PERSONAL CONNECTION
In your notebook, how many people do you think are on the planet? Which 3 regions of the world contain the largest populations? If you could live anywhere in the world, where would it be? Why?

Ch 4: Demos

Introduction: Demography

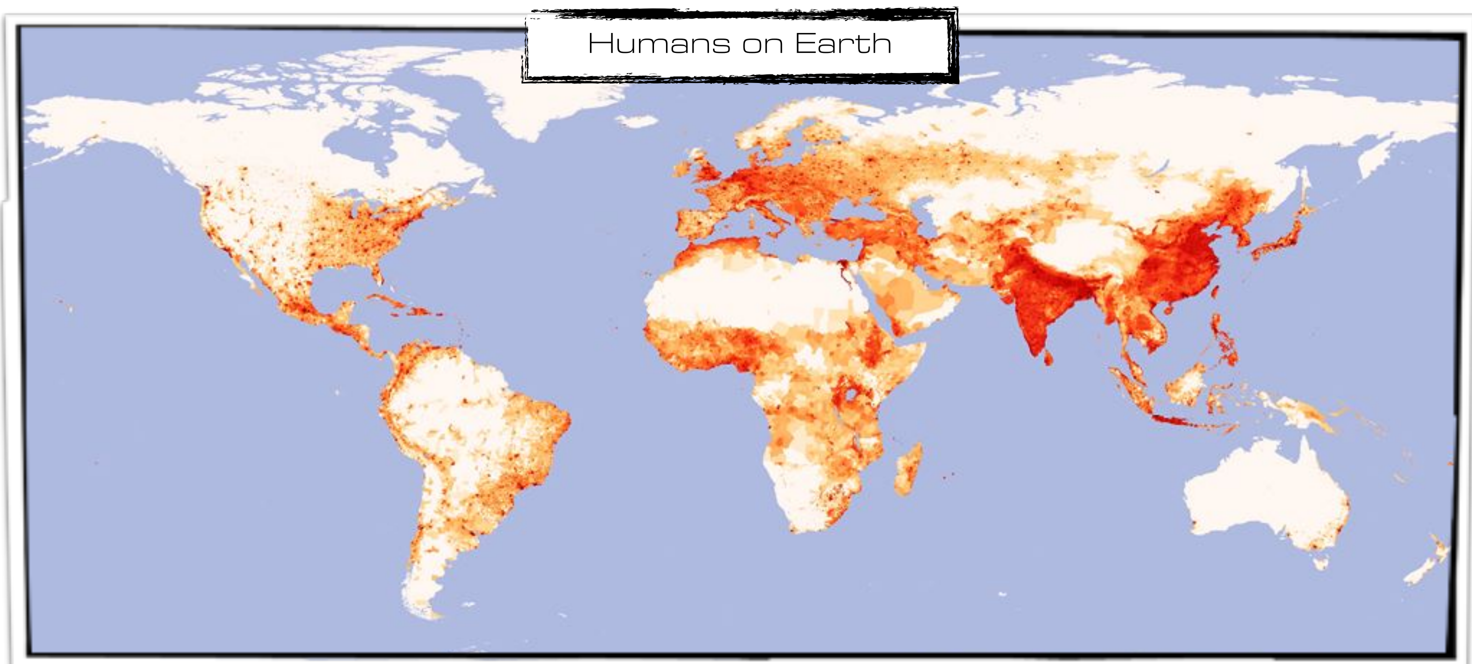
Life.

Life is simple. A person is born. The person lives. The person dies. Biologically, end of story. However, as the conversation changes scale from a single person, to a family, to a city, to a country, to the globe, the story of life takes on greater depth and complexity.

This is demography: an analysis of the shifts and changes within the human population over time and space. Demography is composed of three key components: fertility, mortality, and migration. Within the study of demography, there are a set of five variables to be analyzed:

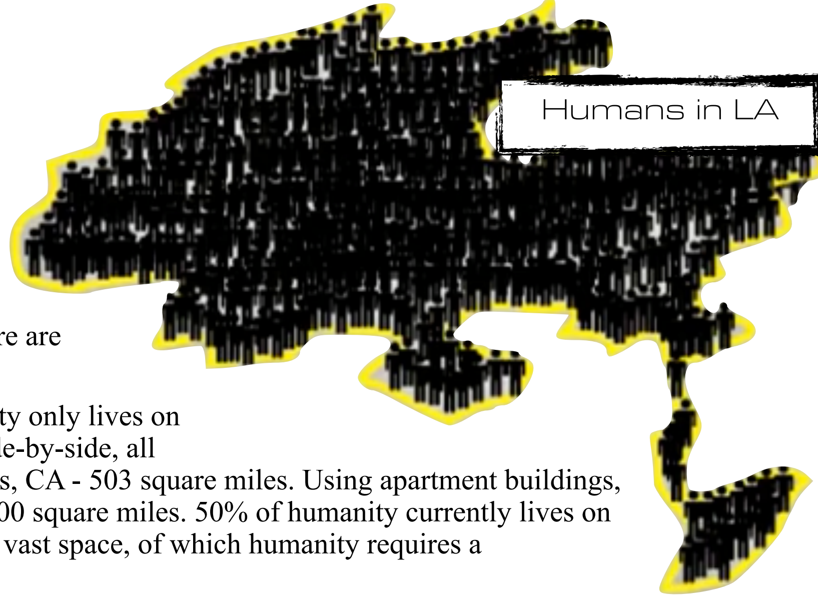
1. How many people are alive?
2. How many are being born?
3. How many are dying and why?
4. What are the characteristics of the living?
5. Where are they all living?

Beyond the basic numbers and simple statistics lies a series of deeper challenges: Who has the right to live? At what point are there "too many" people? What are the impacts and consequences of an expanding population?


Humans on Earth

A. Where is Everyone?

Where Can Humans Live?



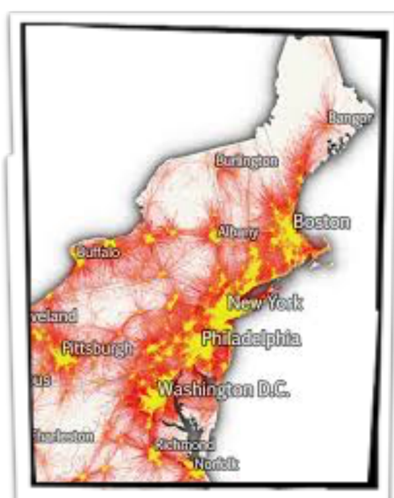
On planet earth, there are an estimated 7.7 billion people, and the number is rapidly growing as a part of a population explosion. Many demographers predict that the human race will exceed 9 billion people by 2050. 7.7 billion is an extraordinary number hard to fathom and spurs many important questions. The first question to be addressed: where are these 7.7 billion people distributed across the planet?

Despite the earth having 196.9 million square miles, humanity only lives on a tiny portion. If every person on the plant was squeezed side-by-side, all the human race could fit within the city limits of Los Angeles, CA - 503 square miles. Using apartment buildings, every human being could “live” in the state of Texas - 269,000 square miles. 50% of humanity currently lives on less than 5% of the earth’s dry land. Therefore, the earth is a vast space, of which humanity requires a minuscule portion.

Humans require ecumenical spaces to exist and thrive. Ecumene are locations where humans can make a permanent residence with sustainable agriculture while also being usable for economic purposes. The site must have the physical characteristics needed for survival: appropriate climate, clean sources of water, soil to support vegetation, appropriate elevation, etc. Ecumenical sites must abide by the goldilocks principle, where everything must be just right. If the space is too hot or too cold, too wet or too dry, too elevated or too low, then the human species will fail to thrive in large numbers. As a result, 90% of humans live above the equator, between 20° and 40° north. This zone is the best suited for growing food while also providing raw materials needed to support large populations. 60% of humanity lives within 300 miles of an ocean.

Thus, the physical features of the site determine the carrying capacity of the region. Carrying capacity is the number of humans that can be reasonably supported with food and clean water by a given area of land. If the population exceeds the carrying capacity, people will die from starvation or dehydration. Regions with a larger carrying capacity will attract and support larger populations. Conversely, regions with a low carrying capacity will support a smaller population. The ideal scenario is for humanity and nature to develop a homeostatic plateau - where there is balance between the consumption and production of resources and the number of people demanding those resources.

The situation of the site also contributes to where people live. Situation takes into account where a place is located in relationship to other surrounding sites and examines how interconnected a place can become to build networks and create a flow of resources. On example is New York City, which is surrounded by Newark, Boston, Philadelphia, and Washington DC. Along with being in a prime location for waterway travel with an inland river and the Atlantic Ocean, its situation allows NYC to be highly interconnected, build networks easily, and allows access to global markets. Contrast that with Bhutan’s situation of being isolated in the Himalayan Mountains, and you can see how situation can either promote or hinder connectivity with other communities.



Something to consider though is that a site’s situation can change over time. Before 1920, Miami, Florida was essentially abandoned swamp land until highways, railways, and refrigerated containers were developed. As the region became interconnected, multinational businesses were able to transport food, water, and building materials into Miami. Now, Miami is no longer a swamp land, but instead a large regional population hub.

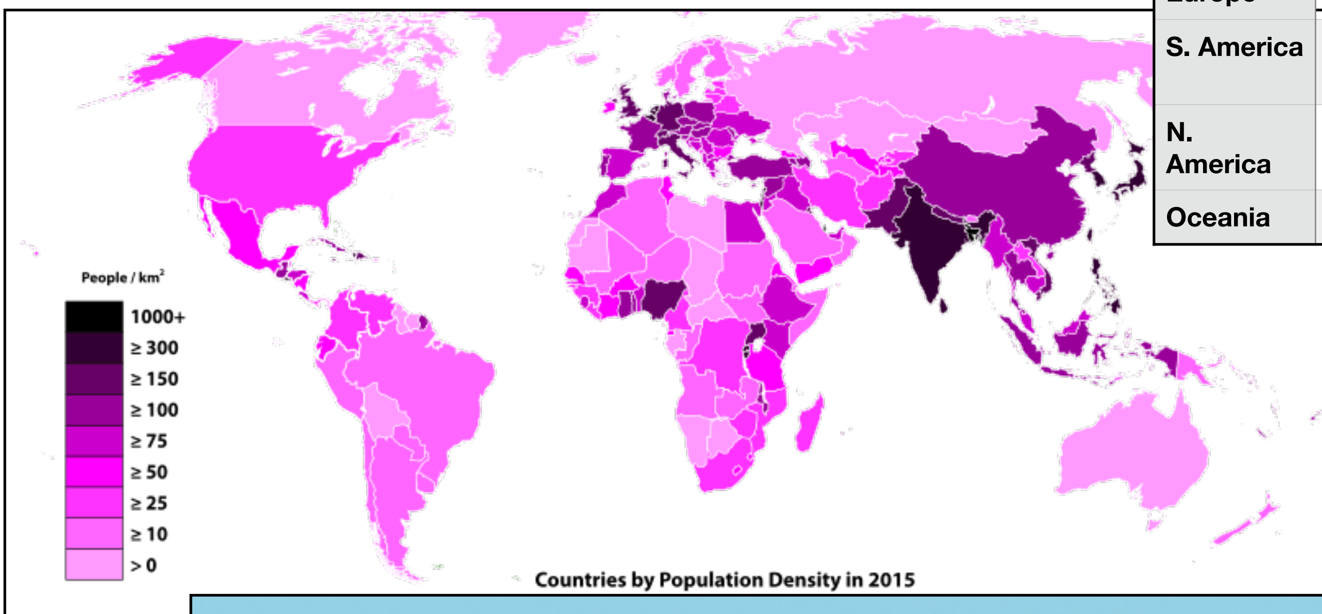
The final elements that contribute to the population's global distribution are the attributes of place: economic, social/cultural, and political. People are drawn most to economic opportunities. The modern capitalist system requires money to purchase necessary food and shelter for survival, and to get this money, a person needs a job. Locations with robust economies and a wealth of job opportunities will grow a large, dense population as people from outside the city migrate in for work. The political factor relates to the governing of the people who live in the place. People tend to migrate towards societies that provide all citizens opportunities and freedoms. Inversely, people tend to flee from oppression. Finally, cultural factors, such as language and religion, can draw people together. People find comfort in populations that speak the same language, worship the same religion, and follow similar cultural traditions as themselves.

Arithmetic Density Across Scales

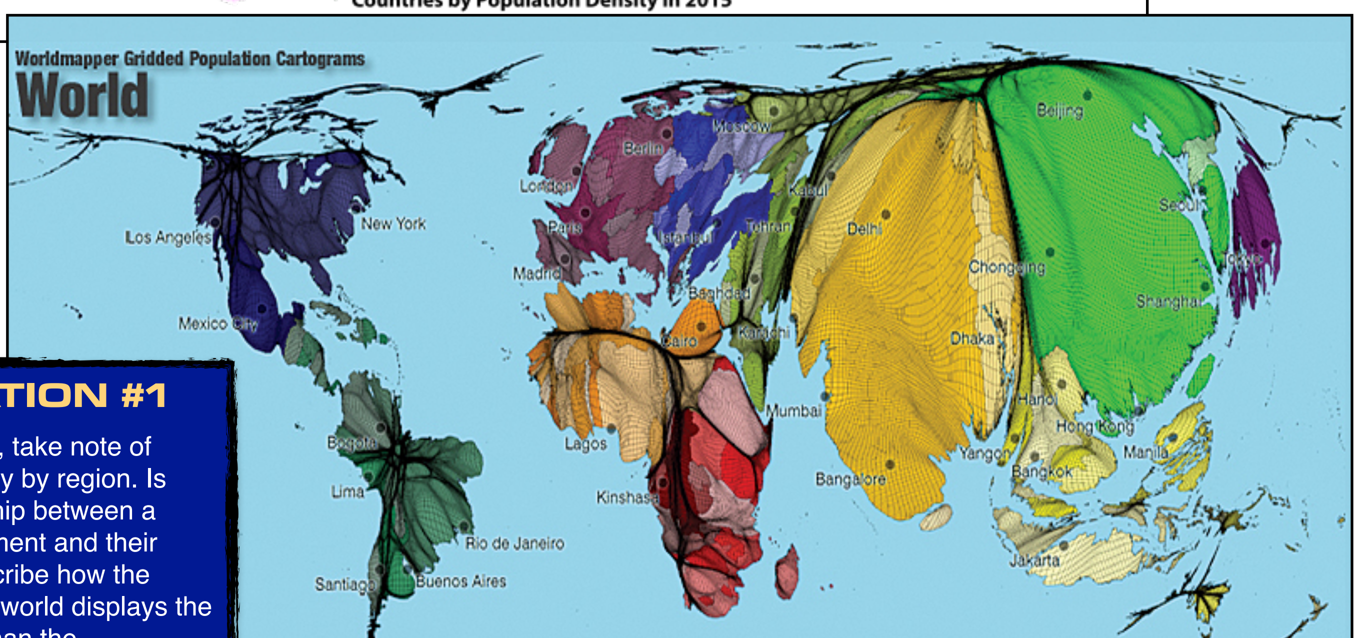
One tool used for measuring population is arithmetic density: the number of people that exist or live per a stated unit of area. For example: 140,000 people *per* mi^2 or 20,000 people *per* km^2.

Global Scale. The human population is not distributed evenly across the planet. Asia dominates the population rankings, with 4.6 billion inhabitants; Africa and Europe come in second and third, respectively.

Continent	Population
Asia	4.6 Billion
Africa	1.3 Billion
Europe	.7 Billion
S. America	.4 Billion
N. America	.3 Billion
Oceania	.04 Billion



Countries by Population Density in 2015



APPLICATION #1

In your notebook, take note of population density by region. Is there a relationship between a regions development and their population? Describe how the cartogram of the world displays the data differently than the chloropleth?

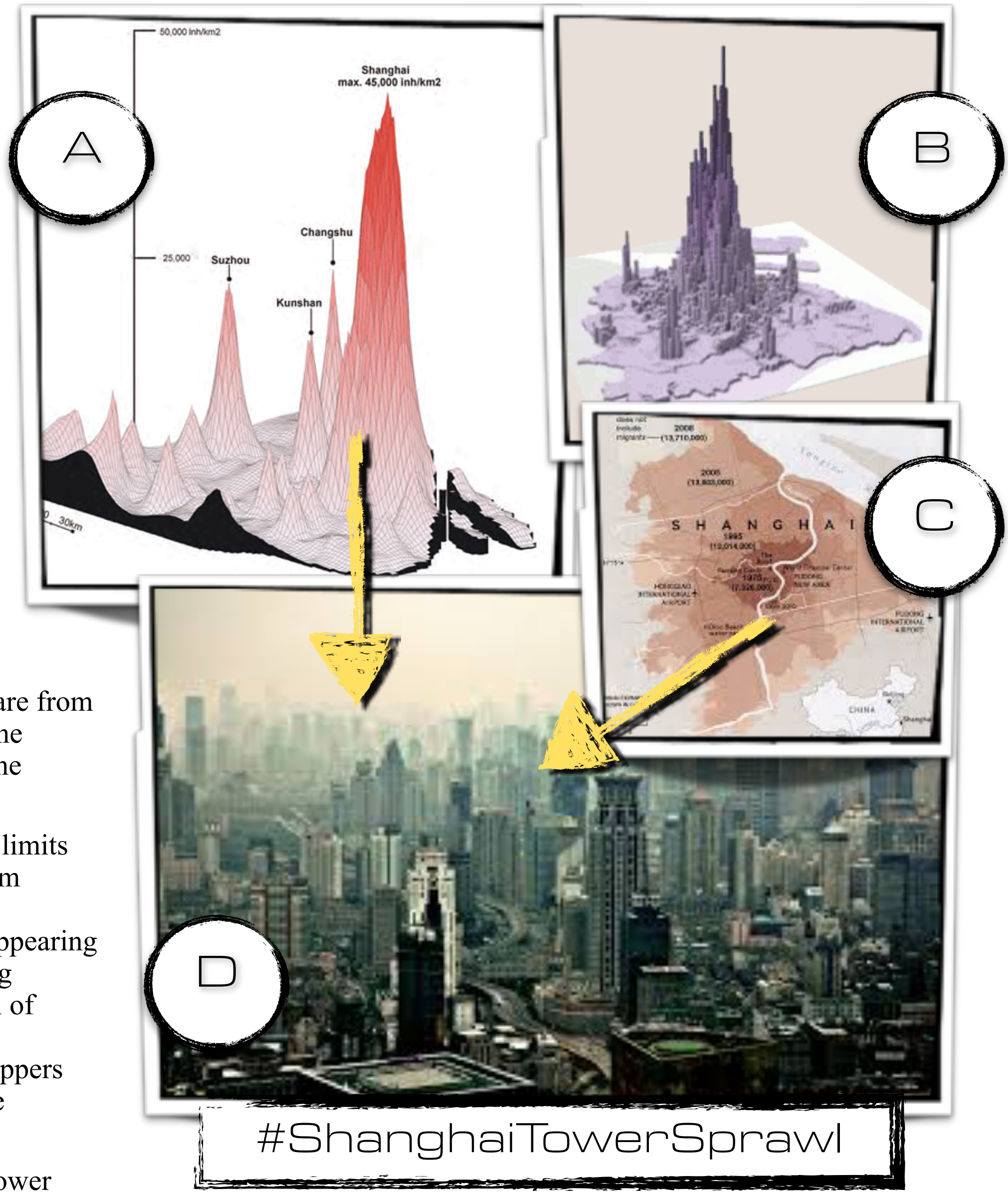
Regional Scale. There are four regions containing the highest arithmetic densities:

- The largest, most populated region is South Asia, with 1.9 billion people. This region, containing India, Pakistan and Bangladesh, is home to 25% of the world's population.
- East Asia is second with 1.6 billion people - 22% of the world's population.
- Southeast Asia (760 thousand), and
- Europe (700 thousand) round out the top four.

National Scale- A Case Study. The broader the scale being analyzed, the more generalized the trend appears on a map or in the data. Inversely, the more local the scale, the easier it is to spot specific variations. This trend also applies to demographics. To understand this phenomenon, let's analyze the world's most populous country: China.

Looking back to the global scaled map at the start of this section, China has the highest arithmetic density in the world with close to 1.3 billion citizens within its borders. At the regional level, China displays an uneven spatial distribution of its population. In western regions like Tibet, there is a low arithmetic density on the same level as the Sahel in West Africa and Central America; where pockets of people are dispersed across a vast frontier. This results from the physical features in the region, namely the Himalayan Mountains and the Gobi Desert meeting the Tibetan Plateau. The physical landscape makes the space difficult to live in, or non-ecumenical, creating a barrier to growth and development. Moving Eastward, population density gradually increases resulting in the moderately high concentrations of people along the Yellow and Yangxi Rivers. Connected by the Grand Canal, the physical landscapes along the rivers are very fertile, providing easy to access clean water, food, and transportation across China. The most densely populated areas exist along the coast where these rivers meet the Pacific Ocean. The industrialized Export Processing Zones and urbanized regions of China are located here, providing an economic and cultural draw pulling hundreds of millions of internal migrants every year for job opportunities and government services.

Zooming to the city level, variations in the population density become apparent:



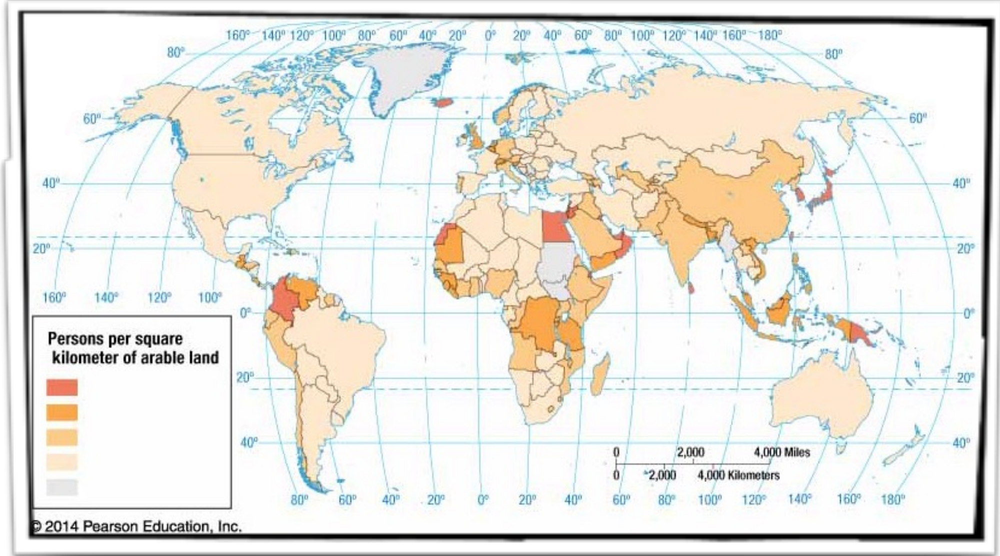
- **Graph A** displays the arithmetic densities of the Shanghai metropolitan area, including the nearby urban centers Suzhou, Kunshan, and Chanshu. The graphic using height to represent points of highest arithmetic density reveals the Central Business Districts (CBD) of Shanghai contains the areas of highest population density, which makes sense since it is at the center of the urban areas and is the economic heartbeat of the city. Urban populations are nodal or functional regions, with the population density experiencing distance decay: the further away they are from the Central Business District (CBD), the greater the decrease in the density of the population.
- **Graph B and Map C** display the city limits of Shanghai. Carrying on the trend from Graph A, the population is unevenly distributed, with the greatest density appearing at the center of the CBD and dispersing towards the edge of the city. This level of density is possible because of vertical architecture - tall buildings or sky scrappers that provide accommodations for more businesses and to house more people.
- Shanghai is currently experiencing “Tower Sprawl,” where the city builds a massive number of tall buildings in a close space to accommodate the rapidly expanding population. Picture D displays the immense quantity of vertical architecture in the heart of the Shanghai. One 24 story apartment building can house 300-400 families, with a 50 story building accommodating close to 800 families. This allows for urban centers to support high arithmetic densities.

The case study of China reveals that urban centers are the highest points of density for the human population. The main draw for people living in urban centers is economic opportunities from the large quantity of tertiary, quaternary and quinary sector job opportunities. These jobs (and available housing) are possible due to investment into infrastructure such as electricity, sanitation and transportation. Infrastructure is easier to provide to the larger number of people when they are grouped together. Higher density urban spaces are especially appealing to women, for whom cities are a means of escaping traditional primary sector activities and the more “traditional female” social roles that are associated with them. Another key draw is the social/cultural aspect of urban centers. The dense populations, plus the massive amount of financial capital available, allows for cities to support entertainment such as sports teams, parks, musicians, and theater.

Physiological Density

As a second measure of density, physiological density is the number of people per arable (farmable) section of land. Physiological density is critical for judging the carrying capacity of a place. If the size of a population puts too much stress on the arable land, it can signal the potential coming of a food crisis. The larger the physiological density number, the more at risk the population is of exceeding its carrying capacity. The smaller the number, the “safer” the population is from a food crisis.

At a global scale, the physiological density for the human population is 325 people per km². This means around the world, there are 325 people per km² of farmland. However, when examined at a different scale, the data changes in its appearance. Singapore has one of the world's highest *physiological density* with 833,333 people per km² of arable land. Japan has an *arithmetic density* of 880 people per km², but due to its mountainous landscape has a *physiological density* of 7,953 people per km² of arable land. Egypt and the Netherlands are also examples of countries with lower arithmetic densities, but high physiological densities. In contrast, Canada and Australia have less than 200 people per km² of arable land.



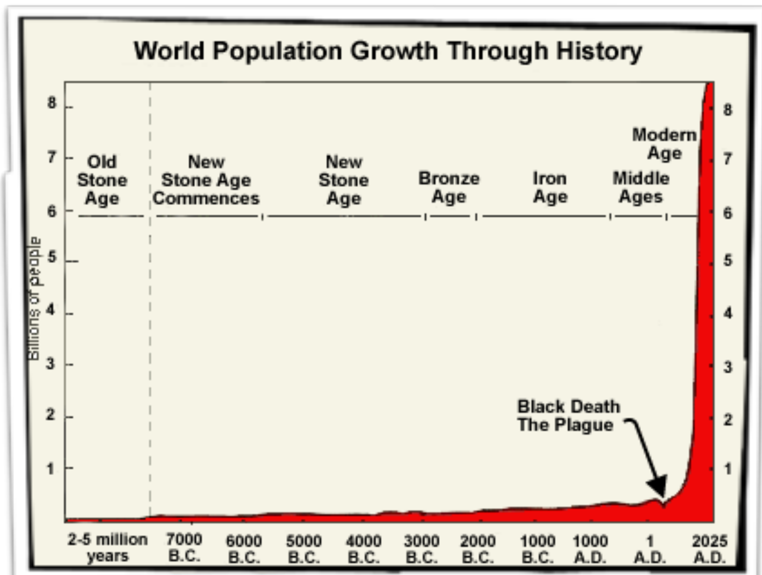
APPLICATION #2

How is the physiological densities of the earth compare to the arithmetic densities?

B. History of Population Growth

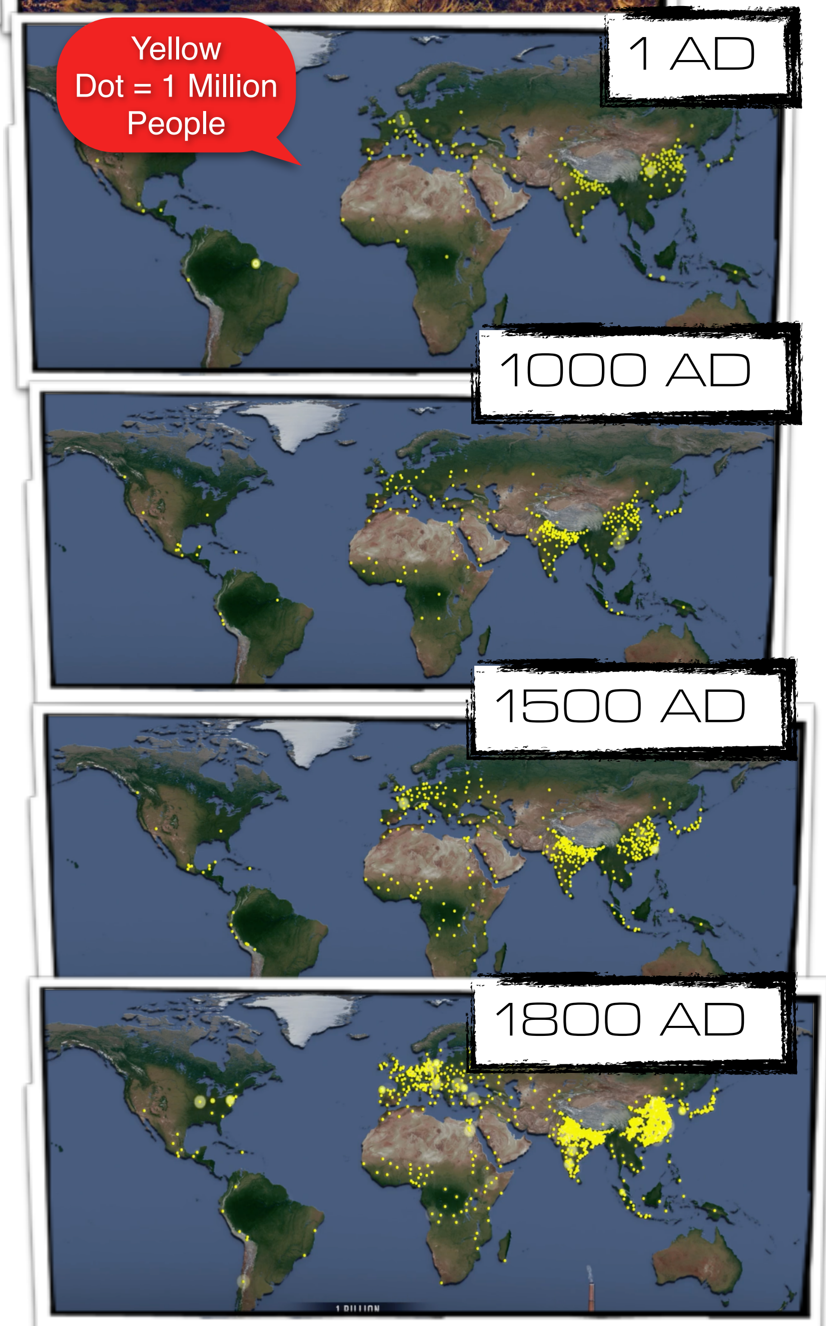
Overview

As of early 2019, the global population is estimated to be at 7.7 billion people, increasing at a rate of 75 million people per year. At this current rate of growth, the human population will reach 8 billion people by 2024 and 9 billion people by the year 2050. Has humanity always been this populous? How did humanity get to this point of explosive population growth?



Hunting-Gathering

Before 10,000 BCE, the estimated total human population across the planet was less than 1 million people. This reflects the vast majority of human history, where human existence was composed of low density hunting and gathering tribes sparsely dispersed across all of Africa, Europe, Asia, and Oceania. Food quantities were small, with the entire human population being preoccupied with the primary sector - searching for its next meal. Because of being constantly on the move, family sizes were relatively small despite high fertility rates. Disease, animal attacks, tribal warfare, and the occasional ice age assisted in keeping the population small, creating an especially high infant and child mortality rate. In certain regions, violence between tribal groups over limited food and water resources was so prevalent that 85% of the population died from the tip of a spear.



Agricultural Revolution

The trajectory of human population was dramatically altered around 10,000 BCE with the invention of agriculture. Agriculture is the human domestication of plants and animals for use and consumption. Farms and ranches began to form in the key River Valley Regions: Mesopotamia (Iraq), the Nile River (Egypt), the Indus River (Pakistan), and the Yellow River (China). Farms represented a stable, reliable food source that could be grown in larger quantities to support large populations. With a stable food supply, birth rates increased and infant mortality rates mildly decreased. By 1,000 BCE, the global human population had exceeded 50 million people, and societies emerged with stunning architecture, intensive subsistence farms, local governments, local division of labor, and trade networks.

Soon, these settlements became interconnected by inland trade routes like the Silk Road. Settlements grew into civilizations consisting of assorted cities. Egypt, China, Europe, and Mesopotamia's fertile areas caused a massive population growth, resulting the in birth of kingdoms and empires. These locations allowed a high carrying capacity, being able to sustain larger human populations. New tools and techniques further increased the quantities of food produced, creating job specialization and the division of labor. Advancements in architecture created healthier living standards, which increased life expectancy. As the populations of the urban centers grew, new settlements would break off in search of fertile land to settle. Humanity began to fill the globe.

However, agriculture and advanced societies caused an uneven distribution of the population. Higher densities gathered in the fertile regions between the 20°-40° zones, forcing hunting and gathering groups into the sparsely inhabited non-ecumenical lands. These areas had difficult terrain, like highlands, mountains, and deserts. The hunters and gathers could not compete with the dense and expanding urban centers in either size, resources, or technology.

The rapidly expanding population faced a new set of problems never encountered by humans on a global scale before. The first barrier was animal borne contagious/infectious diseases from domesticated animals transmitted to human populations. These diseases became plagues that wiped out large segments of the population. As humans began to increase regional interaction through trade and war, sharing germs would cause devastating disease outbreaks. Empires were won through battle and conquest, also resulting in a great number of deaths through warfare. What war did not kill, ignorance did. While new tools improved harvests, humanity did not yet know how to properly care for the soil. Growing the same crops year after year in the same soil drained the soil of its nutrients, eventually causing sudden and severe famines. Finally, settled populations people became more vulnerable to natural disasters such as floods, fires, earthquakes, hurricanes, tornados and tsunamis.

Despite plagues, natural disasters, and wars, the human population continued to expand and develop, and by 1 CE, the population had reached 170 million. In 1500 CE, on the eve of massive European colonization, the global population was 425 million. European colonization, paired with the advances of the various scientific revolutions in Europe and Asia, assisted the human population in achieving 1 billion people by 1800. This early stage of humanity was driven by environmental determinism, where nature dictated what was possible. The bulk of the population existed in South and East Asia, with strong growth in Western Europe. These areas had large areas of arable land in the 20°-40° zone while also being located close to the hearth of the human species. The Americas were just beginning to experience significant population expansion.

Industrial Revolution

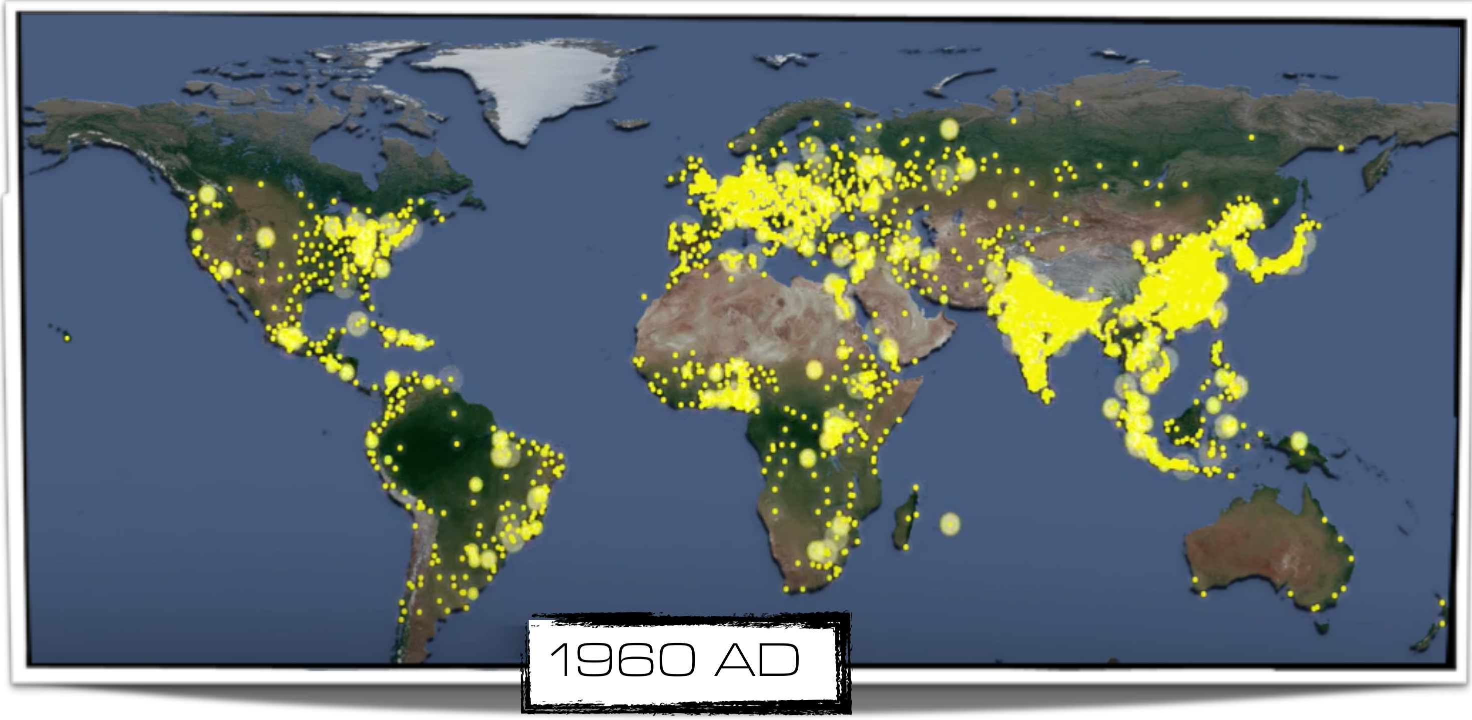
In the late 1700s, the English developed the steam engine, kicking off the Industrial Revolution. The invention of engine-driven machines drastically changed the trajectory of what was "possible."

One of the most important inventions to come out of the 1800s was the tractor, allowing one person to accomplish the work of multiple people in a fraction of the time. Tractors could till up soil that had previously been too hard to break apart with either human or animal labor, resulting in a massive boom of food availability. Using machines, there was a reduction in the number of farmers needed to prepare the land, while also providing larger harvests. Thus, the primary sector shrank while productivity increased. These former farm workers moved from the rural regions into urban settlements, and city populations boomed. New urban settlements rapidly appeared around factories, and London's population grew from 1 million people in 1800 to 5 million in 1880.

These cities became interconnected by networks of industrial transportation and communication, and the development of trains and steam-powered ships allowed mass quantities of affordable food from around the world to reach these large, highly dense urban population centers faster. Economically, the abundance of food being produced caused the price of food to drop. More people lived in urban areas, working secondary and tertiary sector jobs to pay for food. As a result, more people were nourished, became healthier, and lived longer. This was especially true of children and infants, whose mothers' could provide more stable sources of nutrition.

The Scientific Revolution, infused with the power of industry, began to mass produce new inventions that had profound impacts on the population. As people migrated to the cities from farms, better infrastructure and vertical architecture was designed to support the influx of people. Products were made cheaper, faster, and in large quantities; allowing people to have a better quality of life for less money. Germ Theory was discovered, along with the invention of medicines and antibodies that cured devastating plagues like Tuberculosis, Polio, Mumps, Measles, and Malaria. Vaccines were soon developed that prevented people from contracting these diseases at all. Scientists began to eliminate and mitigate humanity's worst threats.

With increased nourishment and decreased death from disease, the global population exploded. Humanity had previously kept a high fertility rate because of the high death and infant mortality rate. However, with newly increased food security, life expectancy began to increase while infant mortality decreased. This resulted in a massive increase in the total population on earth. It had taken humanity over 10,000 years to go from 1 million people to 1 billion people on the planet. The world reached two billion people in 1927. The population increased to 3 billion people by 1960, and that included massive loss of life from fighting two world wars. At this point humanity faced a new problem: what if our population continues at this rate of growth and we outgrow our food and resources?



Green Revolution

In response to the question of *What if we outgrow the earth's carrying capacity?,* businesses and universities began to research potential solutions. In the 1960s, a wave of new technological inventions dramatically increased the production of food. The first invention was chemically designed fertilizers which put nutrients back into the soil, increasing the amount of food produced per harvest. The fertilizers were paired with the invention of pesticides and herbicides that killed common pests and weeds that damaged crops. Scientists learned to manipulate the genetic code of plants, altering crops to produce a higher yield and to be more drought and pest resistant. These three products drastically altered the course of food production, helping farms grow more food on less land, while producing more than enough food to keep pace with population growth. These technologies became known as the Green Revolution.

Paired with the Green Revolution was a transportation and communication revolution that drastically reduced space-time compression around the globe. Trips that used to take weeks, now only took hours, or days, thanks to steamboats, trains and personal automobiles. Along with the faster travel time came containerization: the development of the shipping container for storing and shipping food and items. Containers stored single products in each bin, with each bin stacked on top of each other then lifted and moved from a boat to a train to a truck with ease. Containerization was invented around the same period as refrigeration, preservatives, and improved packaging. This allowed more food to travel faster between countries, reducing the amount lost to spoilage. All these inventions put together allowed for more food to travel more places without spoiling to feed more people affordably. Cities that were connected to these new supply chains were able to supply urban centers with food from around the world. This allowed billions of people to be fed nutritious food every day of the year.

The rapid development of new medicines, transportation, and farming technologies helped increase global carrying capacity. These changes increased life expectancy, decreased infant/child/maternal mortality, resulting in a further a population explosion. The world's total population grew: 4 billion in 1975, 5 billion in 1990, 6 billion in 1999, and 7 billion in 2011. Projections hold that the population will grow to 8 billion people in 2024, and 9 billion by 2042. There will be more babies born today than there were alive on the planet in 1 CE.

The question is:

What can be done to slow this massive growth?

PERSONAL CONNECTION
In your notebook: Is the world as populated as you had imagined it to be? Is there anything that you learned about the human population and its distribution or density that surprised you? What concerns should humans have concerning out population size or growth?