Food pyramids

When an insect eats leaves, energy stored in the leaves is transferred to the insect. When a bird eats the insect, energy stored in the insect is transferred to the bird. The same transfer of energy also occurs when killer whales eat salmon and when you eat meat, vegetables, and fruit. However, not all of the energy that organisms obtain by eating other organisms is stored (Figure 2.12). Food energy is used as you and all other living things work to obtain and digest food, repair damaged tissues, and move. Food energy is also lost when some food remains undigested and is excreted as feces. Between 80 and 90 percent of the food energy taken in by you and other organisms is used for chemical reactions in the body and eventually is lost to the ecosystem as heat. Very little food energy is used for growth or to increase biomass.

A food pyramid is a model that shows the loss of energy from one trophic level to another (Figure 2.13 on the next page). Food pyramids are often referred to as ecological pyramids. There are several types of ecological pyramids such as pyramids of biomass, numbers, and energy (see page 66). The amount of life that an ecosystem can support is determined by the amount of energy captured by producers. A desert or tundra ecosystem with little vegetation cannot support many organisms.

Because of the 90 percent decrease in energy from trophic level to trophic level, an ecosystem supports fewer organisms at the higher trophic levels. Therefore, the lower the trophic level, the higher the number of organisms that can be supported by the ecosystem. Healthy grassland ecosystems can support many herbivores such as mice and jackrabbits, which, in turn, can support large numbers of carnivores such as coyotes.

Food pyramids illustrate that most of the Sun’s energy that is trapped by plants flows out of an ecosystem. Food pyramids also show how important plant life is for making energy available in ecosystems. Maintaining the biodiversity of plants in an ecosystem is essential for maintaining viable food webs.
### Comparing Ecological Pyramids

<table>
<thead>
<tr>
<th>Type of Ecological Pyramid</th>
<th>Diagram</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A pyramid of numbers shows the number of organisms at each trophic level.</td>
<td>10 tertiary consumers 90,000 secondary consumers 200,000 primary consumers 1,500,000 primary producers.</td>
<td>The sizes of individual organisms vary greatly, therefore their energy needs vary greatly. The range of numbers from the producers to the tertiary consumers may be so great that it is impossible to represent the scale of the pyramid accurately.</td>
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<tr>
<td>A pyramid of biomass shows the number of organisms at each trophic level multiplied by their mass, which compensates for differences in size among organisms.</td>
<td>1.5 g/m² tertiary consumers 11 g/m² secondary consumers 37 g/m² primary consumers 809 g/m² primary producers.</td>
<td>In some ecosystems, the biomass of lower trophic levels can be less than that of higher trophic levels. For example, in aquatic ecosystems, pyramids of biomass may be inverted because of the rapid reproduction rates of primary producers such as algae.</td>
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<tr>
<td>A pyramid of energy shows the amount of energy that is available at each trophic level.</td>
<td>0.1% tertiary consumers 1% secondary consumers 10% primary consumers 100% primary producers.</td>
<td>It is difficult to obtain exact values of available energy in an ecosystem.</td>
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</tbody>
</table>

1. How do fungi decompose leaves?
4. Put the following organisms in order from lowest trophic level to highest trophic level. (a) snake (b) eagle (c) grass (d) mouse
6. Give an example of each of the following. (a) a secondary consumer (b) a tertiary consumer (c) an omnivore
8. In the diagram below, identify each of the following. (a) producers (b) primary consumers (c) secondary consumers (d) tertiary consumers
12. In the following diagram of a food web, identify which letter represents a species that:
   (a) is the producer
   (b) has the greatest biomass
   (c) has the smallest biomass
   (d) could be a caterpillar
   (e) could be a decomposer

13. If there are 1,000,000 kcal/m² in the producer level of a food pyramid, how many kilocalories will be incorporated into the bodies of the following, if there is a 90 percent energy loss at each level? (a) primary consumers (b) secondary consumers (c) tertiary consumers
1. Define these terms, refer to page 63 (do not use the glossary).

a) **Ecological pyramid**: There are generally three types:

   __________________________________________

   __________________________________________

   __________________________________________

b) **Food pyramid**:

   __________________________________________

   __________________________________________

   __________________________________________

c) There is no definition, but based on what you know about ecological and food pyramids, define what a **Biomass pyramid** is:

   __________________________________________

   __________________________________________

   __________________________________________

2. True or false. Refer to pages 63, 64, and 66.

a) When one organism eats another, energy is transferred. __________

b) All of the energy organisms obtain through eating is stored. __________

c) Food energy can be stored, used for everyday activities, or lost in feces. __________

d) Between 10 – 20% of the food taken in is used for chemical reactions in the body. ______

e) Very little food energy is used for growth or to increase biomass. ______

f) As trophic levels increase, the amount of stored energy decreases. _______

g) Plants always form the top of food pyramids. _________

h) A pyramid of numbers does not accurately represent the ecosystem because the range of numbers is often so great. ______

i) A pyramid of biomass is more accurate as it compensates for organism size. ______

j) A pyramid of energy is easy because of exact values of energy are available. ______

3. Four of the questions above are false. Rewrite them so they are correct.

   __________________________________________

   __________________________________________

   __________________________________________

   __________________________________________

4. Copy the pyramid of energy (pg 66) in the space to the right. Be sure to include all the labels, arrows, and text. Colour it.
5. Think: In a temperate climate, which animal would require more energy, a reptile or mammal (assume that they have the same mass)? ____________ Explain (see pg 63)
___________________________________________________________________________
___________________________________________________________________________

6. In which ecosystem could a pyramid of biomass be inverted (answer on page 66). Why?
___________________________________________________________________________
___________________________________________________________________________

7. Checking concepts (page 67). Do # 1, 4, 6, 8, 12, 13. Write complete sentences.
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