage [gases and vapors]), FIPS_CNTRY (country code), and COUNTRY (country name).



(Hint: The characteristics ELEV and TYPE can be mapped. Use Step 1-9 as the guide. For the field TYPE, use UNIQUE VALUE as the LEGEND TYPE.)

- 2-6. Add the theme FAULTS to the map. (**Note:** These are only major continental fault lines.) Again, follow steps 1-3, 1-4, and 1-5. The fault lines are viewed best by zooming in on a particular location; for instance, zoom in to the coast of Chile, northern India, or the Rift Valley of Africa.
- 2-7.  Discuss and explore the patterns visible among quakes, volcanoes, and major continental fault lines. Once finished, turn off all layers except the COUNTRIES and the OCEAN layers and click the ZOOM TO FULL EXTENT button. This will take you to a global view.
- 2-8. Turn on the major tectonic PLATES theme. It will display twelve major plates. To see the names of these plates, use the HIDE/SHOW LEGEND button and/or the IDENTIFY tool (see Steps 1-5 and 1-8).

Because this plate theme uses opaque colors, it is not possible to see through it to some key layers below, such as the countries. To aid in the viewing, turn on the COUNTRY BORDERS theme at the top of the TABLE OF CONTENTS. This will allow you to see the relationship between the continental land masses and the plates in a different way. For instance, notice the “shadow” of Africa visible at the Mid-Atlantic Ridge. As interest moves you, add other layers to this display for further exploration.

Can't see a particular theme? As new layers are turned on, it may not be possible to see some items because of the theme order in the TABLE OF CONTENTS. If this happens, turn off unnecessary layers or rearrange the order in the TABLE OF CONTENTS. To rearrange the theme order, click and hold on the name of the theme you want to move, then drag it to a new location in the list. The map builds from the bottom up.

- 2-9. Use the various ZOOM and navigation buttons/tools and the EXTENTS menu to explore areas of interest. Also, experiment with the IDENTIFY tool to see basic characteristics about layers currently being mapped. (**Note:** To use the identify tool, make the theme of choice the ACTIVE THEME, as described in step 1-5. To make several themes active, hold down the SHIFT KEY while clicking on the theme names. Once active, click once on the feature(s) for more information.)
- 2-10. Experiment with other themes in the TABLE OF CONTENTS including CAPITAL CITIES and MAJOR CITIES as well as some of the “picture” layers such as ELEVATION to explore other relationships.