

Name \_\_\_\_\_ Period \_\_\_\_\_ Date \_\_\_\_\_

## Eating at a Lower Trophic Level

### Purposes

- Calculate and compare human food needs at different trophic levels, using the data to construct a biomass pyramid
- Analyze the benefits and drawbacks of eating at lower trophic levels on a global scale

### Background

A trophic level, or feeding level, is made up of all the organisms whose energy source is the same number of consumption steps from the sun in a given ecosystem. The trophic level of plants or producers is 1, while that of herbivores is 2 and that of animals that eat herbivores 3. Higher trophic levels can exist for animals even higher on the food chain. In this exercise, you will compute numerical values for human energy needs based on diets at different trophic levels.

In this case study the owner of a farm raises soybeans and chickens. Grasshoppers feed on the farmers soybeans, and are in turn eaten by the chickens. Humans can, though rarely do, eat grasshoppers for sustenance. Humans can also eat soybeans. For the purpose of this exercise, make the following assumptions:

- A human requires 1 chicken/day
- There are 365 days/year
- 1 chicken eats 25 grasshoppers/day
- 1 grasshopper requires about 30 g of soybeans/year
- 1,000 grasshoppers have a mass of 1 kg
- 1 human requires about 600 grasshoppers/day
- Dry soybeans have about 3.3 cal/g
- There are 1,000g/kg
- A typical human requires 3,000 cal/day

**Show all of your math calculations with proper unit labels!**

1. How many grasshoppers does a chicken need to survive for a year?

2. How many chickens would a human need to survive for one year?
  
  
  
  
  
  
  
  
  
  
3. How many grasshoppers are needed for a year's supply of chickens for one human?
  
  
  
  
  
  
  
  
  
  
4. What is the total mass, in kilograms, of the grasshoppers needed to feed all of the chickens required to feed a human for one year?
  
  
  
  
  
  
  
  
  
  
5. How many kilograms of soybeans are needed to feed all of the grasshoppers (calculated in question #3) for one year?
  
  
  
  
  
  
  
  
  
  
6. Now let's assume we decide to eat grasshoppers (yummy!) instead of chickens. How many people could the grasshoppers feed for a year compared to the one human that the chickens (calculated in question #2) fed for a year?*Hint: Use your answer from #3 as a starting point*

7. Next, let's eat only soybeans for a year instead of chickens or grasshoppers. How many people could we feed using the soybeans fed to grasshoppers (calculated in question #5)?
  
8. Draw a biomass pyramid using the data you have calculated to this point. Label the trophic levels. Assume that 1 chicken has 1 kg of biomass and 1 human has 59 kg of biomass.
  
  
  
  
  
  
  
  
  
  
9. Why do most terrestrial (land-based) food chains tend to have less than five trophic levels?
  
  
  
  
  
  
  
  
  
  
10. Generally speaking, would we be able to feed more humans if we ate at a lower trophic level more often? Why or why not?
  
  
  
  
  
  
  
  
  
  
11. Much of the earth's land area is covered by grasslands that are too dry to cultivate crops but capable of supporting grazing animals (bison, antelope, cattle, sheep, etc.) on a sustainable basis. Humans are incapable of effectively digesting grass. On the dry grasslands, eating at what trophic level would produce the most food for humans?



13. Roughly estimate what percent of your diet comes from the first trophic level.

14. Roughly estimate what percent of your diet comes from the second trophic level.

15. Roughly estimate what percent of your diet comes from the third or higher trophic levels.

16. Large predatory marine fish (ex: tuna, swordfish, marlin, shark, etc.) usually eat at the third through seventh trophic levels. Is it efficient for humans to rely heavily on these species as food sources? Why or why not?