POPULATION FUTURE

INTRODUCTION

The global population reached 7.8 billion in 2021 and continues to grow by more than 80 million people each year. Even though the overall growth rate has slowed in recent decades, **demographers** expect population to grow through this century. Current projections for 2100 range from a low of 9.4 billion to a high of 12.7 billion. This trajectory of growth will be determined largely by fertility trends in different parts of the globe, so demographers closely track the factors that may impact family size decisions. There are, of course, limits to population growth, such as the resources needed to meet human needs. Only a sustainable balance of people and resources will enable a decent quality of life for humanity in the coming decades.

MATERIALS

For each group:
• Markers (green, red, brown, yellow, blue, and purple)
• Student Worksheets 1 – 4

PART 1: POPULATION 2100 PROCEDURE

1. Display the UN Population Projections graph. Explain the following:

    *"Demographers are social scientists who analyze populations. They can make projections about how a population will grow based on a variety of factors that center around trends in **fertility** (births) and **mortality** (deaths). Every two years, the demographers at the United Nations release projections for world population. They do this by examining trends in each country and projecting how these trends might play out*

CONCEPT
Demographers project global population growth through the 21st century by considering trends in fertility and mortality for different world regions.

OBJECTIVES
Students will be able to:

• Interpret a population projections graph.

• Describe factors that affect fertility and mortality trends.

• Create bar graphs to represent the population sizes of different world regions over time.

• Draw correlations among different pieces of demographic data to help explain population trends in different world regions.

• Define demographic terms including fertility rate, infant mortality rate and life expectancy.

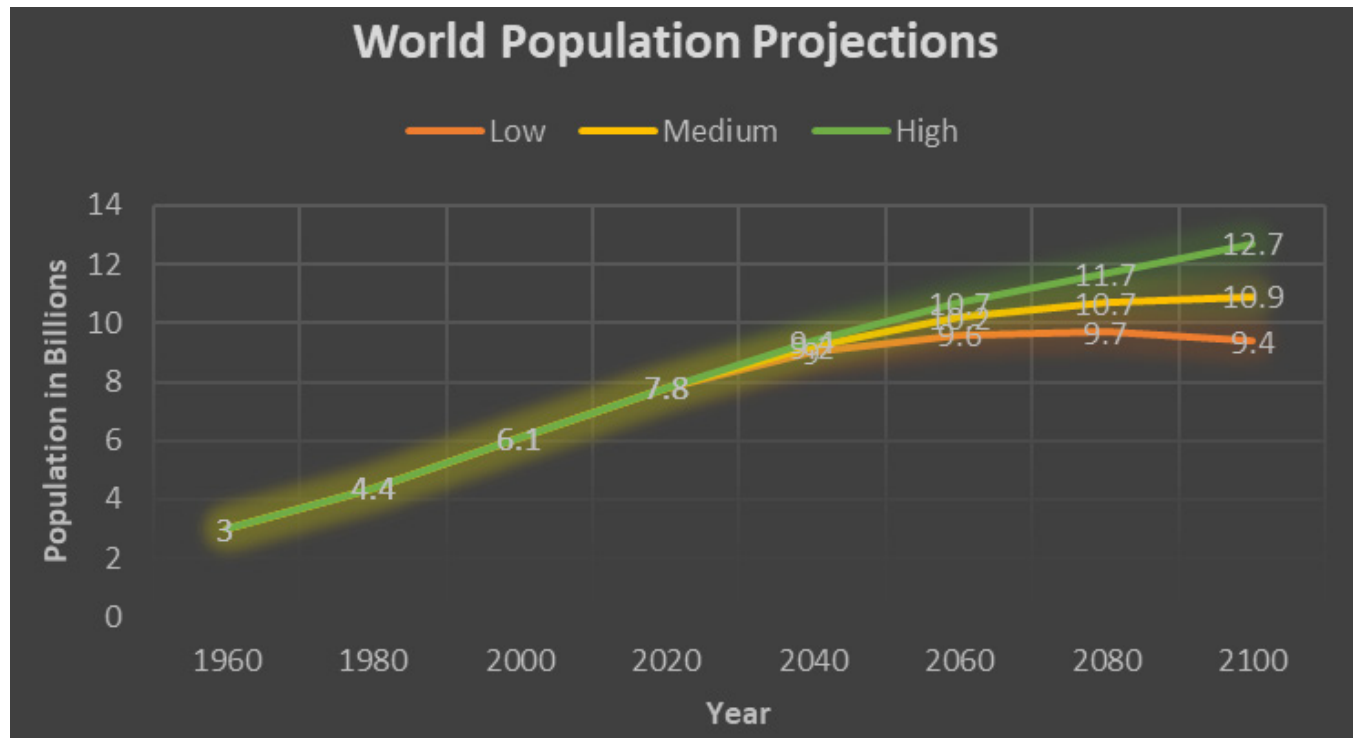## SUBJECTS
Social Studies (history, geography), math

SKILLS
Graphing and analyzing data, interpreting bar graphs, drawing correlations among data, identifying trends and patterns

METHOD
Students interpret a graph showing global population projections through 2100, then create gridded bar graphs to represent the relative size of different regions' populations for different years (past and future).

in the coming decades. Because there are so many different scenarios for trends in births and deaths, the UN demographers actually release several projections – low, medium and high – to represent these different scenarios. The range from the low to the high projections actually represents a "95 percent confidence interval," meaning that demographers are 95 percent sure that the population will reach somewhere between 9.4 billion and 12.7 billion by 2100. The medium projection (10.9 billion) is their best estimate at this time."

World Population Projections

Legend: —Low —Medium —High

Y-axis: Population in Billions (0, 2, 4, 6, 8, 10, 12, 14)
X-axis: Year (1960, 1980, 2000, 2020, 2040, 2060, 2080, 2100)

Data labels: 3, 4.4, 6.1, 7.8, 9.2, 10.2/9.6, 11.7/10.7/9.7, 12.7/10.9/9.4

2. Help students understand what they are seeing by asking the following questions:

   a. What is the difference between the low estimate and the high estimate for 2100?
   Answer: 3.3 billion

   b. Do all three scenarios show sustained world population growth through 2100?
   Answer: No. The low estimate shows world population decreasing between 2080 and 2100.

   c. Projections are based on possible trends in fertility and mortality. What conditions/situations can affect or influence fertility and mortality trends?
   Fertility: *People choosing to have more or fewer children. This could be influenced by economic conditions (such as availability of jobs and the costs of raising children), educational and employment opportunities for women (in societies where women have more options, they tend to have smaller families), availability of reproductive healthcare (including birth control), and child survivability.*
   Mortality: *Life expectancy can be affected by the quality of healthcare, breakthroughs in combatting diseases, lifestyles (healthy or unhealthy), pandemics (widespread contagious diseases), economic conditions, wars, and crime.*

PART 2: WHERE ARE WE GROWING?

As the projections graph shows, demographers expect world population to grow by about 3 billion people between now and the end of the century. However, this growth is not expected to be equally distributed around the globe.

PROCEDURE

1. Divide students into groups of four and distribute one of each Student Worksheet to every group. These provide regional population sizes in 1980 and 2021, as well as projections for 2050 and 2100. Each group member will complete one of the four Worksheets.

2. Provide each group with six different colors of marker as noted on the Worksheets.

    Note: It's best if within groups, students use the same colors for the same regions for comparison as suggested on the Worksheet.

3. Students will be creating bar graphs using the data and grids on the Worksheets. They will first need to fill in the table at the top of the Worksheet to find how many grid squares will be needed in each bar. They can decide the width and height of each bar. For example, a population of 750 million would require 30 grid squares (because each square = 25 million people). The student can create the bar as 3 squares across by 10 squares high or 5 squares across and 6 squares high, etc. Some bars will be uneven based on the number represented.

4. When all of the bar graphs are completed, have students lay all four in front of their small group to compare and discuss what they see using the questions on their Student Worksheets as a guide.

5. Go over the following questions as a whole class, referring to both the numerical data on the four Worksheets and the gridded bar graphs they created from that data.

    a. Which regions grew the most between 1980 and 2021?
       Answer: Asia grew the most in raw numbers (2 billion); Africa grew by the largest percentage – more than doubling.

    b. Which region is expected to grow by the most between 2021 and 2100?
       Answer: Africa, which is expected to quadruple in population size.

    c. Are any regions' populations expected to shrink by 2100?
       Answer: Europe, by about 16 percent (118 million).

    d. How are these demographic changes expected to alter each region's representation in the world population?
       Answer: Africa will grow in representation (from 17 to 39 percent of world population). Asia will remain the largest region, population-wise. Europe, Latin America, and Northern America will represent smaller percentages of world population.

6. Ask students why they think demographers are expecting such large shifts in global population among these world regions. Then project the following data table and give the class time to read through the chart and ask if they have any questions about the data or definitions. With the data table still projected, transition to the Discussion Questions.

	World	Africa	Asia	Europe	Latin America	Northern America	Oceania
Fertility Rate (Number of children per woman)	2.3	4.3	1.9	1.5	2.0	1.6	2.3
Infant mortality rate (Deaths per 1,000 children under age 1)	31	47	26	4	15	5	16
% of population under age 15	26	40	24	16	24	18	23
% of population age 65+	10	4	9	19	9	17	12
Life expectancy at birth	73	64	74	78	76	78	79

Answers to Student Worksheets
See Answer Key

DISCUSSION QUESTIONS

1. Looking at the data column for Africa (green), do any of these statistics begin to explain why demographers expect Africa's population to grow by so much through this century? Why or why not?

   Yes. The fertility rate in Africa is much higher than for any other world region. Also a much larger percentage of the population is very young, so those children will be having children in the coming years. On the other hand, Africa has a higher infant mortality rate and lower life expectancy than other world regions. Still, it is the fertility trends that are driving world population growth in this region.

2. Looking at the data column for Europe (brown), do any of these statistics begin to explain why demographers expect Europe's population to shrink?

   Yes. The fertility rate in Europe is low and there is a larger percentage of older people (65+) and smaller percentage of younger people than for other world regions.

3. The data on the table above represents averages for each world region. Africa, for example, is a continent of 57 countries. Would you expect each of those countries to have the same demographics?

   No. The averages are made of numbers much higher and lower. For example the fertility rate of African countries ranges from 2.3 in Tunisia to 7.0 in Niger.[1]

4. How would you describe the relationship between infant mortality rate and life expectancy?

   A higher infant mortality rate means that fewer babies survive. This reduces the overall life expectancy.

5. Do you think there may be a connection between a high infant mortality rate and a high fertility rate? If so, what might that be?

   Parents may choose to have more children if they fear some may not survive.

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6. Think back to the earlier discussion on conditions/situations that can affect fertility trends. To better understand the reasons for the trends you see on the graphs and in the data table, what information would be useful to know about the world regions, especially related to economics, culture, history, geography, and the environment?

    Answers may include: cultural traditions and attitudes about family size, children's role in the economy, education, gender roles, average age of marriage, impacts of colonialism, access to reproductive healthcare.

7. What challenges might some African countries face with such rapid population growth?

    Answers may include: providing residents with enough social resources like schools, hospitals, roads, clean water, and waste disposal. Also, having sufficient jobs and fertile land for growing crops, as well as housing.

8. What challenges might European countries face with a smaller population?

    Answers may include: labor shortages, need for more elderly care, fewer people paying taxes.

9. What are some reasons it might be desirable for the global population to level off at the lower end of the projection range (9.4 billion)? Do you think this is possible? Why or why not?
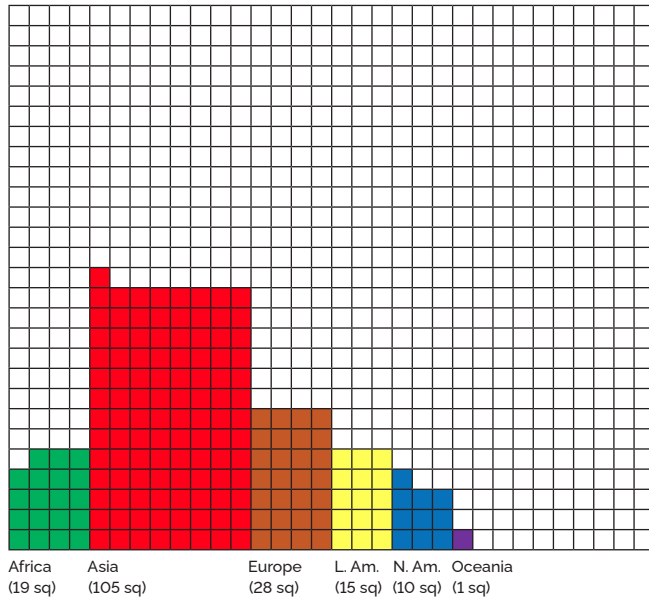
ASSESSMENT

Review students' completed graphs. Students complete an exit ticket naming three variables or trends that demographers would consider when making population projections for the global population.

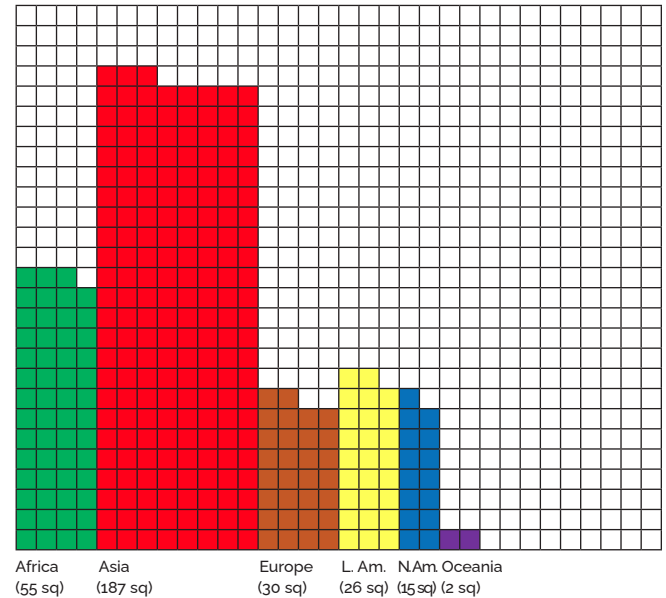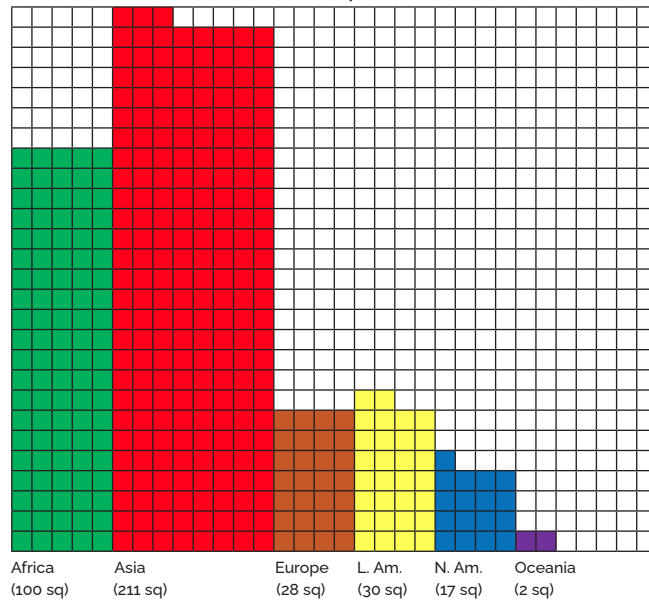[1] Population Reference Bureau. (2021). *2021 World Population Data Sheet*. [Wall chart]. Retrieved October 10, 2021 from https://interactives.prb.org/2021-wpds/

POPULATION FUTURE

ANSWER KEY - PAGE 1

Student Worksheet 1: 1980 Population

Africa (19 sq) Asia (105 sq) Europe (28 sq) L. Am. (15 sq) N. Am. (10 sq) Oceania (1 sq)

Student Worksheet 2: 2021 Population

Africa (55 sq) Asia (187 sq) Europe (30 sq) L. Am. (26 sq) N.Am. (15 sq) Oceania (2 sq)

Student Worksheet 3: 2050 Population

Africa (100 sq) Asia (211 sq) Europe (28 sq) L. Am. (30 sq) N. Am. (17 sq) Oceania (2 sq)

Student Worksheet 4: 2100 Population

Africa (171 sq) Asia (189 sq) Europe (25 sq) L. Am. (27 sq) N. Am. (20 sq) Oceania (3 sq)
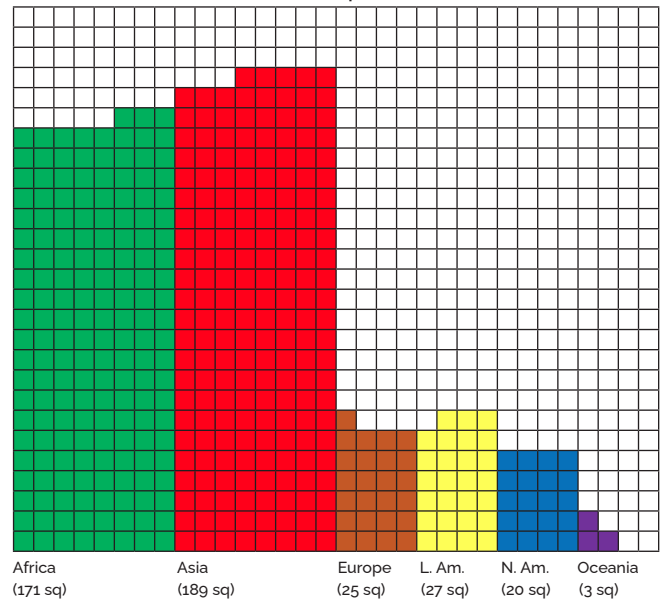
Region	# Grid Squares 1980	% World Population 1980	# Grid Squares 2021	% World Population 2021	# Grid Squares 2050	% World Population 2050	# Grid Squares 2100	% World Population 2100
Africa	19	11	55	17	100	26	171	39
Asia	105	59	187	59	211	54	189	43
Europe	28	16	30	10	28	7	25	6
Latin Am.	15	8	26	8	30	8	27	6
Northern Am.	10	6	15	5	17	4	20	5
Oceania	1	<1	2	1	2	1	3	1
TOTAL	178		315		388		435	

POPULATION FUTURE
ANSWER KEY - PAGE 2

1. Looking at the four graphs, what trends do you observe?

    Students will probably recognize that from 1980 to 2021, every region experienced population growth. From 2021 until 2050, every region except Europe is expected to see population growth. From 2050 to 2100, Africa is expected to be the only region experiencing significant population growth, while Asia, Latin America, and Europe are projected to have a decrease in their populations.

2. You've seen the data displayed two ways – as numbers on a table and as a gridded bar graph. Is either format more effective in helping you understand the changes over time or among regions? Explain your answer.

    Answers will vary. It is likely that many students will find the data displayed on the gridded bar graph as more effective in grasping the population differences among regions and changes over time. There is evidence that data visualization (through graphs, maps, etc.) makes it easier for the human mind to comprehend data and identify trends and patterns within data sets.

3. Which regions grew the most between 1980 and 2021?

    Asia grew the most in raw numbers (by nearly 2 billion). Africa grew by the largest percentage (287%) – nearly tripling.

4. Which region is expected to grow the most between 2021 and 2100? What might be some social, economic, or environmental impacts of this change?

    Africa, which is expected to triple in population size. Meeting the needs of this much larger population will require a rapid expansion in education and health care systems, infrastructure systems (utilities, waste treatment, etc.), and economic development. Such rapid population growth can have negative impacts on the environment, including air and water pollution and shrinking wildlife habitat.

5. Which regions' populations are expected to shrink between 2021 and 2100? What might be some social, economic, or environmental impacts of this change?

    Europe's population is expected to gradually shrink by about 16 percent between 2021 and 2100 (748 million to 630 million). Populations in Latin America and Asia are expected to continue to grow through at least 2050 before starting to shrink back to slightly more than the 2021 populations by 2100. Europe is already concerned about a shrinking labor force and a graying population that will need more eldercare services. The environmental impacts of a smaller "footprint" could be positive, enabling more land conservation, as demand for housing, cropland and other resources decreases.

6. How are these demographic changes expected to alter each region's representation in the world population? (Think about a region's percentage of the total global population.)

    Africa is expected to represent 39 percent of the world's population in 2100 (up from 17 percent in 2021). Northern America is expected to remain at 5 percent of the world population. Asia is expected to maintain the largest population of all world regions but would drop from 59 to 43 percent of the total world population.
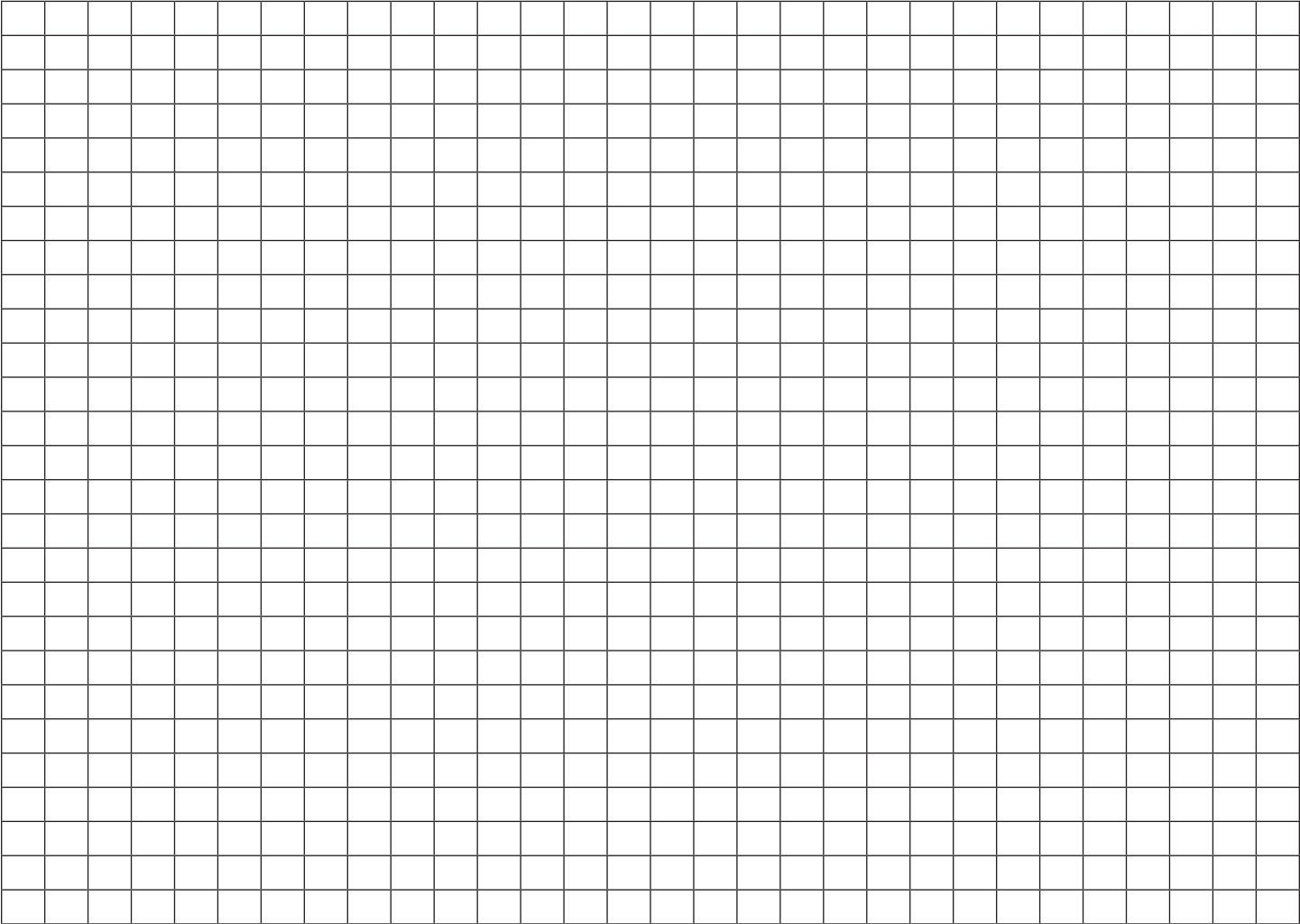
POPULATION FUTURE
STUDENT WORKSHEET 1 - PAGE 1

Name: _____   Date: _____

Construct a bar graph of the world's population by regional grouping.

WORLD POPULATION - 1980

Region	Population (in millions)	# of Grid Squares	% of World Population
Africa	478		
Asia	2,625		
Europe	694		
Latin America and the Caribbean	365		
Northern America	254		
Oceania	23		
TOTAL			

1. Use the scale: 1 grid square = 25 million people. Calculate the number of grid squares needed for each region.

2. Plot the grid squares on the graph below. Use a different color to identify each region. (Colors: Africa – Green; Asia – Red; Europe – Brown; Latin America – Yellow; Northern America – Blue; Oceania – Purple)

POPULATION FUTURE

STUDENT WORKSHEET 1 - PAGE 2

When all group members have completed their graphs, lay them all out on a table and compare. Then answer the following questions as a group.

1. What are the trends you observe? Which regions have gotten larger? Smaller? What does this tell us about global population growth that has already happened and that is projected to occur?

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2. You've seen the data displayed two ways – as numbers on a table and as a gridded bar graph. Is either format more effective in helping you understand the changes over time or among regions? Explain your answer.

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3. Which regions grew the most between 1980 and 2021?

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4. Which region is expected to grow by the most between 2021 and 2100? What might be some social, economic, or environmental impacts of this change?

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5. Which regions' populations are expected to shrink between 2021 and 2100? What might be some social, economic, or environmental impacts of this change?

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6. How are these demographic changes expected to alter each region's representation in the world population? (Think about a region's percentage of the total global population.)

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POPULATION FUTURE
STUDENT WORKSHEET 2 - PAGE 1

Name: _____ Date: _____

Construct a bar graph of the world's population by regional grouping.

WORLD POPULATION - 2021

Region	Population (in millions)	# of Grid Squares	% of World Population
Africa	1,373		
Asia	4,680		
Europe	748		
Latin America and the Caribbean	660		
Northern America	371		
Oceania	43		
TOTAL			

1. Use the scale: 1 grid square = 25 million people. Calculate the number of grid squares needed for each region.

2. Plot the grid squares on the graph below. Use a different color to identify each region. (Colors: Africa – Green; Asia – Red; Europe – Brown; Latin America – Yellow; Northern America – Blue; Oceania – Purple)

POPULATION FUTURE
STUDENT WORKSHEET 2 - PAGE 2

When all group members have completed their graphs, lay them all out on a table and compare.

1. What are the trends you observe? Which regions have gotten larger? Smaller? What does this tell us about global population growth that has already happened and that is projected to occur?

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POPULATION FUTURE
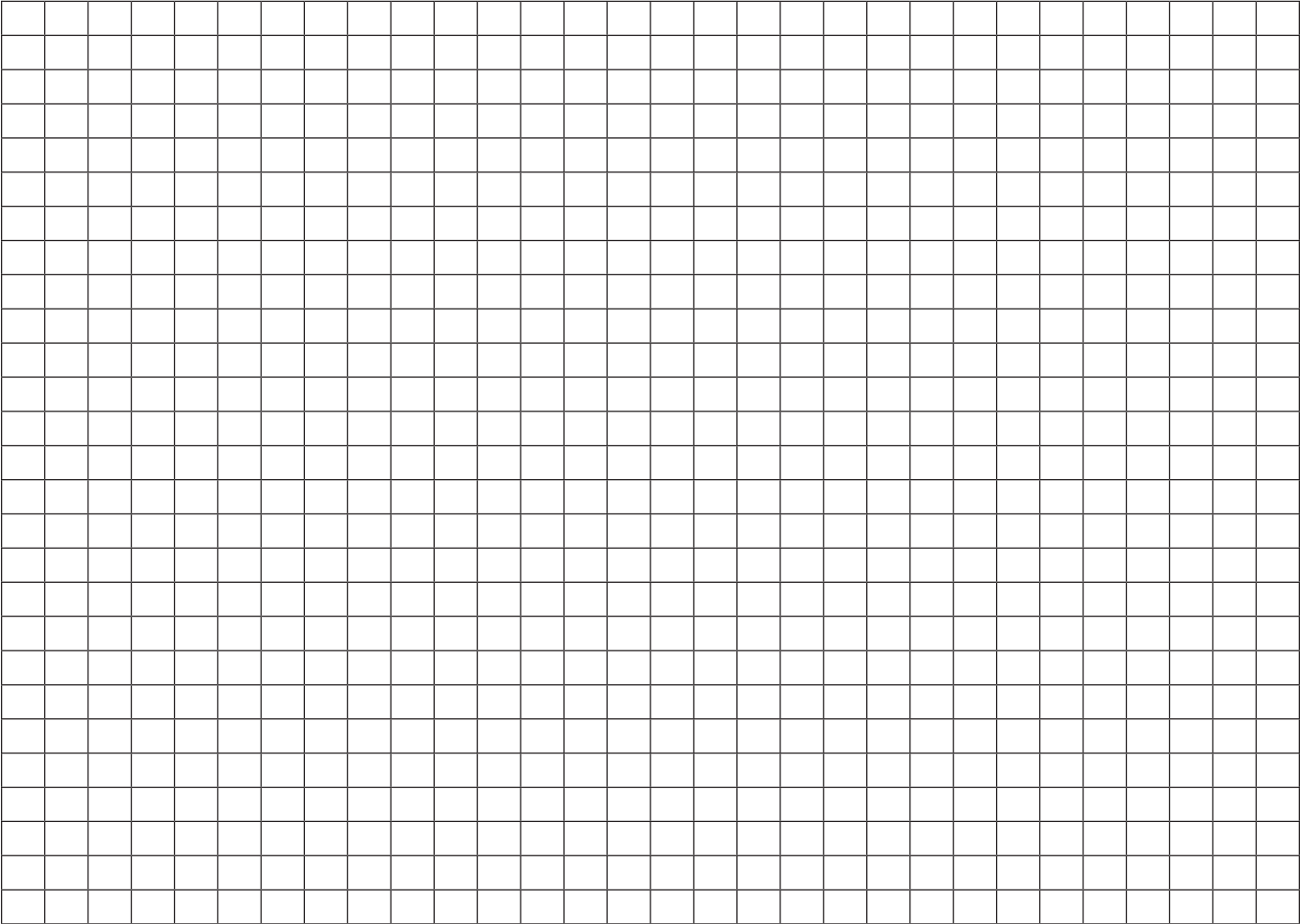## STUDENT WORKSHEET 3 - PAGE 1

Name: _____   Date: _____

Construct a bar graph of the world's population by regional grouping.

WORLD POPULATION - 2050 Projection

Region	Population (in millions)	# of Grid Squares	% of World Population
Africa	2,489		
Asia	5,290		
Europe	710		
Latin America and the Caribbean	762		
Northern America	425		
Oceania	57		
TOTAL			

1. Use the scale: 1 grid square = 25 million people. Calculate the number of grid squares needed for each region.

2. Plot the grid squares on the graph below. Use a different color to identify each region. (Colors: Africa – Green; Asia – Red; Europe – Brown; Latin America – Yellow; Northern America – Blue; Oceania – Purple)

POPULATION FUTURE
STUDENT WORKSHEET 3 - PAGE 2

When all group members have completed their graphs, lay them all out on a table and compare.

1. What are the trends you observe? Which regions have gotten larger? Smaller? What does this tell us about global population growth that has already happened and that is projected to occur?

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2. You've seen the data displayed two ways – as numbers on a table and as a gridded bar graph. Is either format more effective in helping you understand the changes over time or among regions? Explain your answer.

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3. Which regions grew the most between 1980 and 2021?

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4. Which region is expected to grow by the most between 2021 and 2100? What might be some social, economic, or environmental impacts of this change?

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POPULATION FUTURE
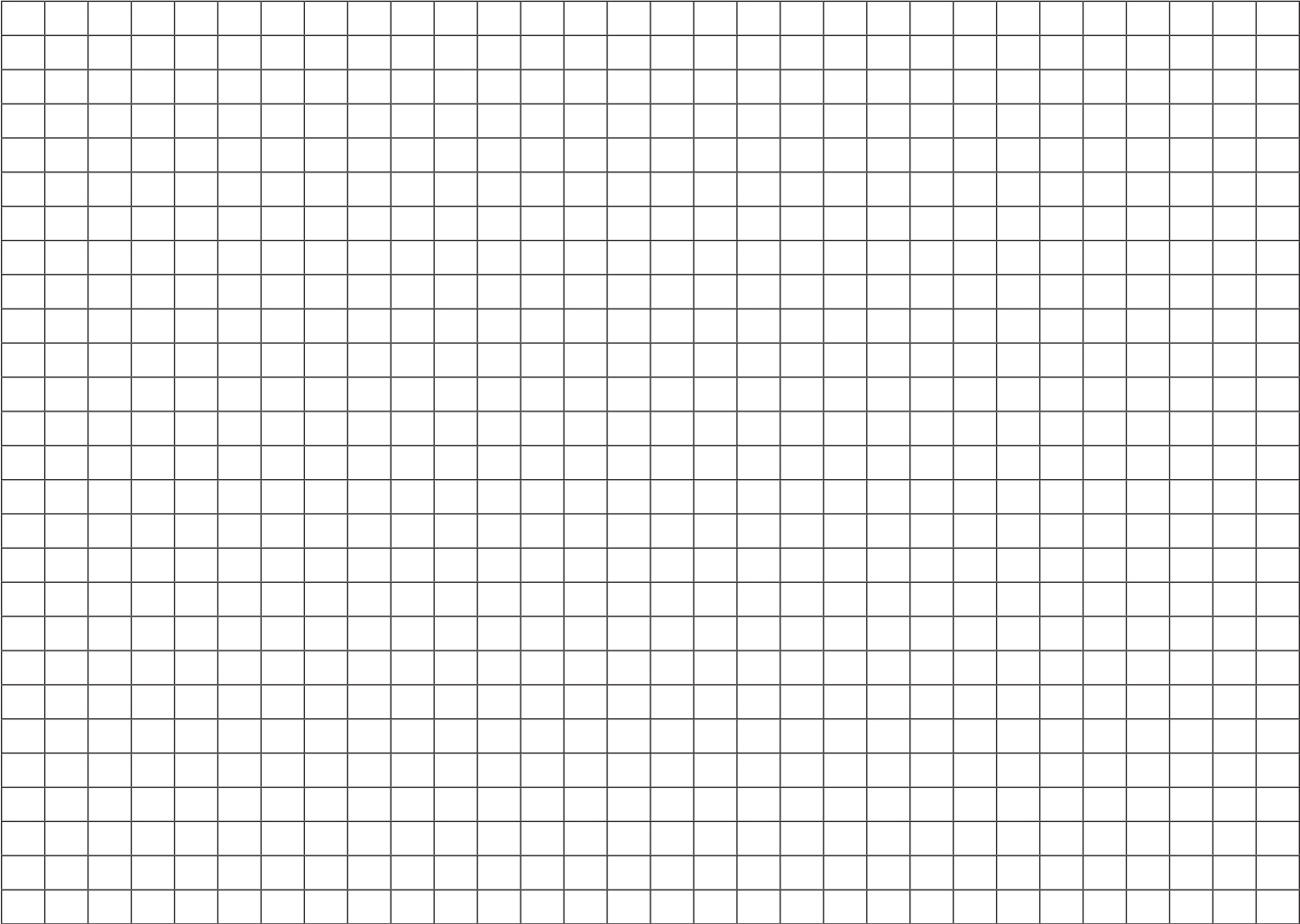## STUDENT WORKSHEET 4 - PAGE 1

Name: _____   Date: _____

Construct a bar graph of the world's population by regional grouping.

WORLD POPULATION - 2100 Projection

Region	Population (in millions)	# of Grid Squares	% of World Population
Africa	4,280		
Asia	4,720		
Europe	630		
Latin America and the Caribbean	680		
Northern America	491		
Oceania	75		
TOTAL			

1. Use the scale: 1 grid square = 25 million people. Calculate the number of grid squares needed for each region.

2. Plot the grid squares on the graph below. Use a different color to identify each region. (Colors: Africa – Green; Asia – Red; Europe – Brown; Latin America – Yellow; Northern America – Blue; Oceania – Purple)

POPULATION FUTURE
STUDENT WORKSHEET 4 - PAGE 2

When all group members have completed their graphs, lay them all out on a table and compare.

1. What are the trends you observe? Which regions have gotten larger? Smaller? What does this tell us about global population growth that has already happened and that is projected to occur?

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