

# POWER OF THE PYRAMIDS

## introduction

Many of the vast differences we see in societies across the globe can be related to the composition of their respective populations. This is true on the local, state, and national level. So when exploring variations among countries, a good place to start is with their **population pyramids** – graphs that display the age and sex (assigned at birth) distribution of the country’s population.

To help make population projections for different countries, **demographers** look at the profile of the countries’ residents. What are the ages of the people? How many are male? How many are female? Taking this information, they construct population pyramids that depict the configuration of a country’s population as impacted by over 80 years of economic, political, and natural events.

**Vocabulary:** cohort, demographers, population pyramids, zero population growth

## materials

### Part 1

- None

### Part 2

- Student Worksheet (provided)
- Power of the Pyramids Graph Paper (provided)
- Colored pencils
- Calculators (optional)

## Part 1: What is a Population Pyramid?

### procedure

1. Display the world population pyramid and explain that this is a type of graph used by demographers to study the distribution of people across sex and age categories.

**Note:** Demographers often study population by dividing people into sex and age cohorts. Sex typically refers to sex assigned at birth. In this lesson, we’ll use “male” to mean “assigned male at birth” and “female” to mean “assigned female at birth.”



Studies For Our Global Future

### concept

The age and sex distribution of a population affects its growth rate and provides information on its past, present, and future growth patterns.

### objectives

Students will be able to:

- Describe the three general shapes of population pyramids and their meanings.
- Construct a population pyramid for one of six different countries.
- Make correlations between the shape of a country’s pyramid and its growth pattern.
- Analyze countries’ population pyramids to make inferences about past events, current trends, and future growth.

### subjects

AP Human Geography, Geography, Environmental Science (General and AP), Mathematics

### skills

Calculating percentages, graphing and analyzing data, interpreting bar graphs, comparing and evaluating, writing

### method

Students use real-world data to construct and interpret population pyramids and discuss differences in population growth rates among several different countries.

2. Explain to the students that the graph represents the entire world population, sorted by age and sex. The youngest people are at the bottom and the oldest at the top; males are on the left and females are on the right. Each age level/sex grouping is called a **cohort**. A cohort represents the *percentage* of people within that sex and age range within the population. So on the world population pyramid, we can see that 4.5 percent of the global population is made up of males aged 0-4.

3. Ask the students the following comprehension questions and allow them time to ask their own questions.

a. What is the largest age cohort and how can you tell?

*Answer: 0-4 year old males; that bar extends furthest from the center axis.*

b. What cohort makes up 4 percent of the global population?

*Answer: 15-19 year old males.*

c. What percentage of the world's population is the same age as you?

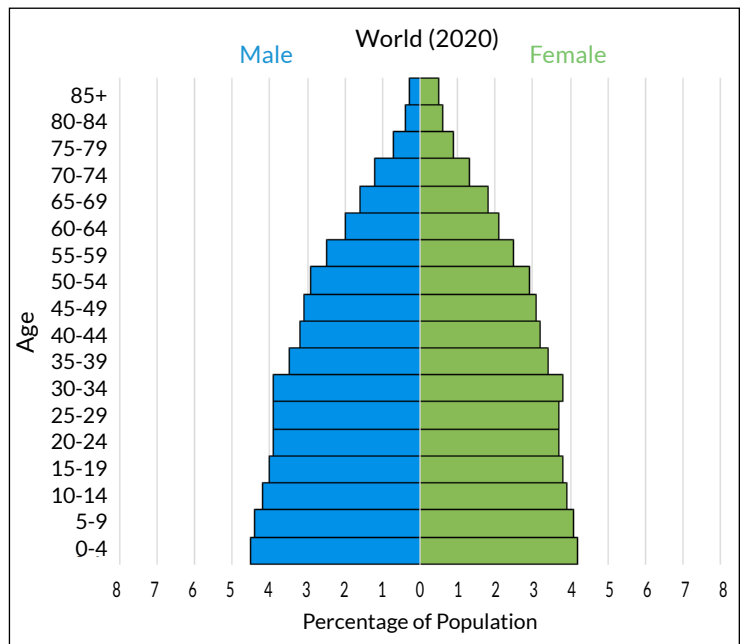
*Answers will vary.*

d. Are there currently more old people or young people living on the planet? How can you tell?

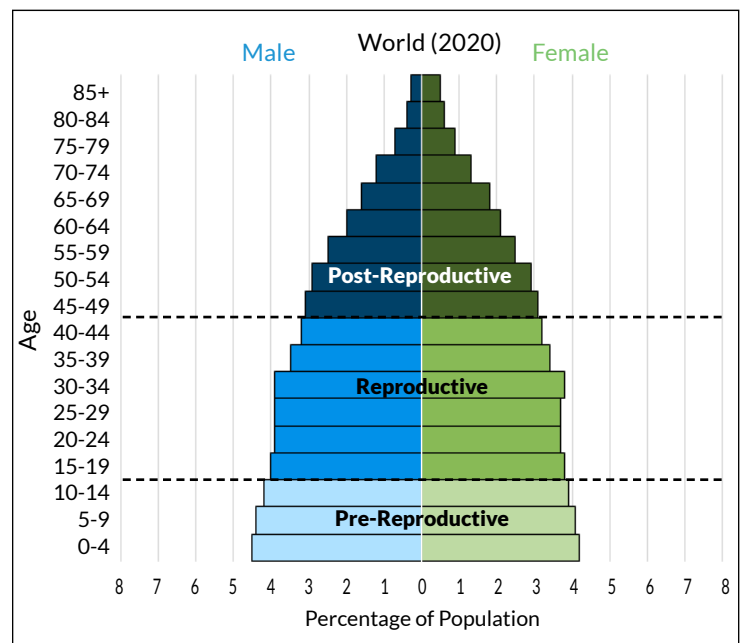
*Answer: More young people. The cohorts for young ages extend out further than the cohort bars for elderly people.*

4. Discuss the shape of the world population pyramid and ask students if they think the graph represents a population that is growing or shrinking and their reasoning.

5. Now display the world population pyramid showing the age intervals grouped into reproductive categories.



Source: United States Census Bureau, International Database



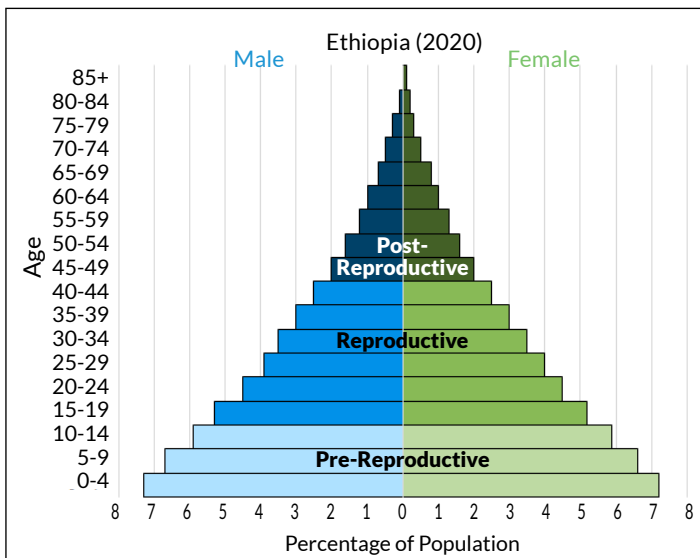
Source: United States Census Bureau, International Database

Explain that the percentage of a population that falls within each reproductive category provides clues to the population's future growth. As such, the shape of a population pyramid reveals a lot about how a population is growing.

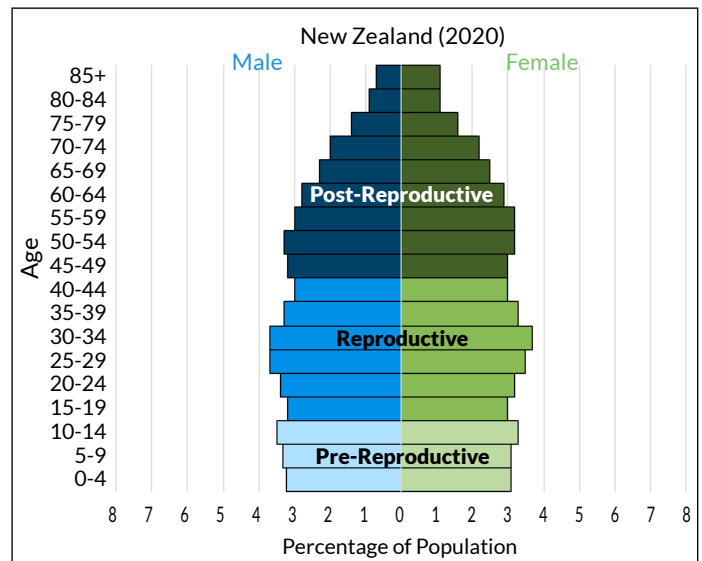
6. Display the three sample population pyramids below.

- **Graph 1: Expanding – Ethiopia.** The triangular shape reflects a growing population. A significant percentage of people are in the pre-reproductive age groups. As those children age and enter their reproductive years and are able to have children of their own, the population will almost surely grow.
- **Graph 2: Stable – New Zealand.** The rectangular shape shows a stable population. There is a fairly even distribution of people across each age group. Generations are replacing each other so the population will not grow or shrink.
- **Graph 3: Diminishing – Japan.** The cup shape shows a shrinking population. The largest percentage of people are in their post-reproductive years and no longer having children. As fewer and fewer people reach reproductive age, the size of the population will decrease.

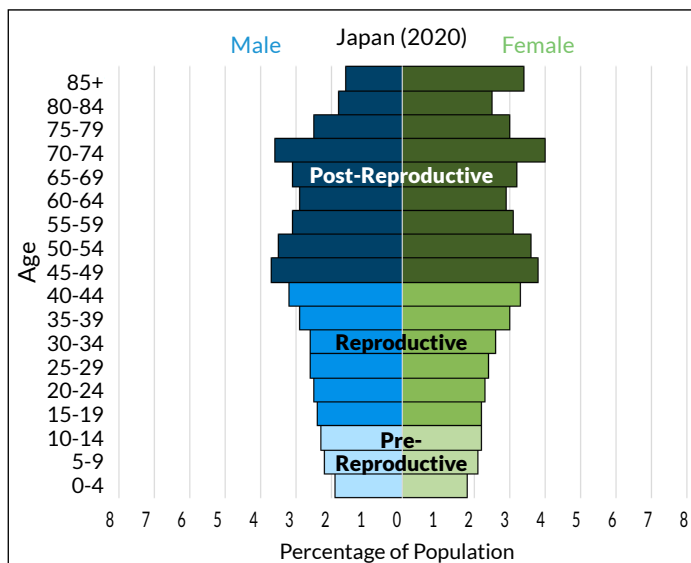
Graph 1



Graph 2



Graph 3



Source: United States Census Bureau, International Database

## Part 2: Exploring Pyramids from Across the Globe

### procedure

1. Distribute the Student Worksheet and the Pyramid Graph Paper to each student and assign them one of the six countries. If you'd prefer, students can work in pairs.
2. The figures on the Worksheet are the population of each age group within each sex for each particular country. In order to construct the country's pyramid, students must first calculate the percentage of the population of each sex in each age group.

Example: According to the Worksheet, the total population of the United States in 2020 was 332,639,102. The population of U.S. males aged 0-4 was 10,445,659.

$$\frac{10,445,659}{332,639,102} = .031 \text{ or } 3.1\%$$

Students should complete these calculations for each cohort.

3. Model how to construct a population pyramid. You may want to project a blank sheet of Pyramid Graph Paper with a data sheet on the board using a document camera or Smartboard.
4. Students construct a population pyramid for their assigned country by graphing the percentage data onto the Pyramid Graph Paper.
5. Choose one completed pyramid from each country to display for the class.

### Answers to Student Worksheet

See Answer Key for the Population Pyramids and Student Worksheet

### discussion questions

1. Can you tell from the data if there are more male or female babies in each country?

*Yes, there are more male babies. There is a slightly greater probability of giving birth to male children. For every 100 females born, there are about 105 males born. For most countries, this 5 percent difference is reflected in the numbers on the data sheet. There are two countries in this set (India and China) where the sex difference is more pronounced. In India, there are nearly 11 percent more males than females ages 0-4 and in China there are 11.5 percent more males than females in that age group. This is due to sex selection based on a cultural preference for sons.*

2. Can you tell from the graphs which country has the most people?

*No. The graphs represent 100 percent of the population of each country broken down by age groups.*

Percentages are used, rather than the raw data, so that each pyramid fits on the same size grid and can be compared to other population pyramids.

3. Are there more elderly females or males? Why might that be the case?

*There are more elderly females. Throughout the world, life expectancy for females is higher than for males. This is due to a number of genetic and social factors. In general, males are more predisposed to certain health risks than females, and female bodies tend to have stronger immune systems. In general, males tend to engage in riskier behaviors and are also more likely to serve in the military and be injured or killed in conflict.*

4. Imagine you are a business owner in the United States and you want to base your business plan on population data. What would you sell and why? How would your plan change if your business was in Nigeria? In Germany?

*United States – Answers should include any products for people between 25-34 or 55-64 because they make up the largest percentages of people. Nigeria – Answers should include any products for children and infants. Germany – Answers should include any products for older people.*

5. Which of the six countries is growing the fastest? How do you know? Can you think of any other information we can infer from the pyramid shape?

*Nigeria is growing the fastest. It has the widest base, and the largest percentage of the population in pre-reproductive and reproductive years. Population growth occurs when the segment of the population currently in its childbearing years (ages 15-44; bars 4-9 on the graphs) has produced a generation larger than itself (bars 1-3). The triangular pyramid shape also indicates that a relatively small proportion of the population is elderly – the bars at the top of the graph are very small – and could mean that life expectancy is low.*

6. Looking at the pyramids, which countries appear to have the slowest rates of population growth? How can you tell?

*Germany has the slowest population growth with over half of the country's population in their post-reproductive years. The pyramid is inverted with a wide top and thin base showing that 53 percent of the population is over the age of 45 (bars 10-18 on the graphs). The United States is also growing slowly. The graph is closer to a rectangle than a pyramid, showing more uniform population size across the age groups and therefore a more stable population.*

7. **Zero population growth (ZPG)** occurs when a country's birth rate and death rate are roughly equal. Which country would you suspect is closest to zero population growth?

*Though the graphs do not display birth and death rates, we can reason by their shapes that Germany and the U.S. are closest to reaching ZPG. Their pyramids are roughly rectangular. This means that the number of babies being born is roughly equal to the number of adults in the reproductive years.*

8. What factors would change the shape of the pyramids in the future?

*A decrease in the birth rate. The people in their childbearing years would be having fewer children, and therefore, be producing a generation more similar in size to itself. This would change the shape of the graph over time from a pyramid to more of a rectangle, indicating a more stable population. Additionally, as life expectancy increases and the proportion of older people increases, the top bars will expand.*

9. There are two noticeable “bumps” on the U.S. population pyramid. What do these larger cohorts correspond to?

*The “bump” closer to the top of the pyramid reflects the baby boom generation – children born following World War II. (The baby boom generation includes those born between 1946 and 1964.) The “bump” lower down the pyramid is an echo boom – the children of baby boomers.*

10. China’s population pyramid is the most varied of the six. Can you think of any historic events from the past 85 years that helped shape the Chinese pyramid?

*In the early 1950s, females in China were having an average of six children. Then the Great Leap Forward (1958-1962), a national campaign that moved many agricultural workers into industries, created widespread famine and an estimated 20-40 million people died of starvation. The years of the Great Leap Forward are the only time in modern Chinese history that more people died than were born, as both fewer babies were born and the death rate rapidly increased. These years, included in the 55-64 age cohorts on the graph, are disproportionately smaller compared to other generations. Older cohorts were once larger than those born during the famine. As the Chinese population has aged, more members of the older cohorts have died of other causes, and the older cohorts have correspondingly shrunk.*

*The Chinese population continued to grow in the 1960s and 1970s and in 1980, the one-child policy was put in place. The birth rate dropped as many people were allowed only one child, and this is reflected in the cohorts for ages 40-44. The one-child policy remained until 2016. The larger percentages for the 25-34 year old cohorts are an “echo boom,” the children of those in the 45-54 age cohorts.*

11. Which of the three general pyramid shapes would you use to describe India’s population pyramid? What does this mean for India’s future growth?

*The top portion of India’s pyramid is triangular while the bottom portion is rectangular. This shows that in years past, India was growing significantly with each younger cohort larger than its predecessor. In more recent years, India’s growth has slowed and we see that the bottom four cohorts are more evenly balanced.*

*It is important to note that India’s population is still increasing and will do so until the birth rate (currently 20) and death rate (currently 6) are equal.*

12. Compare and contrast the population pyramids of Nigeria and Guatemala. How are they similar/different and what does this mean for each countries’ future growth?

*The pyramids for both Nigeria and Guatemala are generally a triangle shape – the base of each is much wider than its top, and every younger cohort is larger than its predecessor. So we know that both countries are growing.*

*However, we can see in the pyramid for Guatemala that younger cohorts are showing less variation. For instance, compare the male 0-4 cohort with the male 15-19 cohort within each pyramid. There is a small difference between these two cohorts on the Guatemala pyramid of only 0.4 percent (5.9 vs. 5.5), while on the Nigerian pyramid the difference is 1.5 percent (7.9 vs. 6.4). Less variation between the younger cohorts shows the pyramid of Guatemala is starting to become more rectangular and, as such, the population will most likely grow at a slower rate.*

## assessment

Provide students with a population pyramid from the Census Bureau’s International Data Base ([www.census.gov/data-tools/demo/idb/](http://www.census.gov/data-tools/demo/idb/)). To find a pyramid, select a country on the left sidebar, and scroll down to the pyramid graph under “Patterns and Trends.” Students write a paragraph or two analyzing the pyramid. They should describe the pyramid’s shape, explain what that shape means, and hypothesize what sort of growth patterns the country might expect in the future.

# POWER OF THE PYRAMIDS | student worksheet

Name: \_\_\_\_\_ Date: \_\_\_\_\_

UNITED STATES (2020)					CHINA (2020)					NIGERIA (2020)				
AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %
0-4	10,445,659		9,992,880		0-4	43,933,770		38,898,766		0-4	16,813,967		16,053,449	
5-9	10,325,131		9,875,278		5-9	43,303,522		37,227,422		5-9	15,044,440		14,423,094	
10-14	10,603,765		10,166,213		10-14	42,059,047		35,656,239		10-14	13,713,331		13,198,226	
15-19	10,732,423		10,305,932		15-19	40,312,118		34,191,682		15-19	12,130,595		11,720,651	
20-24	11,198,945		10,700,531		20-24	45,817,723		39,684,466		20-24	9,892,065		9,638,102	
25-29	12,029,149		11,482,838		25-29	53,218,977		48,128,777		25-29	7,850,577		7,734,216	
30-34	11,649,087		11,330,329		30-34	64,173,087		62,018,343		30-34	6,751,995		6,718,188	
35-39	10,990,413		10,931,596		35-39	50,883,009		48,596,175		35-39	5,944,240		5,948,352	
40-44	10,168,231		10,261,555		40-44	47,096,321		45,387,943		40-44	5,013,838		5,014,734	
45-49	9,947,289		10,157,342		45-49	58,099,063		56,128,753		45-49	4,044,321		4,037,313	
50-54	10,109,501		10,400,905		50-54	60,319,274		58,451,566		50-54	3,203,942		3,233,671	
55-59	10,598,811		11,172,941		55-59	48,010,856		47,409,493		55-59	2,475,859		2,552,575	
60-64	10,091,925		10,918,867		60-64	36,816,789		36,148,014		60-64	1,851,988		1,961,689	
65-69	8,491,889		9,538,282		65-69	34,411,322		35,544,771		65-69	1,374,968		1,501,109	
70-74	6,836,985		7,922,281		70-74	22,080,119		23,360,749		70-74	979,963		1,085,776	
75-79	4,502,437		5,550,601		75-79	13,084,854		14,835,509		75-79	593,642		672,316	
80-84	2,764,750		3,743,461		80-84	7,738,618		9,800,033		80-84	274,821		331,556	
85+	2,418,086		4,282,794		85+	4,271,577		6,917,230		85+	105,689		143,044	
Total	332,639,102				Total	1,394,015,977				Total	214,028,302			



# POWER OF THE PYRAMIDS | student worksheet page 2

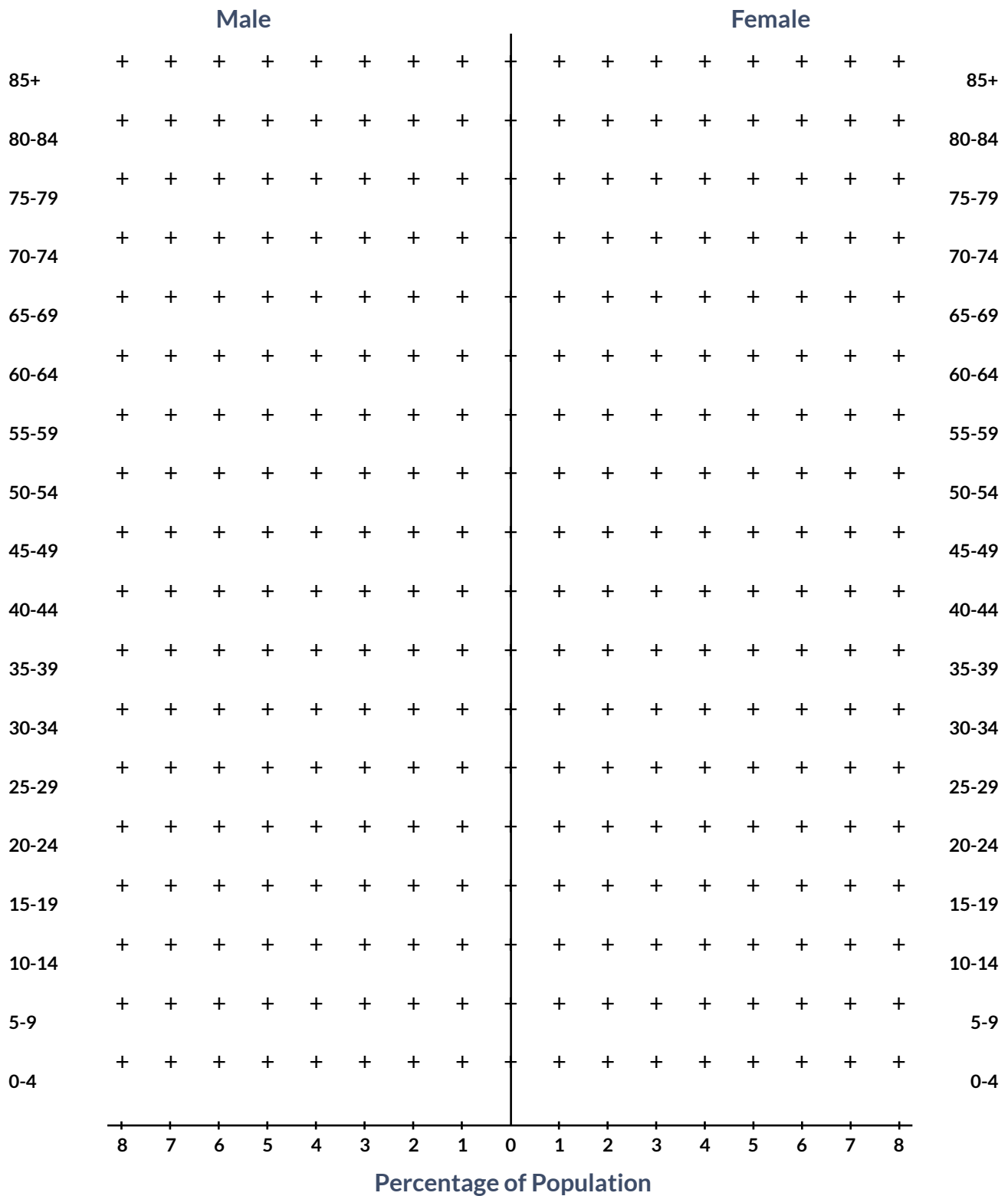
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GUATEMALA (2020)					GERMANY (2020)					INDIA (2020)				
AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %
0-4	1,010,695		968,598		0-4	1,776,761		1,684,135		0-4	61,476,291		54,844,472	
5-9	996,756		959,055		5-9	1,761,223		1,669,702		5-9	61,662,844		54,471,426	
10-14	936,694		905,779		10-14	1,764,866		1,672,026		10-14	61,877,954		54,528,674	
15-19	869,188		852,395		15-19	1,884,828		1,792,996		15-19	62,153,754		54,704,937	
20-24	836,542		831,151		20-24	2,127,584		2,061,475		20-24	61,269,777		54,034,843	
25-29	762,843		767,087		25-29	2,298,179		2,253,770		25-29	57,794,800		51,429,767	
30-34	647,084		658,754		30-34	2,577,005		2,526,601		30-34	53,489,399		48,939,213	
35-39	537,577		553,941		35-39	2,455,944		2,450,154		35-39	49,987,699		46,481,566	
40-44	458,964		482,619		40-44	2,350,680		2,351,081		40-44	46,115,904		43,539,933	
45-49	378,759		407,606		45-49	2,521,809		2,501,884		45-49	41,980,723		40,396,572	
50-54	280,706		316,809		50-54	3,349,711		3,286,927		50-54	35,907,142		35,055,268	
55-59	238,627		272,111		55-59	3,433,935		3,390,809		55-59	29,320,623		29,052,650	
60-64	192,790		224,632		60-64	2,863,951		2,925,215		60-64	23,124,194		23,394,388	
65-69	149,151		174,219		65-69	2,384,833		2,582,179		65-69	17,324,501		18,037,720	
70-74	104,288		121,664		70-74	1,839,689		2,071,543		70-74	12,027,804		13,112,207	
75-79	63,790		78,431		75-79	1,649,406		2,033,966		75-79	7,415,100		8,646,670	
80-84	30,367		41,330		80-84	1,356,200		1,885,712		80-84	3,676,445		4,727,348	
85+	15,864		26,422		85+	918,745		1,704,138		85+	1,610,609		2,480,030	
Total	17,153,288				Total	80,159,662				Total	1,326,093,247			

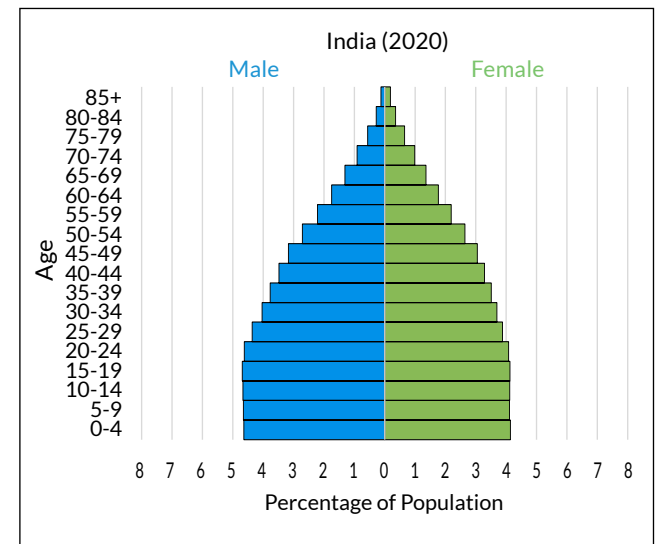
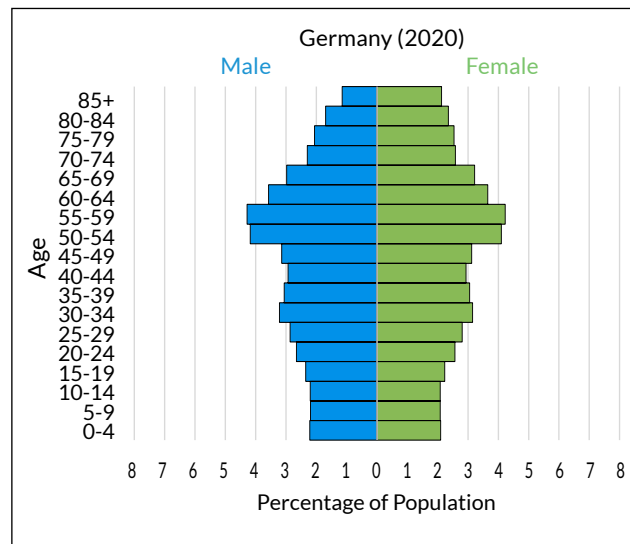
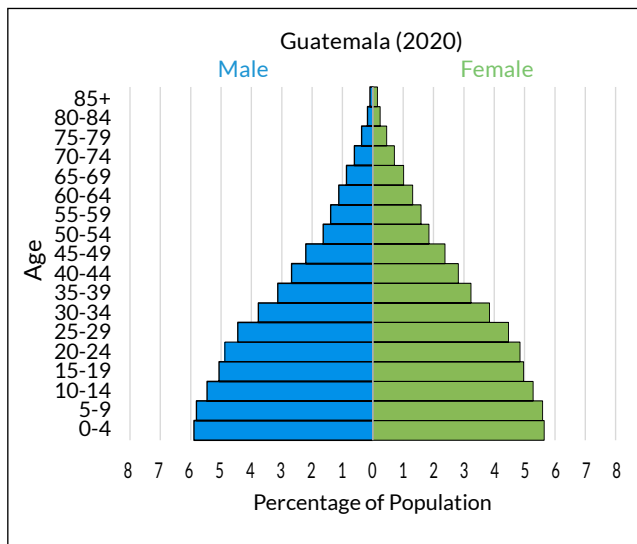
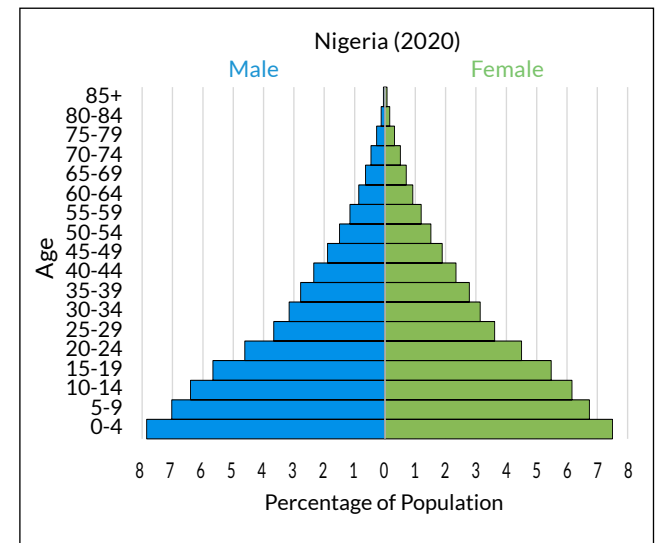
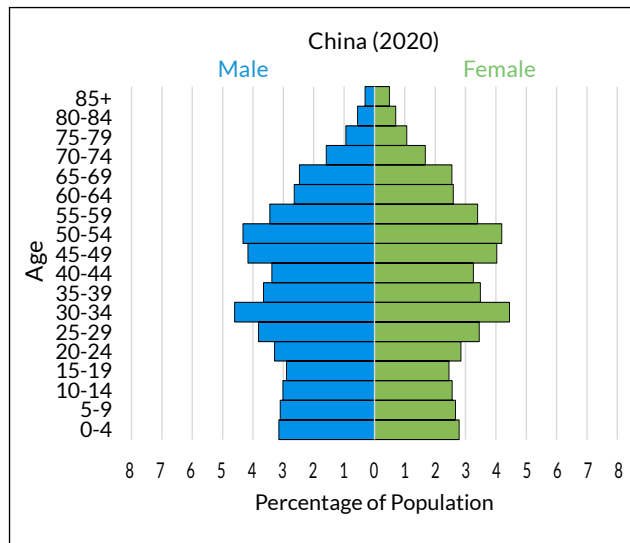
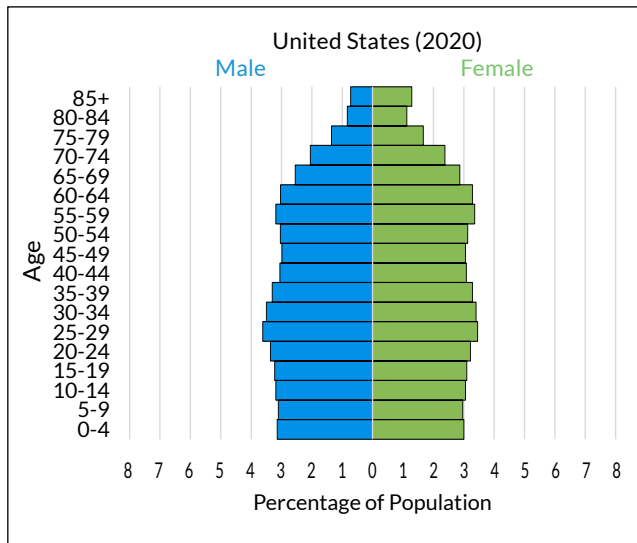
# POWER OF THE PYRAMIDS | graph paper

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Country \_\_\_\_\_



# POPULATION PYRAMIDS | answer key



# POWER OF THE PYRAMIDS | answer key

UNITED STATES (2020)					CHINA (2020)					NIGERIA (2020)				
AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %
0-4	10,445,659	3.1%	9,992,880	3.0%	0-4	43,933,770	3.2%	38,898,766	2.8%	0-4	16,813,967	7.9%	16,053,449	7.5%
5-9	10,325,131	3.1%	9,875,278	3.0%	5-9	43,303,522	3.1%	37,227,422	2.7%	5-9	15,044,440	7.0%	14,423,094	6.7%
10-14	10,603,765	3.2%	10,166,213	3.1%	10-14	42,059,047	3.0%	35,656,239	2.6%	10-14	13,713,331	6.4%	13,198,226	6.2%
15-19	10,732,423	3.2%	10,305,932	3.1%	15-19	40,312,118	2.9%	34,191,682	2.5%	15-19	12,130,595	5.7%	11,720,651	5.5%
20-24	11,198,945	3.4%	10,700,531	3.2%	20-24	45,817,723	3.3%	39,684,466	2.8%	20-24	9,892,065	4.6%	9,638,102	4.5%
25-29	12,029,149	3.6%	11,482,838	3.5%	25-29	53,218,977	3.8%	48,128,777	3.5%	25-29	7,850,577	3.7%	7,734,216	3.6%
30-34	11,649,087	3.5%	11,330,329	3.4%	30-34	64,173,087	4.6%	62,018,343	4.4%	30-34	6,751,995	3.2%	6,718,188	3.1%
35-39	10,990,413	3.3%	10,931,596	3.3%	35-39	50,883,009	3.7%	48,596,175	3.5%	35-39	5,944,240	2.8%	5,948,352	2.8%
40-44	10,168,231	3.1%	10,261,555	3.1%	40-44	47,096,321	3.4%	45,387,943	3.3%	40-44	5,013,838	2.3%	5,014,734	2.3%
45-49	9,947,289	3.0%	10,157,342	3.1%	45-49	58,099,063	4.2%	56,128,753	4.0%	45-49	4,044,321	1.9%	4,037,313	1.9%
50-54	10,109,501	3.0%	10,400,905	3.1%	50-54	60,319,274	4.3%	58,451,566	4.2%	50-54	3,203,942	1.5%	3,233,671	1.5%
55-59	10,598,811	3.2%	11,172,941	3.4%	55-59	48,010,856	3.4%	47,409,493	3.4%	55-59	2,475,859	1.2%	2,552,575	1.2%
60-64	10,091,925	3.0%	10,918,867	3.3%	60-64	36,816,789	2.6%	36,148,014	2.6%	60-64	1,851,988	0.9%	1,961,689	0.9%
65-69	8,491,889	2.6%	9,538,282	2.9%	65-69	34,411,322	2.5%	35,544,771	2.5%	65-69	1,374,968	0.6%	1,501,109	0.7%
70-74	6,836,985	2.1%	7,922,281	2.4%	70-74	22,080,119	1.6%	23,360,749	1.7%	70-74	979,963	0.5%	1,085,776	0.5%
75-79	4,502,437	1.4%	5,550,601	1.7%	75-79	13,084,854	0.9%	14,835,509	1.1%	75-79	593,642	0.3%	672,316	0.3%
80-84	2,764,750	0.8%	3,743,461	1.1%	80-84	7,738,618	0.6%	9,800,033	0.7%	80-84	274,821	0.1%	331,556	0.2%
85+	2,418,086	0.7%	4,282,794	1.3%	85+	4,271,577	0.3%	6,917,230	0.5%	85+	105,689	0.0%	143,044	0.1%
Total	332,639,102				Total	1,394,015,977				Total	214,028,302			

# POWER OF THE PYRAMIDS | answer key page 2

GUATEMALA (2020)					GERMANY (2020)					INDIA (2020)				
AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %	AGE GROUP	MALES	MALES %	FEMALES	FEMALES %
0-4	1,010,695	5.9%	968,598	5.6%	0-4	1,776,761	2.2%	1,684,135	2.1%	0-4	61,476,291	4.6%	54,844,472	4.1%
5-9	996,756	5.8%	959,055	5.6%	5-9	1,761,223	2.2%	1,669,702	2.1%	5-9	61,662,844	4.6%	54,471,426	4.1%
10-14	936,694	5.5%	905,779	5.3%	10-14	1,764,866	2.2%	1,672,026	2.1%	10-14	61,877,954	4.7%	54,528,674	4.1%
15-19	869,188	5.1%	852,395	5.0%	15-19	1,884,828	2.4%	1,792,996	2.2%	15-19	62,153,754	4.7%	54,704,937	4.1%
20-24	836,542	4.9%	831,151	4.8%	20-24	2,127,584	2.7%	2,061,475	2.6%	20-24	61,269,777	4.6%	54,034,843	4.1%
25-29	762,843	4.4%	767,087	4.5%	25-29	2,298,179	2.9%	2,253,770	2.8%	25-29	57,794,800	4.4%	51,429,767	3.9%
30-34	647,084	3.8%	658,754	3.8%	30-34	2,577,005	3.2%	2,526,601	3.2%	30-34	53,489,399	4.0%	48,939,213	3.7%
35-39	537,577	3.1%	553,941	3.2%	35-39	2,455,944	3.1%	2,450,154	3.1%	35-39	49,987,699	3.8%	46,481,566	3.5%
40-44	458,964	2.7%	482,619	2.8%	40-44	2,350,680	2.9%	2,351,081	2.9%	40-44	46,115,904	3.5%	43,539,933	3.3%
45-49	378,759	2.2%	407,606	2.4%	45-49	2,521,809	3.1%	2,501,884	3.1%	45-49	41,980,723	3.2%	40,396,572	3.0%
50-54	280,706	1.6%	316,809	1.8%	50-54	3,349,711	4.2%	3,286,927	4.1%	50-54	35,907,142	2.7%	35,055,268	2.6%
55-59	238,627	1.4%	272,111	1.6%	55-59	3,433,935	4.3%	3,390,809	4.2%	55-59	29,320,623	2.2%	29,052,650	2.2%
60-64	192,790	1.1%	224,632	1.3%	60-64	2,863,951	3.6%	2,925,215	3.6%	60-64	23,124,194	1.7%	23,394,388	1.8%
65-69	149,151	0.9%	174,219	1.0%	65-69	2,384,833	3.0%	2,582,179	3.2%	65-69	17,324,501	1.3%	18,037,720	1.4%
70-74	104,288	0.6%	121,664	0.7%	70-74	1,839,689	2.3%	2,071,543	2.6%	70-74	12,027,804	0.9%	13,112,207	1.0%
75-79	63,790	0.4%	78,431	0.5%	75-79	1,649,406	2.1%	2,033,966	2.5%	75-79	7,415,100	0.6%	8,646,670	0.7%
80-84	30,367	0.2%	41,330	0.2%	80-84	1,356,200	1.7%	1,885,712	2.4%	80-84	3,676,445	0.3%	4,727,348	0.4%
85+	15,864	0.1%	26,422	0.2%	85+	918,745	1.1%	1,704,138	2.1%	85+	1,610,609	0.1%	2,480,030	0.2%
Total	17,153,288				Total	80,159,662				Total	1,326,093,247			