



Quantitative

Eating *at a Lower Trophic Level*

PURPOSE

- 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.

Problem

The owner of a soybean farm raises guinea hens for food and insect control. Guinea hens will eat grasshoppers and other insect pests and ticks. They also act as a “watchdog” by making a lot of noise when intruders approach their territory. The farmer allows the hens free range in his fields during the day and provides roosts for them at night.

For purposes of the following exercises, you may make these assumptions:

- the farmer lives on 1 hen/day for a year
- 1 hen eats 25 grasshoppers/day
- 1,000 grasshoppers have a mass of 1 kg
- 1 grasshopper requires about 30 g of soy/yr
- 1 human requires about 600 grasshoppers/day
- dry soybeans have about 3.3 cal/g



Show all your math using *proper units*.

1. Calculate the number of grasshoppers a hen needs per year.
2. How many grasshoppers are needed for a year's supply of hens for the farmer each year?
3. What is the total mass, in kilograms, of the grasshoppers needed to feed all the hens for one year?
4. How many kilograms of soybeans are needed to feed all the grasshoppers for one year?
5. Estimates of early Native American hunter-gather societies indicate that a person could collect about 90 kg (200 lb) of grasshoppers per hour, when they are abundant. Now suppose the farmer chose to eat grasshoppers instead of hens. How many people could the grasshoppers feed, compared to the one person that the hen fed?

6. The farmer needs to consume 3,000 cal/day. If he ate only soybeans instead of the hens or the grasshoppers, how many people would his soybean crop feed (see your response to Question 4)?

7. Draw a **Biomass Pyramid**, using the data you have developed to this point. Why do most food chains not have a fourth and/or fifth trophic level?

8. Should people generally eat at a lower trophic level? It seems, by a simple analysis, that the Earth could support many more people if we all ate at a lower trophic level.

a. Outline three pros and three cons of such a practice.

b. On average, cows produce 19 kilograms of protein/acre/year and soy produces 200 kilograms of protein/acre/year. Relate these data to the fact that people in the less-developed countries usually eat at lower trophic levels than those in developed countries.

9. Comment on the success of omnivores, such as coyotes, rats, and humans, and the fact that they can eat at many trophic levels.

Exercises

Questions

10. List the foods you have eaten over the last five days.

a. Identify what trophic level each food came from.

b. Estimate what percent of the mass of the food in your diet comes from the first and second trophic levels.

c. What percent of your diet comes from higher trophic levels?

11. Large predatory fish, which may be part of your diet at times, usually exist at the third or fourth trophic level. Explain why it may not be a good idea to eat these fish often, if at all.
