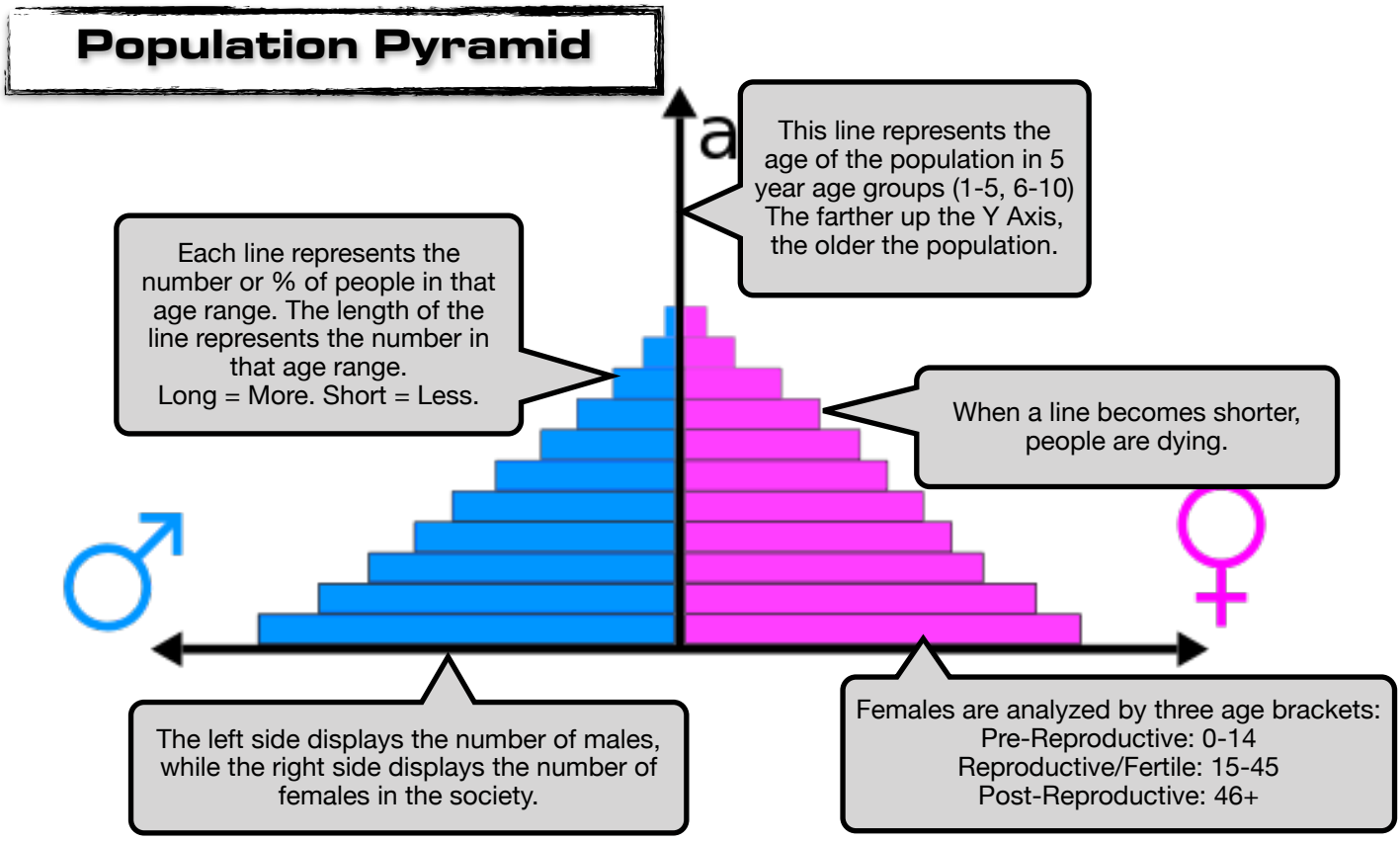
C. Analyzing the Population

Population Pyramids

Population pyramids are a tool used by academic, business, and government professionals to analyze populations. Population pyramids simultaneously display quantitative data about the sex-ratio (the number of men compared to the number of women) and age-distribution of a population. Governments build population pyramids from the county's census data, and they are useful tools for displaying the current population growth of a society, understanding demographic changes over time, and predicting future trends.



APPLICATION #1

Looking at this pyramid, describe the population of this society: Largest age-range? Gender? What happens as the people get older?

Why does the sex-ratio and age composition of population matter? This demographic data serves several purposes within a society:

- **Dependency Ratio.** Dependency measures segments of the population who cannot provide shelter and food for themselves. Instead, they are reliant on other members of society - family, friends, or government services - to meet their basic needs. The *youth dependency ratio* is the number of people under 15 years old; they are too young to work full time or provide shelter for themselves, being reliant on a parent, family member, or a guardian to provide basic needs. Most people in this age group are in (or should be in) elementary or secondary education. The *elderly dependency ratio* measures the population over the age of 65. This age bracket is at the end of their working years. Many are in retirement, if they were able to build up enough savings, or have a limited working capacity. Above 65 years old, many people begin to experience health issues that require the care of family members or health care services. In summary, these dependent groups are people who are not functioning as key labor contributors within society, and instead often need someone else who is working and paying taxes to support them. If this group does not have someone available to support them, they may end up homeless or living on the street.

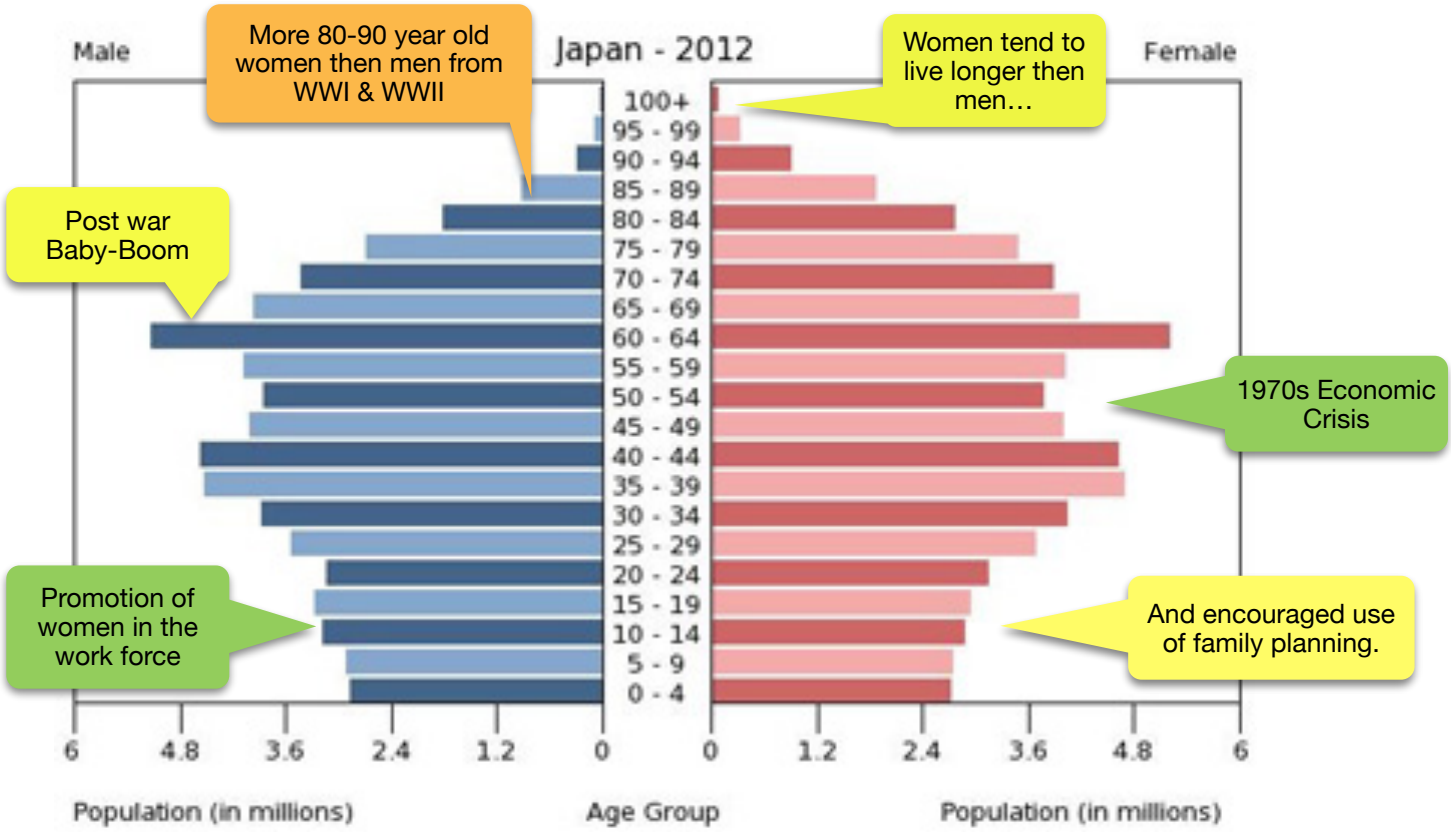
- **Government Services.** A second purpose of population pyramids is to assist governments in planning services by understanding their population and how to best use tax resources to provide the correct resources to serve the people. Populations are diverse, with a high amount of variability between communities. For example: Cities with a large 0-15 year-old population needs to build schools, parks, and libraries, while also zoning for single-family housing. Cities with a large 65-85 year-old population needs to plan for adult assisted living, independent living, and long-term care facilities, while zoning the land for medium-high density retirement housing.

  By looking at population pyramids across multiple years, governments can forecast future needs they need to budget and plan for. A large bulge of 50-60-year-olds will soon become the next bulge of 70-80 year-olds. A significantly small number of 10-20 year-olds means a smaller workforce and a smaller amount of taxes in years to come.

- **Business Marketing**. Similarly to government services, businesses do not market to all customers. Instead, each business has a customer base they aim to sell too. The ability for businesses to identify their target audiences and provide relevant products is critical to both the business and the potential customer. For example: A toy maker or diaper manufacturer needs a large population of young children. Car companies target educated working-age adults with incomes above $40,000 per year. Hearing aid and wheel chair providers primarily sell to populations over 60 years old.

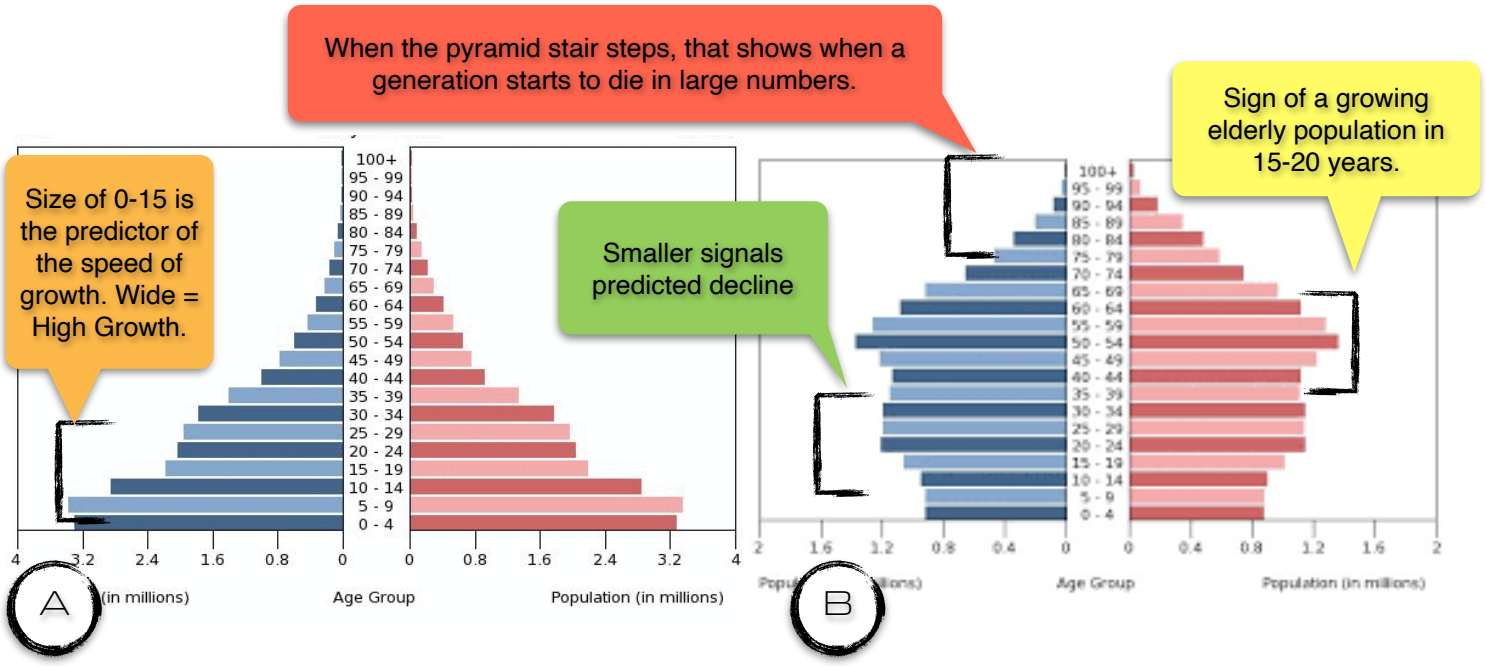
Bulges & Dips

Population pyramids are rarely as smooth and example above. Instead, there are dips and bulges in the pyramids that tell the demographic history of the people. Bulges represent major increases in the population during a certain period of time and can result from: a sudden increase in the birth rate (called a baby boom), a massive in-migration, or a specialty function within the community that would attract a specific age. For instance: college towns have significant bulges of both males and females ages 18-22. Retirement communities have bulges of males and females above 60 years old. Military bases have a large bulge of males that is not reciprocated on the female side of the graph. Certain economic industries attract different genders of working-age adults, such as car manufacturing or deep sea fishing. Inversely, dips reflect a major loss of life during a period. Dips can result from a drop in birth rate resulting from the introduction of family planning, a disease outbreak, a massive emigration from the region, the closing of a business/factory, economic depression, war, or natural disaster.



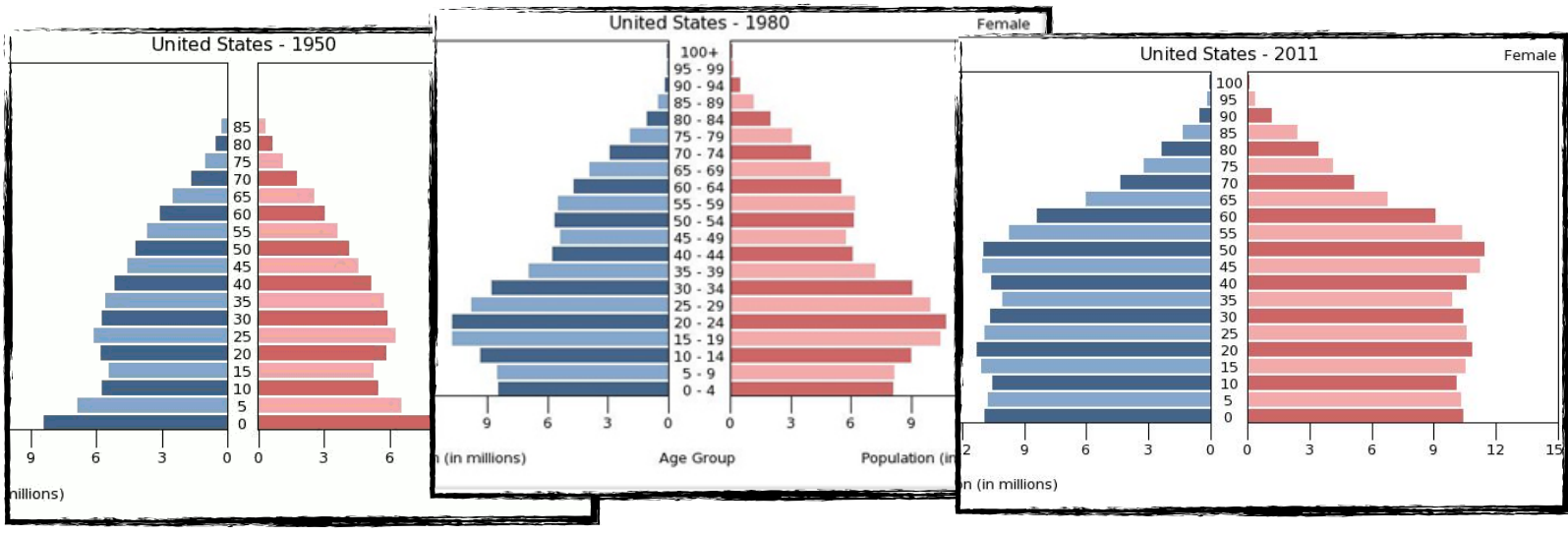
Population Across Time

Population pyramids are used to compare the changes in a population over extended periods of time. Comparing population pyramids shows shifts and trends of a population that should alert government planners to the future of the region. This method is useful for tracking changes in the Crude Birth Rate (# live babies per 1,000 people), Crude Death Rate (# deaths per 1,000 people), and changes in migration patterns.



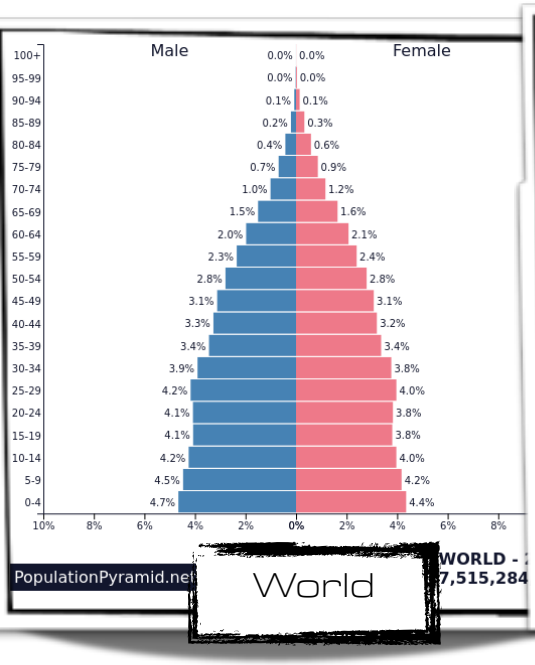
APPLICATION #2

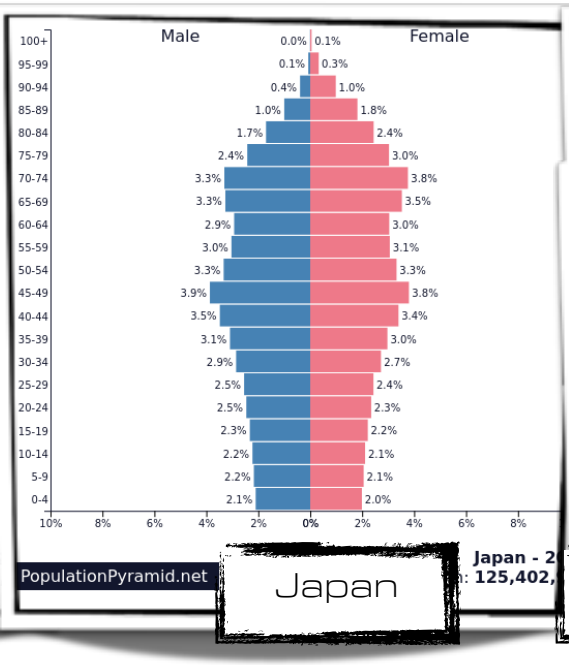
Compare the population pyramids above. How did this society's population change over time? (A = 1950, B = 2010)

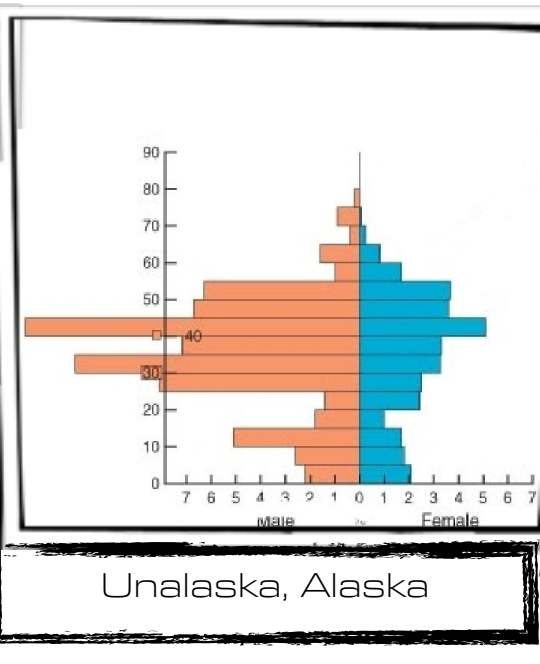


APPLICATION #3

What trends and changes do you notice in the USA population pyramids between 1950-2011?
What do you think caused these trends, bulges, and dips?



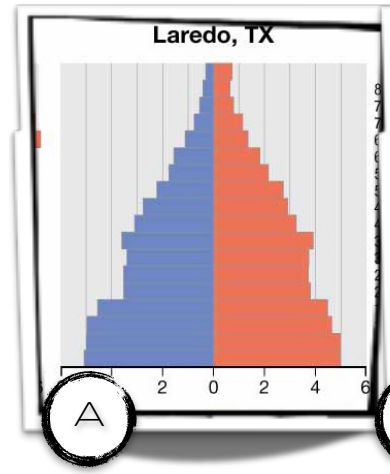


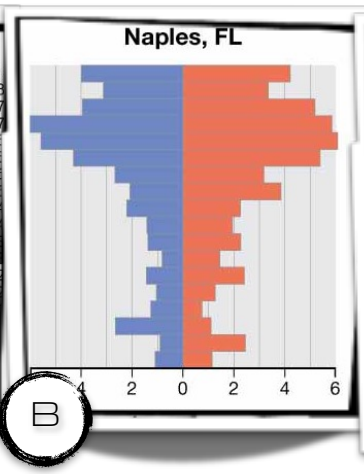


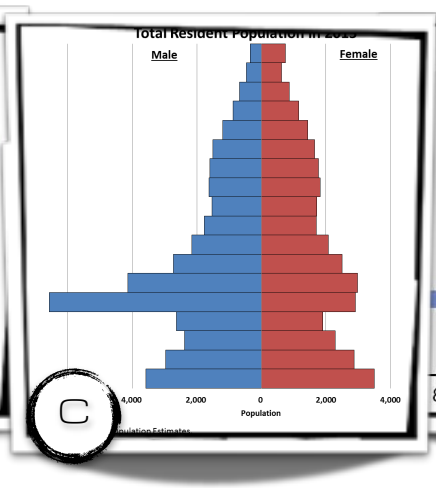
Scales & Specializations

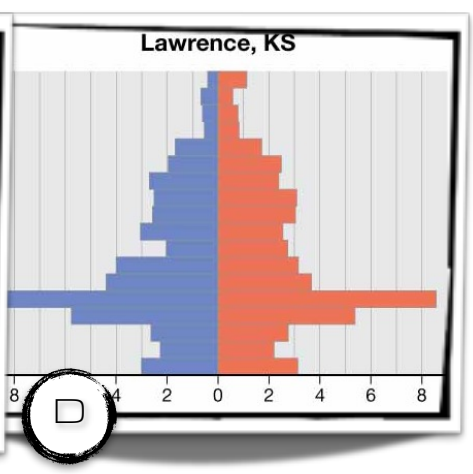
Population pyramids are designed to reflect populations at different scales. The scale represented on the pyramid impacts the level of detail that appears in the data. When examining the population of the world at a global scale, the population pyramid looks evenly balanced between males and females, an average age of ~30 years old, with few dips or bulges. When the scale shifts to a national view of Japan, the shape represents a different reality. Japan has a significantly lower birth rate, with an average age of over 50 years old. When the scale shifts to the local scale, more differences appear. The city of Unalaska, Alaska looks drastically different. Their population has a large bulge of 30-50 year-old men, comparatively few women, and a minimal number of children. While the world's population pyramid is almost evenly balanced, Unalaska is unbalanced, full of dips and bulges.

At the city scale, population pyramids reflect the specialized and unique economic opportunities available in a region. Laredo, TX [Letter A, below] has a similar shape as the general, USA, but with a larger population of people under 20 years old. This reflects the larger primary sector opportunities and the young migrant families who are hired to work the farms. In Naples, FL [Letter B], the pyramid is flipped. In Naples, the bulk of the population is at the top age bracket, reflecting Naples's economic role as a large retirement community. Christian County, KY is the home to one of the USA's largest military institutions, hence the unique bulge of 20-35 year old males, with no corresponding match on the female side. Finally, Lawrence, KS's population pyramid has a similar bulge in the 20-30 population, but for both males AND females. This reflects Lawrence's specialization as home to the University of Kansas. All of these examples show variations with populations at the local scale that are not visible nationally or globally.









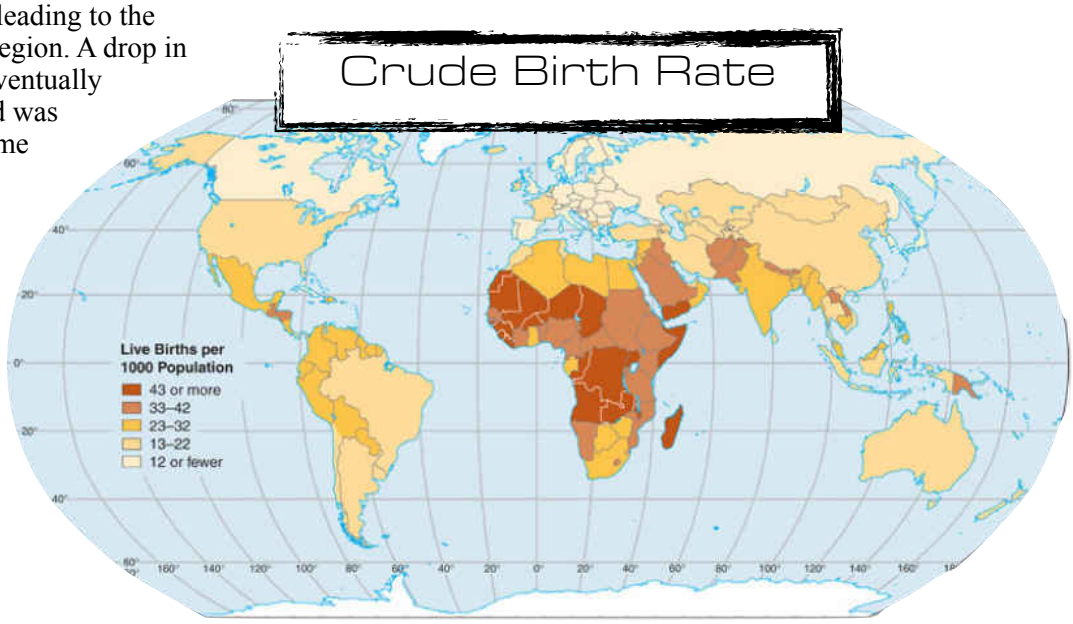
D. Measuring Demographics

Demographic changes are measured by a series of key indicators.

Total Population. The total population measures all the humans living in a region and can be measured across all scales. At the national and local scale, the total population is determined by manipulating the country's census data. The global population is determined by adding all the censuses of all the countries of the world.

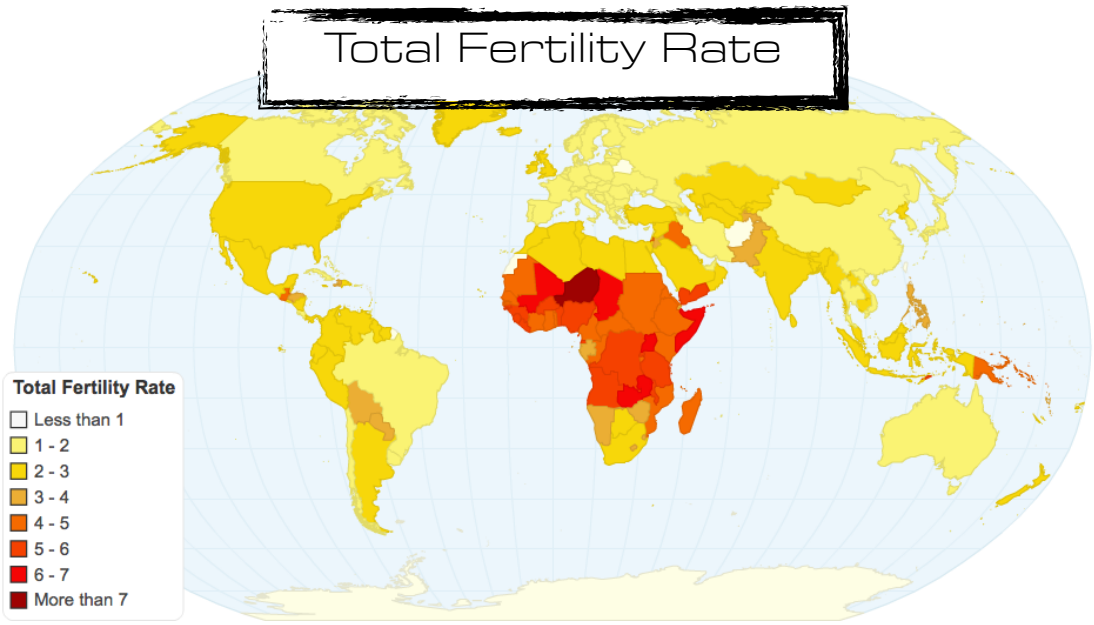
Crude Birth Rate (CBR). The CBR is determined by the total number of births in a year divided by the total population, multiplied by 1,000. A larger the number indicates more babies are being born, leading to the potential of population growth in the region. A drop in CBR may indicate a population will eventually shrink. In 2014, the CBR for the world was 19.4 births per 1,000 people. In the same year:

- China's CBR = 12.4
- USA's CBR = 12.5.
- S. Africa's CBR = 20.7
- Mali's CBR = 43.5



Total Fertility Rate (TFR). Total Fertility Rate measures the average number of births women have in their childbearing years (ages 15 to 49). The higher the number, the more children are born per woman, representing both population growth and limitations to the economic and social opportunities for women in that society. The lower the fertility rate, the fewer babies are born per woman. This value has a direct correlation with a woman's access to contraception. In 2014, the global Fertility Rate was 2.45. In the same year:

- China TFR = 1.5
- USA TFR = 1.8
- S. Africa TFR: 2.3
- Mali TFR: 6.2

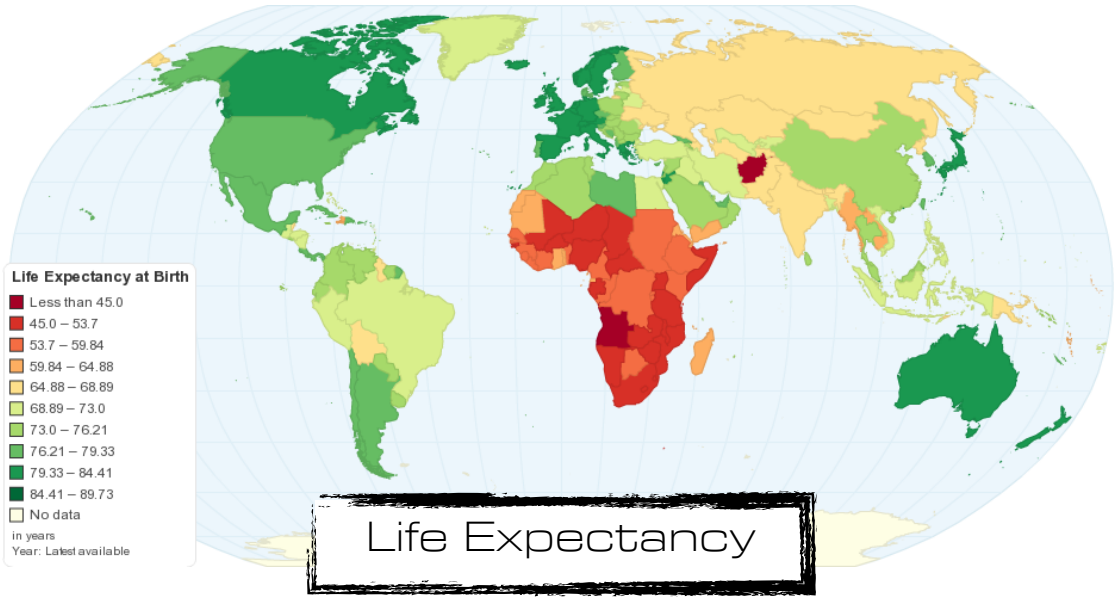


For the world population to remain in a steady state (no net growth in number), the fertility rate must be 2.1, also known as Zero Population Growth or a Replacement Rate. This means that 2 adults procreate to create 2 children - one child for each parent. If the Replacement Fertility Rate is 2.2 or above, the population will increase and grow overtime. Remember, the higher the number, the faster the growth. If the Fertility Rate is 2.0 or below, the population will shrink over time. Again, the lower the number, the more drastic the shrinkage of the population.

Life Expectancy. Life expectancy is the average number of years a person lives after birth. The higher the number, the longer the average person is expected to live. The lower the number, the shorter the average person is expected to live. This number is an average that can be affected by outliers or extremes. As proof, if there are two people who die: one who was 100 and another who was 10 days old - what would the average be? The average would be 50 years and 5 days. Thus, societies with low life expectancies do have people who live to older ages, but they also have high IMR. The global average for life expectancy is 71 years old.

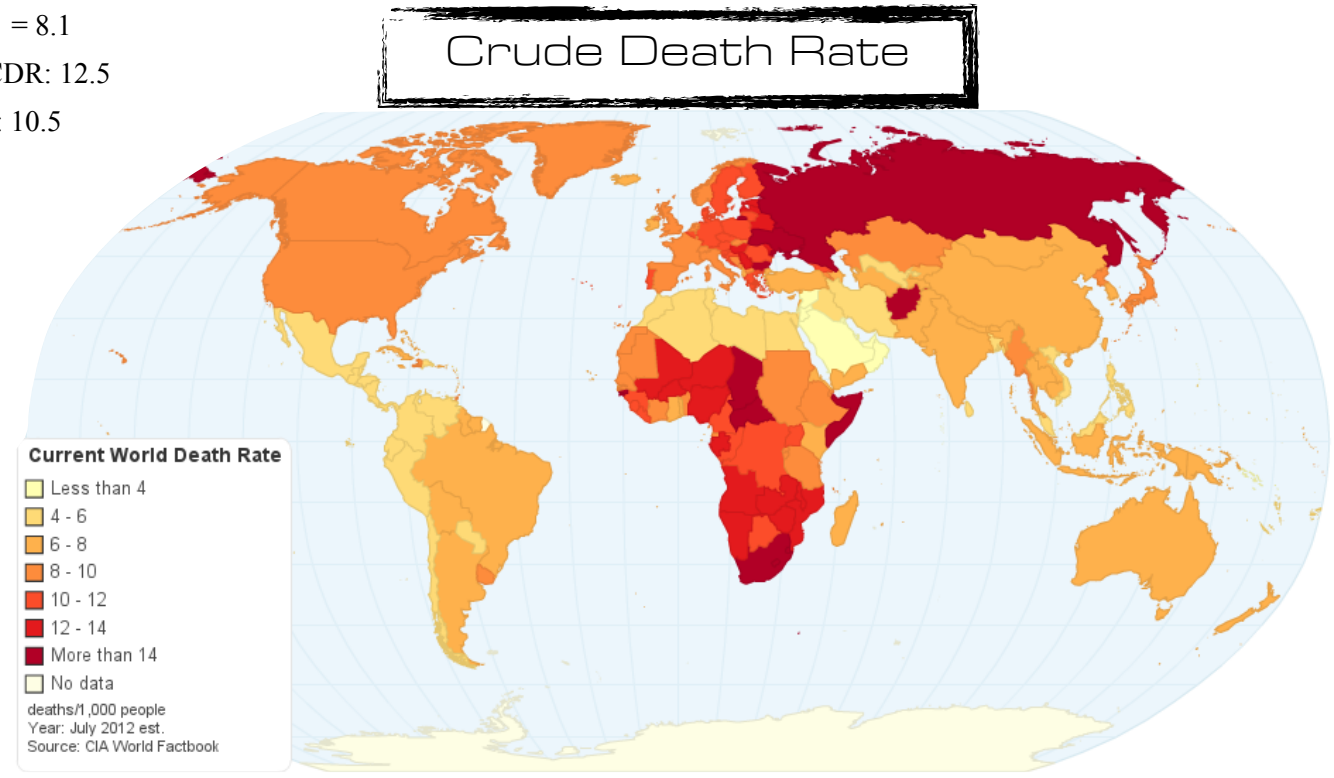
- China = 75.8
- USA = 78.9
- S. Africa: 57.2
- Mali: 58

When life expectancy increases, it is common for the total population to also increase. This is because when people live longer (i.e. they are not dying) while babies are still being born, it results in more total people being on the planet. In the 1940s, children barely got to know their grandparents. In 2019, children are getting to meet their great-grandparents.

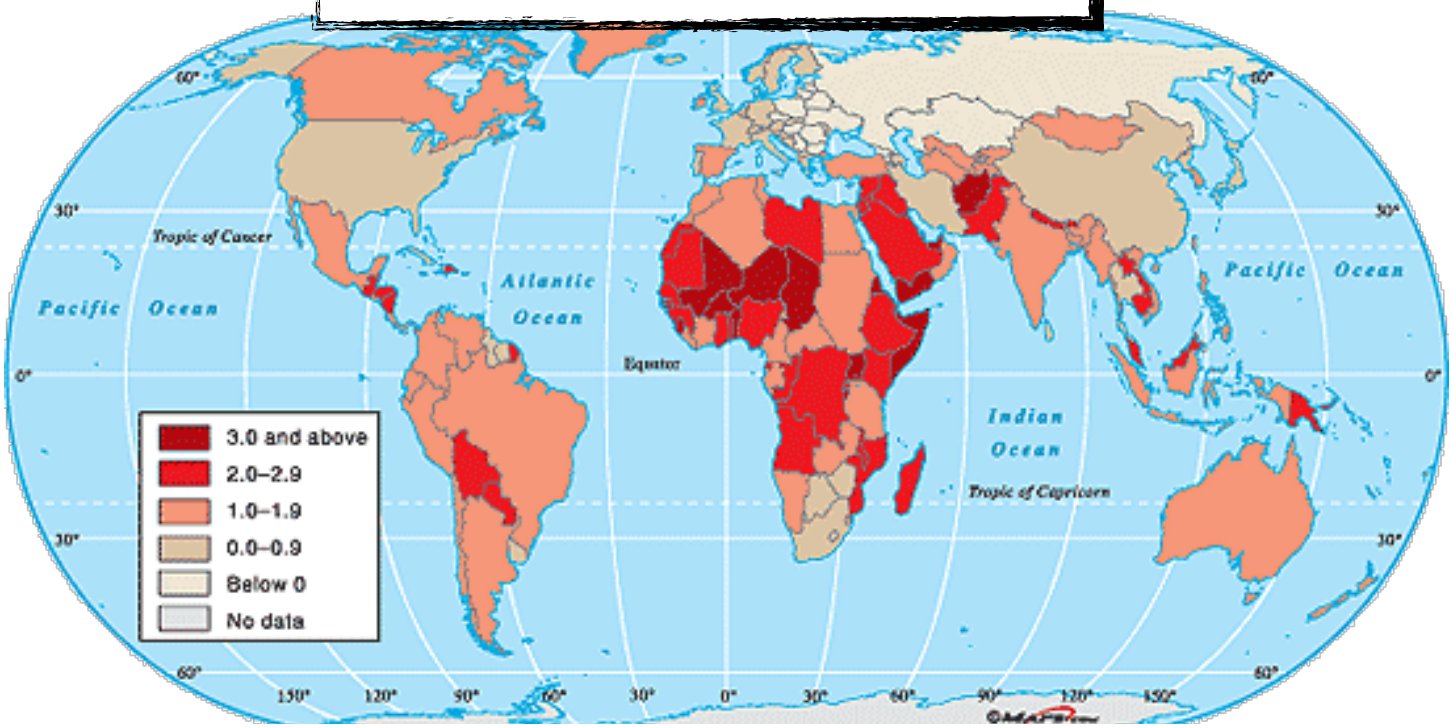


Crude Death Rate. The Crude Death Rate (CDR) is the total number of deaths in a year, divided by the total population, multiplied by 1,000. The CDR does not take the cause of death into account. A murder counts towards the CDR the same way a heart attack would. If the CDR is higher, there is the potential for the population to shrink. The global CDR is 7.75. In the same year:

- China CDR = 7.2
- USA CDR = 8.1
- S. Africa CDR: 12.5
- Mali CDR: 10.5



Natural Increase Rate



Rate of Natural Increase (RNI). Rate of Natural Increase (RNI) - sometimes referred to as the the Natural Increase Rate (NIR) - is the measure of the rate of growth of a region ONLY from child birth. The larger the RNI, the faster the population is growing. If the RNI is negative, the society is shrinking.

The RNI is calculated by subtracting the Crude Death Rate (CDR) from Crude Birth Rate (CBR), then dividing by 10.

$$\frac{\text{CBR - CDR}}{10}$$

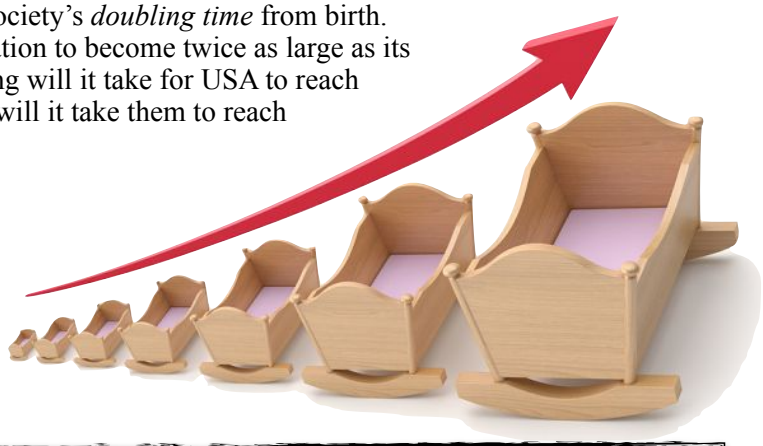
To illustrate, the global CBR is 19.4 and the CDR is 7.75. The CBR (19.4) - CDR (7.75) = 11.65. The 11.65 divided by 10 = 1.165. Thus, the RNI is 1.16. In 2019, the world's CBR is 18.5 with a CDR of 8. This calculates to an RNI of 1.05.

NIR	Doubling Time (Years)
0.5	140
1	70
2	35
3	23
4	18

Rate of Natural Increase (RNI) is important for deterring a society's *doubling time* from birth. Doubling time refers to how long it will take the total population to become twice as large as its current amount. If the USA's population is 330,000, how long will it take for USA to reach 660,000? If Luxembourg's population is 590,000, how long will it take them to reach 1,180,000? The doubling time uses the Rule of 70:

$$\text{Doubling Time} = \frac{70}{\text{RNI}}$$

In the USA, the NIR is .54. The doubling time (70/.54) = 129.6 years. Mali's RNI is 3.1. The doubling time (70/3.1) is 22.5 years.



APPLICATION #4

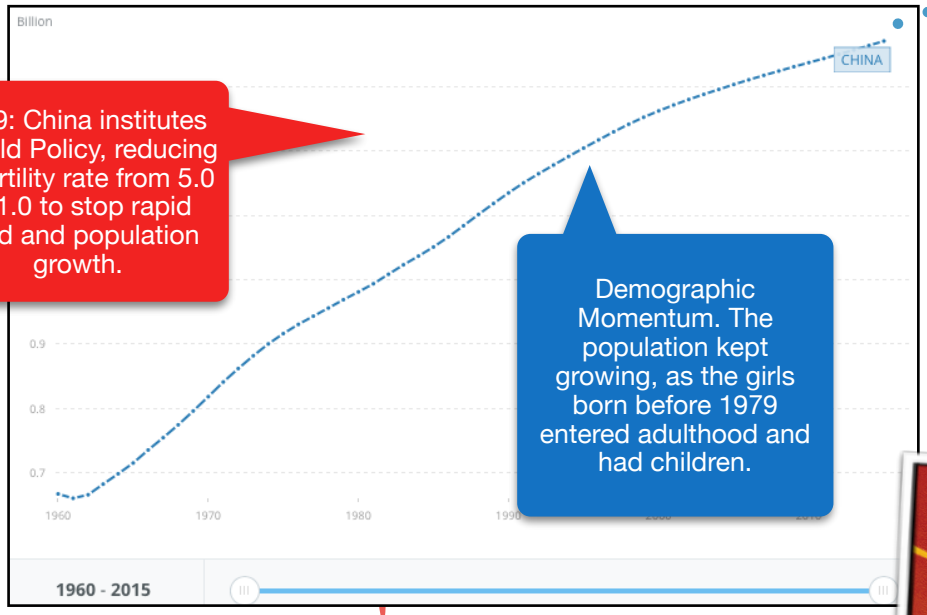
How long will it take for Canada, Saudi Arabia, India, Russia, and South Africa to double their populations?

Demographic Momentum

A drop in the Total Fertility Rate (TFR) will not create a sudden drop in a nation's population. If a nation's fertility rate drops, the region will experience a phenomenon called *demographic momentum* where there will be a continued increase in the population for 3-4 generations, despite the drop in fertility rate. This is because the babies born today will grow up to have children in 20 years, and then their children will grow up to produce grandchildren in another 20 years, and the grandchildren will grow up in another 20 years to produce great-grandchildren. With a general life expectancy of 78, there will be 3-4 full generations of people born before the first generation dies. Thus, any demographic change from the fertility rate that happens in 2020 will take until 2070 (50-60 years) before the society truly feels the effects of the change.

As a real world example, in 1979 China instituted their 1-Child Policy, limiting women to giving birth to only one child. China brutally enforced this, forcing women to have abortions who were pregnant with their second child - averaging 13 million abortions a year (35,000/day; 1,484/hour; 24/minute). For the next 40 years, China's population kept growing as the girls who were born as a part of the baby boom (before the 1 Child Policy) entered adulthood and began to reproduce. The Chinese population is projected to stop growing around the year 2030 before finally starting to shrink around 2050.

China's Population Growth (1979-2015)



1979: China institutes 1 Child Policy, reducing its fertility rate from 5.0 to 1.0 to stop rapid child and population growth.

Demographic Momentum. The population kept growing, as the girls born before 1979 entered adulthood and had children.