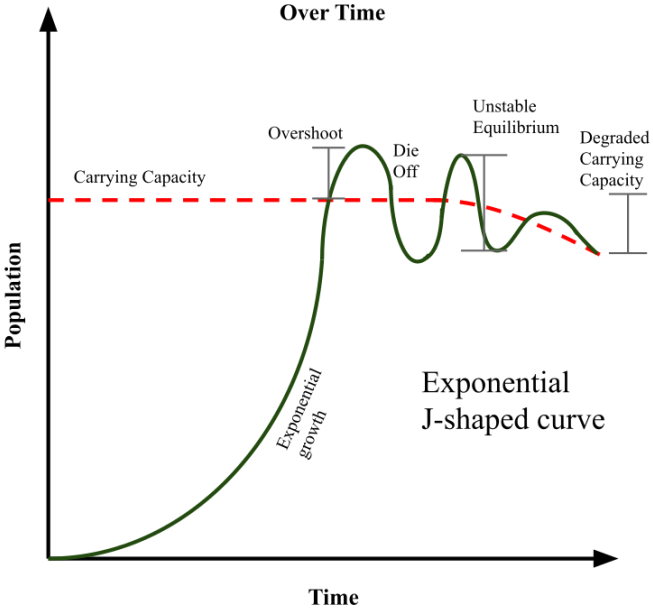
Lesson 6 - Human Population and Carrying Capacity (8.4)

Purpose - Understand and apply the concept of carrying capacity to human populations.

1. Discuss - What is carrying capacity based on this picture?

Figure 1: Exponential Growth of Population Size Over Time

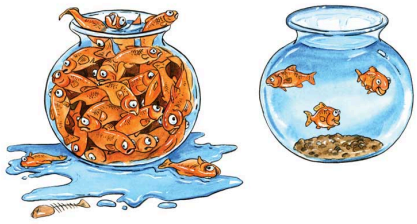


Carrying capacity is the amount of organisms within a region that the environment can support sustainably

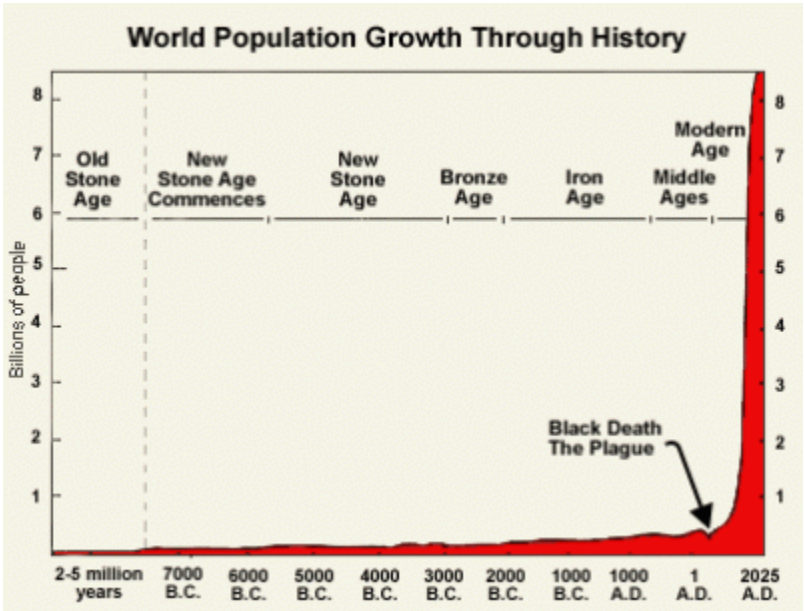
Overshoot occurs when the population growth exceeds the carrying capacity, leading to a die off for the individuals in the population

Unstable equilibrium is the fluctuation of the population above and below the carrying capacity, changing based on the relationship between natality and mortality

Degraded carrying capacity may be due to resource destruction during an overshoot, carrying capacity is not static



a. What factors often influence carrying capacity in nature?
b. Have humans shown a “carrying capacity?”



c. How have humans overcome many of the challenges in nature to increase our own population? (p. 392-393)

2. Discuss - Environmental Value Systems
    a. Pick a value system - ecocentric, technocentric, or anthropocentric.
    b. How would a person with that value system approach challenges of carrying capacity factors for humans?

3. Ecological Footprint Comparison - Go to the Global Footprint Network.

    a. Click on “Explore Data - Compare Countries”

    b. Check that you are on
    c. What are the top 10 and bottom 10 countries shown on this graph?
    d. What might be some reasons that a country is in the top 10 or bottom 10?

4. Test Review 4 - IB ESS Exam Overview - How to take the test. Review old exams for style and planning.

5. Practice - Read and discuss (or write) questions 1-8 with a partner or small group. Check your answers below AFTER attempting the work.

To do

Ecological footprints of MEDCs and LEDCs

Data for food consumption are often given in grain equivalents, so that a population with a meat-rich diet would tend to consume a higher grain equivalent than a population that feeds directly on grain. Look at the data in figure 8.4.7.

Population from	Per capita grain consumption kg yr^{-1}	Local grain productivity kg ha^{-1} yr^{-1}	Per capita CO_2 emissions from fossil fuels kg C yr^{-1}	Net CO_2 fixation by local vegetation kg C ha^{-1} yr^{-1}
Africa	300	6,000	200	6,000
North America	600	300	1,500	3,000

▲ **Figure 8.4.7**

1. What does the high per capita grain consumption in North America suggest about the diet?
2. What does the local grain productivity suggest about the two farming methods in use?
3. Which population is more dependent on fossil fuels? Explain.
4. Why is there a difference in the net CO_2 fixation of the two regions?

These, and other factors, will often explain the differences in the ecological footprints of populations in LEDCs and MEDCs.

5. Calculate the per capita ecological footprint (food land and CO_2 absorption land only) for each region, using the two stated formulae.

$$\frac{\text{per capita food consumption (kg yr}^{-1}\text{)}}{\text{mean food production per hectare of local arable land (kg ha}^{-1}\text{ yr}^{-1}\text{)}}$$

$$\frac{\text{per capita CO}_2\text{ emission (kg C yr}^{-1}\text{)}}{\text{net carbon fixation per hectare of local natural vegetation (kg C ha}^{-1}\text{ yr}^{-1}\text{)}}$$

6. State two differences you would expect between the ecological footprint of a city in a LEDC and that of a city in an MEDC.
7. It has been calculated that the ecological footprint of Singapore is 264 times greater that the area of Singapore. Explain what this means.
8. Assume that in a large city with a stable population, the proportion of the population that has a vegetarian diet increases. Explain how and why this change might affect the city's ecological footprint.

Answers for Part 5 above.

1. High per capita grain consumption implies that people have lots of grain based foods to eat in their diet, like breads and cereals.
2. The high grain productivity in Africa (6,000 kg/ha/yr) implies a more intensive use of the land. They probably are able to have plants closer to each other due to less use of machinery, and probably get more than one crop per year as the climate is warmer all year. This also implies more land overall is used for farming. In North America, the productivity is much lower, showing less grain grown on the land overall and less farming overall.
3. North America is more dependent on fossil fuels based on the much higher per capita emissions of 1,500 (kg x C)/yr.
4. Carbon Dioxide fixation is when plants are able to take in the CO2 and incorporate it into their structure. Since Africa has a higher rate of farming overall, there are more plants on the land to take in CO2 and fix carbon. Additionally, lots of carbon ends up in the soil. Since Africa uses less intense farming practices, its soils are left intact helping carbon to stay in place.
5.

Eco Footprint (of food land) per capita	Africa	North America
Food	300/6000 = .05	600/300 = 2
CO2	200/6000 = .03	1500/3000 = .05

6. Answers will vary - Here are some common themes for differences of eco footprint in a city
    a. LEDC will have a smaller footprint because more people live within a dwelling.
    b. MEDC will have a larger footprint because they use more energy for heating, cooling, and entertainment.
    c. MEDC will have a higher footprint because they eat more meat on a regular basis.
    d. LEDC will have a smaller footprint because less people have cars for transportation.
7. This means that Singapore is consuming more resources than it has within its geographic borders. That implies that Singapore must import most of its resources from other countries.
8. If more people eat a vegetarian diet, then the ecological footprint of that place will go down overall. There are lots of extra resources required to support a meat eating diet. These resources mainly include extra water and food for animals in addition to the increased use of fossil fuels often required to support the farm systems we currently have in place.