ArcMap: The Basics Module 1 MODULE 1 ArcMap Part 1: Introducing the software Step 4 Work with layers Which layers are not visible on the map but are turned on in the table of contents? Rivers, Lakes q i What happened on your map? The rivers show up on the map. What happened on your map? The lakes show up on the map. j-1 j-2 What would happen if you dragged the Lakes under Land Areas? The lakes will disappear again; or, the lakes will be covered up by the Land Areas layer. Step 5 Change the active data frame What is the name of the layer that is turned on in the World Population data frame? World Countries b Step 7 Identify a country and record country data g-1 What is the fourth listing in this column? CNTRY_NAME g-2 What is the fifth listing in this column? TOT_POP g-3 What is the final listing in this column? Shape_Area What do you guess the field entitled "SQMI" stands for? Square miles h-1 h-2 What is the number to the right of the field "SQMI"? 3,648,399.8 Step 8 Compare the Identify Results data with the table data Which row in this table has the attributes for the United States? The third row (OBJECTID 154) а b-1 Where are these field names displayed in the table? Across the top of the table; or, as column headings in the table b-2 How many square miles of land are in the United States? 3,648,399.8 b-3 Give a brief explanation of the relationship between the Identify Results window and the table. The Identify Results window has the same items of information that are in the table. The Identify Results window has information about only one country while the table has all the countries. (Students may not pick up on the second part just yet.) Step 9 Explore city data on the world map Use the Identify tool to find the name and country of any two cities you choose. Answers will vary. Possible answers include: **CITY NAME** COUNTRY WHERE THE CITY IS LOCATED Zaragoza Spain Hamburg Germany Step 10 Explore Europe with an attribute table a-1 What is the name of the table you opened? Attributes of World Countries a-2 What country is listed in the first row of the table? Falkland Is.

MODULE 1	b	What country is listed in the last row of the table? Vanuatu
ArcMap	g	What happens to the map when you click on these rows in the table? The three additional countries are outlined in blue.
MODULE 2 global	h-1	What happens to Poland and the other countries that were highlighted? The blue outlines disappear.
MODULE 2 regional	h-2	Did you see the United States become outlined in blue on the map? If not, why not? Most students will not be able to see the United States outlined in blue because it isn't in the part of the world they are looking at. Some students may see the U.S. if they didn't zoom in enough or if they have a large screen.)
MODULE 3 global	j	Why can you see the United States now when you couldn't see it in the previous step? The instructions had the students zoom in too far for them to be able to see the United States. Once they zoomed to the full extent of the map, they were able to see the United States.
MODULE 3 regional	Ster b	D 11 Practice identifying features What do you see on your map? South America only
MODULE 3 advanced	d-1	What country is it? Brazil
	d-2	What is this country's total population? 172,860,000
global	e-1	What city is it? Manaus
MODULE 4	e-2	What population class is this city in? 1,000,000–5,000,000
regional	h-1	What are the names of these two large cities? São Paulo, Rio de Janeiro
MODULE 4 advanced	h-2	What population class are these cities in? 5,000,000 and greater
MODULE 5	Step c-1	12 Practice zooming out What does your map look like? It's small or reduced in size.
growar	c-2	Which button could you use to return your map to full size? Full Extent (the button that looks like a globe)
regional	Step k-1	13 Practice finding a feature How many tourists arrive in Sudan each year? 30
MODULE 5	k-2	How many people live in Sudan? 35,080,000
MODULE 6 global	k-3	Does this seem like a low or high number of tourists for this population? It is a very low number for that population. Students should wonder why this is such a low number. This is a good example of how geographic analysis can lead to further questions.
MODULE 6 regional	Step d	14 Zoom to a feature and create a bookmark Is Qatar a large country or a small one? A small one
MODULE 7	k-1	How many people live in Qatar? 744,000
global	k-2	How many cell phones do they have? 322,152
MODULE 7	k-3	How many people are there for every cell phone in Qatar? 2.3 people per cell phone
regional	m	What large country is directly west of Qatar? Saudi Arabia
MODULE 7		

Step 15 Continue to explore the World Population map c-1 What boot-shaped country do you see on the map? Italy c-2 What is the population of that country? 57,634,000 c-3 How many cell phones does that country have? 54,118,327 c-4 How many people are there for every cell phone in this country? 1.06 people per cell phone d-1 What is the population of Japan? 126,550,000 d-2 How many cell phones does Japan have? 80,612,353 d-3 How many people are there for every cell phone in Japan? 1.57 people per cell phone g What happened to Qatar? It is no longer outlined in blue (the blue outline disappeared).

Step 17 Label and print a map

b Where do you think these labels come from?The labels come from the country name attribute field (CNTRY_NAME) in the World Countries layer.

Part 2. The geographic inquiry model

Step 4 Ask a geographic question and develop a hypothesis

- What makes this a geographic question?
 Answers will vary. Students should recognize that the question involves the distribution of something (phone lines) in different places (countries).
- b Write a hypothesis that answers the geographic question:

Answers will vary. Possible answers include: The number of phone lines increases proportionately with the number of people in the world's most populous countries; the number of phone lines does not increase proportionately with the number of people.

Step 5 Add a layer to your map

- a What other attribute of countries do you need in order to investigate your hypothesis? Number of phone lines
- e What is the name of the layer that has been added to your table of contents? World Phone Lines

Step 6 Explore the World Phone Lines map

- b-1 What color in the legend indicates countries with the fewest phone lines? Yellow or light orange
- b-2 What color indicates countries with the most phone lines? Light brown or dark brown
- b-3 What color indicates countries with no data available for this layer? Gray
- c What other layer in your map has a graduated color legend? World Countries
- d-1 Which two countries had the most phone lines in 2002? China and the United States
- d-2 On which continent are most of the countries with the fewest phone lines? Africa
- d-3 Which two countries have the largest populations? China and India

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- d-4 Name three countries that are in the same population class (color) as the United States. Answers will vary. Examples include Brazil, Nigeria, Indonesia, Japan, Pakistan, Bangladesh, Russia.
- d-5 Which of the three countries, if any, are in the same phone line class (color) as the United States? None of the countries
- h What two fields might help in answering the geographic question? POP_2000 LINES_2002 (or LINES_1997)

Step 7 Research and record phone line and population data for China

g, h Use your Find and Identify tools to locate China. Record the population and phone lines in the appropriate columns.

COUNTRY NAME	COUNTRY POPULATION	PHONE LINES 2002	NUMBER OF PEOPLE PER PHONE LINE
China	1,261,832,000	212,929,439	5.93

Record the number of people per phone line for China in the last column of the table.

Step 9 Research and record population, phone line, and phone line density data for all the countries

- c-1 What is the number of people per phone line (PHONE_DENS) for China? 5.93
- c-2 Does this number agree with the value you calculated in step 7? Yes
- d Use the Find and Identify tools to locate the countries in the table below. Record the population, phone lines, and number of people per phone line for each country.

COUNTRY NAME	COUNTRY POPULATION	PHONE LINES 2002	NUMBER OF PEOPLE PER PHONE LINE
China	1,261,832,000	212,929,439	5.93
India	1,014,004,000	40,560,159	25.00
United States	275,563,000	178,013,706	1.55
Indonesia	224,784,000	8,317,008	27.03
Brazil	172,860,000	38,547,781	4.48
Russia	146,001,000	35,332,242	4.13
Pakistan	141,554,000	3,538,850	40.00
Japan	126,550,000	70,614,903	1.79

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Step 11 Analyze results of your research

In the table below, the column on the left ranks the countries by population from highest to lowest. In the column on the right, rank the countries from the lowest number of people per phone line to the highest number of people per phone line, using the data you recorded in step 9. Then draw lines connecting the same country in each column.

RANKED BY POPULATION (HIGHEST TO LOWEST)	RANKED BY NUMBER OF PEOPLE PER PHONE LINE (LOWEST NUMBER OF PEOPLE PER PHONE LINE TO HIGHEST)
China	United States
India	Japan
United States	Russia
Indonesia	Brazil
Brazil	China
Russia	India
Pakistan	Indonesia
Japan	Pakistan

b-1 Which country has the fewest people per phone line? United States

How many people have to share a phone line in this country? 1.55

- b-2 How does the country in question b-1 rank in population size with the other seven countries in your table? It's the third largest in population.
- b-3 Which country has the most people per phone line? Pakistan

How many people have to share a phone line in this country? 40.00

- b-4 How does the country in question b-3 rank in population size with the other seven countries in your table? It's the seventh largest.
- b-5 What is the population of Japan? 126,550,000

How many people have to share a phone line in Japan? 1.7900

b-6 What country has the most phone lines? China

How does the number of people per phone line in this country compare with the seven other countries in your table? It is fifth.

- b-7 Russia and Pakistan have about the same number of people. Why do you suppose these two countries have such a different number of people who have to share a phone line? What factors do you think contribute to this disparity? Answers will vary. Examples: The countries have different cultures, a different economic base, and different economics of citizens.
- b-8 What do you think the answer to the geographic question is?The number of phone lines does not necessarily increase at the same rate as an increase in population.
- b-9 How does your initial hypothesis (step 4b) compare with your answer to the geographic question? Answers will vary.

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	Step 12	2 Develop a plan of action
ArcMap	a U	se the information in your table to describe the current phone line situation in your chosen country.
	A	nswers will vary. Possible answers include:
MODULE 2 global	oi pl Ri	nina has the highest number of phone lines of any country in the world, but its extremely large population (over ne billion people) means that nearly 6 people must share a phone line. Approximately 4 Brazilians must share a hone line. Brazil ranks fourth among countries that have shared phone lines, after the United States, Japan, and ussia. Brazil is ahead of the fifth-ranked country, China, where nearly 6 people must share a phone line.
regional	ln th	Indonesia, 27.03 people must share a phone line. Indonesia falls far behind other countries of similar size such as ne United States (1.55 people per phone line) and Brazil (4.48 people per phone line).
MODULE 3	Tł in	he United States has more than 178 million phone lines—second-most in the world. This country leads the world access to phone lines because only 1.55 people have to share a phone line.
MODULE 3	b D qı	o you think that increasing the number of phone lines operating in your chosen country would improve the uality of life there? Why or why not?
regional	А	nswers will vary.
MODULE 3 advanced	c Li A m	ist three concerns you have about increasing the number of phone lines in your chosen country. Inswers will vary. Students may list issues such as (1) difficulty of building phone lines in rural areas or among the many islands of Indonesia, (2) cost of building additional phone lines, or (3) a preference for expanding more
MODULE 4		
giobai	d Li	ist two new geographic questions that you would like to investigate to help you develop a sound plan.
MODULE 4 regional	~	inswers will vary but should include a geographic component.
MODULE 4 advanced		
MODULE 5 global		
MODULE 5 regional		
MODULE 5 advanced		
MODULE 6 global		
MODULE 6 regional		
морице 7 global		
MODULE 7 regional		
MODULE 7 advanced		

Module 2 Global perspective: The Earth Moves

Step 3 Look at earthquake location data

- b-1 Do earthquakes occur in the places you predicted? List the regions you predicted correctly for earthquake locations. Answers will vary depending on where students predicted earthquakes.
- b-2 What patterns do you see in the map?

Answers will vary, but they should indicate that earthquakes largely occur on the western coast of North and South America, along the eastern coast of Asia, and along the islands of the Pacific Rim. The pattern follows the Ring of Fire. They may also note a pattern of earthquakes down the center of the Atlantic Ocean and a string in the southern Atlantic, from South America eastward through to the Indian Ocean. Another pattern that is evident is a string that runs east and west through the south-central part of Asia and the southern part of Europe.

Step 4 Sort and analyze earthquake magnitudes

g How do the 15 selected locations compare to your original paper map? List three ways. Answers will vary based on their original predictions. If they selected any spots around the Ring of Fire, then their predictions were fairly close to reality.

Step 5 Look at volcano data

a-1 How do the volcano locations compare with your original predictions? List the regions of volcanic activity you predicted correctly.

Answers will vary based on their original predictions. If they selected any spots around the Ring of Fire, then their predictions were fairly close to reality.

a-2 What patterns do you see in the volcano points and how do they compare with the earthquake patterns?
 The earthquake and volcano points line up so that they are similar in their patterns with the exception of the volcanoes along the eastern side of Africa.

Step 6 Select all active volcanoes

- h-1 Does this data provide any patterns that were not evident before? Identify those patterns. The majority of the world volcanoes on the map are active, particularly in the islands of the Pacific Rim.
- h-2 Create a hypothesis as to why volcanoes and earthquakes happen where they do. Student answers will vary. Their hypothesis should begin to allude to the idea of plate tectonics and the fact that movement at plate boundaries causes disruptions on the earth's surface.

Step 7 Identify the active volcanoes on different continents

e Use the Identify tool to find the name, elevation, activity level, and country location of three volcanoes. Write that information in the space below.

Student answers will vary. Here is a correct example: On Take, 3,063 m, Solfatara Stage, Japan; Banahao, 2,177 m, Active, Philippines; and Ibu, 1,340, Active, Indonesia.

Step 8 Add the plate boundaries layer

i Compare the actual plate boundaries to the ones you drew on your paper map. Record all similarities and differences.

Answers will vary based on students' original hypotheses on plate boundary locations. If they drew the boundaries to follow the patterns of earthquakes and volcanoes, then they are on target.

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MODULE 4 regional

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MODULE 7 regional

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Step 9 Add a layer file and an image

g, h Use MapTips to find out the names of all major landforms formed at plate boundaries. Write them below and label them on your paper map. Next to the name of each landform, write how you think the landform was created.

NAME OF LANDFORM	FORMED BY
Mid-Atlantic Ridge	The separation of South American and African plates
Aleutian Trench Aleutian Islands	The boundary between the North American and Pacific plates
Rocky Mountain Range Cascade Mountain Range Sierra Nevada Mountain Range Baja California	The boundary of the eastern edge of the Pacific plate and the western edge of the North American plate
Sierra Madre Occidental Sierra Madre del Sur	The boundary of the North American, Pacific, and Coca plates
Andes Mountain Range Peru—Chile Trench	The boundary of Nazca and the South American plate
Alps Mountain Range Atlas Mountains	The boundary of the African and Eurasian plates
East Africa Rift Valley	The boundary of the African, Arabian, and Somali plates
Himalayas Tibetan Plateau	The boundary of the Indo-Australian, Indo-Chinese, Eurasian, and Amur plates
Mariana Trench	The boundary of the Philippine and the Pacific plates

Note: The above list covers landforms identified in MajorLandforms.lyr in the ArcMap map document. Students can find additional landforms by consulting an atlas or physical map of the world.

Step 10 Identify major cities at high and low risk for seismic activity

b Find the names of specific cities that are high-risk or low-risk for a seismic event. Write those names in the table.

	HIGH RISK		LOW RISK
1	Tokyo, Japan	1	Kazan, Russia
2	Reykjavik, Iceland	2	Tombouctou, Mali
3	San Francisco, United States	3	Kansas City, United States
4	Quito, Ecuador	4	Minsk, Belarus
5	Managua, Nicaragua	5	Godhavn, Greenland

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MODULE 7

Module 2 Regional case study: Life on the Edge

Step 2 Open the region2.mxd file and look at cities data

g Use the Identify tool to locate one city within each country listed in the table below and record that city's population.

Student answers will vary. This is an example of a table with correct information:

CITY NAME	COUNTRY NAME	CITY POPULATION
Kunming	China	1,280,000
Delhi	India	7,200,000
Токуо	Japan	23,620,000

Step 3 Look at population density

c Use the Identify tool to locate two world cities in East Asia in areas where the population density is greater than 200 people per square kilometer. Record below.

Student answers will vary. This is an example of a table with correct information:

WORLD CITIES THAT HAVE A POPULATION DENSITY GREATER THAN 200 PEOPLE PER SQUARE KILOMETER	
Nanjing, China	
Calcutta, India	

Step 4 Look at earthquake magnitudes

- a-1 Where did the largest earthquakes occur?
 Student answers will vary. They should include a statement that large earthquakes tend to fall along the islands of the Pacific Rim, including some that occur under the ocean.
- a-2 Did large earthquakes occur near densely populated areas? Where? No. For the most part, the largest earthquakes occurred underwater.

Step 5 Measure the distance between active volcanoes and nearby major cities

g-1 Are there many active volcanoes located close to highly populated areas? What is the closest distance you found? Record the name of the volcano and the city, and their distance apart.

Yes, there are many active volcanoes near highly populated areas. There are several possible answers for close distances. For example, Manado, Indonesia, is only 4 miles from Mahawu, an active volcano.

g-2 What patterns do you see in the volcano points and how do they compare with the earthquake patterns? The patterns of earthquake and volcanic activity are virtually the same, especially along the islands of the Pacific Rim (the western edge of the Ring of Fire). MODULE 1

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Module 3 Global perspective: Running Hot and Cold

Step 3 Observe annual world temperature patterns

 b Write three observations about the pattern of temperatures displayed on the map.
 Student answers will vary. Possible observations include the following: The warmest temperatures are clustered halfway between the North and South poles.
 Temperatures get steadily colder as you go from the equator toward the North Pole.
 There are many cities with cold temperatures in the Northern Hemisphere, but none in the Southern Hemisphere.

Step 4 Label the latitude zones

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Use the Identify tool to get information on cities and complete the table below.

ZONE	TYPICAL TEMPERATURE RANGE	EXAMPLE CITY (IT REFLECTS TYPICAL TEMPERATURES OF THAT ZONE)	ANOMALIES (CITIES THAT DO NOT FIT THE PATTERN OF THEIR ZONE)
Tropical	65°–85° F	Any of the 28 cities colored red or orange and that are between the Tropic of Capricorn and the Tropic of Cancer.	Quito (51°–60°) and La Paz (41°–50°)
North Temperate Zone	31°64° F	Any of the cities colored purple, blue, or green and that are between the Tropic of Cancer and the Arctic Circle.	Students should look for cities that seem to differ from the others around them or from other cities at the same latitude. Examples include Lhasa or Ankara.
South Temperate Zone	54°–64° F	Any of the cities colored green or orange and that are between the Tropic of Capricorn and the Antarctic Circle. (Buenos Aires, Cape Town, Johannesburg, Sydney, Melbourne, Wellington, Auckland.)	None

- s-1 Why do you think there aren't any cities in the North or South polar zones? The temperatures are probably too cold to support major cities.
- s-2 How is the North Temperate Zone different from the South Temperate Zone?
 Student answers will vary. Possible observations include the following:
 There is more land area in the North Temperate Zone.
 There are cities with average temperatures below 51° in the North Temperate Zone, but none in the South Temperate Zone.

Step 5 Observe climate distribution

b-1 Complete the table.

LATITUDE ZONES	CHARACTERISTIC CLIMATE(S)
Tropical zones	Tropical Wet, Tropical Wet and Dry, and Dry Some areas of Arid, Semiarid, Humid Subtropical, Highlands
Temperate zones	Humid Subtropical, Humid Continental, Marine, Mediterra- nean, Subarctic Some areas of Arid, Semiarid, Highlands, Tundra
Polar zones	Subarctic, Tundra, Ice Cap

- b-2 Which zone has the greatest number of climates? North Temperate Zone
- c Give an example of a city in each of the following climate zones. Student answers will vary. This list represents sample answers:

Arid Khartoum Tropical Wet Kisangani Tropical Wet and Dry Bamako Humid Subtropical Atlanta Mediterranean Rome Marine Paris Humid Continental Warsaw Subarctic Irkutsk Highland Lhasa

Step 6 Observe monthly temperature patterns in the Northern Hemisphere

- j-1 What does the graph show now? Average monthly temperatures in Miami
- j-2 What city is highlighted on the map? Miami
- k-1 What does the graph show now? Average monthly temperatures in Miami and Boston
- k-2 What city or cities are highlighted on the map? Miami and Boston
- Use the Monthly Temperature graph to complete the table below.

CITIES	COLDEST MONTH	LOWEST TEMPERATURE (°F)	HOTTEST MONTH	HIGHEST TEMPERATURE (°F)	TEMPERATURE RANGE OVER 12 MONTHS
Boston	January	28°	July	73°	45°
Miami	January, February	68°	August	83°	15°

- m-1 What is the name of the city? Quebec
- m-2 How does its monthly temperature pattern differ from Boston's?

The overall pattern is the same, but winter temperatures are colder and summer temperatures are slightly cooler. The annual temperature range is slightly greater: -55°. Summer is slightly shorter and winter slightly longer in the more northern city.

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n-1 What is the name of the city? Kingston

n-2 How does its monthly temperature pattern differ from Miami's?

Kingston has a smaller temperature range (5°) than Miami. Both cities are warm year-round, but Miami shows more seasonal variation. They have identical high temperatures, but Kingston's lows are not as cool as those in Miami.

o List the name of each of the cities displayed in the graph and complete the information in the table below.

CITY	LATITUDE	COLDEST MONTH	LOWEST TEMPERATURE (°F)	HOTTEST MONTH	HIGHEST TEMPERATURE (°F)	TEMPERATURE RANGE OVER 12 MONTHS
Quebec	46.9°	January	15°	July	70°	55°
Boston	42.5°	January	28°	July	73°	45°
Miami	25.9°	January, February	68°	August	83°	15°
Kingston	18.8°	January, February	78°	July, August	83°	5°

p Based on the information displayed in the graph, the map, and the table on your answer sheet, state a hypothesis about how the monthly temperature patterns change as latitude increases.

Student answers will vary. Answers should include the following points:

As latitude increases, the range of temperatures over the year increases.

The lower latitudes have less seasonal variation and tend to be warm year-round.

Temperatures get steadily colder as latitude increases.

January and February are the coldest months and July and August are the hottest months. (Note: this is a correct observation based on the four cities students are observing in this problem. A later step will focus on the difference between the Northern and Southern hemispheres.)

Step 7 Test your hypothesis

- g-1 Complete the table below.
 - Student answers will vary.

CITY	LATITUDE
Stockholm	59°
Berlin	53°
Warsaw	53°
Prague (Praha)	50°
Vienna	48°
Budapest	48°
Athens (Athinai)	38°
Rome (Roma)	42°

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MODULE 3 global

g-2 Do the cities you selected confirm or dispute your hypothesis? Explain.

Student answers will vary depending on their hypothesis. These cities show a similar pattern to that observed in North America.

Step 8 Analyze temperature patterns in the Southern Hemisphere

e Complete the table below.

CITY	LATITUDE	COLDEST MONTH	LOWEST TEMPERATURE (°F)	HOTTEST MONTH	HIGHEST TEMPERATURE (°F)	TEMPERATURE RANGE OVER 12 MONTHS
Darwin	-13°	July	78°	January, February	84°	6°
Brisbane	-27°	July	59°	January, February	77°	18°
Sydney	-34°	July	53°	January, February	72°	19°
Melbourne	-38°	July	48°	February	68°	20°

f Compare the monthly temperature patterns in the Southern Hemisphere to those in the Northern Hemisphere. Patterns in the Southern Hemisphere mirror those in the Northern Hemisphere. Winter temperatures are not as cold in the Southern Hemisphere because none of the cities has a latitude greater than -38° . The major difference is that the warmest and coldest months are reversed.

Formulate a hypothesis about the relationship between monthly temperature patterns and increases in latitude. Student answers will vary.

Step 9 Test your hypothesis on how latitude affects monthly temperature patterns in the Southern Hemisphere

e-1 Complete the table below.

CITY	LATITUDE
Cape Town	-34°
Johannesburg	-26°
Gabarone	-25°
Luanda	-9°

e-2 Based on your observations, do the cities you selected confirm or dispute your hypothesis about how latitude affects monthly temperature patterns in the Southern Hemisphere? Explain.

Student answers will vary. The patterns are the same as those seen in Australia.

Step 10 Investigate the ocean's influence on temperature

- b-1 In which Canadian city would you experience the coldest winter temperatures? Winnipeg
- b-2 In which Canadian city would you experience the warmest winter temperatures? Vancouver
- b-3 Looking at the map, why do you think the warmest city has temperatures that are so much warmer than the others in the winter?

Vancouver is the only Canadian city (on this map) located on the coast. The proximity to the ocean has a steadying effect on the air temperature in Vancouver throughout the year. Therefore, the fluctuation between summer and winter temperatures is not as large as with inland cities at the same latitude.

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k-1 Complete the table below.

CITY	LATITUDE
London	51°
Amsterdam	52°
Berlin	52°
Warsaw	52°
Kiev	50°

k-3 Which cities have the mildest temperatures? London and Amsterdam

the ocean (or distance from it) on patterns of temperature.

Winter temperatures get steadily colder as you move east and inland.

What happens to the winter temperatures as you move from London to Kiev?

cities at the same or similar latitudes located on the interior of continental landmasses.

- k-2 What do these cities have in common as to their location on the earth?
- - k-5 Why do you think some cities have milder temperatures than the others? Students should note that these cities are the warmest near the ocean (London on an island, Amsterdam on the

k-4

coast).

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- Step 11 Investigate the impact of elevation on temperature patterns e-1 Complete the table below.

CITY	LATITUDE
Kisangani	1° (0.7)
Libreville	0°
Quito	1° (–.38)
Singapore	1° (1.11)

What do these cities have in common as to their location on the earth? All are located very close to the equator. e-2

All the cities are in the Northern Hemisphere, on the continent of Europe, and at approximately 50° north latitude.

Based on your observations of Canada and Western Europe, state a hypothesis about the influence of proximity to

Student answers will vary. They should note that those cities closest to the ocean have milder temperatures than

e-3 What temperature pattern do these four cities have in common? All five cities show very little range in monthly temperatures throughout the year (6° or less).

- How is Quito different from the other three? e-4 Its temperatures are significantly cooler than the other three cities.
- Since all these cities are located on or very near the equator, what other factor could explain the difference in their e-5 temperature patterns?

Student answers will vary. They should not predict that Quito's close proximity to the ocean causes its cooler temperatures, because they just learned that proximity to the ocean causes milder temperatures.

h Analyze the selected records and complete the table below.

CITY	ELEVATION (FEET)
Kisangani	1,361
Libreville	32
Quito	9,226
Singapore	104

j Based on your observation of temperatures along the equator and the information in the table above, state a hypothesis about the influence of elevation on patterns of temperature.
 Student answers will vary. Students should note that cities at significantly higher elevations have cooler temperatures than other cities at a similar latitude.

Step 12 Revisit your initial ideas

g Rank the 13 cities from coldest to hottest according to their average January temperatures.

1.	Irkutsk	8.	Quito
2.	Minneapolis	9.	Wellington
3.	Helsinki	10.	Miami
4.	Lhasa	11.	Khartoum
5.	Vancouver	12.	Buenos Aires
6	London	12	Singanoro

- 6. London13. Singapore
- 7. Tunis
- j Rank the 13 cities from hottest to coldest according to their average July temperatures.

1.	Khartoum	8.	Vancouver
2.	Miami	9.	Helsinki
3.	Singapore	10.	Lhasa
4.	Tunis	11.	Quito
5.	Minneapolis	12.	Buenos Aires
6.	London	13.	Wellington

- 7. Irkutsk
- Put a check mark (\checkmark) next to those answers that you predicted correctly.

ArcMap
MODULE 2 global
MODULE 2 regional
MODULE 3 global
MODULE 3 regional
MODULE 3 advanced
MODULE 4 global
MODULE 4 regional
MODULE 4 advanced
MODULE 5 global
MODULE 5 regional
MODULE 5 advanced
MODULE 6 global
MODULE 6 regional
MODULE 7 global
MODULE 7 regional
MODULE 7

Module 3 Regional case study: Seasonal Differences

Step 3 Observe patterns of rainfall

- a-1 Which month gets the most rainfall in Bombay? July
- a-2 Which months appear to get little or no rainfall in Bombay? December-April
- a-3 Approximately how much rainfall does Bombay get each year (in inches)? 83
- a-4 Write a sentence summarizing the overall pattern of rainfall in Bombay in an average year. Bombay gets more than 80 inches of rain per year in a concentrated period from June to September.
- d-1 How did this change the map? The new city is selected. It turns blue on the map.
- d-2 How did this change the graphs? Both graphs now reflect data for the new city.
- e Analyze the graphs and fill in the Mangalore section of the table below.

CITY	MONTHS WITH RAINFALL	HIGHEST MONTHLY RAINFALL (INCHES)	TOTAL ANNUAL RAINFALL (INCHES)
Mangalore	April–November	40	135
Bombay			
Ahmadabad			

f-1 Complete the rest of the table in step e above.

CITY	MONTHS WITH RAINFALL	HIGHEST MONTHLY RAINFALL (INCHES)	TOTAL ANNUAL RAINFALL (INCHES)
Mangalore	April–November	40	135
Bombay	May–October	26	84
Ahmadabad	June–September	13	32

f-2 As you move northward along the subcontinent's west coast, how does the pattern of rainfall change? The rainy season gets shorter. It starts later in the year and ends earlier. The monthly and yearly rainfall totals decline.

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

In all three cities, the rainy seasons and dry seasons are at the same time of year. In each city, July has the highest rainfall total of any month, and the period from December through March is dry.

Step 4 Compare coastal and inland cities

a Complete the table below.

CITY	MONTHS WITH RAINFALL	HIGHEST MONTHLY RAINFALL (INCHES)	TOTAL ANNUAL RAINFALL (INCHES)
Bangalore	April–December	7	36

How does the rainfall pattern of Bangalore compare with that of Mangalore?Similarities: The two cities have a rainy season between April and December.Differences: Mangalore gets approximately four times as much rain as Bangalore.

b

MODULE 3

regional

- d What is the distance between the two cities? Approximately 170 miles
- e How can this data help you explain the differences between patterns of rainfall in inland Bangalore and coastal Mangalore?

Mangalore is on the coast while Bangalore is on the interior (Deccan) plateau. A narrow coastal mountain range (the Western Ghats) separates the two cities. The significant difference in total and monthly rainfall results from the orographic effect produced by the Western Ghats. Moist monsoon winds are forced to rise to go over these mountains as they come ashore. Condensing in the cooler upper atmosphere, most of the monsoon's moisture falls on the windward side of the mountains, leaving the inland side much drier.

Step 5 Compare eastern and western South Asian cities

a-1 Analyze the graphs and complete the table below.

CITY	MONTHS WITH RAINFALL	HIGHEST MONTHLY RAINFALL (INCHES)	TOTAL ANNUAL RAINFALL (INCHES)
Kabul	December–May	3	11
Herat	December–April	2	10

- a-2 Describe the pattern of rainfall in these two cities.Both of these cities are extremely dry. What little rainfall they do receive falls in the early months of the year.
- a-3 How do you think Afghanistan's rainfall pattern will affect the way of life in that country? There is not enough rainfall to support agriculture. They will have to rely on activities such as nomadic herding or extractive industry if any appropriate resources exist.
- b-1 Analyze the graphs and complete the table below.

CITY	MONTHS WITH RAINFALL	HIGHEST MONTHLY RAINFALL (INCHES)	TOTAL ANNUAL RAINFALL (INCHES)
Calcutta	February–November	13	64
Dhaka	February–November	16	79

b-2 Describe the pattern of rainfall in these two cities.

These two cities have significant annual rainfall total with a distinct rainy season that lasts longer than the rainy season on the southwest coast. The dry season lasts from November to February. The majority of the rain falls between May and October.

c What is happening to the patterns of rainfall as you move from west to east across South Asia? The amount of annual rainfall increases as you move eastward and the length of the rainy season gets longer.

Step 6 Observe yearly precipitation

- e-1 Which regions within South Asia get the least rainfall? The northwest (Afghanistan and Pakistan)
- e-2 Which regions within South Asia get the most rainfall? The southwest coast and the northeast
- e-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.
 Student answers will vary, but essentially, students should observe that precipitation does increase as you move from west to east across South Asia.

MODULE 1

MODULE 2 global

MODULE 2 regional

MODULE 3

MODULE 3 regional

MODULE 3 advanced

MODULE 4

MODULE 4

MODULE 4 advanced

MODULE 5

module 5 regional

MODULE 5 advanced

MODULE 6

MODULE 6 regional

MODULE 7 global

MODULE 7 regional

MODULE 1 ArcMap	f	What relationships do you see between South Asia's patterns of yearly rainfall and its physical features? The region's heaviest rainfall is on the windward side of the Western Ghats and the Himalayas. Orographic lift is responsible for these areas of heavy rainfall. Cities on the Deccan Plateau, on the subcontinent's interior, get signifi- cantly less rainfall because they lie in the rain shadow of the mountains.
global	Step	7 Explore the monsoon's impact on agriculture and population density
MODULE 2 regional	b-1	Which regions or countries of South Asia are suitable for agriculture and which are not? Explain. Student answers will vary. The western section of South Asia (Afghanistan, Pakistan, and western India) does not get enough rainfall to support agriculture. Additionally, much of Afghanistan and Pakistan is in the mountains, making agriculture unlikely there. Most of the remainder of the subcontinent is suitable for farming because it gets.
MODULE 3 global	b-2	sufficient rainfall and is either a plain or plateau. In which regions of South Asia do you expect to see the lowest population density? Explain.
MODULE 3 regional		Student answers will vary. Students should expect the dry mountainous west to have the lowest population density because the region cannot produce enough food to support a large population.
MODULE 3 advanced	b-3	In which regions of South Asia do you expect to see the highest population density? Explain. Student answers will vary. Students should recognize the importance of rivers to agriculture (alluvial flood plain, fertile deltas, and a steady source of water) and predict a high population density there.
MODULE 4 global	e-1	Does the Agriculture layer reflect the predictions you made in step 7b? Explain. Answers will vary depending on their answer in step 7b. However, the data does illustrate lack of farming in the dry mountainous regions.
MODULE 4 regional	e-2	Why are grazing, herding, and oasis agriculture the major activities in Afghanistan? Mountainous terrain and scarce rainfall make these the only viable economic activities for most people.
MODULE 4 advanced MODULE 5	e-3	What do you know about rice cultivation that would help explain its distribution on the agriculture map? Students familiar with rice cultivation will note that this is a crop that is often grown in flooded fields (wet rice cultivation) and requires a lot of water. Therefore, it makes sense that rice is cultivated in areas with the highest rainfall.
global MODULE 5 regional	e-4	Is there any aspect of the agriculture map that surprised you? Explain. Student answers will vary. Some students may be surprised about the agricultural activity in Pakistan since the area is so dry.
MODULE 5 advanced	i-1	Does the Population Density layer reflect the predictions you made in step 7b? Explain. Student answers will vary depending on their prediction.
MODULE 6 global	i-2	Why is Afghanistan's population density so low? Its harsh conditions make this an area that cannot support a large population.
MODULE 6 regional	i-3	Since most of Pakistan gets little to no rainfall, how do you explain the areas of high population density in that country? The Indus River provides a rich alluvial flood plain and a year-round supply of water for irrigation.
MODULE 7 global	i-4	What is the relationship between population density and patterns of precipitation in South Asia? Overall population density is highest where rainfall amounts are conducive to agriculture. The notable variation to this pattern is the high population density along the rivers—particularly in the west. The rich soil and dependable
MODULE 7	. –	source of water on the Indo-Gangetic Plain enable agriculture to support dense populations in spite of insufficient rainfall in some areas or at some times of year.
MODULE 7 advanced	I-5	Population density is lowest in mountainous areas of Afghanistan and Pakistan and highest on the Indo-Gangetic Plain.

Module 3 Advanced investigation: Sibling Rivalry

Step 4 Analyze characteristics of El Niño and La Niña

e, f Record your temperature observations in the table. Record your observations of precipitation characteristics for the same time period.

YEAR / SO	TEMPERATURE CHARACTERISTICS	PRECIPITATION CHARACTERISTICS
1997 / El Niño	Ranges above normal from 1–5 degrees Celsius	500 mm above normal over much of the Pacific
1999 / La Niña	Ranges below normal from 1–2 degrees Celsius	200 mm below normal over Pacific west of South America

h Synthesize the information you've recorded and develop a definition of El Niño and La Niña. Write these definitions on your answer sheet.

Student answers will vary.

Step 5 Are El Niño and La Niña equal and opposite?

a Complete the table on your answer sheet by filling in your observations for El Niño and La Niña's effect on the different regions of the world.

	TEMPERATURE		PRECIPITATION		OTHER		OTHER	
WORLD REGION	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA
North America	Ranges above normal from 1–2° C.	1–1.5° above normal in north and 1–1.5° C below normal in south.	Parts of southeast 10–50 mm above normal with scattered areas 10–20 mm below normal.	Predominantly normal with small areas in north 10–20 mm below and 10–50 mm above in south.				
South America	Northern half of continent ranges above normal from 1–5° C. South- ern parts are 0–1.5° C below normal.	Predominantly normal.	10–500 mm below normal in north with small areas 10–100 mm above normal.	10–40 mm below normal in east and 10–200 mm above normal in central part of the region.				
Europe	Central Europe 0.5–1° C above normal.	Normal.	South and west 10–50 mm above normal.	Normal.				

MODULE 1 ArcMap

MODULE 2 **global**

MODULE 2 regional

MODULE 3 global

MODULE 3 regional

MODULE 3 advanced

MODULE 4 **global**

MODULE 4 regional

MODULE 4 advanced

MODULE 5

MODULE 5

MODULE 5 advanced

MODULE 6 **global**

MODULE 6 regional

MODULE 7 **global**

MODULE 7 regional

MODULE 1 ArcMap
MODULE 2 global
MODULE 2 regional
MODULE 3 global
MODULE 3 regional
MODULE 3 advanced
MODULE 4 global
MODULE 4 regional
MODULE 4 advanced
MODULE 5

Step 5 Are El Niño and La Niña equal and opposite? (continued)

a (continued)

	TEMPE	RATURE	PRECIP	ITATION	OTHER		OTHER	
WORLD REGION	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA	DEC. 1997 EL NIÑO	MAR. 1999 LA NIÑA
Africa	.5–2° C above normal.	Central Africa .5–1.5° C above normal.	Mixed central and south 10–200 mm below normal. Small areas 10–100 mm above normal.	South 10–50 mm above normal. Small areas 10–250 mm below normal.				
Asia	.5–1.5° C below normal in north and .5–2° C above normal in south.	.5–2° C above normal in the South. Small scattered areas 1° C below normal.	Southeast 10–200 mm above normal. Small areas 10–20 mm below normal.	Small areas 10–30 mm above normal. Much of south 10–40 mm below normal.				
Oceania	.5–3° C above normal in most areas. Some spots slightly below normal.	Predominantly normal except western Aus- tralia .5–2° C above normal. Small sections of east 1° C below normal.	10–400 mm below normal with isolated areas 200 mm above normal.	Western areas 10–250 mm below normal. Eastern areas 10–200 mm above normal.				
Pacific Ocean	Ranges above normal from .5–5° C.	Ranges from 1° C above normal to 2° below normal	400 mm above normal over much of the Pacific.	200 mm below normal over Pacific west of South America.				

b Based on the data you recorded in the previous question, is La Niña equal and opposite to El Niño? Explain your answer.

No. El Niño is a much longer-lasting event and produces a larger difference in precipitation and temperature than La Niña. It is true that they are opposite. Where El Niño is associated with an increase in water temperature (off the coast of South America), La Niña is associated with a decrease in water temperature. However, the increase in water temperature during El Niño is greater than the decrease in water temperature during La Niña. Therefore, they are not equal effects.

- c-1 Was one year better than the other for you and your community? Student answers will vary depending on which region of the world they are living in or addressing.
- c-2 If in one year you received greater than normal rainfall, did your town have problems with flooding? Student answers will vary depending on which region of the world they are living in or addressing.
- c-3 If weather was unseasonably warm and mild, did outdoor activities such as amusement parks have greater turnout?

Student answers will vary depending on which region of the world they are living in or addressing.

c-4 How did these things affect the local economy? Student answers will vary depending on which region of the world they are living in or addressing.

Module 4 Global perspective: The March of Time

Step 3 Look at cities in 100 C.E.

- b-1 Where are they located on the earth's surface?
 Many of the cities are approximately 30 degrees north latitude. All of the cities are in the northern or eastern hemispheres.
- b-2 Where are they located in relation to each other?Five of the cities are located in the lands surrounding the Mediterranean Sea. All but three of the cities are in Asia.None of the cities is located in North or South America or Australia.
- b-3 Where are they located in relation to physical features? All of the cities are located near rivers or near the coast.
- c What are possible explanations for the patterns you see on this map? Answers will vary. Possible answers include the influence of climate, the extent of the Roman Empire, trade, suitability for agriculture, and so on.

Step 4 Find historic cities and identify modern cities and countries

HISTORIC CITY NAME	MODERN CITY NAME	MODERN COUNTRY
Carthage	Tunis	Tunisia
Antioch	Antioch	Turkey
Peshawar	Peshawar	Pakistan

e, g Use the Find and Identify tools to complete the information in the table below.

Step 5 Find the largest city of 100 C.E. and label it

- a What's your estimate of how many people lived in the world's largest city in 100 C.E.? Answers will vary.
- g-1 What was the largest city in 100 C.E.? Rome
- g-2 What was the population of the world's largest city in 100 C.E.? 450,000

Step 6 Look at cities in 1000 C.E. and label the most populous city

- c-1 What notable changes can you see from 100 C.E. to 1000 C.E.? The Mediterranean Sea is no longer the site of half the world's largest cities.
- c-2 What similarities can you see between 100 C.E. and 1000 C.E.? Cities still cluster around 30 degrees north latitude. All of the cities are under 1,000,000 population. All but two of the cities are in Asia. None of the top 10 cities is located in the Americas or Australia.
- f-1 What was the largest city in 1000 C.E.? Cordova
- f-2 What was the population of the world's largest city in 1000 C.E.? 450,000

MODULE 2 **global**

MODULE 2 regional

MODULE 3 **global**

MODULE 3 regional

MODULE 3 advanced

MODULE 4 **global**

MODULE 4 regional

MODULE 4 advanced

MODULE 5

MODULE 5

MODULE 5 advanced

MODULE 6

MODULE 6 regional

MODULE 7 **global**

MODULE 7 regional

MODULE 1 ArcMap
MODULE 2 globa l
MODULE 2 regional
MODULE 3 globa
MODULE 3

MODULE 4 global

Step 7 Observe and compare other historic periods b

Explore the map to complete the table below.

YEAR C.E.	LARGEST CITY	POPULATION OF LARGEST CITY	MAJOR DIFFERENCES FROM PREVIOUS TIME PERIOD
100	Rome	450,000	Not applicable
1000	Cordova	450,000	Mediterranean Sea is no longer a center of urban development.
1500	Beijing	672,000	Four of the 10 largest cities are now in China.
1800	Beijing	1,100,000	A city exceeds 1,000,000 for the first time. Europe now has three of the largest cities. Japan now has three of the largest cities.
1900	London	6,480,000	 Nine of the 10 largest cities are now in Europe (six) and North America (three). Five of the European cities are in Western Europe. Only one of the cities is in Asia. All 10 cities are over 1,000,000. For the first time, major cities move into more northern middle latitudes. The size of the largest city is six times what it was 100 years earlier.
1950	New York	12,463,000	First time a South American city is on the Top Ten list. First city in Southern Hemisphere is listed. Europe drops back to three of the top 10 cities with only two in Western Europe.
2000	Tokyo	23,620,000	Half of cities are over 15,000,000. Western Europe has only one of the top 10 cities.

Step 8 State a hypothesis

In the table below, state in the left column which periods in history are associated with the greatest changes. In the b right column, state possible explanations for the changes that you see.

TIME PERIODS OF SIGNIFICANT CHANGE	EXPLANATION FOR CHANGE
1800 through 1900	The Industrial Revolution caused rapid growth of European and North American cities. It also led to the immigration of millions of people to the United States from Europe.
1950 through 2000	The size of the world's largest cities mushroomed because of rapid economic growth in the developed world and the loss of agricultural jobs in the developing world (sending people to cities in hopes of finding a job).

Step 9 Investigate cities in the present time

- a-1 How many of your original guesses are among the cities in Top Ten Cities, 2000 C.E.? Answers will vary.
- a-2 Which cities did you successfully guess? Answers will vary.
- f, g In the table below, write the name, population, and rank for the other cities on your list. For cities that are not in the top 30, leave the population column blank and write >30 in the rank column.

CITY NAME	POPULATION	RANK
Los Angeles	9,763,600	14
Hong Kong	5,395,997	27
Bombay	9,950,000	12
Detroit		>30
Chicago	7,717,100	18

i In general, how far are these other cities from the top 10? Answers will vary.

MODULE 1 ArcMap	
MODULE 2 global	
MODULE 2 regional	
MODULE 3 global	
MODULE 3 regional	
MODULE 3 advanced	
MODULE 4 global	
MODULE 4 regional	
MODULE 4 advanced	
MODULE 5 global	
MODULE 5 regional	
MODULE 5 advanced	
MODULE 6 global	
MODULE 6 regional	
MODULE 7 global	
MODULE 7 regional	
MODULE 7 advanced	

MODULE 1	Mo	odule 4	Regional case	e study: Growing P	ains
	Step b-1	3 Compar Which world	e birth rate and deat	h rate data • the highest birth rates? Sub-Sa	haran Africa. Southwest Asia
global	b-2	Which world region or regions have the lowest birth rates?			
MODULE 2		North Ameri	ca (Canada and the Un	ited States), Australia, Europe (w	vith Asian Russia)
regional	c-1	Which world	region or regions have	e the highest death rates? Sub-S	aharan Africa
MODULE 3 global	c-2	Which world Mexico, Cen	region or regions have tral America, Australia,	e the lowest death rates? China, and the Middle East	
MODULE 3 regional	d-1	If the overall the fastest? Most sub-Sa	rate of growth is based naran African countries	d on the formula BR – DR = NI, v	which world regions do you think are growing
MODULE 3 dvanced	d-2	d-2 Which world regions do you think are growing the slowest? Many European countries			
MODULE 4 global	 Choose two European countries and two African countries and record their birth and death rates in the table below. Answers will vary. The answers provided below are examples of correct responses: 			rd their birth and death rates in the table below. rect responses:	
MODULE 4		COUNTRY	AND CONTINENT NAME	BIRTH RATE/1,000	DEATH RATE/1,000
regional		1	liger (Africa)	51.45	23.17
MODULE 4		S	pain (Europe)	9.22	9.03
dvanced		Hu	ngary (Europe)	9.26	13.34
MODULE 5		Et	niopia (Africa)	45.13	17.63
global		(Chad (Africa)	48.81	15.71
MODULE 5	m	List three que Answers will	estions that the Birth R. vary.	ate and Death Rate maps raise ir	n your mind.
MODULE 5 dvanced	Step c-1	5 4 Add the What is happ	Natural Increase laye pening to the populatic	er on in the countries that are red?	
MODULE 6 global		Their death r makes up fo	ates exceed their birth r the net loss from natu	rates—over time these populatio ural increase.	ns will decline unless migration into the country
MODULE 6	c-2	Which world	region is growing the	fastest? Sub-Saharan Africa	
regional	c-3	Which world region is growing the slowest? Europe			
MODULE 7 global	c-4	c-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?			
MODULE 7		Most probler	ns would occur in cour	ntries with fast growth.	
regional		On the answer sheet, briefly list some of the problems you would expect to see. Answers will vary, but students should recognize that a country with rapid growth will have a difficult time keeping			
dvanced		up with the (constantly increasing no	eed for education, health care, s	ocial intrastructure, resources, and jobs.

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

f Complete the table below.

INDICATOR	COMPARE SUB-SAHARAN AFRICA AND EUROPE	WHAT DOES THIS "INDICATE" ABOUT THE STANDARD OF LIVING IN THESE REGIONS?
Population > 60 years	Africa: Most countries have 3.15–5.7% in this age group. Europe: Most countries have 17.13–23.91% in this age group.	Africa: Low percent indicates many people die prematurely and do not reach old age. Low standard of living. Europe: High percent indicates more people live into their sixties and beyond because of good health care, sanitation, adequate food curply, and so forth. High standard of living
GDP per capita	Africa: Most countries have the lowest level of GDP. Europe: Most countries have the highest or second-highest level of GDP.	This is not the same as average income—be sure that students do not make that assump- tion. A higher GDP per capita does indicate a wealthier country, and that means more money to spend on the infrastructure. High GDP means a high standard of living and enough capital to continue to grow and expand economically.
Infant mortality rate	Africa: All countries have 19.84 infant deaths/1,000 born or higher. Europe: All countries have fewer than 19.84 infant deaths/1,000 born.	High rate of infant mortality indicates a low standard of living. This statistic is typically used to evaluate the health conditions (sani- tation, health care, food supply, disease, and so forth) in a country because newborns are much more susceptible to death from such health problems than adults or older children.
Life expectancy	Africa: There is a mix of low to high life expectancy, with most countries having a life expectancy of 37.24–57.42 years. Europe: Most countries have the highest life expectancy of 73.79– 83.46 years.	A higher life expectancy reveals a higher standard of living because it reflects prevail- ing conditions in a country at this time.
Literacy rate	Africa: Literacy rate varies from country to country, with no country at the highest level. Europe: All but one country is at the highest level of literacy.	Information on literacy, while not a perfect measure of education in a country, is proba- bly the most easily available and valid for international comparisons. Low levels of lit- eracy and education in general can impede the economic development of a country in the current rapidly changing, technology- driven world.
Percent of workforce in service sector	Africa: The service sector of the workforce varies from the lowest level to the highest level from country to country. Europe: The service sector of the workforce varies between the top two levels through- out Europe.	A higher percent of the workforce in the service sector indicates a higher standard of living. As a country becomes more developed economically, a larger percent of its workforce is employed in the service sector. The workforce of less developed countries is characterized by higher percent of workers in agriculture and industry.

MODULE 4 regional

	Stop	6 Add the Net Migration laver				
MODULE 1 ArcMap	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?				
MODIII E 2		Negative: Europe (countries with high standards of living)				
global		Positive: Sub-Saharan Africa (countries with low standards of living)				
5		Explain your answer:				
regional		Answers will vary, but students should recognize that there will be more out-migration from countries with low standards of living and more in-migration to countries with a higher standard of living.				
MODULE 3	d	Summarize the overall patterns of r	net migration in E	urope and sub-Sał	haran Africa in the table below.	_
global		NET MIGRATION IN SUB-SAHARA	N AFRICA	NET	MIGRATION IN EUROPE	
MODULE 3 regional		Generally, there is a tendency for out-migr Saharan Africa.	ation from sub-	Generally, there is a to the exception of certa	endency for in-migration to Europe with in Eastern European countries.	
MODULE 3 advanced	e	What are possible political or social on the map? Possible answers include Balkan war	conditions or even	ents that could exp any, political unrest	lain any of the migration patter in Liberia and Rwanda, and so or	ns you see n.
MODULE 4 global	Step	7 Draw conclusions				
<u> </u>	h	Based on your map investigations,	write a hypothesi	s about how a cou	intry's rate of natural increase af	fects its
MODULE 4		standard of living and its net rate of	of migration.	ural increase has a	direct effect on standard of livi	na and that
regional		standard of living creates push-pul	l factors that influ	ience migration.	direct chect on standard of ivi	ig, and that
MODULE 4 advanced	i	In the table below, illustrate your hypothesis with data from one European country and one sub-Saharan African country.				
MODULE 5 global		Answers will vary depending on the hypothesis that was created in step 7h. However, students should include data for each European and African country that includes natural increase, net migration, and other datasets that support their hypothesis.				
MODULE 5		EUROPE	DA	TA	AFRICA	
regional			Countr	y name		_
MODULE 5			Natural	increase		
advanced		Net migration				
						_
global						
MODULE 6	C .					
	Step 8 Design a layout					
global	11		C: KIIOHIELEIS			

Module 4 Advanced investigation: Generation Gaps

Step 2 Create new layers

- a-1 What world regions have the highest rates of natural increase today? Africa and the Middle East
- a-2 What world regions have the lowest rates of natural increase today? Europe and Russia

Step 3 Thematically map world age structure

- I-1 What regions of the world have populations with a high percentage below age 15? Most African countries and some parts of the Middle East
- I-2 What regions of the world have populations with a relatively low percentage below age 15? Europe and North America
- I-3 Why do you think there is a much higher percentage of children in some populations than in others? Student answers will vary. There is a high percentage of children in growing populations because of high birth rates and sustained high fertility rates. As a result, each generation will be larger than the one before it.
- I-4 Why are there far more people 60 years of age and older in some populations than in others? Student answers will vary. Populations with high standards of living and good medical care tend to have large populations over 60 years old.
- I-5 Based on the layers in the Generation Gaps data frame, how do you think natural increase is related to age structure?

Where natural increase is high, the population less than 15 years of age is also high. Countries with the greatest percentage of population over age 60 have a low natural increase. A high rate of natural increase leads to an age structure with a large percent of children.

Step 7 Analyze census data for your county

h Are there identifiable concentrations of children between birth and five years old in your county? How do you explain these concentrations?

Student answers will vary based on their chosen county.

- i Where is the greatest number of this age group found? Student answers will vary based on their chosen county.
- j-1 Do you have any colleges in your county? Any retirement communities? Are these institutions reflected in the census data?
 Student answers will vary based on their chosen county.

Student answers will vary based on their chosen county.

j-2 Identify patterns of age distribution in your county and suggest explanations for those patterns. Student answers will vary based on their chosen county. MODULE 2 **global**

MODULE 2 regional

MODULE 3 global

MODULE 3 regional

MODULE 3 advanced

MODULE 4 global

MODULE 4 regional

MODULE 4 advanced

global

regional

MODULE 5 advanced

MODULE 6

MODULE 6 regional

MODULE 7 global

MODULE 7 regional

MODULE 1 ArcMap

L

Module 5 Global perspective: Crossing the Line

Step 3 Explore mountain ranges as physiographic boundaries

The Pyrenees Mountains are the border between which two countries? Spain and France

n Complete the table below:

COUNTRIES THAT HAVE MOUNTAIN RANGES AS POLITICAL BOUNDARIES	MOUNTAINS THAT FORM THE BOUNDARY
Italy and Switzerland	Alps
Italy and France	Alps
Poland and Czech Republic	Sudeten Mountains

Step 4 Explore bodies of water as physiographic boundaries

c In the table below, record the names of three sets of countries that share a boundary that's a river. Some examples include:

COUNTRIES THAT HAVE RIVERS AS BOUNDARIES	RIVER THAT FORMS THE BOUNDARY
France and Germany	Rhine
Germany and Poland	Oder
Romania and Bulgaria	Danube
Belarus and Ukraine	Dnieper

Some examples include: Switzerland, Austria, Czech Republic, Slovakia, Hungary, and Serbia and Montenegro.

MODULE 5

d

Step 5 Explore geometric boundaries

e Record three sets of countries in the table below. Some examples include:

Name three landlocked countries in Western Europe.

COUNTRIES THAT ARE SEPARATED BY GEOMETRIC BOUNDARIES				
Egypt and Libya	Niger and Algeria	Namibia and Botswana		
Sudan and Chad	Libya and Sudan	Algeria and Mauritania		
Libya and Chad	Algeria and Mali	Angola and Zambia		

Step 6 Explore anthropographic boundaries based on language and religion

h Determine the principal language groups in the regions listed below.
 South America: Indo-European
 Western Europe: Indo-European, Uralic, and Others

j Locate three examples in the world where political boundaries coincide with anthropographic boundaries based on language.

Possible answers include:

ANTHROPOGRAPHIC BOUNDARIES BASED ON LANGUAGE COINCIDE WITH POLITICAL BOUNDARIES BETWEEN				
India and China	Kazakhstan and Russia	Thailand and Laos		
Georgia and Russia	Finland and Norway/Sweden	Botswana and Zimbabwe		
North Korea and China	Brazil and Paraguay	Venezuela and Guyana		

- n Determine the principal religions in the following regions:
 North America: Protestant, Roman Catholic, Mixed Christian, Mormon, Indigenous
 Africa: Sunni Muslim, Indigenous, Roman Catholic, Mixed Christian, Protestant, Eastern, Orthodox
- p Locate three examples in the world where political boundaries coincide with anthropographic boundaries based on religion.
 Possible answers include:

ANTHROPOGRAPHIC BOUNDARIES BASED ON RELIGION COINCIDE WITH POLITICAL BOUNDARIES BETWEEN				
India and China	Vietnam and Cambodia/Laos	Finland and Russia		
India and Myanmar	Kazakhstan and Russia	Ireland and United Kingdom		
India and Pakistan	Mongolia and Russia	Bangladesh and India		
Thailand and Malaysia	Iran and Pakistan/Iraq/Turkmenistan	Germany and Czech Republic		

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 below.

Answers will vary. See answers above for possible answers to each category.

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

f Locate another example of each type of country. Record them in the following table in the Example 2 column. Some examples include:

TYPE OF COUNTRY	EXAMPLE	EXAMPLE 2
Elongated	Chile	Vietnam, Panama
Fragmented	Philippines	Indonesia, Japan
Circular/Hexagonal	France	Uruguay, Zimbabwe
Small/Compact	Bulgaria	Costa Rica, Belgium
Perforated	South Africa	Italy (Vatican City, San Marino), Malaysia (Brunei)
Prorupted	Namibia	Thailand, Afghanistan

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

Answers will vary. Some examples include Japan, France, Argentina, Italy, and Hungary.

MODULE 2 **global**

MODULE 2 regional

MODULE 3

MODULE 3 regional

MODULE 3 advanced

MODULE 4 **global**

MODULE 4 regional

MODULE 4 advanced

MODULE 5 global

MODULE 5

MODULE 5 advanced

MODULE 6

MODULE 6 regional

MODULE 7 **global**

MODULE 7 regional

MODULE 7 advanced

- g-2 By using language groups as an indicator of cultural diversity, identify three countries that reflect cultural diversity. Answers will vary. Some examples include Canada, Spain, Nigeria, Burkina Faso, Syria, Turkey, India, Switzerland, Myanmar (Burma), Sudan, Sri Lanka, and Namibia.
- i Use the ArcMap tools and buttons you've learned in this investigation to find an example of a landlocked country on each of the following continents. For a continent that does not have a landlocked country, write "none." Complete the table:

CONTINENT	LANDLOCKED COUNTRY
North America (including Central America)	None
South America	Bolivia and Paraguay
Africa	Mali, Burkina Faso, Niger, Chad, Central African Republic, Rwanda, Burundi, Uganda, Zambia, Zimbabwe, Botswana, Lesotho
Asia	Jordan, Afghanistan, Nepal, Bhutan, Laos, Mongolia, Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, Armenia, Azerbaijan

- o-1 Name two Southeast Asian countries that do not have any oil and gas resources within their borders. Cambodia, Laos, Vietnam
- o-2 Name two Southeast Asian countries that have oil and gas resources within their borders. Indonesia, Brunei, Thailand, Malaysia, Philippines, Myanmar (Burma)

Step 9 Explore boundary changes in the 1990s

- c-1 Describe three political boundary changes you see between 1992 and 2004. Answers will vary, but they should focus on the changes in Eastern Europe and the former USSR.
- c-2 Name two countries that existed in 1992, but do not exist in 2004. USSR, Czechoslovakia, Yugoslavia

Step 10 Compare new countries

a Select three countries from group A and three from group B and complete the table on the answer sheet. Answers will vary based on countries selected. Refer to Global5.mxd for specific data.

MODULE 5

global

Module 5 Regional case study: A Line in the Sand

Step 3 Identify countries that border the Arabian Peninsula

c Record the names of the countries on the map that border the Arabian Peninsula to the north. Jordan, Iraq, Kuwait

Step 4 Investigate the physical characteristics of the Arabian Peninsula

- a-1 Is any part of the Arabian Peninsula mountainous? Yes
- a-2 If so, where are the mountains located?
 The peninsula is mountainous along its west (Red Sea) coast. A second region of mountains can be seen on the northeast (Gulf of Oman) coast.
- c-1 Are there any parts of the Arabian Peninsula that do not have any water at all? If so, where are these regions? Yes. The south-central part of the peninsula has no permanent bodies of water or streams.
- c-2 Do you see any relationship between landforms and the availability of water? Mountains and areas of higher elevation have more surface water.
- e Describe the bodies of water.The permanent bodies of water look like disconnected fragments of rivers and lakes.
- h-1 How many millimeters equal 10 inches? 254 mm
- h-2 Based on the amounts of rainfall displayed on the map, do you think there is much farming on the Arabian Peninsula? Explain.
 No. Most of the Arabian Peninsula is so dry that agriculture wouldn't be possible without an alternative source of water such as a river. Egypt, for example, is just as dry, but the Nile River provides water for agriculture.
- h-3 Approximately what percentage of the Arabian Peninsula is desert? Approximately 70–90 percent of the Arabian Peninsula is desert.
- i What is the approximate range of temperatures across the Arabian Peninsula during this period? Sept.–Nov.: 14° C to 30° C; 57° F to 87° F
- j-1 Which season is the hottest? Summer (June–August)
- j-2 What is the approximate range of temperatures across the Arabian Peninsula during this period? 18° C to 40° C; 66° F to 104° F
- k-1 What relationship do you see between the Arabian Peninsula's ecozones as displayed on this map and its patterns of landforms, precipitation, and temperature?

The limited zones of temperate grassland on the Arabian Peninsula are found in the mountains where there is more precipitation and milder temperatures.

MODULE 2 **global**

MODULE 2 regional

MODULE 3 **global**

MODULE 3 regional

MODULE 3 advanced

MODULE 4

MODULE 4 regional

MODULE 4 advanced

global

MODULE 5 regional

MODULE 5 advanced

MODULE 6

MODULE 6

MODULE 7 global

MODULE 7 regional

k-2	Complete the table.	List three observations for ea	ach physical characteristic.
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ArcMap			PHYSICAL CHARACTERISTICS OF THE ARABIAN PENINSULA			
MODULE 2 global		Landforms and bodies of water	The Arabian Peninsula has a narrow coastal plain along the Red Sea that is separated by a low moun- tain range from the rest of the peninsula. The highest mountains in this range are at the southern point of the peninsula where the Red Sea meets the Gulf of Aden. A second, smaller range of mountains is found on the northeastern point of the peninsula along the Gulf of Oman.			
MODULE 2			There are few permanent bodies of water on the Arabian Peninsula. The region has many intermittent streams.			
MODULE 3		Climate	Most of the Arabian Peninsula is a desert because it gets less than 10 inches of rainfall per year. Winters are mild in terms of temperature, but in the summer, average temperatures are extremely high.			
global MODULE 3		Ecozones	Most of the Arabian Peninsula has a desert ecosystem. The primary exception to this are the temperate grasslands. They can be found in the mountains and higher elevations of the western part of the peninsula, and in the mountains of the northeast.			
regional	k-3	In your opinion, wh	ich of the region's physical characteristics would be considered "valuable" in a bound	ary		
idvanced		decision? Explain. In a boundary decis (19.5 inches) of ann	ion, the valuable characteristics are grassland ecosystems, areas with greater than 500 nual precipitation, and areas with access to permanent bodies of water or springs.) mm		
MODULE 4 global	Step	5 Investigate the	e human characteristics of the Arabian Peninsula			
MODULE 4	b-1	What is the principa The principal agricu	al agricultural activity on the peninsula? Itural activity of the Arabian Peninsula is nomadic herding.			
MODULE 4	b-2	Based on what you now know about the physical characteristics of the region, why do you think the agricultural activity is so limited? There is not sufficient water for farming in most of the region. Livestock can be herded from place to place				
		depending on the seasonal availability of water and pastureland.				
global	c-1	How does Yemen compare to the rest of the Arabian Peninsula in population density? Southwestern Yemen has the largest area of relatively high population density (greater than 50 people per sq. km.).				
MODULE 5 regional	c-2	Describe the overall population density of the Arabian Peninsula. Most of the Arabian Peninsula has fewer than 25 people per sq. km. and at least half of that area has fewer than one person per sq. km.				
idvanced	f-1	Speculate on the most frequent use of the water at these springs and water holes.				
MODULE 6		Student answers will vary. Because of the large amount of nomadic herding, a logical conclusion is that most of the springs and water holes are used to water livestock.				
GIODAI MODULE 6	f-2	Use your answers from previous step 5 questions and analysis of the maps to complete the table. List three observations for each human characteristic.				
regional	HUMAN CHARACTERISTICS OF THE ARABIAN PENINSULA					
MODULE 7 global		Agricultural activities	The principal agricultural activity of the Arabian Peninsula is nomadic herding. Farming exists on a very limited basis in desert oases, on irrigated lands along the Red Sea, and in the high elevations of southern Yemen.			
MODULE 7		Population density and distribution	The Arabian Peninsula is very sparsely populated overall. Most of the population centers are along the coast (with a few exceptions in Saudi Arabia). The largest concentration of people is found in southern Yemen.			
MODULE 7						

f-3 If an international boundary were to be drawn across some part of the Arabian Peninsula, how would these characteristics influence the perception of certain regions as being more "valuable" than others?
Nomadic herders would place a high value on having access to sources of water and grazing land. The population density of a region is a direct reflection of the ability of land to support population. Those areas with very low population density would be least valuable and those with high population density would be most valuable.

Step 6 Locate and describe the Empty Quarter

b-1 Complete the table. List three observations in each column.

THE EMPTY QUARTER			
PHYSICAL CHARACTERISTICS	HUMAN CHARACTERISTICS		
The Rub' al-Khali or Empty Quarter is a desert region with vir- tually no permanent bodies of water and less than 2 inches of rainfall per year.	The Rub' al-Khali or Empty Quarter has no agricultural activity at all. The region is virtually uninhabited—most of it has less than one person per sq. km. And about one third has no peo- ple at all. The lack of roads in this region indicates minimal human presence.		

b-2 What difficulties would an area like this present if an international boundary must cross it?
 International boundary difficulties include:
 There's no one living in the area to enforce the boundaries.
 The lack of permanent landmarks (due to shifting sand dunes) makes the line difficult to mark and see.

Nomadic herders would want easy access throughout the border area.

Step 7 Explore Saudi Arabia's southern boundaries

- c-1 Are the boundaries what you expected them to be? Student answers will vary.
- c-2 Which boundary remained unsettled? The border between Saudi Arabia and Yemen was the only border that remained undefined.
- i What does the area between the green and purple lines represent?It is claimed by both Saudi Arabia and Yemen—it is the disputed territory between these two countries.
- j What is the principal economic activity of the regions in dispute? Nomadic herding. The disputed territory is an area of land that borders the Empty Quarter.
- k Describe the population distribution in the disputed territory.
 The disputed territory is mostly uninhabited. Most of the disputed territory has fewer than one person per sq. km.
 The only area with a higher concentration of people is the western part of the territory with 1–25 people per sq. km.

Step 8 Draw the Saudi–Yemeni boundary

- b-1 Does the red line go through any cities or towns? (Hint: You may need to zoom in again to answer the question.) If yes, approximately how many does the boundary pass through?
 Student answers will vary. There are fewer than 10 villages that the boundary line actually passes through, but if you consider villages within a mile or two of the border (approximately 1.25 km.), there are many more.
- b-2 How would you decide which side of the town to put the boundary on? Remember, this decision would determine whether the residents of that village would be citizens of Saudi Arabia or Yemen.
 Student answers will vary. One way to decide where to put the boundary line is to survey villagers to find out whether they feel a closer affiliation with Yemen or Saudi Arabia. Such affiliations are based on long-standing tribal traditions.

MODULE 1

MODULE 2 **global**

MODULE 2 regional

MODULE 3

MODULE 3 regional

MODULE 3 advanced

MODULE 4

MODULE 4 regional

MODULE 4 advanced

MODULE 5 **global**

MODULE 5 regional

MODULE 5 advanced

MODULE 6 global

MODULE 6

MODULE 7 **global**

MODULE 7 regional

MODULE 1 ArcMap	r D Ti
MODULE 2 global	Step 9 d V
MODULE 2 regional	e H S ^r th
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MODULE 3 regional	
MODULE 3 advanced	n
MODULE 4 global	Step 1 a H
MODULE 4 regional	m-1 lr Tl Y
MODULE 4 advanced	m-2 W
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MODULE 5 regional	
MODULE 5 advanced	
MODULE 6 global	
MODULE 6 regional	
MODULE 7 global	
MODULE 7 regional	
MODULE 7 advanced	

Does the new line seem to favor Yemen or Saudi Arabia? Explain. The new border seems to favor Yemen. It gained control of all the disputed territory and gained even more territory beyond the previous boundary.

Step 9 Enter the maritime part of the boundary

- What body of water does the maritime boundary traverse? The Red Sea
- How does the actual boundary established by the Treaty of Jeddah compare with the boundary you drew earlier?
 Student answers will vary. In most cases, students will find that the Treaty of Jeddah gave more land to Yemen than they predicted.
- f Write three observations about the boundary line created by the Treaty of Jeddah.

Student answers will vary. Here are three possible responses:

The new boundary increased Yemen's territory.

Most of Yemen's new territory is land used by nomadic herders and desert. The border settlement probably did not have a significant impact on Yemen's overall population as most of the new territory is uninhabited or very sparsely settled.

Step 10 Define the pastoral area

- How many miles is 20 kilometers? (Hint: 1 kilometer = .6214 miles) 20 km. = 12.428 miles
- m-1 In which part of the Saudi–Yemeni border will the pastoral area be most significant? Explain.

The pastoral area will be most significant in the western part of the boundary region (corresponding to Yemen1.shp) because this is the part of the boundary where nomadic herding is the characteristic agricultural activity. The remainder of the new boundary is north of the nomadic herding areas.

m-2 Why do you think the Treaty of Jeddah created a pastoral area?

Student answers will vary. However, students should understand that the establishment of a pastoral area recognizes that nomadic herding is incompatible with fixed and finite boundaries. The pastoral area represents a compromise between the need to clearly define the boundary between Saudi Arabia and Yemen and the reality that the border area is populated by people whose nomadic traditions include territory on both sides of that boundary.

Module 5 Advanced investigation: Starting from Scratch

Step 2 Explore map layers

- List other important factors that influence boundary decisions.
 Historic events (wars and treaties), ethnicity, natural resources are some. Student answers will vary.
- c Use the Religion legend and MapTips to determine three principal religions of South Asia. Record them here. Hindu, Sunni Muslim, Buddhist
- e The boundary between which two religions corresponds to a physiographic boundary visible in the satellite image? Hindu and Buddhist
- f Identify the principal language groups in South Asia. Indo-European, Dravidian, Sino-Tibetan
- g The boundary between which two language groups corresponds to a physiographic boundary visible in the satellite image? Sino-Tibetan and Indo-European

Step 5 Draw the boundaries of new countries

a Choose the continent you will be working on and record it here. Student answers will vary.

MODULE 1 ArcMap

MODULE 2 **global**

MODULE 2 regional

MODULE 3

MODULE 3 regional

MODULE 3 advanced

MODULE 4

MODULE 4 regional

MODULE 4 advanced

MODULE 5

MODULE 5

MODULE 5 advanced

global

MODULE 6 regional

MODULE 7 **global**

MODULE 7 regional

MODULE 1	Mo	odule 6 G	obal pers	pective: Th	ne Wealth	of Nation	S	
ArcMap	Step 3 Evaluate the legends and patterns of the maps a-1 What do the darkest colors represent? A very high percentage in that sector							
global	a-2	What do the lightest colors represent? A very low percentage in that sector						
MODULE 2 regional	b-1	What does the description "Very High" refer to in this map? It refers to the percentage of the workforce that is in the agriculture sector.						
MODULE 3	b-2 Where are the countries with a high percentage of agricultural workers generally located? Africa and parts of					d parts of Asia		
global MODULE 3	b-3	Where are the countries with a low percentage of agricultural workers generally located? North America and Australia						
regional	c-1	Where are the countries with a high percentage of service workers generally located? North America, eastern South America, Australia, and Europe						
dvanced	c-2	Where are the countries with a low percentage of service workers generally located? Central Africa and India						
MODULE 4 global	c-3	What relationship, if any, do you see between the agriculture and services workforce maps? They are generally opposite; where one is high, the other is low.						
MODULE 4	d	What patterns do you see on the map? The lightest colors are in Africa, the darkest are in Eastern Europe and Argentina.						
MODULE 4 dvanced	e	Using the workforce information in all three maps, in what part or parts of the world do you find the greatest number of developing countries? In Africa and parts of the Middle East and Asia						
MODULE 5 global	Step -1	P 4 Analyze data on Bolivia What percentage of workers in Bolivia are involved in agriculture? 38.9						
MODULE 5	MODULE 5 I-2 What percentage of workers in Bolivia are involved in industry? 20.8							
regional I-3 What percentage of workers in Bolivia are involved in service?			l in service? 40.3).3				
MODULE 5	-4	Would you classify Bolivia as a developed or developing country? Explain. Developing. Regardless of their answer, it is important for students to support their answer with the data.						
MODULE 6 global	n	n In the table below, record the classification (developed or developing) you gave Bolivia in the previous question. Complete the rest of the table by following the instructions in step 5.						
MODULE 6		COUNTRY	AGRICULTURE	INDUSTRY	SERVICE	DEVELOPING	DEVELOPED	
regional		Bolivia	High	Low	High	×		_
MODULE 7		India	Very High	Low	Low	×		
global		Australia	Very Low	Moderate	Very High		×	
MODULE 7		South Korea	Low	Moderate	Very High		×	
regional		Ukraine	Moderate	High	High		×	
MODULE 7		Uruguay	Very Low	Moderate	Very High		×	
Step 8 Analyze GDP per capita and energy use data

- b-1 What level is the GDP per capita for Bolivia? Low
- b-2 Based on this new information and the workforce data, should Bolivia be classified as a developing or developed country? Developing

Why?

Low GDP is consistent with a developing nation. Previous data on workforce statistics also indicate that Bolivia is a developing country.

- c-1 What level is the Energy use for Bolivia? Very Low
- c-2 Based on this new information and previous data, should Bolivia be classified as a developing or developed country? Developing
- c-3 Why does energy use increase when a country develops? Energy is used more when countries build infrastructure and establish manufacturing plants than when the primary mode of economic production is agriculture. Industry- and service-oriented production consume more energy than agriculture.
- d-1 Complete the table below.

COUNTRY	GDP PER CAPITA	ENERGY USE	DEVELOPED OR DEVELOPING	IS THIS A CHANGE FROM YOUR EARLIER CLASSIFICATION?
Bolivia	Low	Very Low	Developing	No
India	Very Low	Moderate	Developing	No
Australia	Very High	Low	Developed	No
South Korea	High	Low	Developed	No
Ukraine	Very Low	Very Low	Developing	Yes
Uruguay	Moderate	Very Low	Developing	Yes

d-2 Name one country from above that you earlier classified as developed and that has GDP and Energy Use data that indicates it's developing.

Possible answers include Ukraine and Uruguay.

d-3 Based on the data you collected on these six countries, do you feel that the employment criteria are good indicators of a country's economic status? Explain your answer.

Student answers will vary. Employment criteria appear to be good indicators of developing or developed status in some cases, but not all. Students should realize that many factors make up a country's economic status, and as different factors are included as criteria, a country's classification may change. For example, although Ukraine and Uruguay have a high percentage of workers in the service industry, they have a low or average GDP and lower energy use. Inclusion of these additional factors make Ukraine and Uruguay lean toward a "developing" classification.

ArcMap

MODULE 2 **global**

MODULE 2

MODULE 3 global

MODULE 3 regional

MODULE 3 advanced

MODULE 4 **global**

MODULE 4 regional

MODULE 4 advanced

global

MODULE 5 regional

MODULE 5 advanced

MODULE 6 global

MODULE 6 regional

MODULE 7 **global**

MODULE 7 regional

MODULE 7 advanced

MODULE 1	Module 6 Regional case study: Share and Share Alike
	Step 3 Examine the map and attribute table c-1 Which years does the layer contain data for? 1991 to 2000
global	c-2 How many attributes are there for each year? Six
MODULE 2	c-3 What was the value of goods and services exported from Canada to the United States in 1991? \$91,064,000,000
regional	e-1 What is the name of the table? Attributes of NAFTA Countries
MODULE 3 global	e-2 How many rows are there for each country on the map? One
MODULE 3 regional	Step 4Relate another table to the layer tabled-1How many rows are there for each country? Four
MODULE 3 advanced	d-2 What information is collected under the field titled "Item" for Canada? Total Exports to United States Trade Balance with United States
MODULE 4 global	Total Exports to Mexico Trade Balance with Mexico
MODULE 4	d-3 Describe in general terms the information collected in the field titled "Item." Total Exports and Trade Balance for each of the NAFTA countries
	d-4 How many years of data are represented in the table? 10
advanced	g What happens in the NAFTA Trading Statistics table? The rows for the selected country (U.S.) become highlighted.
MODULE 5 global	 What happens in the two tables and the map? Canada is highlighted (blue) on the map and in the Attributes of NAFTA Countries table. Nothing changes in the NAFTA Trading Statistics table; the rows for the United States remain highlighted.
regional	j What happens in the two tables and the map? The Mexico row that was clicked in the NAFTA Trading Statistics table becomes highlighted but Canada remains selected in the attribute table and map.
advanced MODULE 6 global	 What have you observed about the way the NAFTA Trading Statistics table is tied to the NAFTA Countries attribute table and map layer? The related table does not automatically reflect changes to a selection in the map or layer attribute table. The relate must be updated in one table or the other to show the related records.
MODULE 6 regional	Step 5 Examine export graphs b-1 Which country exported more goods and services to Canada—Mexico or the United States? United States
MODULE 7	b-2 Why is the graph empty in the space for Canada? A country (Canada) doesn't export goods to itself.
MODILLEZ	d What happened to the graph? Only the data for Mexico (the selected country) is displayed.
regional	e-1 How many years of data are represented on the graph? 10
MODULE 7 advanced	e-2 What year does the first bar on the left represent? 1991

- e-3 Compare the numbers on the y-axis with those in the two tables. Are the numbers on the graph in thousands, millions, or billions of dollars?
- e-4 Looking at the graph, how would you describe the trend of Mexican exports to Canada over the 10-year period? They increased dramatically
- e-5 What was the approximate value of Mexican exports to Canada in 1991? \$2,300,000,000 (\$2.3 billion) In 2000? \$8,000,000,000 (\$8 billion)
- e-6 Approximately how many times greater is the 2000 export figure than the 1991 export figure? 3.5 (or 4, depending on how the student has rounded)
- g-1 How would you describe the trend of Mexican exports to the United States over the 10-year period? They increased steadily and dramatically.
- g-2 Approximately how many times greater is the 2000 export figure than the 1991 export figure? 4.6 (or 5, depending on how the student has rounded)

Step 6 Examine a trade balance graph

- c-1 Did Mexico have a trade surplus or deficit with the United States for 1992? Deficit
- c-2 What was the approximate value of the trade balance for 1992? (Remember, the y-axis is in millions of dollars.) \$-5,000,000,000 (\$-5 billion)
- c-3 What was the first year that Mexico exported more to the United States than it imported from the United States? 1995
- c-4 Describe the trend of Mexico's trade balance with the United States over the 10-year period. It went from a deficit to a surplus that continued to grow until 2000.
- d Did Canada have a deficit trade balance with the United States anytime during the 10-year period? No
- e-1 In 1998, was Canada's trade balance with the United States greater, smaller, or about the same as Mexico's? About the same
- e-2 In 2000, was Canada's trade balance with the United States greater, smaller, or about the same as Mexico's? Greater
- f Referring to the Attributes of NAFTA_Trading_Statistics table, what was the exact value of Canada's trade balance with the United States in 2000? \$51,897,000,000 surplus

MODULE 1 ArcMap

MODULE 2 **global**

MODULE 2 regional

MODULE 3

MODULE 3 regional

MODULE 3 advanced

MODULE 4

MODULE 4

MODULE 4 advanced

global

MODULE 5 regional

MODULE 5 advanced

MODULE 6 global

MODULE 6 regional

MODULE 7

MODULE 7 regional

advanced

relationships.



Step 8 Evaluate the effectiveness of NAFTA

b Use the graphs to find the value of exports between each set of countries for the year 2000. Write the information in the table below.

Student answers may vary slightly because they will be approximating the values from the chart.

DIRECTION OF EXPORT FLOW	VALUE OF EXPORTS (MILLION \$)	TOTAL VOLUME BETWEEN PARTNERS (MILLION \$)	
United States to Mexico	115,000	255 000	
Mexico to United States	140,000	233,000	
United States to Canada	180,000	410.000	
Canada to United States	230,000	410,000	
Canada to Mexico	1,000	11.000	
Mexico to Canada	10,000	11,000	

Add the export values together for each pair of countries (for example, United States to Mexico plus Mexico to United States) and write that number in the Total Volume Between Partners column.
 Refer to totals in the table above.

- d Rank the trading partners by the overall volume of trade between the two countries. Use 1 for the partners trading the most and 3 for the partners trading the least.
 United States–Mexico: 2 United States–Canada: 1 Canada–Mexico: 3
- d-1 Do you think that NAFTA had a positive (+), negative (–), or neutral (n) effect on trade volume between each set of partner countries?

United States–Mexico: + United States–Canada + Canada–Mexico +

d-2 Do you think that any one of these three countries benefited more than the other two by NAFTA? If so, which country? Explain your answer.Student answers will vary because they are asked to speculate. Trade volume has increased for all the trading

q-1 What country has a healthier trade balance with Canada—Mexico or the United States? Mexico

g-2 On what graph do you find a set of bars that looks like a mirror image of those for the U.S. trade balance with Canada?
 Canada on the Trade Balance with U.S. graph

h-1 What country had the most dramatic change for the better after NAFTA came into being? (Remember, NAFTA went into effect in 1994.) Mexico

h-2 Estimate the U.S. trade deficit with Canada and Mexico for 1999 and 2000. Express the values in billions of dollars, using round numbers that you estimate from the graphs.

	1999 (\$ BILLION)	2000 (\$ BILLION)
U.S. trade balance with Mexico	\$ –23 billion	\$ –25 billion
U.S. trade balance with Canada	\$ –30 billion	\$ –51 billion
Combined deficit (total)	\$ –53 billion	\$ –76 billion

MODULE 7

MODULE 6

regional

h-3 Did the U.S. combined trade balance get better or worse between 1999 and 2000? Worse By how much? \$23 billion

Module 7 Global perspective: Water World

Part 1: A South Pole point of view

Step 3 Look at Antarctica

- Do you think this map gives you a realistic representation of Antarctica? Explain your answer.
 Student answers will vary. They should observe that the map of Antarctica is very skewed in size, shape, and determining distance.
- e Does this projection give you a better view of the region around the South Pole? Why or why not? No. The region around the South Pole is distorted in size.
- f Do any of these projections work well for viewing Antarctica? No. None of the projections represent Antarctica in a realistic way.

Part 2: Just Add Water

Step 1 Activate the Water World data frame

f What significant differences to you see between today's country outlines and the elevation map of 20,000 years ago? List at least three.

Student answers will vary. Possible answers include: Alaska was connected to Russia, Florida was much larger, and Australia was connected to the islands of Indonesia.

Step 2 Analyze global sea levels if Antarctic ice sheets melted

a Record your general observations of each layer in the table below. Student answers will vary. Possible answers include:

SEA LEVEL	OBSERVATIONS
Today	Country outline matches up perfectly with the shorelines.
Plus 5 meters	There is no dramatic change. However, some coastal cities in the southern United States (Miami) will be under water.
Plus 50 meters	There is dramatic change. Most of Florida is under water, there is a large gap in the Amazon Basin in South America, and parts of Europe are gone.
Total Thaw (plus 73 meters)	Much of eastern Europe and western Asia are under water. Large portions of Australia, South America, and southeast United States are gone. Africa is the least affected.

MODULE 1

MODULE 2 **global**

MODULE 2 regional

MODULE 3 **global**

MODULE 3 regional

MODULE 3 advanced

MODULE 4

MODULE 4 regional

MODULE 4 advanced

MODULE 5

MODULE 5 regional

MODULE 5 advanced

MODULE 6

MODULE 6 regional

MODULE 7 global

MODULE 7 regional

advanced



Step 3 View changes in water levels

c-1 What kinds of changes do you see in the rivers and lakes? Provide a specific example.

Student answers will vary. In South America, a large lake appears in the north central area. This lake is the result of the increased water level of the Amazon River. The Parana River in Argentina and the Amazon River Basin are significantly shorter in length.

c-2 With a sea level increase of 50 meters, what kinds of consequences do you foresee for the major river ecosystems of South America? Provide a specific example.

Student answers will vary. The Amazon Basin has the possibility of flooding the rain forests of central South America.

c-3 There are several locations around the globe that are on the interior of landmasses and are below sea level. One of them is in South America. Hypothesize how these low-lying areas were formed.
 Student answers will vary. One explanation is that plate boundaries are drifting apart at that location. Another is that the land surrounding the Amazon Basin could have risen up due to tectonic activity.

Step 4 View changes in political boundaries

f, g Record your results in the table below.

REGION	COUNTRIES/AREAS AFFECTED	POSSIBLE CONSEQUENCES
Middle East	Iraq	Boundary disputes over lost land.
Asia	Cambodia	Cambodia is almost completely under water. There will be a large migration of the population moving to neighboring countries.
Europe	Netherlands	Netherlands would be completely submerged. As a result, a large migration of the population would move to neighboring countries.
Africa	Guinea-Bissau	Guinea-Bissau would be completely submerged. As a result, a large migration of the population would move to neighboring countries. There might be a climate change to the drier areas of the continent.
Oceania	Australia	There would be a loss of major cities and economic areas. These people would move inland.
North America	United States	There would be a loss of most major southern ports: Houston, New Orleans, Miami—and most of Florida. These people would move inland.
Latin America	Brazil	The loss of much of the Brazilian rain forest could have negative repercussions on the global environment.

Step 5 Look for additional data to explore

Based on your previous observations, list other possible layers of data you would like to analyze to study the impact of this phenomenon. In your final assessment, you will have the opportunity to explore many other datasets; this list will help to guide you in further explorations.

Student answers will vary. For a complete list of available data, refer to the assessment data sheet.

MODULE 7

MODULE 7

Module 7 Regional case study: In the Eye of the Storm

Part 1: The calm before the storm

Step 3 Focus on the capital cities of Central America

g Record the capital cities for each of the countries in Central America in the Populated Places column in the table on the next two pages.

The table on the following page presents the correct answers.

Step 4 Focus on Central America prior to Hurricane Mitch

b Record this data in the Populated Places and Transportation Network columns in the answer sheet on the next two pages.

Answers will vary. The table on the following page presents a sampling of possible answers.

- Malyze the precipitation for each country and record the precipitation data in the Average Precipitation column in the table on the next two pages.
 Answers will vary. The table on the following page presents a sampling of possible answers.
- p-1 Which country has the most area devoted to agriculture? El Salvador
- p-2 Which country has the most area covered by mountains? Honduras
- p-3 Which country has the most extensive transportation network? El Salvador

MODULE 1

MODULE 2 **global**

MODULE 2 regional

MODULE 3 **global**

MODULE 3 regional

MODULE 3 advanced

MODULE 4 global

MODULE 4 regional

MODULE 4 advanced

MODULE 5 global

MODULE 5 regional

MODULE 5 advanced

MODULE 6 global

MODULE 6 regional

MODULE 7 **global**

MODULE 7 regional

advanced

Central America Prior to Hurricane Mitch

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COUNTRY	POPULATED PLACES	TRANSPORTATION NETWORK	MAJOR EXPORTS	AGRICULTURAL LAND USE	AVERAGE PRECIPITATION	PHYSICAL LANDMARKS
Belize	Capital: Belmopan Distribution: Throughout the country, but concentrated around the capital	Roads: Sparse road network Railways: None Airports: 1 civilian	Bananas	Primarily forest with some irrigated land and little cropland	Primarily 1,401–2,800 mm	Maya Mountains
Guatemala	Capital: Guatemala Distribution: Concentrated near southern coast	Roads: Well devl. network, esp. along southern coast Railways: Primarily in south Airports: 1 civilian, 7 total	Coffee	About 1/2 forest mixed with irrigated land, cropland, and forested wetlands along the south coast	Mixed from less than 1,000 to 5,600 mm	Sierra De Santa Cruz Sierra De Los Cuchumatanes Sierra Madre
Honduras	Capital: Tegucigalpa Distribution: Concentrated near the capital; bare in the east	Roads: Well devl. along eastern half of country Railways: Along northern coast Airports: 12 total, 1 civilian	Coffee	1/4 forest, some cropland, some grazing land, 1/2 nonirrigated land	Mixed from less than 1,000 mm in center of country to 4,000 mm along the coast	11 mountains Montana De Botaderos Montana
El Salvador	Capital: San Salvador Distribution: Concentrated around the capital	Roads: Well developed Railways: Well devl. network Airports: 4 total	Coffee	Primarily cropland with some grazing, forested wetlands along the coast, little forest	Primarily 1,401–2,800 mm	Volcan De Santa Ana Cordillera De Celague Volcan De San Miguel
Nicaragua	Capital: Managua Distribution: Coast communities and concentration near capital; bare patches in central	Roads: Well devl. in most of country, esp. west coast Railways: Sparse; near capital Airports: 7 total	Coffee	One-third forest, some crop- land, grazing land, some forested wetland along the east coast	Mixed from less than 1,000 mm in the northwest to 5,600 mm along the east coast	3 mountains, 2 volcanoes Volcan Cosiguina Cordillera Dariense
Costa Rica	Capital: San Jose Distribution: Concentrated near Pacific coast and capital	Roads: Along west coast Railways: Through center of country and capital Airports: 13 total, 1 civilian	Garments	Little agriculture: mostly nonirrigated land, small amounts of cropland and forest	2,800–5,600 mm along most of coastline with the exception of less than 1,400 mm in the northwest	4 mountains, 2 volcanoes Volcan Barva Cerro Chirripo
Panama	Capital: Panama Distribution: Concentrated in southern coast and capital; bare in southeast region	Roads: Southwest coast, west of capital Railways: Sparse Airports: 16 total, 1 civilian	Bananas	No agricultural places identified	Primarily a range from 2,000–4,000 mm	6 mountains, 1 volcano Cerro Santiago Volcan De Chiriqui

Part 2: The storm

Step 2 Track Hurricane Mitch

- d-1 At what time was Tropical Storm Mitch at this location? 10/22/21Z
- d-2 What does the "z" mean in the time? Zulu time. (The time at 0° longtitude. It is used as a standard reference for anywhere on the globe.)
- d-3 What was Mitch's wind speed at this location? 40 mph
- f-1 What are the latitude and longitude coordinates for Hurricane Mitch at this location? 14.3 latitude, –77.7 longitude
- f-2 At what time was Hurricane Mitch at this location? 10/24/09Z
- f-3 What was Mitch's wind speed at this location? 80 mph
- h-1 At what time was Hurricane Mitch at this location? 10/27/21Z
- h-2 What was Mitch's wind speed at this location? 135 mph
- Write down the times for each event and determine the time difference. The time is written in this format: Month/Day/Hour (of 24).
 Hurricane - 5: 10/26/12Z
 Tropical_Storm: 10/24/03Z
 Time Difference: 00/02/09 (it took 2 days and 9 hours)
- r Examine the attribute table further and identify the maximum wind speed. 155 mph

Step 3 Measure the size of the storm

- g What is the diameter of the eye of Hurricane Mitch? 25 miles
- h, q Record your measurements and observations in the table below.

Note: Answers in this table are approximate values. Student values will differ depending on the precise location of each measurement taken.

	DIAMETER OF EYE	DIAMETER OF STORM	DISTANCE OF EYE TO COASTLINE OF HONDURAS	HOW HAS THE STORM CHANGED FROM THE PREVIOUS IMAGE?
Mitch2sat.tif	25 miles	830 miles	110 miles	Not applicable.
Mitch3sat.tif	13 miles	995 miles	50 miles	Storm appears more intense and enlarged. It's closer to the coastline.
Mitch4sat.tif	0 (not visible)	825 miles	0 (on shore)	The eye is not visible, clouds are much thicker, but the spiral shape is still visible.
Mitch5sat.tif	0 (not visible0	875 miles	0 (on shore)	There is still a large amount of clouds, but the spiral shape is gone.

ArcMap
MODULE 2 global

regional

MODULE 3

MODULE 3 regional

MODULE 3 advanced

MODULE 4 **alobal**

MODULE 4 regional

MODULE 4 advanced

global

MODULE 5 regional

MODULE 5 advanced

MODULE 6

MODULE 6 regional

MODULE 7 global

морице 7 regional

MODULE 7 advanced

MODULE 1	Step 4 Analyze rainfall from Hurricane Mitch
ArcMap	The greatest amount of precipitation is on the southwest arm of the storm.
MODULE 2 global	c-2 Is this a pattern you expected to find? Why or why not? Student answers will vary depending on their familiarity with hurricanes.
MODULE 2	e-1 At the Mitch4 location, what was the highest range of rainfall measured? 24–29 inches
	e-2 Which country received the majority of this heavy rain? Nicaragua
global	e-3 Describe the difference between the rainfall patterns on October 30 and October 31, 1998. The rainfall pattern on October 30 was centered heavily over the western coast of Nicaragua and southern
MODULE 3 regional	October 31, the main rain center was much larger in area, but less intense in rainfall. The outside bands appear to have merged with the main rain band from October 30.
MODULE 3 advanced	e-4 What kind of damage do you expect to find with this type of storm? What aspects of the region will be most affected? Elaborate on your answer using your table, Central America Prior to Hurricane Mitch, as a resource. Student answers will vary. They should mention the possibility of flooding, potential problems with landslides,
MODULE 4 global	damaged utility lines, and power outages due to high winds. Nicaragua, Honduras, and El Salvador were severely affected by the rainfall and wind.
MODULE 4 regional	
MODULE 4 advanced	
MODULE 5 global	
MODULE 5 regional	
MODULE 5 advanced	
модице 6 global	
MODULE 6 regional	
MODULE 7 global	
MODULE 7 regional	
морице 7 advanced	

Module 7 Advanced investigation: Data Disaster

Step 2 Add the mystery data

- b-1 What is the name of the feature class that the layer is based on? WWF_Eco
- b-2 What is the name of the geodatabase that contains the feature class? World7.mdb
- d What do you think this map is showing?
 Student answers will vary. They should observe that the data addresses the environment in some way. The legend displays the names of different biomes.

Step 3 Evaluate the attribute table and map two layers

b-1 Write each field name and the type of data it contains (numeric or text) in the table below.

FIELD NUMBER	FIELD NAME	FIELD TYPE
1	SHAPE	Text
2	ECOREGION	Text
3	MHT_NAME	Text
4	BDI	Numeric
5	THREAT	Numeric
6	FINAL	Numeric

b-2 Write a hypothesis on what you think the data represents.

Student answers will vary, but they should include some of the following information: The numeric fields appear to be some sort of scale. It's unclear which value is considered most critical—1 or 5. "0" is more than likely a "no data" value. There is a relationship between the numeric fields and the string fields. The numeric fields represent the status of the various ecoregions.

- c Which field does this layer map? MHT_NAME
- p Record the similarities and differences between these two layers.The WWF_Eco (ECOREGION) layer contains much more detail than the WWF_Eco1 (MHT_NAME) layer.

Step 4 Map the data and analyze it

- e-1 After mapping out all the data fields, what additional conclusions can you make about the data? Possible answers include:
 The numeric fields appear to be some sort of scale.
 "0" is likely to be a "no data" value.
 There is a relationship between the numeric and string fields.
- e-2 Use this new information to revise your hypothesis about what the data represents. Student answers will vary and depend on their response to the previous question.

MODULE 7 advanced f

global

regional

MODULE 7 **global**

MODULE 7 regional

MODULE 7 advanced Read the table below and use the mapped data to complete the missing pieces. The definitions in the table belong to the six fields you identified in step 3b-1. Fill in the table with the appropriate field name from the attribute table.

FIELD NAME	DEFINITION
FINAL	The final assessment of the ecoregion as the estimated threat to the ecoregion over the next 20 years.
ECOREGION	Descriptive name for the that are relatively large areas of land or water that share a large majority of their species, dynamics, and environmental conditions.
BDI	The biological distinctiveness index. It is based on the species richness, endemism, rareness, and so forth.
SHAPE	Represent global terrestrial and freshwater areas defined as ecoregions.
MHT_NAME	The major habitat for the area.
THREAT	Degree of threat to the ecoregion. Some examples include logging, conversion to agriculture/ urbanization, and so on.

g Complete the following tables by filling in the numeric values for each description. Keep in mind that the definitions may not be listed in numeric order and don't forget about zero. The first table has been filled in for you.

THREAT		
5	Relatively stable in degree of threat	
4	Relatively intact in degree of threat	
3	Vulnerable in degree of threat	
0	Not assessed or unknown	
2	Endangered in degree of threat	
1	Critical in degree of threat	

FINAL		
0	Not assessed or unknown	
1	Critical in estimated threat over the next 20 years	
2	Endangered in estimated threat over the next 20 years	
4	Relatively intact in estimated threat over the next 20 years	
3	Vulnerable in estimated threat over the next 20 years	
5	Relatively stable in estimated threat over the next 20 years	

Step 5 View metadata documentation

- j-1 How would you describe this dataset? It represents the boundaries for the continents of the world.
- j-2 Who made this data? ESRI (Environmental Systems Research Institute, Inc.)
- j-3 When was this data published? 2004
- j-4 Which section explains whether or not you can reuse the data for a project or publish a work that uses the data? The question "Are there legal restrictions on access or use of the data?" displays the use constraints of the data. It includes information on redistribution rights and the data license agreement for continents.
- k How would you describe the data in the WWF_Eco layer that you investigated? Student answers will vary and depend on their response in previous questions 3b-2 and 4e-2.

Step 6 Create metadata documentation

e–s Type information into the metadata document. Student answers will vary. You can view the actual metadata document for WWF_Eco from within the module 7 data folder (C:\MapWorld9\Mod7\Data). The file is wwf_eco.htm.

MODULE 7 advanced

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Entire Agreement: The parties agree that this constitutes the sole and entire agreement of the parties as to the matter set forth herein and supersedes any previous agreements, understandings, and arrangements between the parties relating hereto.

Installing the Exercise Data

Part 1. Be sure to follow the instructions in part 2, "How to install the exercise data,"About the exercise data installation data installationBe sure to follow the instructions in part 2, "How to install the exercise data," and do not copy the files directly from the CD to your hard drive. A direct file copy does not remove write protection from the files. In addition, a direct file copy will not enable the automatic uninstall feature.

Allow about ten minutes to install the exercise data. Actual time will vary depending on processor, hard drive, and CD drive speeds. The data uses about 340 megabytes of disk space on your computer.

Part 2. How to install the exercise data

The screen graphics in this part reflect the standard appearance of the Windows 2000 operating system. If you have a different operating system, such as Windows XP, your screen images will look slightly different. The differences do not affect the installation steps.

- **a** Put the MOWGLE 9 Exercise Data CD in your computer's CD drive.
- **b** Right-click the Start button in the Windows taskbar. On the context menu, click Explore to open Windows Explorer.

	Open
	Explore
	Search
	Open All Users Explore All Users
Start	

c In Windows Explorer, navigate to your CD drive, called ESRI (D:). (The drive letter may be different.) Click the drive icon a to display the contents of the CD.

Name 🛆	Size	Туре
🚞 MapWorld9		File Folder
🗐 data1.cab	456 KB	WinZip File
🔊 data1.hdr	31 KB	HDR File
🗐 data2.cab	187,955 KB	WinZip File
🔊 ikernel.ex_	339 KB	EX_ File
🗃 layout bin	1 KB	BIN File
💾 setup.bmp	709 KB	Bitmap Image
Setup.exe	55 KB	Application
🗟 Setup.ini	1 KB	Configuration Settings
📑 setup.inx	134 KB	INX File

d Double-click the Setup.exe file.



e Click Next.

noose Destination Location	
Select folder where Setup will install f	files.
Setup will install Mapping Our World,	ArcGIS Desktop Edition in the following folder.
To install to this folder, click Next. To another folder.) install to a different folder, click Browse and select
- Destination Falder	
Destination Folder	
Destination Folder C:\MapWorld9	Browse
Destination Folder C:\MapWorld9	Browse
Destination Folder C:\MapWold9 allShield	Browse

f Accept the default destination folder (C:\MapWorld9), unless you have a good reason to choose another folder.

If you want to choose a different folder, click the Browse button and navigate to the location you want (for example, C:\TEMP). Click OK on the Choose Folder dialog box. No matter which location you choose, a MapWorld9 folder will be created inside it and "MapWorld9" will become the final part of the path name. Be advised, however, that exercise instructions for opening map documents and adding data refer to C:\MapWorld9 as the data location.

g Click Next and let the installation process run.



h Click Finish.

If ArcGIS 9 Desktop software (either ArcView, ArcEditor, or ArcInfo) is already installed on your computer, you are ready to begin the book. If you are installing the ArcView 9 Demo Edition software that comes with this book, go to "Installing and Registering the ArcView 9 Demo Edition Software."

Part 3. How to uninstall the exercise data **a** Click the Start button on your Windows taskbar, point to Settings, and click Control Panel.



- **b** In the Control Panel, double-click Add/Remove Programs.
- c In the Add/Remove Programs window, click on Mapping Our World, ArcGIS Desktop Edition.

🙀 Mapping Our World, ArcGIS Desktop Edition	Size	<u>956KB</u>
To change this program or remove it from your computer, click Change/Remove.	Change/Re	emove

- d Click Change/Remove.
- e On the wizard panel, click the option to "Remove," as shown.

InstallShield W	izard	×
Welcome Modify, repai	ir, or remove the program.	
Welcome to This program	the Mapping Our World, ArcGIS Desktop Edition Setup Maintenance program. I lets you modify the current installation. Click one of the options below.	
O Modify		
1 ¹	Select new program components to add or select currently installed components to remove.	
C Repair	Reinstall all program components installed by the previous setup.	
Remove	Remove all installed components.	
in recentor note	<back next=""> Cancel</back>	

f Click Next. Click OK when you are prompted to confirm the uninstall. Let the uninstallation process run.



g Click Finish.

Installing and Registering the ArcView 9 Demo Edition Software

Part 1. About the software installation

The ArcView 9.0 Demo Edition software included with this book is intended for use only with *Mapping Our World: GIS Lessons for Educators*. Once installed and registered, ArcView 9 will run for 365 days. The time limit cannot be extended, nor can the software be reinstalled on the same machine once the time limit has expired.

The ArcView 9 Demo Edition software may be installed on more than one computer in accordance with the provisions contained in the "License Agreement" section (page 521) of this book.

Subsequent installations of the ArcView 9 Demo Edition software are subject to the expiration date of the first installation. For example, if you make a second installation ten days after the first, the evaluation period for the second installation will be 355 days. If you intend to install the Demo Edition software on more than one computer, plan accordingly.

If ArcGIS 9 Desktop software (either ArcView, ArcEditor, or ArcInfo) is already installed on your computer, you do not need to—and, in fact, cannot—install the Demo Edition software. Use the book with the software that is already installed.

If ArcGIS 8 Desktop software (any 8.x version of ArcView, ArcEditor, or ArcInfo) is already installed on your computer, you must uninstall it before you can install the Demo Edition software. (You can subsequently reinstall it.) The exercises require ArcGIS version 9 software.

If ArcView 3.x software is already installed on your computer, you can install the Demo Edition software. ArcView 3 and ArcGIS Desktop 9 can coexist on your computer.

If you have problems with the software installation or registration process, go to the following Web site for frequently asked questions and troubleshooting tips:

www.esri.com/mappingourworld

or request help by sending an e-mail to this address:

workbook-support@esri.com

Before you install the Demo Edition software, you should make sure that your computer system satisfies the following minimum requirements.

System requirements

Part 2.

Processor	Intel [®] Pentium [®] 800 MHz minimum
Operating system	Microsoft Windows Server 2003 Microsoft Windows XP Microsoft Windows 2000 Microsoft Windows NT—Intel 4.0 Service Pack 6a (collectively referred to as Microsoft Windows)
Internet Explorer	Microsoft Internet Explorer 6.0 (If your computer does not have Microsoft Internet Explorer 6.0 or a later version, the ArcView 9 Demo Edition setup program will notify you of the missing requirements and exit. After installing the appropriate version, you can run the setup program again.)
RAM	256 MB minimum
Disk space	Approximately 600 MB

Part 3. How to install the Demo Edition software

The screen graphics in this part reflect the standard appearance of the Windows 2000 operating system. If you have a different operating system, such as Windows XP, your screen images will look slightly different. The differences do not affect the installation steps.

- **a** Close all open applications.
- **b** Put the Demo Edition software CD in your computer's CD drive.
- c Right-click the Start button in the Windows taskbar. On the context menu, click Explore to open Windows Explorer.

	Open	
	Explore	ľ
	Search	
	Open All Users	
	Explore All Users	
Start		

d In Windows Explorer, navigate to your CD drive, called ESRI (D:). (The drive letter may be different.) Click the drive icon 🔊 to display the contents of the CD.

Name 🛆	Size	Туре
Documentation		File Folder
Support		File Folder
🛅 Tutorial		File Folder
🖲 Install.htm	1 KB	HTML Document
🚰 instmsiw.exe	1,780 KB	Application
🗒 Readme.txt	14 KB	Text Document
😼 Setup.exe	39 KB	Application
🖉 setup.hlp	50 KB	Help File
🐻 Setup.ini	1 KB	Configuration Settings
🐻 Setup.msi	27,747 KB	Windows Installer Package
💭 Setup1.cab	301,941 KB	WinZip File



e Double-click the Setup.exe file and wait for the ArcView Setup program to load.

If the program doesn't load and you are instead prompted to install **Microsoft Windows Installer**, click Yes and restart your computer when prompted. If ArcView 9 Demo Edition does not then resume installation on its own, navigate to the Setup.exe file and double-click on it again.

f Click Next. Read the license agreement. If you agree to the terms, click "I accept the license agreement," as shown. (If you do not agree to the terms, click Cancel to end the installation.)

🖟 ArcView 9.0 (Demo Edition) Setup
License Agreement
You must agree with the license agreement (E204 and E300) below to proceed.
IMPORTANT-READ CAREFULLY
UNLESS IT IS SUPERSEDED BY A SIGNED LICENSE AGREEMENT
BETWEEN YOU AND ESRI, ESRI IS WILLING TO LICENSE THE
SOFTWARE, DATA, OR DOCUMENTATION TO YOU ONLY ON THE
CONDITION THAT YOU ACCEPT ALL OF THE TERMS AND CONDITIONS 💌
EXHIBIT 1
SCOPE OF USE
(E300 3/04)
The scope of use for each ESRI Software identified below
is described in the applicable footnotes listed in
I accept the license agreement
I do not accept the license agreement
View PDF Reset < Back Next > Cancel

g Click Next.



h Make sure the installation type is set to Typical. Click Next.



i Accept the default installation folder (C:\Program Files\ArcGIS), unless you have a good reason to choose another folder.

If you want to choose a different folder, click the Browse button and navigate to the location you want. Click OK on the ArcView 9.0 (Demo Edition) Setup dialog box.

j Click Next.

侵 A	rcView Setup			
r yu	Select a folder where Python will be installed.			Cath
	Python 2.1 and Win 32all 151 extension are re Geoprocessing tools. It is recommended that setup.	equired to suppo they be installed	ort certain core I by the ArcGIS [Desktop
	The setup will install Python 2.1 and Win 32all To install into a different folder, click Browse a	151 extension nd select anoth	in the following fi er folder.	older.
	Python Folder			
	C:\Python21\		Biov	vse
	The Python 2.1 installation directory should no 32all 151 extension will need 33 MB of additio	it contain space nal disk space t	is. Python 2.1 ai o install.	nd Win
	Help	< <u>B</u> ack	<u>N</u> ext >	Cancel

k Accept the default installation folder for the Python program (C:\Python21), unless you have a good reason to choose another folder.

Python[®] is a scripting language used by some ArcGIS geoprocessing functions. If the Python application is already installed on your computer, the setup program bypasses this step.

1 Click Next.



m Click Next and let the installation process run. It takes several minutes.



n Click Finish. Uncheck the ArcGIS Tutorial Data box, as shown.



o Click OK.



You are ready to continue with part 4.

Part 4. About the software registration

ArcView 9 Demo Edition software cannot be used until it has been registered.

If you are installing the software on more than one computer, each installed copy must be registered separately.

The recommended way to register the software is over the Internet. This is the simplest and fastest way. The instructions for Internet registration are given below in part 5, "How to register ArcView 9 Demo Edition software over the Internet."

The software can also be registered in other ways, as listed in part 7, "Other ways to register the software."

The 365-day software evaluation period begins when your registration is processed by ESRI, not when you first use the software. If you do not intend to use the software soon, you should exit the registration process and return to it later. For instructions on resuming the registration process at a later date, see part 8, "How to resume the registration process."

- **a** Make sure you are connected to the Internet.
- **b** Click Register Now.



Part 5. How to register ArcView 9 Demo Edition software over the Internet **c** Make sure the following option is selected: "I have installed ArcView and need to register the software." Click Next.

월 ArcView Registration Wizard	×
Registration Method	
Select the method you want to use to register the software.	
Register now using the Internet (Recommended)	
This automatic method is the easiest way to register. Requires an Internet connection.	
${\rm C}$ Register at ESRI's website and receive your authorization file via email.	
C Register by email and receive your authorization file via email.	
C Fax or mail your registration to ESRI.	
< <u>B</u> ack <u>N</u> ext> <u>Cancel</u>	

d Make sure the following option is selected: "Register now using the Internet." Click Next.

뎱 ArcView Registration ¥	Vizard X
Registration Inf	ormation
Please supply the follow our records and authoriz notify you of important up	ing information about yourself. We will use this information to verify e your use of the software. We may also use this information to dates about the software. (* = required field)
* First Name:	
* Last Name:	
* Organization:	
Department:	
* Address 1:	
Address 2:	
* City:	
* State/Province:	
* Zip/Postal Code:	
* Country:	United States (Continued on next panel)
	< Back Next > Cancel

e Fill out the first part of the registration form with your information. Only English-language characters are accepted. Click Next.

🗿 ArcView Registration Wiz	🖟 ArcView Registration Wizard 📃 🗶					
Registration Information (continued)						
			(* = require	d field)		
* Phone Number:						
FAX Number:						
* Email:	Unkno	wn				
* Your Organization:	<pleas< td=""><td>e choose a categ</td><td>jory></td><td>•</td></pleas<>	e choose a categ	jory>	•		
* Your Industry:	<pleas< td=""><td>e choose a categ</td><td>gory></td><td>•</td></pleas<>	e choose a categ	gory>	•		
* Yourself:	<pleas< td=""><td>e choose a categ</td><td>pory></td><td>•</td></pleas<>	e choose a categ	pory>	•		
The personal information you supplied is protected under ESRI's privacy policy. If you want to review ESRI's privacy policy, click the View button below.						
		< <u>B</u> ack	<u>N</u> ext >	Cancel		

f Finish the registration form. Click Next.

rc¥iew Registration Wizard			
ArcView Registration N	Number		
Enter the ArcView registration numb ArcView box.	er located on the	e registration card ir	n the
The registration number consists of ABC123456789	3 letters and a se	eries of numbers sin	nilar to:
Registration Number:		-	
	/ Rack	Masts	Cancel

g Enter the registration code printed on the software CD jacket on the inside back cover of your copy of *Mapping Our World*. It will be a text string such as *EVA123456789*. Click Next.



h Make sure the following option is selected: "I do not want to evaluate any extensions at this time." Click Next.

Auto	Registration Wizard]
State	is of your connection: Connecting to https://service Sending registration informati Receiving authorization file Authorizing software	e.esri.com on		
Succe ArcV Congra	sstully registered and authorize	d: en authorize	d and is now ready for	r usel
	[< <u>B</u> ack	Einish	Cancel

i The software is registered and ready to use. Click Finish.

If the registration fails, make a note of the problem and use the help resources listed at the end of part 1, "About the software installation." You may also want to try a different registration method (see part 7, "Other ways to register the software").

j Continue with part 6, "How to test the installation."

Part 6. How to test the installation

ArcView 9 contains the ArcMap and ArcCatalog applications. To confirm that the installation was successful, you should test both applications.

a Click the Start button, point to Programs, point to ArcGIS, and click ArcMap.



- **b** Click OK to start using ArcMap with a new, empty map.
- c~ Click the Close button (marked with a small X) in the upper-right corner of the ArcMap window.

d Click the Start button, point to Programs, point to ArcGIS, and click ArcCatalog.

📣 ArcCatalog - ArcView				_ 🗆 ×
Eile Edit <u>V</u> iew <u>G</u> o <u>T</u> ools <u>W</u> indow	Help			
1 😂 🗃 🖻 🖻 🗙 🕒	# 🖩 # 😣 Q 🗞 I	🗆 🙌 🛛 🍳 🌒 🌒 🗖	0 😤	
Location: Catalog		_		
Stylesheet: FGDCESRI	• • • • • • •			
x	Contents Preview Metadata			
E Catalog	Name	Туре	Size	
	(a) (a)	Folder Connection		
🕀 🗑 Database Connections	() D:\	Folder Connection		
🕀 🥨 Address Locators	Search Results	Search Results Folder		
GIS Servers	Colboxes			
Hard Toolboxes	Database Connections	Database Connections Folder		
	GIS Servers	GIS Servers Folder		
-	<u>p</u>			

e Click the Close button (marked with a small X) in the upper-right corner of the ArcCatalog window.

If either application does not open as expected, contact workbook-support@esri.com.

f Your ArcView 9 Demo Edition software installation and registration are complete. You do not need to read the remaining instructions until you are ready to uninstall the software.

Part 7. Other ways to register the software

The ArcView 9 Demo Edition software can be registered in four ways:

- Over the Internet (described in part 5, above)
- By e-mail
- At the ESRI Web site
- By fax or regular mail

Instructions for each of these methods are found in the file software_reg.pdf, located on the ArcView 9 Demo Edition CD (and also at *www.esri.com/mappingourworld*). To read this file, you need Adobe Reader[®] 6.0 or higher software. Adobe Reader can be downloaded free of charge from www.adobe.com.

- a Make sure the Demo Edition software CD is in your computer's CD drive.
- **b** In Windows Explorer, navigate to your CD drive: ESRI (D:). Click the drive icon to display the contents of the CD.
- **c** Double-click the file software_reg.pdf to open it. Print the document.
- **d** Follow the instructions in the software_reg.pdf document for the registration method you want to use. (After Internet registration, the option to register by e-mail is the most common method.)
Part 8. How to resume the registration process

Follow the instructions below if you have installed the ArcView 9 Demo Edition software but exited the registration process before completing it.

- **a** Click the Start button in the Windows taskbar. Point to Programs, point to ArcGIS, and click Desktop Administrator.
- **b** In the left-hand panel of the Desktop Administrator, click the "Register Single Use and Extensions" folder.

🖟 ArcGIS Desktop Administrator					
ArcGIS Desktop (YOURCOMPUTER) Register Single Use and Extensions Availability	ArcView/ArcEditor (Single Use) and its extensions must be registered prior to use. To register, click: 'Register Now' below to start the registration wizard. Register Now				
Help	OK Cancel Apply				

- c In the right-hand panel, click Register Now.
- **d** Go to part 5, "How to register ArcView 9 Demo Edition software over the Internet," or to part 7, "Other ways to register the software."

Part 9. How to uninstall the ArcView 9 Demo Edition software

It is recommended that you uninstall the software when the 365-day time limit expires. You must uninstall it before you can install a standard licensed version of ArcGIS 9 Desktop software.

a Click the Start button on your Windows taskbar, point to Settings, and click Control Panel.



- **b** In the Control Panel, double-click Add/Remove Programs.
- c In the Add/Remove Programs window, click on ArcView 9.0 (Demo Edition).

🙀 ArcView 9.0 (Demo Edition)	Size	<u>645MB</u>
Click here for support information.	Used	<u>rarely</u>
To change this program or remove it from your computer, click Change or Remove.	Change	Remove

- **d** Click Remove. Click Yes at the prompt to confirm the uninstall. Let the uninstallation process run.
- e Uninstall the "Python 2.1" and "Python 2.1 combined Win32 extensions" programs in the same way.
- **f** When the software has been removed from your computer, click the Close button (marked with a small X) in the upper-right corner of the Add/Remove Programs window.

GIS Terms QUICK REFERENCE

ArcGIS	Computer software for implementing a geographic information system (GIS).
ArcView	Desktop GIS software that includes ArcMap for displaying and inter- acting with maps and layouts, and ArcCatalog for previewing data and metadata.
attribute	A piece of information that describes a geographic feature on a GIS map. The attributes of an earthquake might include the date it occurred, its latitude and longitude, depth, and magnitude.
attribute table	A table that contains all of the attributes for like features on a GIS map, arranged so that each row represents one feature and each column represents one feature attribute. In a GIS, attribute values in an attribute table can be used to find, query, and symbolize features. The attribute table for the Top 10 Cities, 1950 layer includes attributes for each of the ten cities listed.

l	III Attributes of Top 10 Cities, 1950								
I		OBJECTID*	Shape*	CITY NAME	COUNTRY NAME	HISTORIC NAME	RANK_1950	POP_1950	
I		1	Point	Moscow	Russia	Mocow	6	5,100,000	
I		2	Point	London	United Kingdom	London	2	8,860,000	
I		3	Point	Paris	France	Paris	4	5,900,000	
I		4	Point	Chicago	United States	Chicago	8	4,906,000	
I		5	Point	New York	United States	New York	1	12,463,000	
I		6	Point	Tokyo	Japan	Edo	3	7,000,000	
I		7	Point	Shanghai	China	Shanghai	5	5,406,000	
I		8	Point	Calcutta	India	Calcutta	10	4,800,000	
I		9	Point	Buenos Aires	Argentina	Buenos Aires	7	5,000,000	
I		10	Point	Essen	Germany	Ruhr	9	4,900,000	

- **axis** The vertical (y-axis) or horizontal (x-axis) lines in a graph on which measurements can be illustrated and coordinated with each other. Each axis in a GIS graph can be made visible or invisible and labeled.
- **bookmark** In ArcMap, a shortcut you can create to save a particular geographic extent on a map so you can return to it later. Also known as a spatial bookmark.

color selector The window that allows you to change the color of geographic features and text on your GIS map.



- **comma-delimited** values file (.csv) A data table in text form where the values are separated by commas. This is a popular format for transferring data from one program to another, for example between spreadsheet programs and ArcMap. These programs use the commas to determine where a new piece of data stops and starts.
- **coordinate system** A system of intersecting lines that is used to locate features on surfaces such as the earth's surface or a map. In ArcMap, each feature class (layer) of data has a coordinate system that tells ArcMap where on the map to draw the features. A feature class may also have a map projection. (*See also* feature class; map projection.)
 - **data** Any collection of related facts, from raw numbers and measurements to analyzed and organized sets of information.
 - **data folder** A folder on the hard drive of your computer or your network's computer that is available for storage of GIS data and map documents that you create.

Add Data		
Look in:	🛄 Data	
Timages LayerF EastAs World2	s iiles sia.mdb 2.mdb	

- **data frame** A map element that defines a geographic extent, a page extent, a coordinate system, and other display properties for one or more layers in ArcMap. In data view, only one data frame is displayed at a time; in layout view, all a map's data frames are displayed at the same time.
- **data frame, active** In ArcMap, the active data frame is the target for many tools and commands. In data view, the active data frame is bold in the table of contents and visible in the display area. In layout view, the active data frame has a dashed line around it to show it is the active one.



This map document, shown in layout view, has two data frames: South Asia and The World. South Asia is the active data frame.

data source

e The data referenced by a layer or a layer file in ArcMap or ArcCatalog. Examples of data sources are a geodatabase feature class, a shapefile, and an image.





data view

A view in ArcMap for exploring, displaying, and querying geographic data. This view hides all map elements, such as titles, north arrows, and scale bars. *Compare* layout view.



decimal degrees Degrees of latitude and longitude expressed in decimals instead of in degrees, minutes, and seconds. Decimal degrees converts the degrees, minutes, and seconds into a decimal number using the mathematical formula below. In a GIS, decimal degrees is more efficient than degrees, minutes, and seconds because they make digital storage of coordinates easier and computations faster.

decimal degrees = degrees + (minutes/60) + (seconds/3,600)

73° 59′ 15″ longitude is equal to 73.9875 decimal degrees.

feature A geographic object on a map represented by a point, a line, or a polygon.

- A point feature is a point on a map that represents a geographic object too small to show as a line or polygon. A point feature might represent a tree, or a phone line, or even a city viewed from a satellite.
- A line feature is a line on a map that represents a geographic object too narrow to show as a polygon at a particular scale. A line feature might represent a river on a world map or a street on a city map. In ArcGIS, another name for a line feature is a polyline feature.

feature (continued) • A polygon feature is an area on a map that represents a geographic object too large to show as a point or a line. A polygon feature might represent a lake, or a city viewed from an airplane, or a whole continent viewed from a satellite.



- feature class A collection of geographic features with the same geometry type (point, line, or polygon), the same attributes, and the same spatial reference (coordinate system and map projection).
 - **field** The column in a table that contains the values (information) for a single attribute of each geographic feature in a GIS layer.

ObjectID*	Shape*	City Name	Country Name	Population
1	Point	Guatemala	Guatemala	1,400,000
2	Point	Tegucigalpa	Honduras	551,606
3	Point	San Salvador	El Salvador	920,000
4	Point	Managua	Nicaragua	682,000
5	Point	San Jose	Costa Rica	670,000
6	Point	Belmopan	Belize	4,500
7	Point	Panama	Panama	625,000

In this table, the City Name field contains the name for each city in this layer. The Population field contains the population value for each city.

- **field name** The column heading in an attribute table. Because field names are often abbreviated, ArcGIS allows you to create a an alternative name, or alias, that can be more descriptive. In the graphic above, City Name and Country Name are aliases for fields named "NAME" and "COUNTRY."
- **Find button** An ArcMap button used for locating one or more map features that have a particular attribute value.
- **folder connection** A shortcut that allows you to navigate to a folder without having to enter the entire path.
 - **geodatabase** A database used to organize and store geographic data in ArcGIS.
 - **georeference** To assign coordinates from a reference system, such as latitude/ longitude, to the page coordinates of an image or map.
- **graduated color map** A map that uses a range of colors to show a sequence of numeric values. For example, on a population density map the more people per square kilometer the darker the color.

GIS Terms Quick Reference



graph A graphic representation of tabular data.

Identify tool

An ArcMap tool used to display the attributes of features in the map.

- **image** A graphic representation of data such as a photograph, scanned picture, or a satellite photograph.
 - **join** An operation that appends the fields of one table to those of another through an attribute field common to both tables. A join is usually used to attach more attributes to the attribute table of a map layer so that these attributes can be mapped. For example, you could join a country table with population data to a country layer attribute table. *Compare* relate.
- **label** Text placed next to a geographic feature on a map to describe or identify it. Feature labels usually come from an attribute field in the attribute table.
- **layer** A layer is a set of geographic features of the same type along with its associated attribute table, or an image. Example layers are "Major Cities," "Countries," and "Satellite Image." A layer references a specific data source such as a geodatabase feature class or image. Layers have properties, such as a layer name, symbology, and label placement. They can be stored in map documents (.mxd) or saved individually as layer files (.lyr). *See also* data source.



A layer has many properties, including Symbology properties. Some of the properties for the NAFTA Countries layer are pictured here.

- **layer, turn on** Turning on a layer allows the layer to display in the map. In ArcMap, a layer is turned on by placing a check mark in the box next to the layer name in the table of contents.
 - NAFTA Countries
 Canada
 Mexico
 United States
 - **layer file** In ArcGIS, a file with a .lyr extension that stores the path to a data source and other layer properties, including symbology.
 - layout In ArcMap, an on-screen presentation document that can include maps, graphs, tables, text, and images.
 - **layout view** A view in ArcMap in which geographic data and map elements, such as titles, legends, and scale bars are placed and arranged for printing.



- **legend** A list of symbols on a map that contains a sample of each symbol as well as text that identifies what the symbol represents.
 - line *See* feature.
- **Magnifier window** A window in ArcMap data view that shows a zoomed-in view of a small area of the main map. Moving the Magnifier window around does not change the extent of the map underneath.



map document In ArcMap, the file that contains one or more date frames and the associated layers, tables, graphs, and reports. Map document files have a .mxd extension.

map projection	on A method by which the curved surface of the earth is portrayed on a flat map. Every map projection distorts distance, area, shape, direct or some combination thereof. Map projections are made using comp mathematical formulas that are part of ArcGIS software's automat functions.		
МарТір	In ArcMap, a pop-up label for a map feature that displays when the mouse is paused over that feature. The label comes from a field in the layer attribute table.		
Measure tool	An ArcMap tool used to measure distance on a map.		
metadata	Information about the content, quality, condition, and other character- istics of data. Metadata may include a brief description of the data and its purpose, the names of the authors or compilers of the data, the date it was collected or created, the meaning of attribute fields, its scale and its spatial reference (coordinate system and map projection).		
pan	To move your map up, down, or sideways without changing the viewing scale.		

- **point** *See* feature.
- polygon See feature.
- polyline See feature.
- **projection** See map projection.

record A row in an attribute table that contains all of the attributes values for a single feature.

OBJECTID*	Shape*	City Name	Country Name	Population
1	Point	Guatemala	Guatemala	1,400,000
2	Point	Tegucigalpa	Honduras	551,606
3	Point	San Salvador	El Salvador	920,000
4	Point	Managua	Nicaragua	682,000
5	Point	San Jose	Costa Rica	670,000
6	Point	Belmopan	Belize	4,500
7	Point	Panama	Panama	625,000

This table has seven records. The fourth record is highlighted. It contains the all of the attributes for the point feature representing the city of Managua, Nicaragua.

relate An operation that establishes a temporary connection between records in two tables using a field common to both. Unlike a join operation, a relate does not append the fields of one table to the other. A relate is usually used to associate more records and their attributes to the attribute table of a map layer. For example, you could relate a table listing large cities to a layer attribute table of countries. For example, you could join a world cities table to a country layer attribute table. *Compare* join.

PHOTOUOPY

scale The relationship between a distance or area on a map and the corresponding distance or area on the ground, commonly expressed as a fraction or ratio. A map scale of 1/100,000 or 1:100,000 means that one unit of measure (e.g., one inch) equals 100,000 of the same unit on the earth.



The map on the left has a map scale of 1:80,000,000. The map on the right, which is zoomed in, has a map scale of 1:6,000,000.

selected feature A geographic feature that is chosen and put into a subset so that various functions can be performed on the feature. In ArcMap, a feature can be selected in a number of ways, such as by clicking it on the map with the Select Features tool or based on one or more of its attributes. When a geographic feature is selected it is outlined in blue on the map. Its corresponding record in the attribute table is highlighted in blue.



The Indo-Australian plate is selected in this map of the earth's tectonic plates.

- **shapefile (.shp)** A data storage format for storing the location, shape, and attribute information of geographic features. A shapefile is stored in a set of related files and contains one feature class.
 - source data See data source.
- **sort ascending** To arrange an attribute table's rows in order from the lowest values to the highest values in a field. For example, number values would be ordered from 1 to 100, and alphabetical values would be ordered from A to Z.
- **sort descending** To arrange an attribute table's rows in order from the highest to the lowest values in a field For example, number values would be ordered from 100 to 1, and alphabetical values would be ordered from Z to A.

Symbol Selector

or The dialog in ArcMap for selecting symbols and changing their color, size, outline, or other properties.



table of contents

A list of data frames and layers on a map that may also show how the data is symbolized.



toolbar A set of commands that allow you to carry out related tasks. The Main Menu toolbar in ArcMap has a set of menu commands; other toolbars typically have buttons. Toolbars can float on the desktop in their own window or may be docked at the top, bottom, or sides of the main window.





zoom To display a larger or smaller extent of a GIS map or image.



ArcMap Zoom and Pan Tools

As you work with a map, you might want to zoom and pan around the data to investigate different areas and features. The tools for navigating your map are found on the Tools toolbar.



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Use the Zoom In tool to get a closer look at the data. Click the Zoom In tool, then click a spot on the map or drag a box around an area to zoom in on it. When the map redraws, the point or area you selected will appear in the center of your display.

Use the Zoom Out tool to see a larger area of the data. Click the Zoom Out tool, then click a spot on the map or drag a box around an area to zoom out on it. When the map redraws, the point or area you selected will appear in the center of your display.

Use the Fixed Zoom In button to zoom in a fixed amount from the center of the map. Click the Fixed Zoom In button one or more times depending on how much you want to zoom in.

Use the Fixed Zoom Out button to zoom out a fixed amount from the center of the map. Click the Fixed Zoom Out button one or more times depending on how much you want to zoom out.

Use the Go Back To Previous Extent button to return to a previous view of the data. Click the Go Back To Previous Extent button one or more times to return to previous displays, all the way back to the display when you first opened the map.

Use the Pan tool to reposition the map. Click the Pan tool and hold your cursor over the map display (it turns into a hand). Click a spot on the map, hold down the mouse button, and drag it to a new location. For example, you might want to click on a spot along the edge of the map and drag it to the center.



Use the Full Extent button to view the entire map. Click the Full Extent button once to zoom your map to the extent of all the layers.

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