P H O T O C O P Y

NAME _____   DATE _____

Crossing the Line
A GIS investigation

ACQUIRE

ASK

EXPLORE

ACT

ANALYZE

## Answer all questions on the student answer sheet handout

Boundaries are invisible lines on the earth's surface. They divide the surface area into distinct separate political entities. In this activity, you will use GIS to investigate different types of international boundaries, explore the implications of various boundary configurations, and observe boundary changes in recent years. When you have completed the activity, you will use your knowledge of boundary dynamics to speculate on world boundaries that are likely to change in the future.

Step 1   Start ArcMap

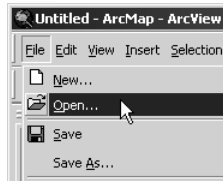*a*   **Double-click the ArcMap icon on your computer's desktop.**

ArcMap

b   **If the ArcMap start-up dialog appears, click An existing map and click OK. Then go to step 2b.**
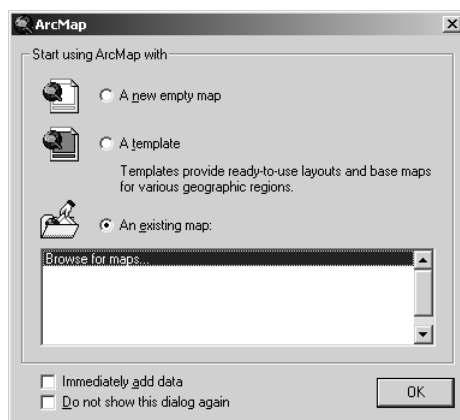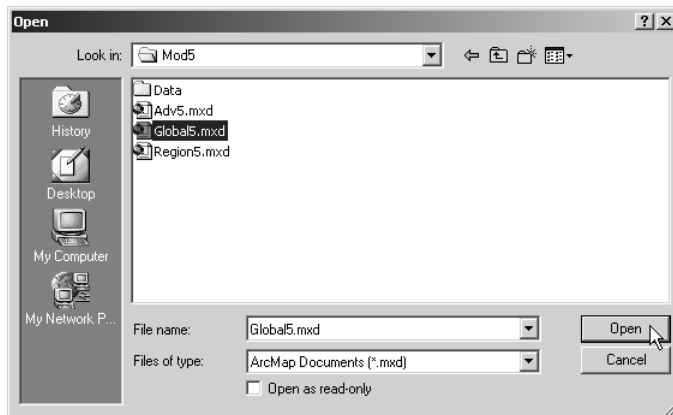
Step 2   Open the Global5.mxd file

a   **In this exercise, a map document has been created for you. To open it, go to the File menu and choose Open.**

b   **Navigate to the module 5 folder (C:\MapWorld9\Mod5) and choose Global5.mxd (or Global5) from the list.**

c   **Click Open.**

The map document opens and you see a composite satellite image of the world. The check mark next to the layer name tells you the layer is turned on and visible in the data frame.

Step 3   Explore mountain ranges as physiographic boundaries

As astronaut Russell L. Schweickart said, if you could view the world from space, you would see no boundary lines. Boundaries are human-made lines that define the world's political entities.

There are several types of boundaries between countries. One type of boundary is called a physiographic boundary. They are based upon natural features on the land-scape such as mountain ranges or rivers.

a   **Click the box next to the Boundaries 2004 layer to turn it on. A check mark appears and the red lines show the international boundaries for the year 2004.**

b   **Click the Zoom In tool. On the map, click and drag a box around Europe. The view is now centered on Europe.**

c   **Drag another box around Europe to zoom in more so you can see the physical features in greater detail.**

d   **Turn off Boundaries 2004 by clicking the check mark next to the layer name.**

Locate Europe's mountain ranges in the satellite image. Notice that ranges such as the Pyrenees Mountains in northeastern Spain form a natural boundary. You will use the Draw Line tool to draw lines where you see a mountain range forming a natural boundary between different parts of the continent. First, you will select a symbol type and color for drawing.

e   **On the Draw toolbar click the drop-down arrow to the right of the New Rectangle tool and select the New Line tool.**

f   **On the Draw toolbar click the down arrow key to the right of the Line Color button and change the color to yellow.**

Now you are ready to draw a physiographic boundary in Europe.

g   **Click the westernmost edge of the Pyrenees Mountains to start your line. Continue clicking along the path of the mountain range until you reach its easternmost edge. Double-click to end the line.**

h   **The yellow line is displayed in the map. Click on the map away from the yellow line to make the blue selection box disappear.**

i   **Turn on the Boundaries 2004 layer. You see that your line corresponds to a border between two countries.**

j   **Click the Identify button. Move the Identify Results window so you can see the map.**

k   **Click the country that borders the Pyrenees Mountains to the north.**

The left side of the window shows the layer name and below it the country name. You can also see all the attributes for that country that are in the attribute table.
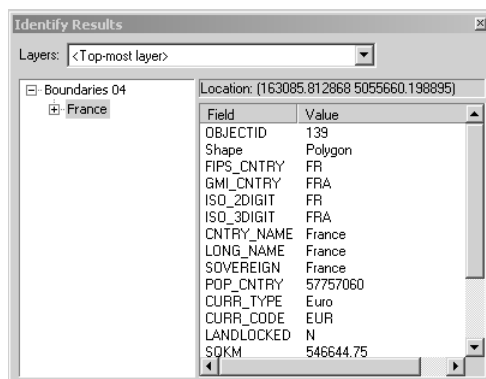
l   **Click on the country on the other side of the border.**

The Pyrenees Mountains are the border between which two countries?

m Click the Select Elements tool. Click and drag a box over the boundary line you previously drew on the map to select the line (the blue box should appear). Press the Delete key on your keyboard to delete the line.

n Use the Identify tool to find other Western European countries where physiographic boundaries created by mountains correspond to actual political boundaries. Click a country to see its information in the Identify Results window.

Complete the table on the answer sheet.

Step 4   Explore bodies of water as physiographic boundaries

a Turn off the Satellite Image layer and turn on the Rivers, Lakes, Countries 2004, and Ocean layers.

Wherever countries have physiographic boundaries based on rivers, the red boundary line disappears beneath the blue river on the map. Look closely at Europe to see if you can find any boundaries that are rivers. The different colored countries will help you find these places.

b In the Identify Results window click the Layers box and make Countries 2004 the active layer. (If the Identify Results window is closed click the Identify button to open it.)

c Click a country that has a river as all or part of a boundary. You may need to zoom and pan to see the rivers that are aligned with the country boundaries. Make sure you click the Identify tool again when you are in a location that you like.

> ***Note: Refer to the ArcMap Toolbar Quick Reference for a brief explanation of the Zoom and Pan tools.***

In the table on the answer sheet, record the names of three sets of countries that share a boundary that is a river.

> ***Note: In order to identify the names of the rivers, you must make Rivers the active layer in the Identify Results window.***

Coastlines are also physiographic boundaries. Countries that do not have a coastline are said to be landlocked.

d Zoom or pan so that Western Europe is in your full view.

Name three landlocked countries in Western Europe. Use the Identify tool if you don't know the name of a specific country. (Remember to set Countries 2004 as the active layer in the Identify Results window.)

Step 5   Explore geometric boundaries

Another type of boundary is a geometric boundary. Geometric boundaries consist of straight or curved lines that do not correspond to physical features on the earth's surface.

a Click the Full Extent button to see all the continents.

b Click the Zoom In tool. Use it to zoom in on Africa.

You see many rivers that overlap boundaries throughout the African continent.

**c** Look at the map and locate countries that have geometric boundaries.

d Click the Identify button. Make Countries 2004 the active layer in the Identify Results window.

e Use the Identify tool to identify African countries that are separated by geometric boundaries.

Record three sets of countries in the table on the answer sheet.

f Close the Identify Results window.

g Click Full Extent to see the entire world.

h Ask your teacher if you should stop here and save this map document. Follow your teacher's instructions on how to rename the map document and where to save it. If you do not need to save the map document, proceed to step 6.

Write the new name you gave the map document and where you saved it.

Step 6 Explore anthropographic boundaries based on language and religion

A third type of boundary is an *anthropographic* boundary. This boundary marks the transition between cultural characteristics on the landscape. Anthropographic boundaries are based on characteristics such as language, religion, or ethnicity.

a Turn off Rivers, Lakes, Boundaries 2004, and Countries 2004.

b Click the Add Data button.

c Navigate to the LayerFiles folder within the module 5 Data folder (**C:\MapWorld9\Mod5\Data\LayerFiles**).

d Select **Language.lyr**. Hold down the Ctrl key and click **Religion.lyr**. Click Add.
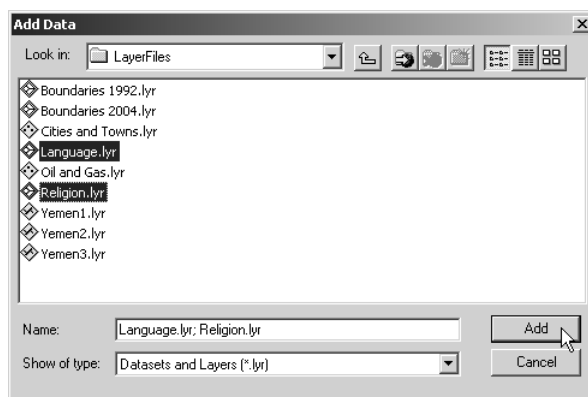
e Drag the Boundaries 2004 layer above the Language and Religion layers in the table of contents.

f Turn on Language and click the plus sign next to it to expand the legend. The distribution of major language groups in the world is displayed. Drag the right edge of the table of contents to widen it if you need to.

g Observe the pattern of anthropographic boundaries based on language in the world.

h Use the Identify tool to determine the principal language groups in South America and Western Europe. (Don't forget to make Language the active layer in the Identify Results window.) Record them on the answer sheet.

i Turn on Boundaries 2004.

j Use the Identify and Zoom tools to locate three examples in the world where political boundaries coincide with anthropographic boundaries based on language. Record them on the answer sheet.

k Click Full Extent. Turn off Boundaries 2004 and Language.

l Turn on the Religion layer and expand its legend. The distribution of major religions is displayed.

m Observe the pattern of anthropographic boundaries based on religion throughout the world.

n Use the Identify and Zoom tools to determine the principal religions in North America and Africa. Record them on the answer sheet.

o Turn on Boundaries 2004.

p Use the Identify and Zoom tools to locate three examples in the world where political boundaries coincide with anthropographic boundaries based on religion. Record them on the answer sheet.

Step 7 **Review physiographic, geometric, and anthropographic boundaries**

a Find additional examples of physiographic, geometric, and anthropographic boundaries between countries. Record your findings in the table on the answer sheet.

*b* Close the Identify Results window when you are finished.

Step 8 **Explore the impact of boundary shape, cultural diversity, and access to natural resources**

Boundaries determine the size and shape, or territorial morphology, of countries. Size and shape can exert a powerful influence on the cohesiveness of a country. Small compact nations or ones that are circular or hexagonal, for example, are more easily united than ones that are elongated or fragmented.

a Click the Full Extent button to see the whole world again. Turn off all layers except for Countries 2004 and Ocean and collapse the Languages and Religions legends in the table of contents (click the minus sign next to the layer title).

b Click the Find button.

c In the Find box type **Chile**. Select Countries 2004 from the drop-down list.
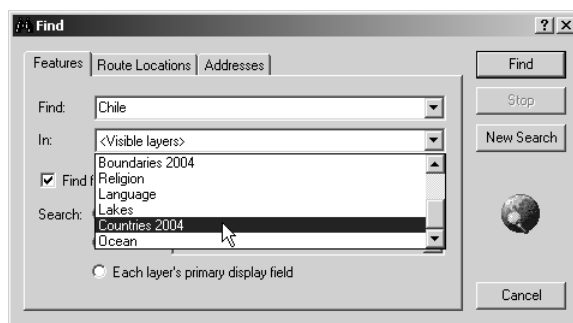
d Click Find. A results box appears at the bottom of the Find dialog and Chile is listed. Move the Find dialog to the side so you can see the map.

e Right-click on the highlighted row for Chile and click Zoom to feature(s). Then right-click again and click Flash feature to locate Chile in the map.

The table in the answer sheet illustrates six types of countries based on shape and gives an example of each. Chile is listed as an example of an elongated country.

f Use the Find, Zoom, and Pan tools to locate another example of each type of country. Record them in the table on the answer sheet in the Example 2 column. Remember, you can use the Identify tool to find the names of countries that you do not know.

Another factor that influences cohesiveness is the extent of cultural diversity.

g Click the Full Extent button. Turn off the Countries 2004 layer. Turn on Boundaries 2004 and Language.

(1) By using language groups as an indicator of cultural uniformity, identify three countries that reflect cultural uniformity.

(2) By using language groups as an indicator of cultural diversity, identify three countries that reflect cultural diversity.

Boundaries also influence economic activities. Earlier in this GIS Investigation, you identified landlocked countries in Western Europe. Historically, these countries were limited in their ability to trade directly with other nations because imports and exports had to pass through other countries en route to their destination.

h Click the Full Extent button. Turn off Boundaries 2004 and Language. Turn on Countries 2004.

i Use the ArcMap tools and buttons you've learned in this investigation to find an example of a landlocked country on each continent listed in the table on the answer sheet. For a continent that does not have a landlocked country, write "none."

j Close the Find dialog if it is still open.

Boundaries also influence economic activities by establishing a country's access to natural resources.

k Click the Full Extent button.

l   **Click the Add Data button. Navigate to the LayerFiles folder within the module 5 Data folder (C:\MapWorld\Mod5\Data\LayerFiles). Double-click Oil and Gas.lyr.**

m   **The locations of oil and natural gas sources around the world are displayed on the map.**

n   **Use the Zoom In tool to focus on Southeast Asia.**

o   **Use the Pan, Zoom, and Identify tools to help you answer the following questions.**

    (1)   Name two Southeast Asian countries that do not have any oil and gas resources within their borders.

    (2)   Name two Southeast Asian countries that have oil and gas resources within their borders.

p   **Turn off the Oil and Gas layer.**

q   **Click the Full Extent button. Turn off Countries 2004 and Ocean, and turn on Boundaries 2004 and Satellite Image.**

Step 9   Explore boundary changes in the 1990s

Political boundaries can change in many ways. Large countries may split into several smaller ones, small countries may combine to produce larger ones, territories that were once part of one country may be incorporated into another.

a   **Click the Add Data button. Navigate to the LayerFiles folder within the module 5 Data folder (C:\MapWorld9\Mod5\Data\LayerFiles) and add Boundaries 1992.lyr.**

b   **The international boundaries from 1992 display as yellow lines.**

    Note: Because the 1992 boundaries cover the 2004 boundaries on the map, the 2004 boundary lines are not visible when they are in the same location as they were in 1992. The only 2004 boundary lines (red) that are visible are those that did not exist in 1992.

c   **Observe the map closely to see the difference between 1992 and 2004. What kind of changes to you see? (Use your Zoom and Pan tools to get a good look at these changes.)**

    (1)   Describe three political boundary changes you see between 1992 and 2004.

    (2)   Name two countries that existed in 1992 but do not exist in 2004.

d   **If you have already saved this map document at the end of step 5, click the Save button to save your work. Otherwise, ask your teacher for instructions on where to save this map document and how to rename it. If you do not need to save the map document, continue to the next step.**

    Write the new name you gave the map document and where you saved it.

Step 10   Compare new countries

Countries in groups A and B below are new countries that have emerged since 1992.

Group A	**Group B**
Czech Republic	Russia
Slovakia	Belarus
Slovenia	Ukraine
Croatia	Moldova
Bosnia and Herzegovina	Armenia
Serbia and Montenegro	Azerbaijan
Macedonia	Georgia
Eritrea	Kazakhstan
	Uzbekistan
	Tajikistan
	Turkmenistan
	Kyrgyzstan

a **Select three countries from group A and three from group B and complete the table on the answer sheet. Use the information and GIS skills you learned in this investigation to answer the questions.**

Step 11   Exit ArcMap

In this exercise, you used ArcGIS to explore the various types of political boundaries and their impact on the countries they define. You added layers and used the Find, Identify, Zoom, and Pan tools to investigate the maps. You observed and analyzed boundary changes between 1992 and 2004.

a **Click the File menu and click Exit. When asked if you want to save changes to the map document, click No.**