Human Population Worksheet

Estimated Human Population Size

Year	Population in Millions
1	170
200	190
400	190
600	200
800	220
1000	265
1200	360
1400	350
1600	545
1800	900
1850	1210
1900	1625
1950	2556
2000	6060
2007	6625
2025*	7965

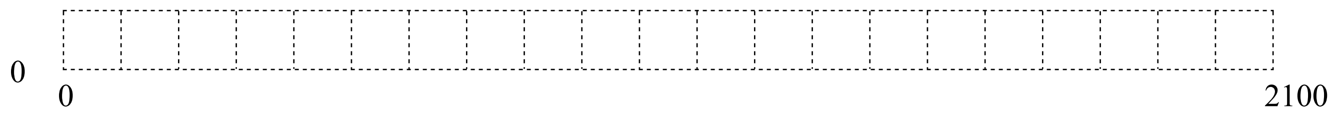
1. In the space at the bottom of this page graph the Human Population (in millions) over Time (Year).

2. Add a dashed line of your projection for the size of the human population through the year 2100.

3. What reasons do you have for your projection?

* Projected by the Population Reference Bureau

8000



Human Population Growth: POPULATION PUZZLE

Bacteria multiply by division. One bacterium becomes two. Then two divide into four; the four divide into eight, and so on. For a certain strain of bacteria, the time for this division process is one minute (the doubling time). If you put one bacterium in a bottle at 11:00 pm, by midnight the entire bottle will be full.

1. At what time will the bottle be half full?

2. Suppose you could be a bacterium in this bottle. At what time would you first realize that you were running out of space? Explain your response.

3. Suppose that at 11:58 some bacteria realize that they are running out of space in the bottle. So they launch a search for new bottles. They look far and wide. Finally, offshore in the Arctic Ocean, they find three new empty bottles. Great sighs of relief come from all the bacteria. This is three times the number of bottles they've known. Surely, they think, their space problems are over. Is that so?

Since their space resources have quadrupled, how long can their growth continue?

(HINT: How full is each bottle, including the original, at:

11:58 pm

11:59 pm

12:00 am

12:01 am

12:02 am

12:03 am

4. What does this puzzle suggest about human population growth and our quest to colonize the moon and/or Mars?

Human Population Growth: Doubling Time

Introduction:

Birth and death rates determine the rate of population growth. If the birth and death rates are similar, a population experiences little or no growth. When the birth rate far exceeds the death rate, the population soars. These rates are expressed as the number of births or deaths for every 1,000 people in a given year. For instance, in 2007 the world's birth rate was 21 per 1,000 and the death rate was 9 per 1,000. Using the formulas below, one can determine the world's annual growth rate and the number of years it will take the population to double if the growth rate remains constant.

Intrinsic rate of natural increase = (birth rate - death rate)/10 = (21 - 9)/10 = 1.2%

Doubling Time (in years) = 70/(rate of increase) = 70/1.2 = 58.3 years

(NOTE: 70 is the approximate equivalent of 100 times the natural log of 2.)

Using the table below, determine the percentage of annual increase and the population doubling times for each country.

Percent annual natural increase = $\dfrac{\textbf{(birth rate) - (death rate)}}{\textbf{10}}$

Doubling time (in years) = $\dfrac{\textbf{70}}{\textbf{rate of increase}}$

Country	Birth Rate (2007)	Death Rate (2007)	Doubling Time
United States	**14 per 1000**	**8 per 1000**	
Kenya	**40 per 1000**	**12 per 1000**	
Mexico	**21 per 1000**	**5 per 1000**	
Bolivia	**29 per 1000**	**8 per 1000**	

India	**24 per 1000**	**8 per 1000**	
China	**12 per 1000**	**7 per 1000**	
Japan	**9 per 1000**	**9 per 1000**	
Germany	**8 per 1000**	**10 per 1000**	
Russia	**10 per 1000**	**15 per 1000**	
World	**21 per 1000**	**9 per 1000**	

Human Population Growth: Grim Reaper's Revenge

Introduction:

We are currently adding 210,000 people (net growth) to the world's population **each day**. Even the deaths from large-scale disasters have little effect on a population growing so rapidly. Below is a listing of some of the world's worst disasters, along with an approximate death toll. At today's present rate of growth, determine how many days, weeks or months it would take to replace those people lost in the column to the right. Round off to one decimal place.

Horrible Things People have done to each other & the time to replace those people.

Event	Year(s)	Death Toll	Time to Replace
Hundred Years War	1337-1453	185,250	
American Civil War	1861 - 1865	620,000	
World War I – All Countries	1914-1918	15,000,000	
World War II – All Countries	1937-1945	55,000,000	

Plagues

Black Death plague	1347-1351	75,000,000	
Influenza -Worldwide	1918	45,000,000	
AIDS	1978-Present	37,000,000	

Other Disasters

Earthquake, tsunami	2004	225,000	
Great Fire of London	1666	17,000	

Averages/year

Disease & Starvation - World	--	10,000,000	
Car Accidents – U.S.	--	42,000	
Genocide - Darfar	--	50,000	

Murders - U.S.	--	21,000	

Human Population Growth: Life Tables

Life tables show how long on average an individual of a given age will live. Survivorship curves are a way to show a life table graphically. By using a percentage scale instead of actual ages on the horizontal axis, you can compare species with widely varying life spans on the same graph. Construct a survivorship curve of a bullfrog, squirrel, and human by plotting the data below on the regular graph paper and the semi-log graph paper.

Life Table for Bullfrogs

Age Interval	Number Living at Start of Age Interval (N)	Number Dying During Interval (D)	Mortality (Death Rate) During Interval (D/N)	Chance of Surviving Interval (1 - D/N)	Percentage of Maximum Life Span	Percentage of Survivors (N for Interval/Number Starting at Age 0)
0	20000	19,698	0.985	0.015	0	100
1	302	46	0.152	0.848	7	1.51
2	256	24	0.094	0.906	14	1.28
3	232	23	0.099	0.901	21	1.16
4	209	30	0.144	0.856	29	1.045
5	179	25	0.140	0.860	36	0.895
6	154	32	0.208	0.792	43	0.77
7	122	10	0.082	0.918	50	0.61
8	112	11	0.098	0.902	57	0.56
9	101	9	0.089	0.911	64	0.505
10	92	9	0.098	0.902	71	0.46
11	83	5	0.060	0.940	79	0.415
12	78	53	0.679	0.321	86	0.39
13	25	25	1.000	0.000	93	0.125
14	0	0			100	0

Life Table for Squirrels

Age Interval	Number Living at Start of Age Interval (N)	umber Dying During Interval (D)	Mortality (Death Rate) During Interval (D/N)	Chance of Surviving Interval (1 - D/N)	Percentage of Maximum Life Span	Percentage of Survivors (N for Interval/Number Starting at Age 0)
0	500	350	0.700	0.300	0	100
1	150	75	0.500	0.500	17	50
2	75	30	0.400	0.600	33	15
3	45	25	0.556	0.444	50	4.5
4	20	15	0.750	0.250	67	2
5	5	5	1.000	0.000	83	0.5

6	0	0	100.000	0.000	100	0

Life Table for the U.S. Population in 2004

Age Interval	Number Living at Start of Age Interval (N)	umber Dying During Interval (D)	Mortality (Death Rate) During Interval (D/N)	Chance of Surviving Interval (1 - D/N)	Percentag e of Maximum Life Span	Percentage of Survivors (N for Interval/Numbe r Starting at Age 0)
0-10	100,000	871	0.009	0.991	0	100
10-20	99,129	420	0.004	0.996	10	99.129
20-30	98,709	933	0.009	0.991	20	98.709
30-40	97,776	1,259	0.013	0.987	30	97.776
40-50	96,517	2,782	0.029	0.971	40	96.517
50-60	93,735	5,697	0.061	0.939	50	93.735
60-70	88,038	11,847	0.135	0.865	60	88.038
80-90	76,191	53,972	0.708	0.292	70	76.191
90-100	22,219	19,709	0.887	0.113	80	22.219
100-110	2,510	2,510	1.000	0.000	90	2.51
110+	0	0	1.000	0.000	100	0

Species that exhibit a Type I curve usually produce few offspring but give them good care, increasing the likelihood that they will survive to maturity. Which of the species exhibit a Type I curve?

Species that exhibit a Type III curve indicates high death rates for the very young and then a period when death rates are much lower for those few individuals who survive to a certain age. Species with this type of survivorship curve usually produce very large numbers of offspring but provide little or no care for them. Which of the species exhibit a Type III curve?

A Type II curve is intermediate, with mortality more constant over the life span. Which of the species exhibit a Type II curve?

Why is the semi-log plot the preferred way to graph survivorship curves?

Plot the data below on both you regular graph and the semi-log graph of the survivorship curves.

Life Table for the U.S. Population in 1904

Age Interval	Number Living at Start of Age Interval (N)	umber Dying During Interval (D)	Mortality (Death Rate) During Interval (D/N)	Chance of Survivin g Interval (1 - D/N)	Percentag e of Maximum Life Span	Percentage of Survivors (N for Interval/Numbe r Starting at Age 0)
0-10	100,000	19,947	0.199	0.801	0	100
10-20	80,053	2,814	0.035	0.965	10	80.053
20-30	77,239	5,196	0.067	0.933	20	77.239
30-40	72,043	6,153	0.085	0.915	30	72.043
40-50	65,890	7,376	0.112	0.888	40	65.89
50-60	58,514	10,568	0.181	0.819	50	58.514
60-70	47,946	34,417	0.718	0.282	60	47.946
80-90	13,529	11,662	0.862	0.138	70	13.529
90-100	1,867	1,836	0.983	0.017	80	1.867
100-110	31	31	1.000	0.000	90	0.031
110+	0	0	1.000	0.000	100	0

What has changed most dramatically in the U.S. population dynamics in the past 100 years?

Name 3 reasons for the change you mentioned above.

Human Population Growth: Power of the Pyramids

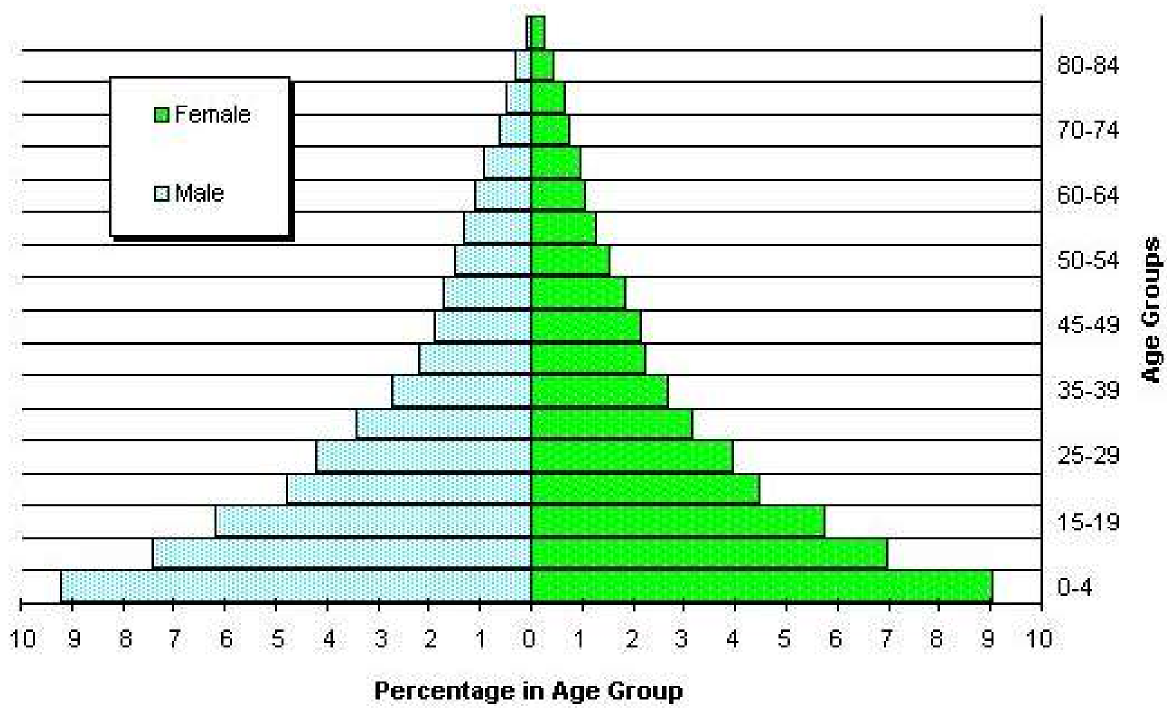
1. The table below represents the population in thousands of each age group within each gender for the United States in 2007. In order to construct a population pyramid you must first calculate the percentage of the population in each subgroup. For example, the United States's total population in 2007 was 301,140,000. The population of males up to age four was 10,635,000.

$$\frac{10,635,000}{301,140,000} = 0.035 \text{ or } 3.5\%$$

2. Complete these calculations for each age group in the table below.

Age Group	Male Population	Male Population %	Female Population	Female Population %
0-4	10,635		10,181	
5-9	10,156		9,718	
10-14	10,360		9,880	
15-19	11,115		10,551	
20-24	10,794		10,241	
25-29	10,570		10,242	
30-34	9,786		9,596	
35-39	10,558		10,491	
40-44	10,878		11,003	
45-49	11,280		11,567	
50-54	10,272		10,721	
55-59	8,855		9,424	
60-64	6,889		7,531	
65-69	5,027		5,758	
70-74	3,857		4,727	
75-79	3,084		4,208	
80+	3,891		7,298	

3. Using the space at the bottom of this page, construct a population pyramid for the United States using the data in the table you constructed. An example of a population pyramid is provided below. The figures along the X-axis represent the calculated percentages of the population, while points along the Y-axis represent age groups. A line drawn down the middle of the graph separates the male and female populations. You should use a different color for each side of the graph.



										80+
										75-79
										70-74
										65-69
										60-64
										55-59
										50-54
										45-49
										40-44
										35-39
										30-34
										25-29
										20-24

										15-19
										10-14
										5-9
										0-4

Using the U.S. population pyramid you constructed answer the following questions.

4. Is there a relatively large or a relatively small gender difference in the youngest age groups? Why is this the case?

5. Is there a relatively large or a relatively small gender difference in the oldest age groups? Why is this the case?

6. What is the cause of the bulge in the middle of the pyramid?

7. Go to the following website:

`http://www.census.gov/ipc/www/idb/pyramids.html`

Select the United States.

Select the Summary (2000, 2025, 2050) button.

Select the Medium graph size.

Click the “Submit Query” button.

Using these graphs answer the following questions.

8. What is the biggest change in the population comparing 2000 and 2050? Why is this?

9. Click the back button and select the country Kenya. Under “Type of output” select “select years”. Medium graph size. Click the “Submit Query” button. Select the year 2007. Make a simple illustration of the shape of this graph below.

10. How does the population pyramid of Kenya compare to that of the United States in 2007 (your graph)?

11. Kenya is a developing country as is India. Find what the pyramid looks like for India in the year 2007. Sketch the shape of this graph of India below.

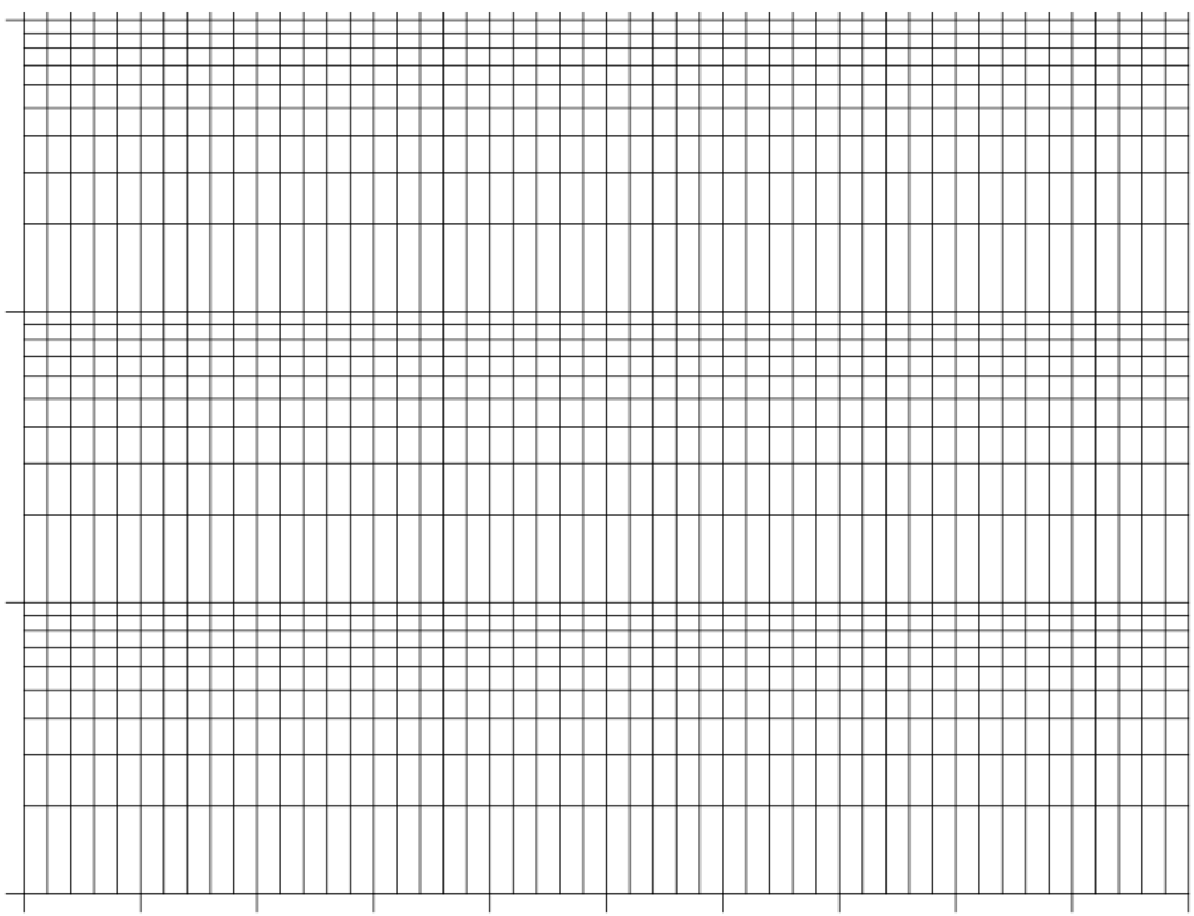
12. All developing countries share this shape of their population pyramid. Why is this?

13. As you have seen Germany and Russia are experiencing negative growth. Find what their graphs look like and sketch a representative graph below.

14. The United States, Japan, and China are experience growth but it is slow growth. Find what their graphs look like and sketch a representative graph below.

15. Make a hypothesis on what the World's population pyramid looks like by sketching it below. How did you come to this hypothesis?

In the hour and a half it has taken you to complete this worksheet 22,772 people have been born and 9,483 people have passed away.



Human Population Growth: Human Carrying Capacity

1. In the year 1950 the human population was estimated to be about 2,515,000,000. The intrinsic rate of natural increase in 1950 was 1.47. If the population was growing exponentially in 1950 predict the population size in 1951. Show your work below.

2. Was the human population between 1950 and 1951 growing exponentially? What evidence do you have to support your answer?

3. In fact the population in 1951 was 2,594,000,000. This is a growth of only 79,000,000 people. If you were to use the logistic growth equation to solve for K; K equals about 2,541,000,000. If this is true, how many people on the Earth are now exceeding the current carrying capacity?

4. Other scientists argue that the human carrying capacity on Earth is around 9 billion people. If this is true what should the population be at the end of 2025?