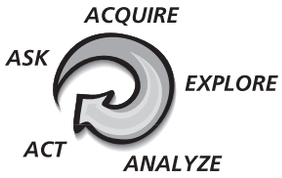
NAME _____ DATE _____

Growing Pains

A GIS investigation



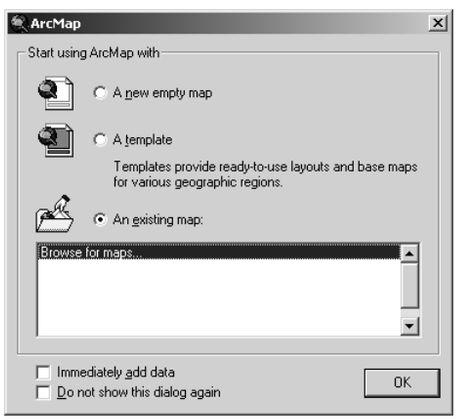
Answer all questions on the student answer sheet handout

In this GIS Investigation, you will observe and analyze population growth by looking at the natural increase of different countries. You will focus on Africa, the fastest growing region in the world, and Europe, the slowest growing region in the world. You will analyze the standard of living indicators for each region and form a hypothesis about the relationship between population growth and standard of living indicators.

Step 1 Start ArcMap

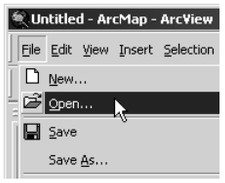
a **Double-click the ArcMap icon on your computer's desktop.**

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

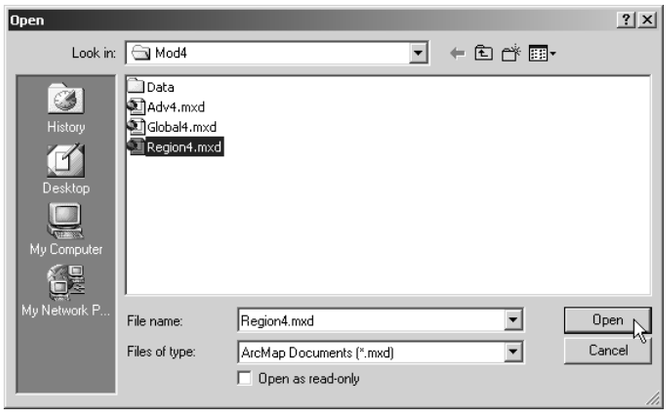


Step 2 Open the Region4.mxd file

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

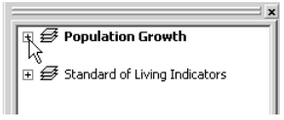


b Navigate to the module folder (**C:\MapWorld9\Mod4**) and choose **Region4.mxd** (or **Region4**) from the list.



c Click Open.

d When the map document opens, click the plus sign next to Population Growth to expand the data frame legend in the table of contents.



You see a world map with two layers turned on (Countries and Ocean). The check mark next to a layer name tells you the layer is turned on and visible on the map. Two layers, Birth Rate and Death Rate, are listed in the table of contents, but are not turned on.

Step 3 Compare birth rate and death rate data

The world's population is growing because there are more births than deaths each year. This fact can be expressed as a simple formula:

Birth rate	=	BR	BR – DR = NIR
Death rate	=	– DR	
Natural increase	=	NIR	

In the first part of this activity, you will compare birth rates and death rates around the world to see if you can identify the regions that are growing fastest and slowest.

World Vital Events

World Vital Events Per Time Unit: 2004

(Figures may not add to totals due to rounding)

Time unit	Births	Deaths	Natural increase
Year	129,108,390	56,540,896	72,567,494
Month	10,759,033	4,711,741	6,047,291
Day	352,755	154,483	198,272
Hour	14,698	6,437	8,261
Minute	245	107	138
Second	4.1	1.8	2.3

Source: U.S. Bureau of the Census, International Data Base

This table from the U.S. Census Bureau shows the number of births, deaths, and rate of natural increase for the world population for every year, month, day, hour, and second in 2004.

a **Click the box to the left of the Countries layer in the table of contents to turn the layer off.**

b **Click the box next to Birth Rate to turn on the layer. This layer shows the number of births for every one thousand people in a country.**

(1) Which world region or regions have the highest birth rates?

(2) Which world region or regions have the lowest birth rates?

c **Turn on the Death Rate layer by clicking the box to the left of its name.**

(1) Which world region or regions have the highest death rates?

(2) Which world region or regions have the lowest death rates?

d **Turn these layers on and off to compare them easily.**

(1) If the overall rate of growth is based on the formula BR – DR = NI, which world regions do you think are growing the fastest?

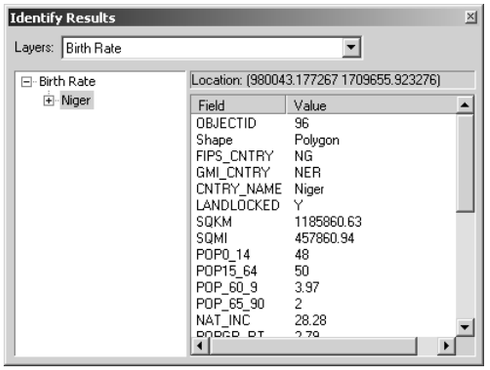
(2) Which world regions do you think are growing the slowest?

e **Turn off the Death Rate layer.**

f **You can use the Identify tool to learn more about the birth and death rates of specific countries. Click the Identify tool and choose Birth Rate from the Layers list in the Identify Results window.**

g **Move the Identify Results window so you can see the map. (Hint: To move the window, click the window's title bar and drag the window to the desired location.)**

h **Move your cursor over an African country where the birth rate is very high. Click the country. Your Identify Results window should look similar to the one below:**



i **Scroll down the list.**

This layer contains a lot of information about each country. As you scroll down the list, you see attribute field names in one column and attribute values in another. The birth rate field is abbreviated as "BRTHRATE" and the death rate field is abbreviated as "DTHRATE." In the example above, Niger has a birth rate of 51.45 births per 1,000 living people, and a death rate of 23.17 deaths per 1,000 living people.

j **Click the × in the upper right corner of the Identify Results window to close it.**

k **Click the Zoom In tool and draw a box around Africa and Europe.**

l **Choose two European countries and two African countries and record their birth and death rates in the table on the answer sheet. Use the Identify tool, as described above, to find information on your chosen countries.**

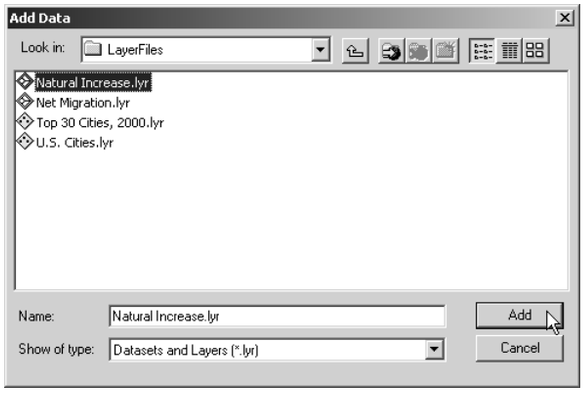
m **List three questions that the Birth Rate and Death Rate maps raise in your mind.**

Step 4 Add the Natural Increase layer

You can test your predictions of the fastest and slowest growing regions (step 3d) by adding the Natural Increase layer to your map. This layer shows the yearly increase in population that results from the difference between births and deaths in each country.

a Click the Add Data button.

b Navigate to the LayerFiles folder within the module 4 Data folder (**C:\MapWorld9\Mod4\Data\LayerFiles**). Select **Natural Increase.lyr** from the list and click Add.



c Click the Full Extent button to return to the view of the entire world. (Hint: If your map doesn't draw completely, click the Refresh View button below the map.)

Like the birth and death rates, the numbers for natural increase are expressed as a rate per 1,000 population. This means that in all the countries colored dark blue on the map, there are between 25 and 39 people being added to the population each year for every 1,000 people already there.

Note: The actual growth rate of an individual country is based on its natural increase plus the net migration of people into or out of that country each year.

(1) What is happening to the population in the countries that are red?

(2) Which world region is growing the fastest?

(3) Which world region is growing the slowest?

(4) Think about what it would mean for a country to have a population that is growing rapidly or one that is growing slowly. Which of these two possibilities (fast growth or slow growth) do you think would cause more problems within the country? On the answer sheet, briefly list some of the problems you would expect to see.

d Click the Go Back to Previous Extent button to return the view to Africa and Europe.

Step 5 Look at standard of living indicators for Europe and Africa

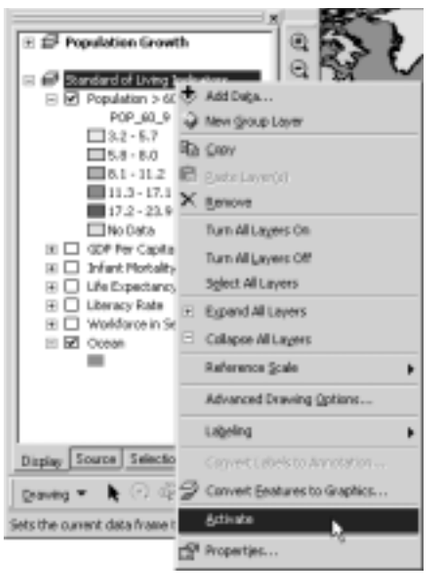
Geographers look at certain key statistics when they want to compare the standard of living in different countries. They refer to these statistics as "indicators" because they typically reveal or provide some information about the quality of life in that country. The indicators that you will look at in this activity are the following:

- Population 60 years old and over: The percent of the total population that is in this age group.
- GDP per capita: The GDP (gross domestic product) divided by the total population for that year, where the GDP is expressed as a per-person figure.
- Infant mortality rate: The number of deaths of infants under one year old in a given year per 1,000 live births in the same year.
- Life expectancy: The number of years a newborn infant would live if prevailing conditions of mortality at the time of birth continue.
- Literacy rate: The percentage of the adult population that can read and write.
- Services: The percentage of the workforce that is employed in the service sector of the economy.

a **Click the minus sign next to Population Growth in the table of contents to collapse the data frame legend.**

b **Click the plus sign next to Standard of Living Indicators to expand this data frame legend.**

c **Right-click the Standard of Living Indicators data frame name and choose Activate.**



d **Click View on the Main menu, point to Bookmarks, and click Europe and Africa.**

The Standard of Living Indicators map is focused on Europe and Africa. Europe is the slowest growing region and sub-Saharan Africa is the fastest growing region in the world.

e **Look down the table of contents to see each of the six standard of living indicators layer names. The first indicator, Population >60 years, shows the percentage of each country's population over 60 years old.**

In order to complete the chart on the answer sheet, you need to explore each of the six standard of living indicators. Remember:

- A layer will cover the one beneath it when it is turned on. You will need to turn layers on and off to see all the indicators.
- You can also reposition the layers by dragging them to a new position in the table of contents.
- You can expand or collapse the layers in the table of contents to show or hide the legends as you examine different layers.

f **Now, complete the table on the answer sheet.**

Step 6 Add the Net Migration layer

The net rate of migration is a statistic that indicates the number of people per 1,000 gained or lost each year as a result of migration. A negative number indicates that more people are leaving the country than coming in. A positive number means more people are coming to the country than leaving it.

a **In step 5 you compared standard of living indicators in Europe and sub-Saharan Africa. Based on your observations of those indicators, which region would you expect to have a negative net migration? A positive net migration? Explain your answer.**

b **Click the Add Data button.**

c **Navigate to the LayerFiles folder (C:\MapWorld9\Mod4\Data) and add Net Migration.lyr.**

d **Summarize the overall patterns of net migration in Europe and sub-Saharan Africa in the table on the answer sheet.**

e **What are possible political or social conditions or events that could explain any of the migration patterns you see on the map?**

Step 7 Draw conclusions

a **Click the Layout View button at the bottom of the map area to switch from Data View to Layout View.**

The two data frames are displayed side by side on a layout so you can easily compare the two maps.

b **The Layout toolbar automatically becomes active. If your Layout toolbar is floating, dock it above the map.**

c **Expand the Population Growth data frame in the table of contents to display its legend.**

d **Enlarge your ArcMap window so that it fills your screen. Click the Zoom Whole Page button on the Layout toolbar.**

e **In the next steps, you will be comparing the Natural Increase and Net Migration layers. Make sure that both these layers are visible (not hidden beneath other layers) and that their legends are visible in the Table of Contents.**

Note: You may want to click the minus sign in front of the other layers to collapse their legends. This way the only visible legends will be the two that you are working with.

f **Click the Zoom In or Zoom Out tool on the Tools toolbar and zoom as needed to focus both maps on Europe and Africa once again. (Hint: If you accidentally use the Zoom In or Zoom Out tool from the Layout toolbar, click the Zoom Whole Page button.)**

g **Look at the two maps and compare the rate of Natural Increase for each country to its Net Migration.**

Think about the following question: What correlation, if any, exists between a country's standard of living, its rate of natural increase, and its rate of net migration?

h **Based on your map investigations, write a hypothesis about how a country's rate of natural increase affects its standard of living and its net rate of migration.**

i **In the table on the answer sheet, illustrate your hypothesis with data from one European country and one sub-Saharan African country. Use the Identify tool to see the data for an individual country.**

j **Close the Identify Results window.**

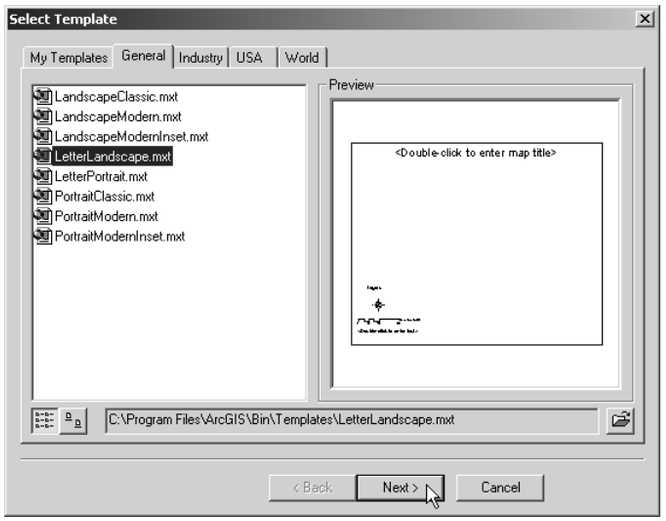
Step 8 Design a layout

You will make some changes to the layout's design before you print it. You will use a template to add a title, legend, and other map elements.

a **Turn off all of the layers in the Population Growth data frame except Natural Increase and Ocean.**

b **Click the Change Layout button.**

c **Click the General tab in the Select Template dialog. If your window looks different from the picture below, click the List button in the lower left corner. Select LetterLandscape.mxt in the list.**



d **Click Next. Make sure the Population Growth data frame is number 1 in the list and click Finish.**

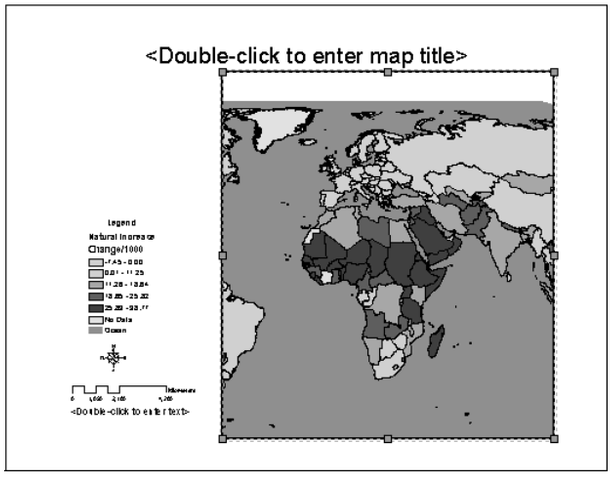
The Population Growth data frame fills the layout. You see text marking the place for a title, a legend, a north arrow, a scale bar, and another place for text.

Notice that the Standard of Living Indicators data frame has not been deleted—it has been moved off the layout. You can see part of it in the lower left corner of the layout view.

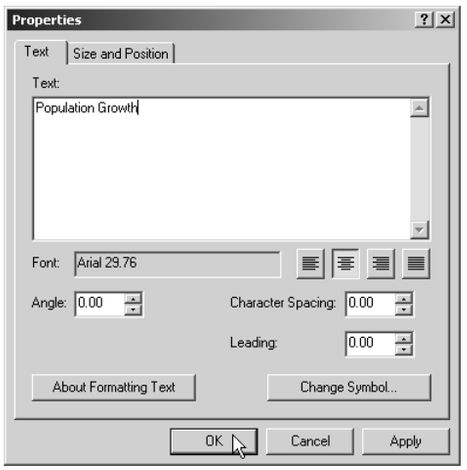
e **Click the Select Elements tool if it is not already selected. Click on the map to display the blue squares at the border of the data frame.**

f **Place your cursor over the top middle blue square. When it changes to a double-headed arrow, click and drag the top of the data frame down below the title.**

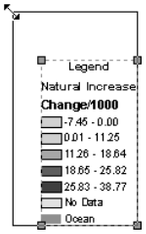
g **Repeat the procedure to drag the left side of the data frame over to the right of the legend and other map elements.**



h **Double-click the text that reads <Double-click to enter map title>. Delete the text in the Properties dialog and type Population Growth. Click OK.**



i **Click anywhere on the legend. Click one of the blue corner squares and drag it to make the legend larger.**



j **Place your cursor in the middle of the legend. Click the legend and hold the mouse button down. Drag the legend up to a suitable location closer to the top of the map.**

k **Double-click the compass rose that's below the legend to open the North Arrow Properties dialog.**

l **Click the North Arrow Style button. Choose a different north arrow that you like from the North Arrow Selector. Click OK in both of the dialog boxes to apply your change.**

The new north arrow displays automatically in the layout.

m **Resize the north arrow using the blue squares.**

n **Double-click the scale bar to see its properties.**

What are the units of measurement?

By default, ArcMap assigns the units of measurement and intervals based on the coordinate system of the data frame.

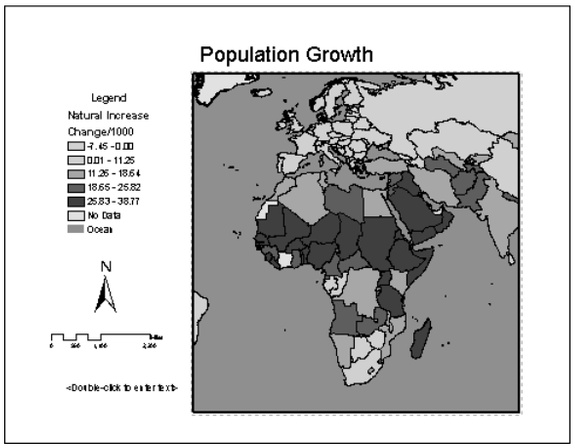
o **Click the Division Units drop-down list and select Miles. Click OK to update the scale bar's units of measurement.**

p **Enlarge the scale bar slightly so that it is easier to read.**

Step 9 Label your map and print it

When making maps, it's important to include the cartographer's name and date that the map was created. In order to make room for that in the bottom right corner of the map, you may need to move the north arrow and scale bar up slightly.

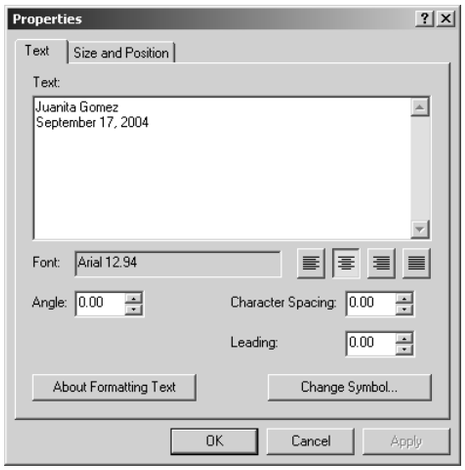
a **Adjust the position of the north arrow and scale bar. Click and drag each one to the desired position so they are centered beneath the legend and in the white space to the left of the map.**



b **To add the name of the cartographer (that's you!) and date, double-click the text below the scale bar.**

A Text Properties dialog appears.

c **In the dialog, type your name. Press Enter to move to the next line and then type the date of the project. Click OK.**



d **Click and drag the text box to the bottom right corner of the layout. Then click any blank area on the layout to clear the box around the text element.**

Your layout of Population Growth is now ready to print. If you need to make any final adjustments to your map, make them now. Otherwise, proceed to the next step.

e **From the File menu, click Print. Click the Setup button.**

f **Use the following settings in the Page and Print Setup dialog.**

- **Make sure the printer you want to use is the one shown.**
- **Under Paper, set the paper size to Letter and the orientation to Landscape.**
- **Under Map Page Size, check the box to Use Printer Paper Settings.**
- **At the bottom of the dialog, check the box to "Scale Map Elements proportionally to changes in page size."**

g **Click OK on both the Page and Print Setup window and the Print window.**

Your map should print after a few moments.

Step 10 Save your map document

In the next steps, you will change the layout. If you want to save your work on this layout, for example to print it or modify it at a later time, you need to save a copy of the map document in its current state.

a **If you wish to save the map document at this point, click the File menu and choose Save As. Ask your teacher for instructions on where to save this map document. Name it ABC_PopGrowth, where ABC are your initials.**

b **Choose Save As again and save another copy of the map document for continuing your work on the next layout. Name this copy ABC_StdLiving, where ABC are your intitials.**

Step 11 Make a standard of living indicators map and print it

a **Turn off all layers in the Standard of Living Indicators data frame except Net Migration and Ocean.**

b **Click the Change Layout button. Make sure the LetterLandscape.mxt template is selected, and click Next.**

c **Click Standard of Living Indicators and then click the Move Up button to move the data frame to the number 1 position. Click Finish.**

The data frames switch positions in the layout.

d **Follow the procedures outlined in steps 8e–8p and step 9 to design your Standard of Living presentation map and print it.**

Step 12 Save your map document and exit ArcMap

In this exercise, you explored world population growth and analyzed standard of living indicators in the fastest and slowest growing regions of the world (Africa and Europe). You added layers and worked in two data frames. You created a layout for each data frame and printed your maps.

a **If you already saved this map document in step 10b, click the Save button to save your work on the second layout. Otherwise, ask your teacher for instructions on where to save this map document and on how to rename it. Save it according to your teacher's instructions.**

b **If you are not going to save the map document, exit ArcMap by choosing Exit from the File menu. When asked if you want to save changes to the map document, click No.**