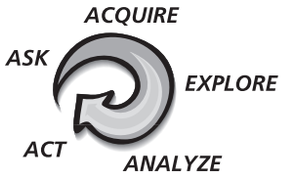
NAME _____ DATE _____

Seasonal Differences

A GIS investigation



Answer all questions on the student answer sheet handout

In this activity, you will analyze the variable patterns of precipitation in South Asia that result from the region's seasonal monsoon winds. As you investigate those patterns, you will explore relationships between rainfall and physical features and analyze the climate's impact on agriculture and population.

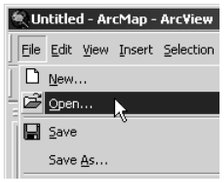
Step 1 Start ArcMap

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

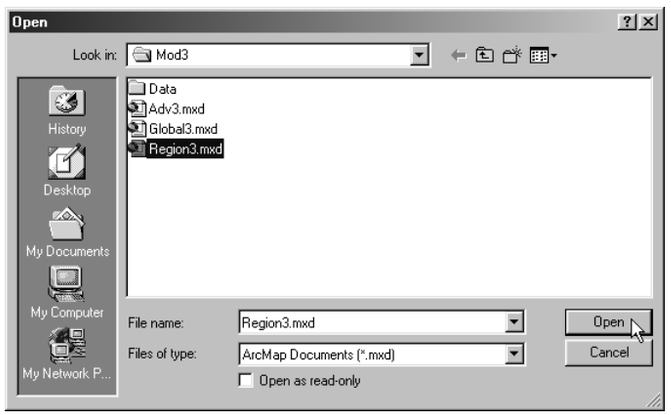
b **If the ArcMap start-up dialog appears, click An existing map and click OK. Then go to step 2b.**

Step 2 Open the Region3.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 3 folder (C:\MapWorld9\Mod3) and choose Region3.mxd (or Region3) from the list.**



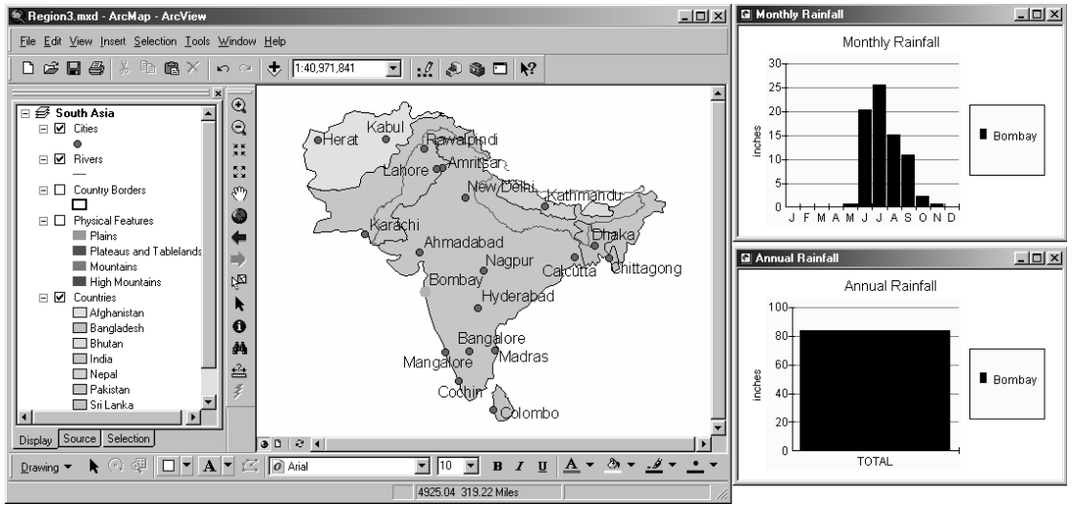
c **Click Open.**

When the map document opens, you see a map of South Asia.

d **Click the Tools menu, point to Graphs, and click Monthly Rainfall. A graph of monthly rainfall for the city of Bombay opens.**

e **Click the graph's title bar and position it anywhere on your desktop that does not cover your map. Stretch or shrink the ArcMap window if you need to.**

f **Repeat step d to open the Annual Rainfall graph. Position it next to the Monthly Rainfall graph.**



Step 3 Observe patterns of rainfall

The map allows you to explore and compare variations in the patterns of rainfall throughout the South Asian region. Look at the map and notice that the city of Bombay is selected—it is highlighted blue. The graphs to the right display rainfall information for the selected city—in this case, Bombay.

a **Analyze the graphs and answer the following questions on your answer sheet.**

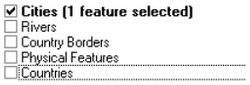
(1) Which month gets the most rainfall in Bombay?

(2) Which months appear to get little or no rainfall in Bombay?

(3) Approximately how much rainfall does Bombay get each year (in inches)?

(4) Write a sentence summarizing the overall pattern of rainfall in Bombay in an average year.

b **At the bottom of the table of contents, click the Selection tab. Click the check boxes to uncheck all the layers except Cities.**



c **Click the Display tab to return to the table of contents.**

d **Click the Select Features tool. Click a dot for another city.**

(1) How did this change the map?

(2) How did this change the graphs?

e **Click the city of Mangalore to select it in the map.**

Analyze the graphs and fill in the Mangalore section of the table on your answer sheet.

f **Hold down the Shift key and click the cities of Bombay and Ahmadabad.**

Note: To enlarge the graphs and make them easier to read, drag any border with your mouse.

(1) Complete the table on the answer sheet.

(2) As you move northward along the subcontinent's west coast, how does the pattern of rainfall change?

(3) Although the monthly rainfall amounts differ, what similarities do you see among the overall rainfall patterns of these three cities?

Step 4 Compare coastal and inland cities

a **Make sure the Select Feature tool is still active and select Bangalore.**

Use the Monthly Rainfall and Yearly Rainfall graphs to complete the table on your answer sheet.

b **Hold down the Shift key and select Mangalore.**

How does the rainfall pattern of Bangalore compare with that of Mangalore?

c **Click the Measure tool. Your cursor turns into a right-angle ruler with crosshairs.**

d **Click the dot that represents Bangalore once, then move it to the dot that represents Mangalore and double-click.**

Note: If you accidentally clicked the wrong spot, you can double-click to end the line and start over.

A segment and total length appear on the status bar at the bottom left of the ArcMap window.

What is the distance between the two cities?

Although Bangalore is located only a short distance inland from Mangalore, it receives far less rainfall than the coastal city.

e **Turn on the Physical Features layer.**

How can this data help you explain the differences between patterns of rainfall in inland Bangalore and coastal Mangalore?

f **Turn off Physical Features.**

Step 5 Compare eastern and western South Asian cities

a **Click the Select Features tool. One at a time, select the Afghan cities of Kabul and Herat.**

(1) Analyze the graphs and complete the table on your answer sheet.

Note: Your first impression may be that the Afghan cities get a fair amount of rainfall. But, notice that the inches scale along the left side of each graph (y-axis) changed to reflect the rainfall range of the selected cities.

(2) Describe the pattern of rainfall in these two cities.

(3) How do you think Afghanistan's rainfall pattern will affect the way of life in that country?

b **Select the eastern cities of Calcutta and Dhaka.**

(1) Analyze the graphs and complete the table on your answer sheet.

(2) Describe the pattern of rainfall in these two cities.

c **Hold down the Shift key and select four cities: Calcutta, Dhaka, Herat, and New Delhi.**

What is happening to the patterns of rainfall as you move from west to east across South Asia?

d **Click in the white space surrounding South Asia to unselect the four cities.**

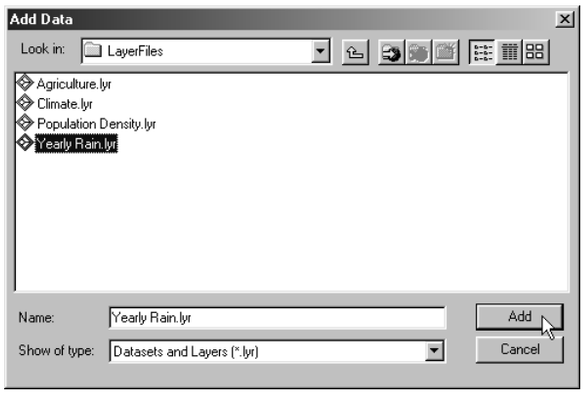
e **Close the Monthly Rainfall and Annual Rainfall graphs.**

Step 6 Observe yearly precipitation

You've already looked at the monthly precipitation patterns for individual cities across South Asia. In this step, you will add data and look at the total yearly rainfall for regions of South Asia.

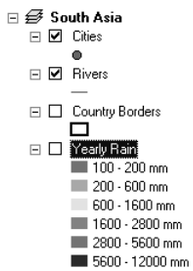
a Click the Add Data button.

b Navigate to the module 3 layer files folder (**C:\MapWorld9\Mod3\Data\LayerFiles**).



c Select **Yearly Rain.lyr**. Click Add.

d Drag the layer down in the table of contents so that it is just below the Country Borders layer.



e Turn off the Cities layer and turn on Yearly Rain.

Amounts of rainfall are given in millimeters rather than inches. Here is a conversion table that compares millimeters to inches (25.4 mm. = 1 in.).

MM	100	200	600	1,600	2,800	5,600	12,000
IN	3.9	7.9	23.6	62.9	110.2	220.5	472.4

(1) Which regions within South Asia get the least rainfall?

(2) Which regions within South Asia get the most rainfall?

(3) In step 5c you were comparing Calcutta, Herat, New Delhi, and Dhaka. Does the map of yearly rainfall that is on your screen now reflect the observation you made at that time? Explain.

f Turn off Yearly Rain and turn on Physical Features.

What relationships do you see between South Asia's patterns of yearly rainfall and its physical features?

Step 7 Explore the monsoon's impact on agriculture and population density

a Turn on the Country Borders layer.

The rain patterns and physical features of an area have a significant impact on the way of life of the people who live there. Now you will look at those layers and determine the kind of impact they have on individual countries.

b Turn the Physical Features and Yearly Rain layers on and off to make your observations and to answer the questions below.

(1) Which regions or countries of South Asia are suitable for agriculture and which are not? Explain.

(2) In which regions of South Asia do you expect to see the lowest population density? Explain.

(3) In which regions of South Asia do you expect to see the highest population density? Explain.

c Turn off Physical Features and Yearly Rain layers.

Now you will add agricultural data for the region and will see if your predictions are correct.

d Click the Add Data button. Navigate to the module 3 layer files folder (**C:\MapWorld9\Mod3\Data\LayerFiles**). Select **Agriculture.lyr** and click Add.

e Drag Agriculture down in the table of contents so that it is just below the Country Borders layer. Turn on the Agriculture layer.

(1) Does the agriculture layer reflect the predictions you made in step 7b? Explain.

(2) Why are grazing, herding, and oasis agriculture the major activities in Afghanistan?

(3) What do you know about rice cultivation that would help explain its distribution on the agriculture map?

(4) Is there any aspect of the agriculture map that surprised you? Explain.

f Turn off the Agriculture layer.

You will now examine population density in relation to precipitation and land use.

g Click the Add Data button. Navigate to the module 3 layer files folder (**C:\MapWorld9\Mod3\Data\LayerFiles**). Add **Population Density.lyr**.

h Drag Population Density below Country Borders in the table of contents.

i Turn on Population Density.

(1) Does the Population Density layer reflect the population predictions you made in step 7b? Explain.

(2) Why is Afghanistan's population density so low?

(3) Since most of Pakistan gets little to no rainfall, how do you explain the areas of high population density in that country?

(4) What is the relationship between population density and patterns of precipitation in South Asia?

(5) What is the relationship between population density and physical features in South Asia?

Step 8 Exit ArcMap

In this GIS Investigation, you explored the patterns of monsoon rainfall in South Asia. You used ArcMap to compare monthly and annual patterns of precipitation in cities throughout the region and explore the relationship between those patterns and the region's physical features. After analyzing this data, you added layers reflecting patterns of agriculture and population density and analyzed the relationship between those human characteristics and the region's climate and landforms.

a **Ask your teacher for instructions on where to save this ArcMap map document and on how to rename the map document.**

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 Region3.mxd (or Region3), click No.**