

CHAPTER

5

Evolution and Community Ecology

YOUR WORLD
YOUR TURN



Lesson 5.3 Ecological Communities

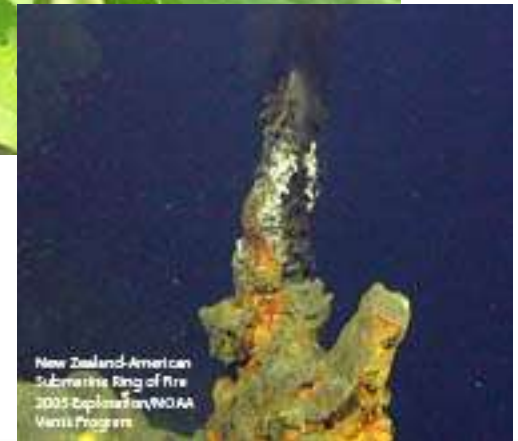
<https://www.youtube.com/watch?v=Gu2EzAlsVQU>

The sun provides the energy for almost all of the ecological communities and species interactions on Earth.



Primary Producers (Autotrophs)

- Capture energy from the sun or from chemicals and store it in the bonds of sugars, making it available to the rest of the community
- Energy from the sun is captured by plants, algae, or bacteria through photosynthesis.
- Energy from chemicals is captured by some bacteria through chemosynthesis.

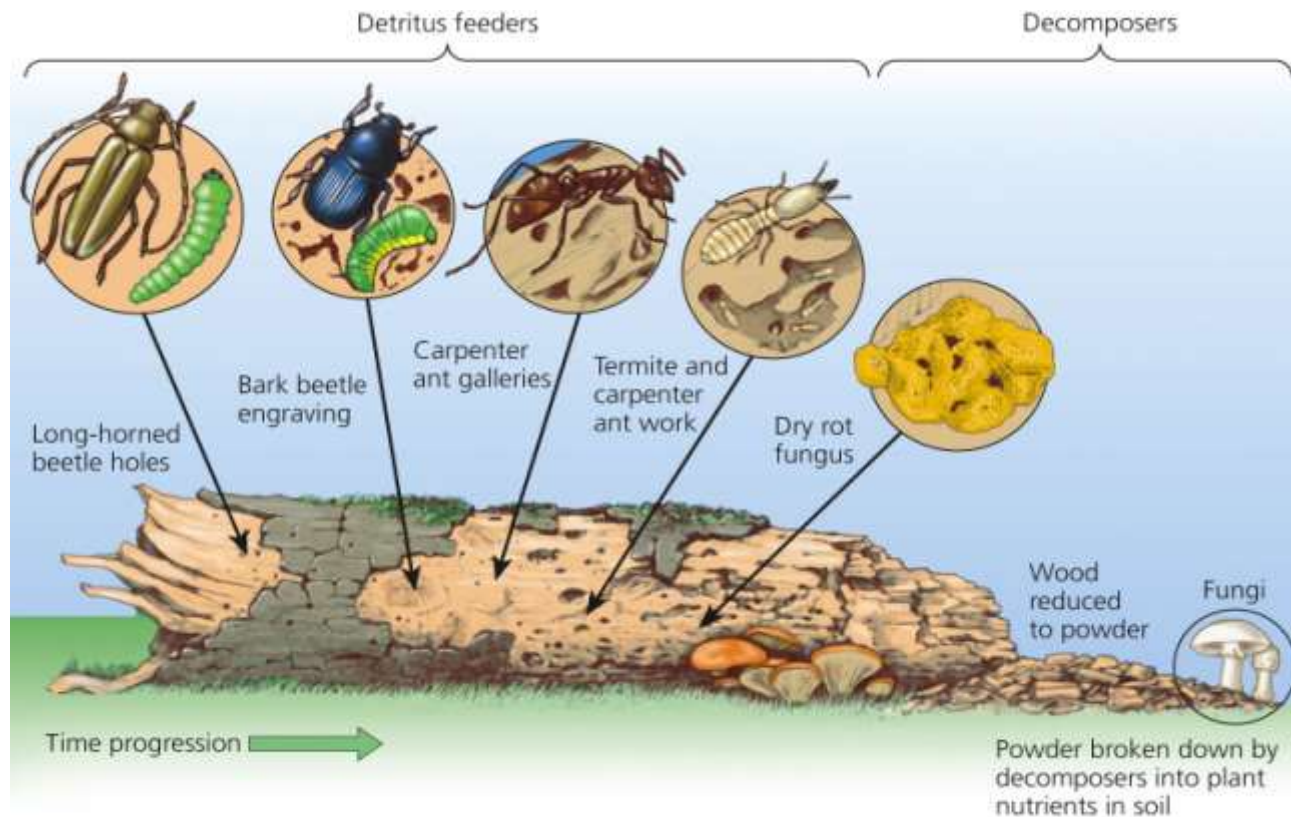


Did You Know? Deep-sea vents, far from sunlight, support entire communities of fish, clams, and other sea animals, which depend on energy converted through chemosynthesis.

Consumers (Heterotrophs)

- Rely on other organisms for energy and nutrients
 - **Herbivores:** plant-eaters
 - **Carnivores:** meat-eaters
 - **Omnivores:** combination-eaters ; plants and meat

Detritivores and decomposers: recycle nutrients within the ecosystem by breaking down nonliving organic matter



Producers and Consumers Are the Living Components of Ecosystems (2)

- **Decomposers**

- Consumers that release nutrients
- Bacteria
- Fungi

- **Detritivores**

- Feed on dead bodies of other organisms
- Earthworms
- Vultures

Energy Flows Through Ecosystems in Food Chains and Food Webs

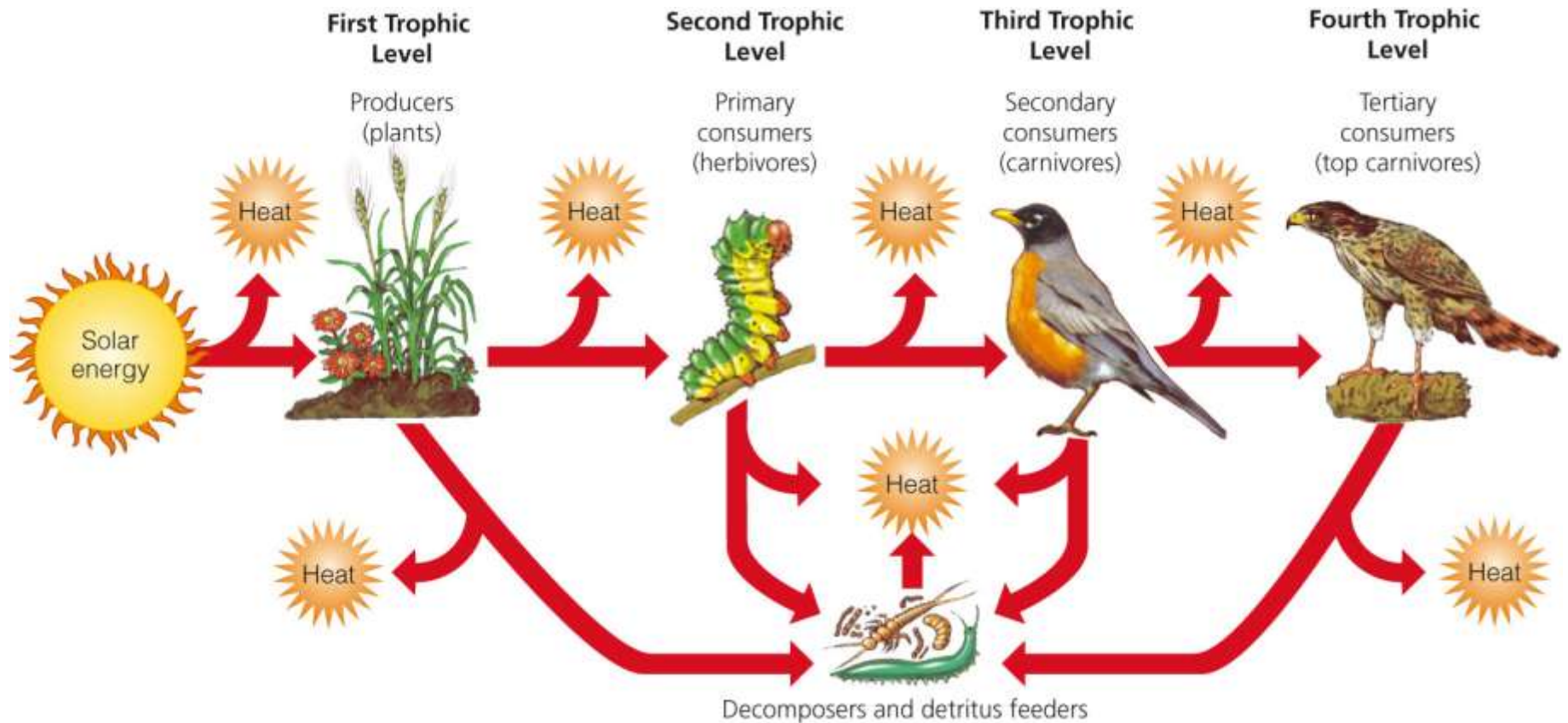
- **Food chain**

- Movement of energy and nutrients from one **trophic level** to the next
- Photosynthesis → feeding → decomposition

- **Food web**

- Network of interconnected food chains

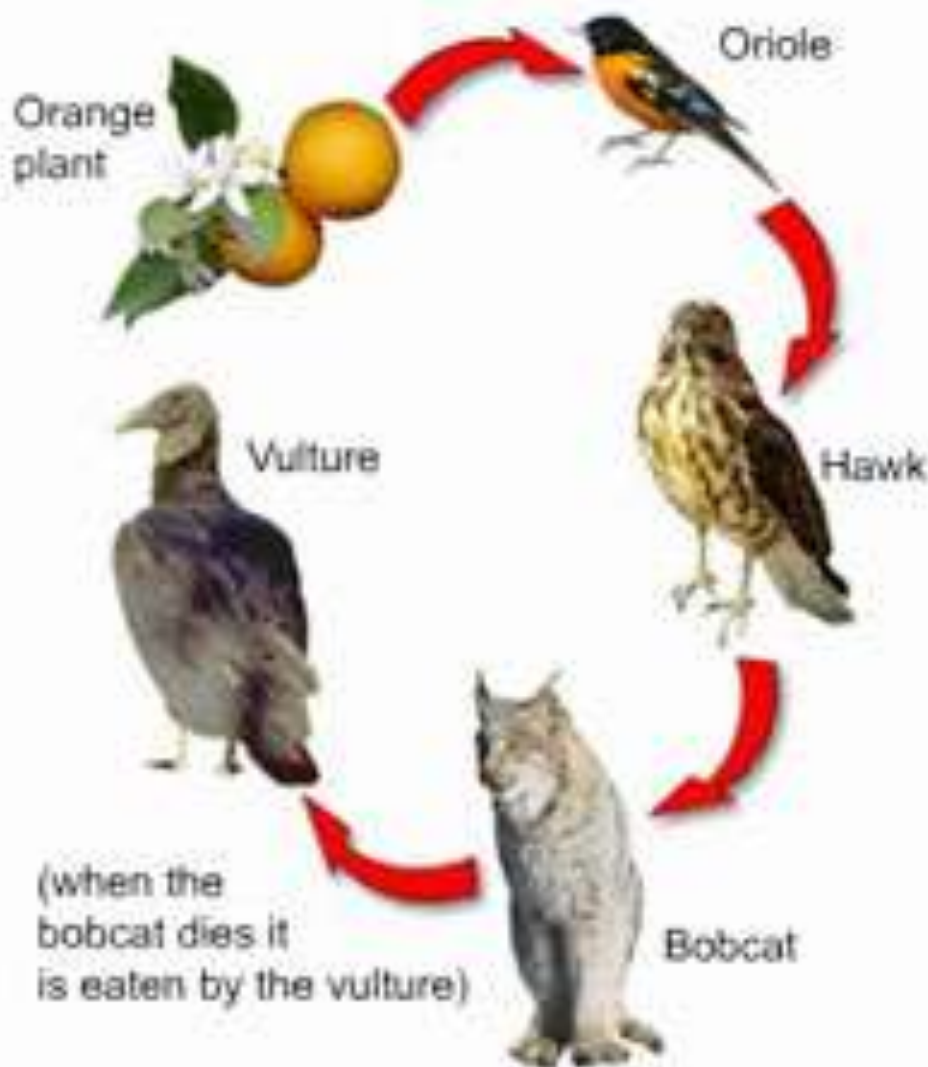
A Food Chain



What is a Food Chain?

A food chain represents the transfer of energy through a series of organisms in a **community** (a group of organisms living in the same environment).

It usually starts with a **producer** (an organism that manufactures simple food by a process such as photosynthesis) and ends with a **top consumer**. Producers are eaten by herbivores or primary consumers. Carnivores may be secondary, tertiary or quaternary consumers.



A Food Web

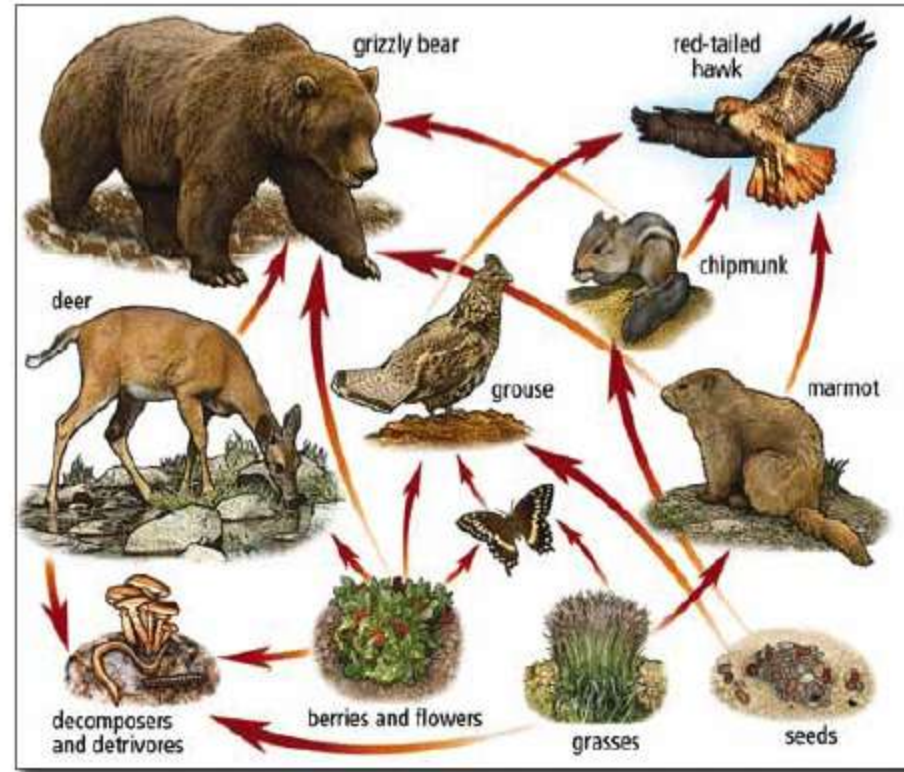
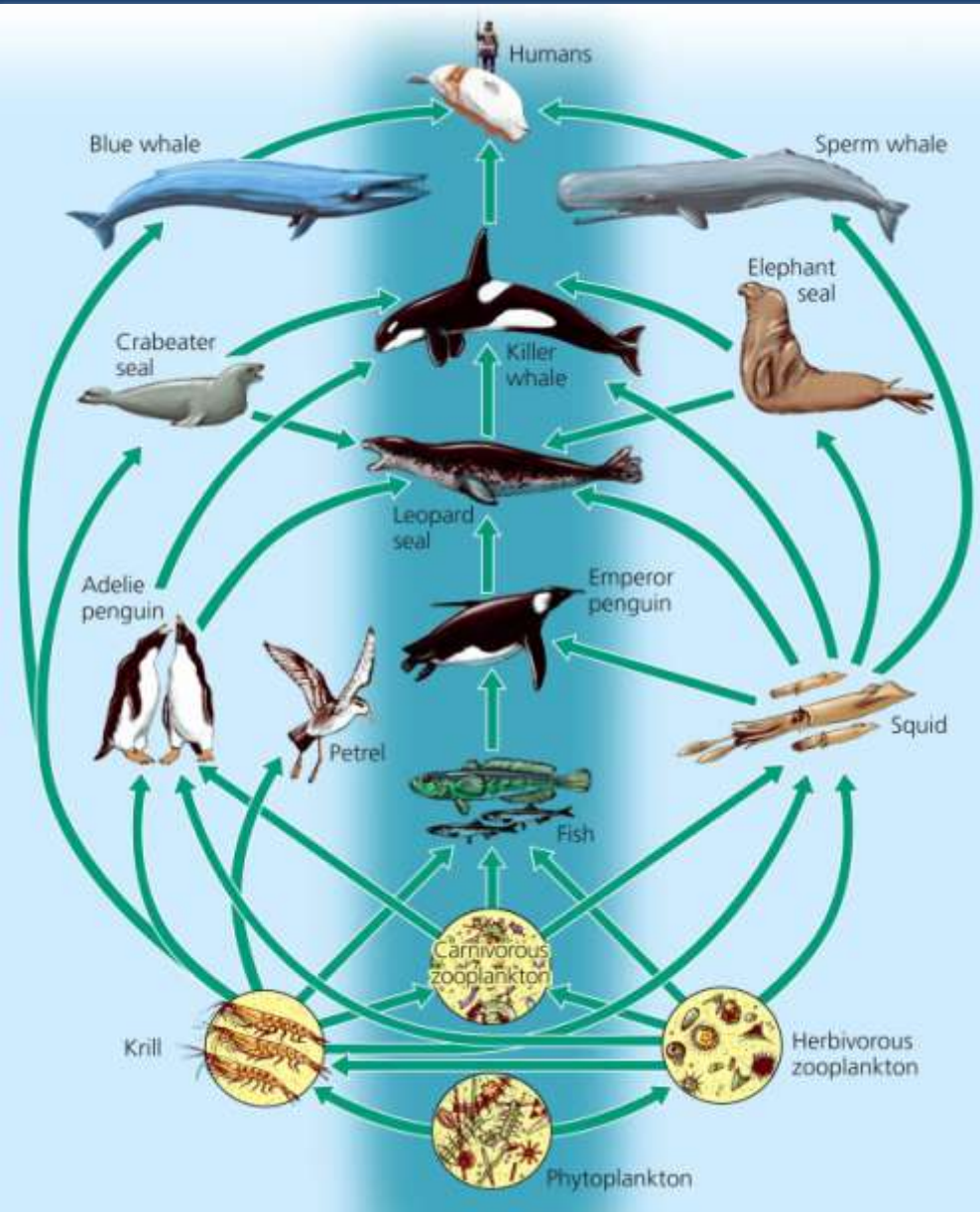
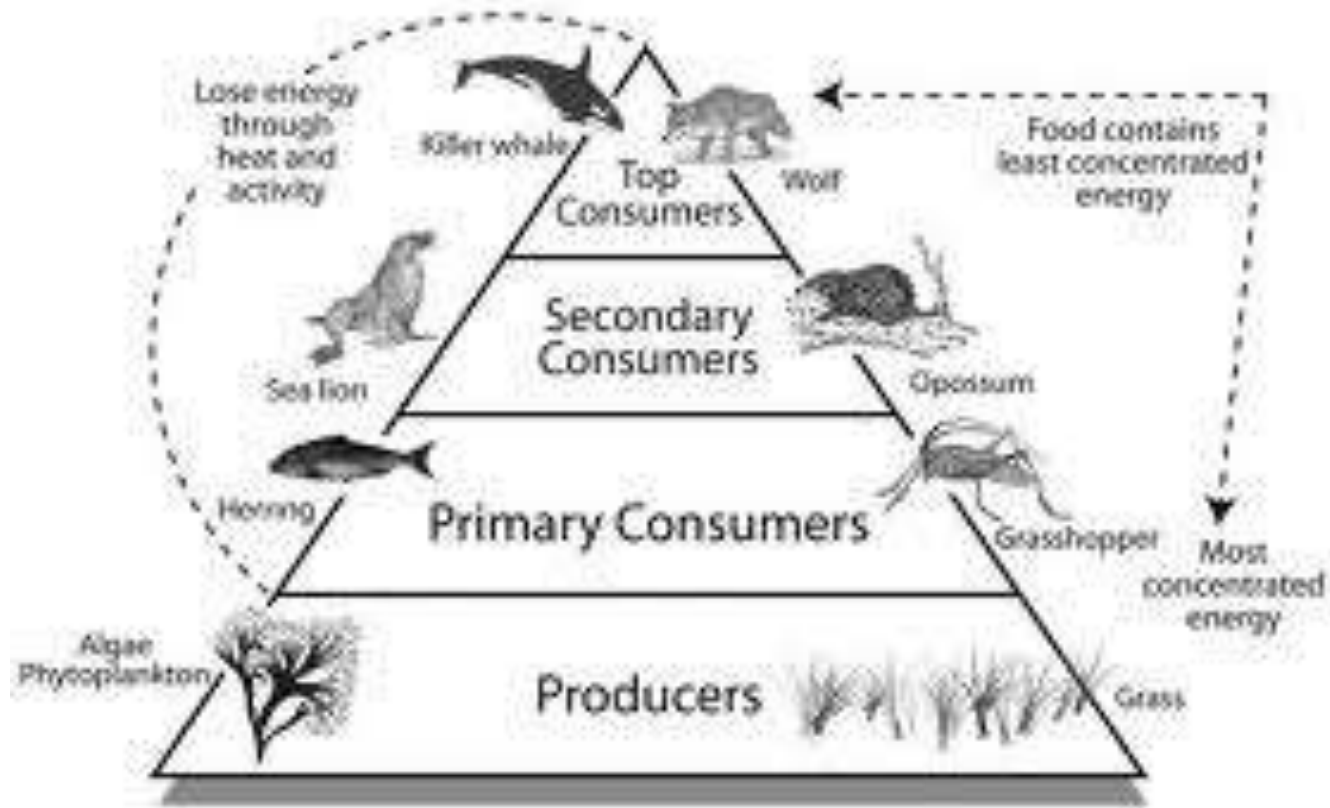


Fig. 3-13, p. 64

- An organism's rank in a feeding hierarchy is its trophic level.
- **Primary producers always occupy the first trophic level of any community.**

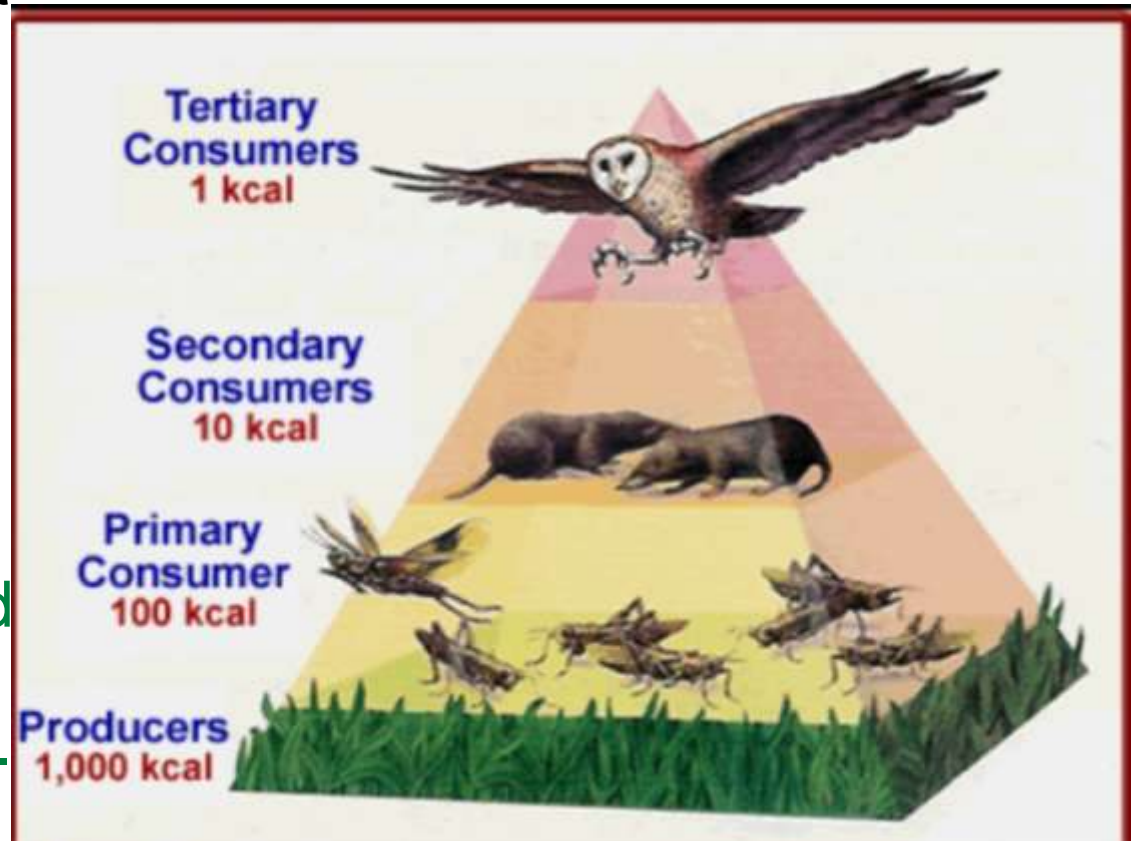
Energy in Communities



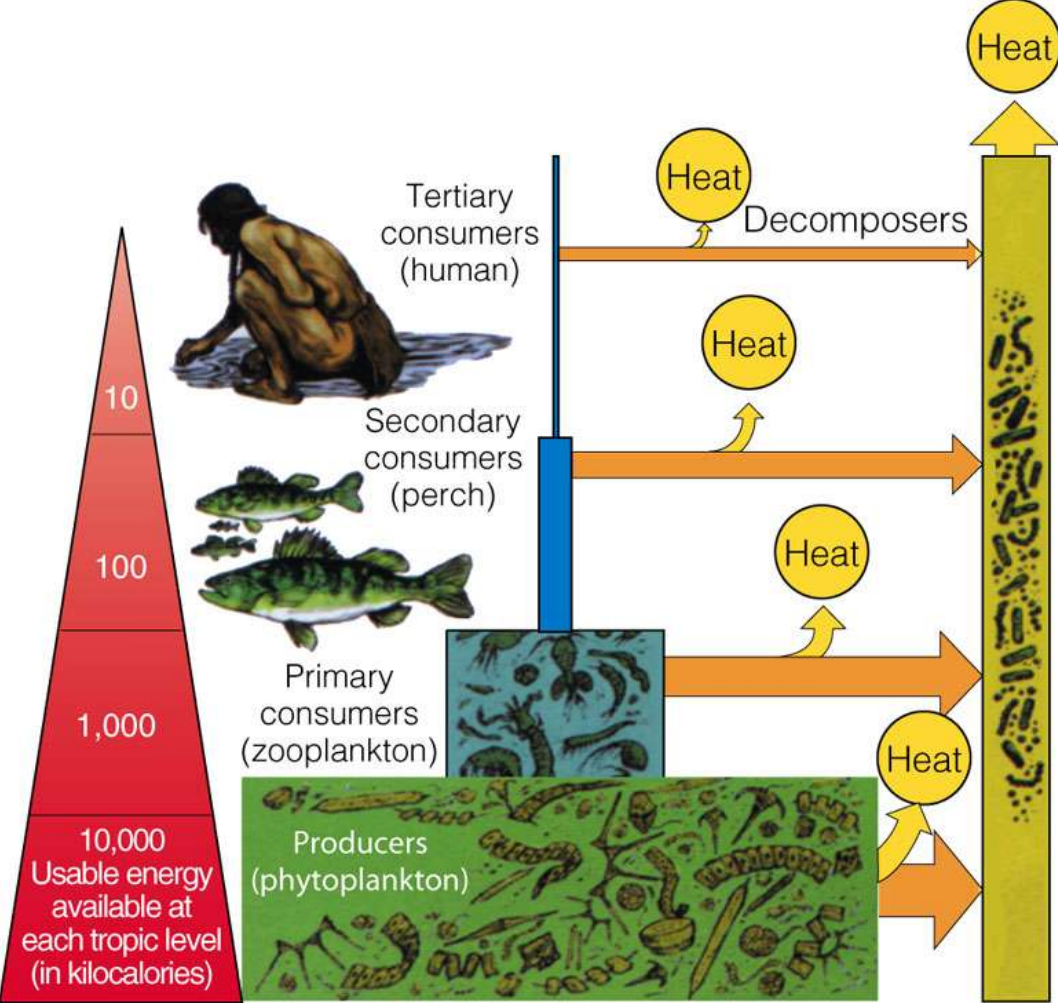
Pyramid of Energy

10% Rule

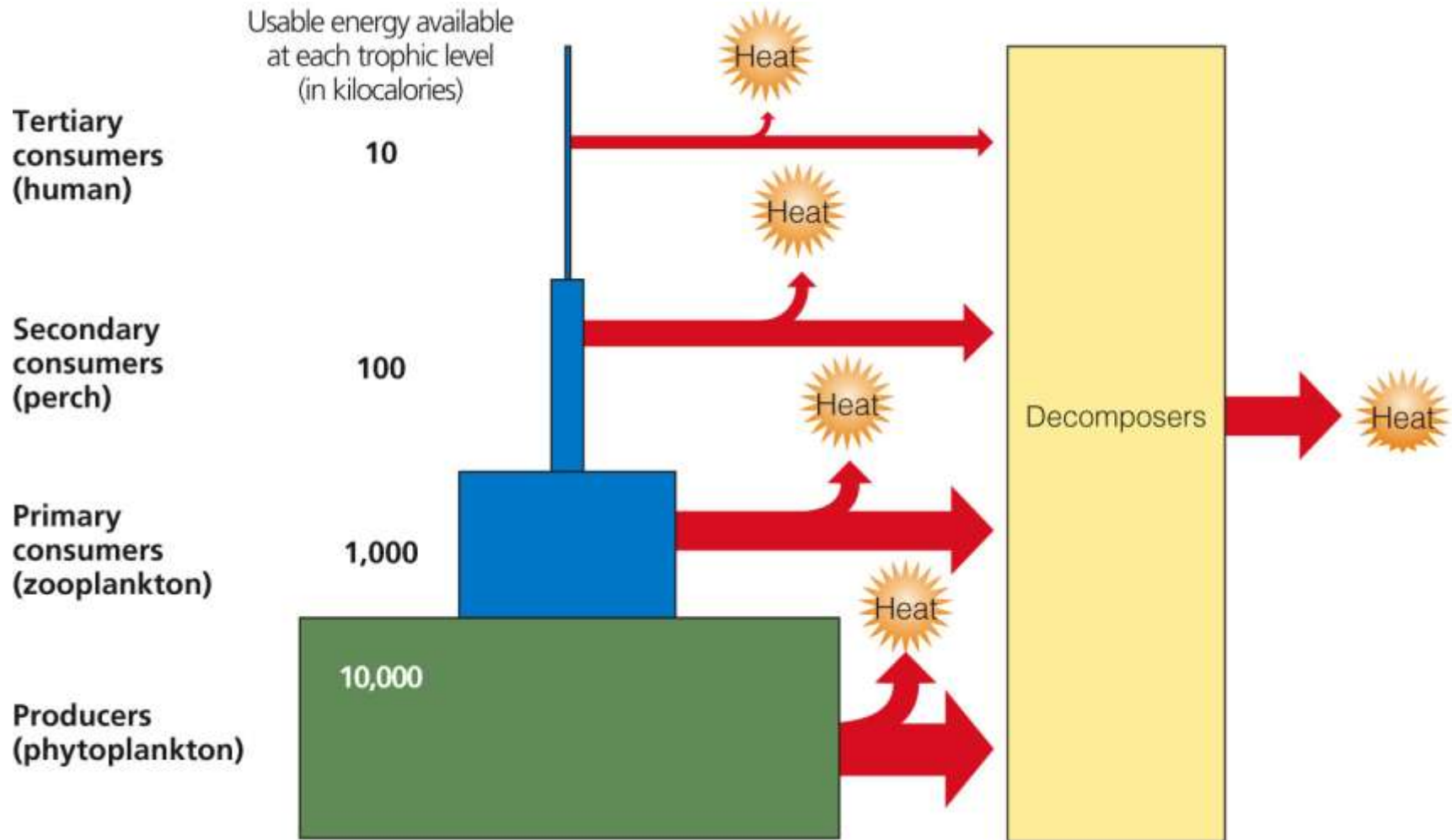
- In general, only about 10% of the energy available at any trophic level is passed to the next; most of the ***rest is lost to the environment as heat.*** Or in hunting/gathering and in digestion/metabolism.



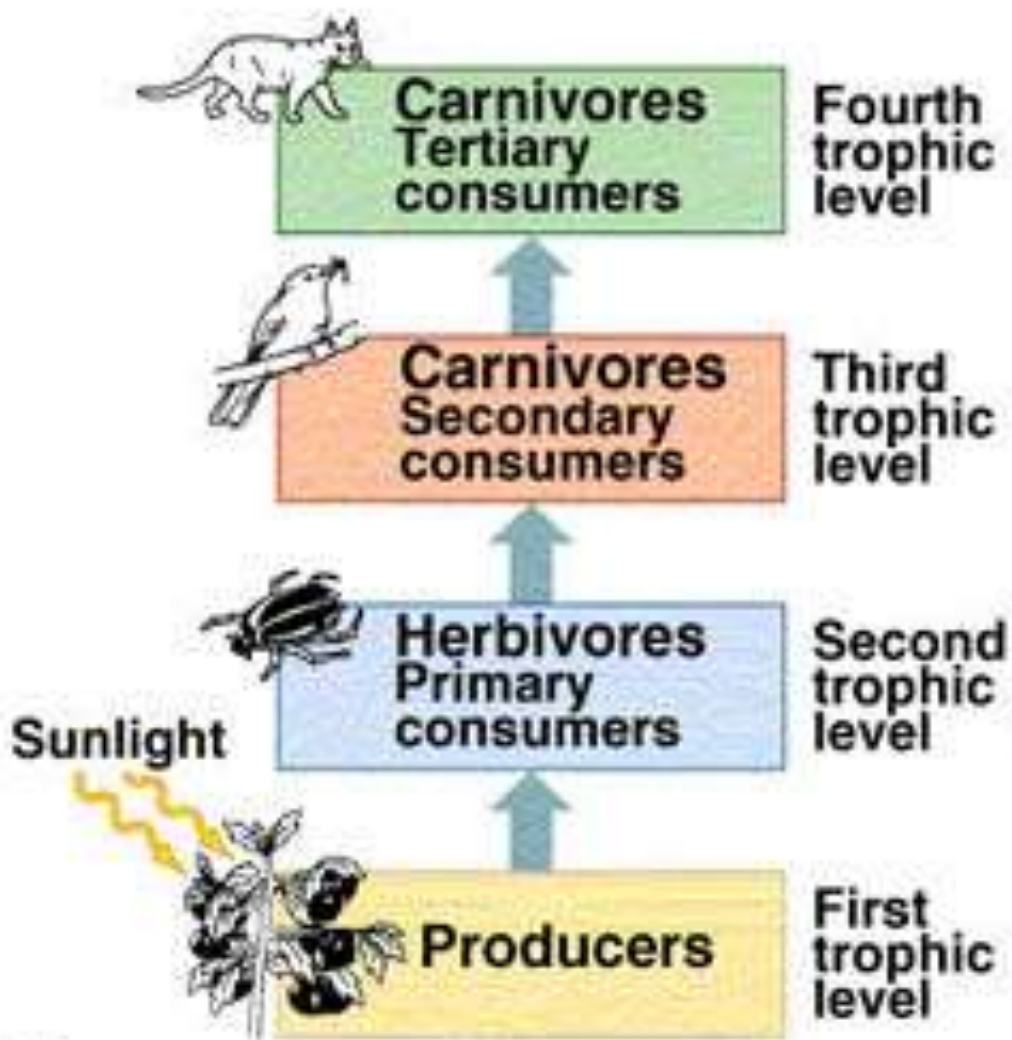
➤ **Ecological efficiency:** percentage of useable energy transferred as biomass from one trophic level to the next.



Pyramid of Energy Flow

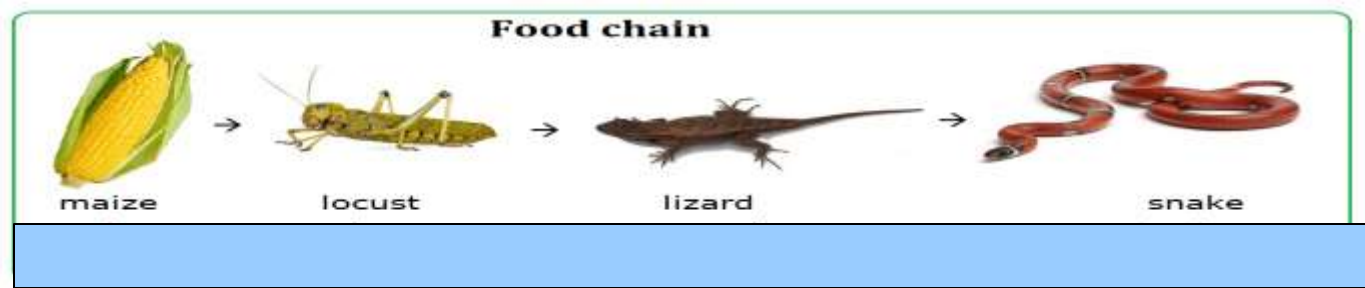


Ecosystem energy flow

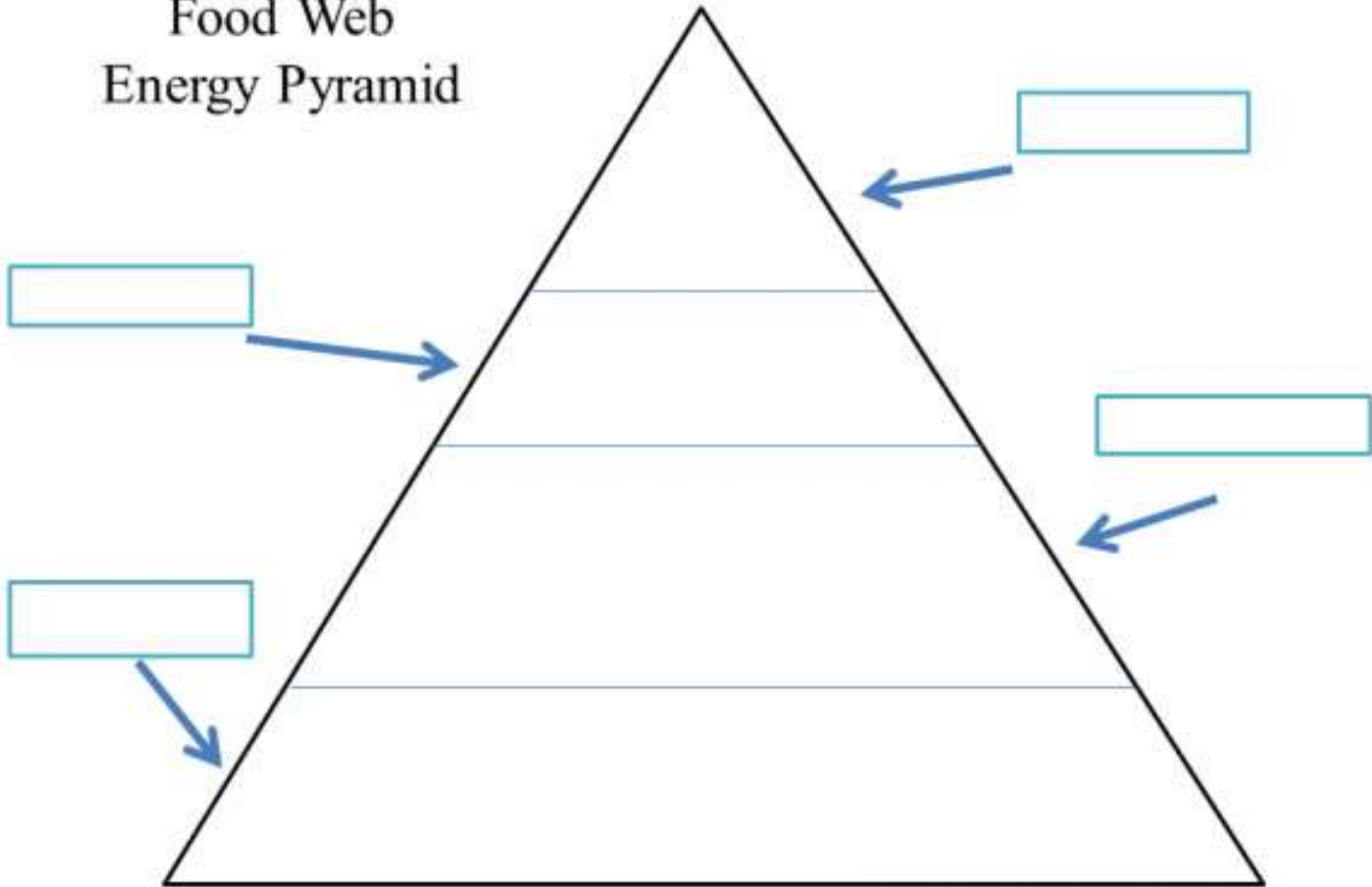


A

• You practice....

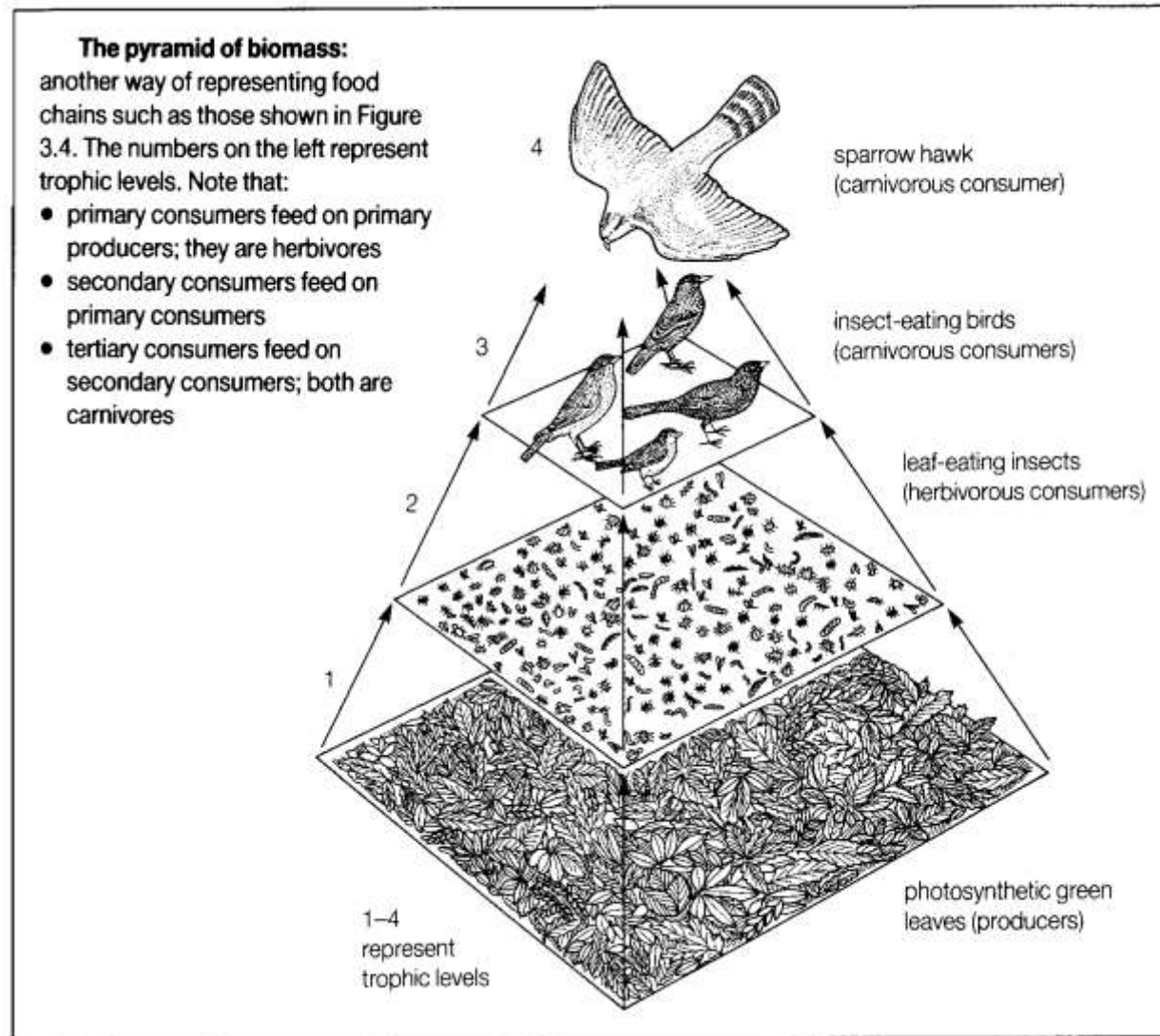


Food Web
Energy Pyramid



Numbers and Biomass in Communities

- A trophic level's **biomass is the mass of living tissue it contains.**
- In general, *there are more organisms and greater biomass at lower trophic levels than at higher ones.*



Some Ecosystems Produce Plant Matter Faster Than Others Do

- **Gross primary productivity (GPP)**

- Rate at which an ecosystem's producers convert solar energy to chemical energy and biomass
- Kcal/m²/year

- **Net primary productivity (NPP)**

- Rate at which an ecosystem's producers convert solar energy to chemical energy, minus the rate at which producers use energy for aerobic respiration
- Ecosystems and life zones differ in their NPP

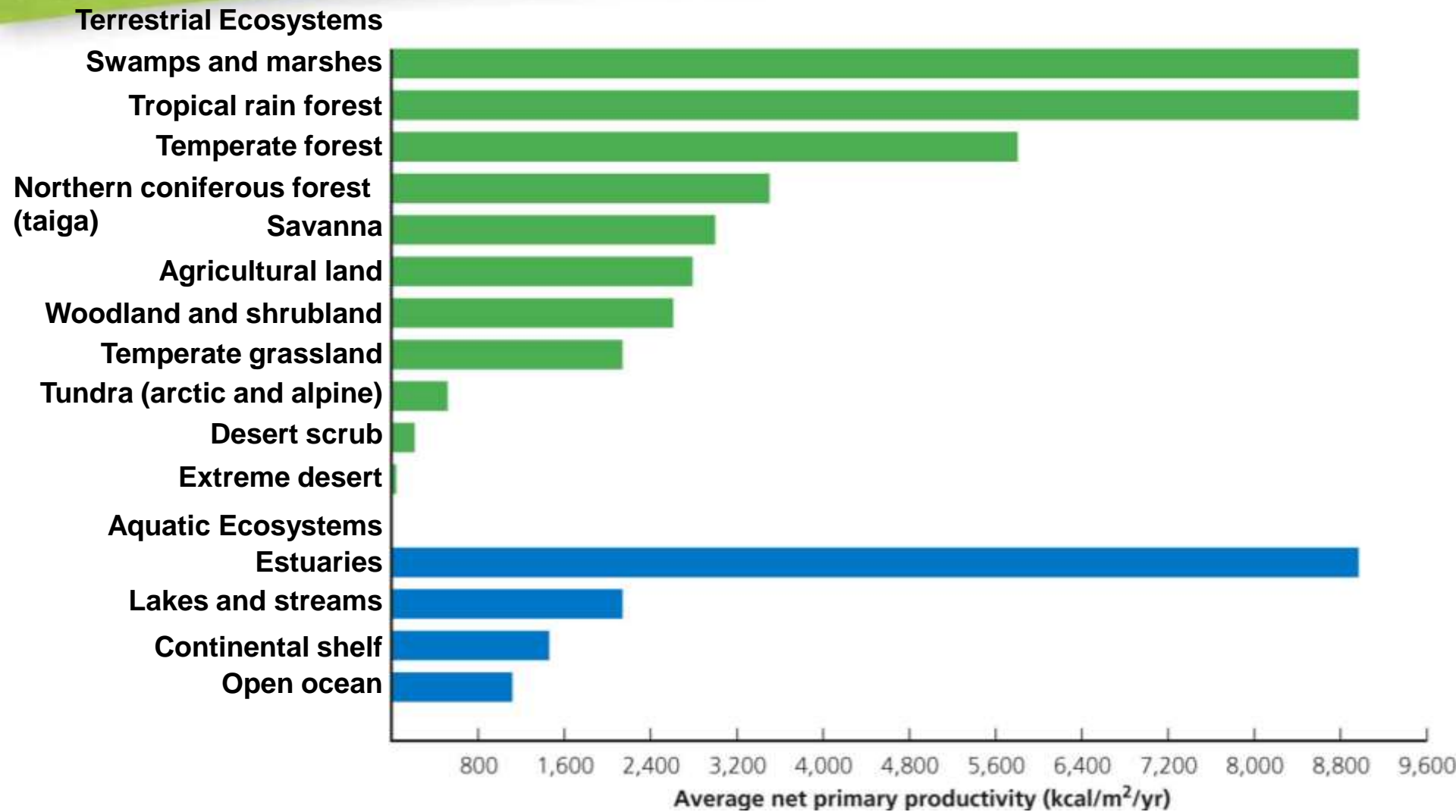


Fig. 3-15, p. 66

"All flesh is grass."

- ***The planet's NPP ultimately limits the number of consumers that can survive on earth.***
- ***Three hundred trout are needed to support one man for a year. The trout, in turn, must consume 90,000 frogs, that must consume 27 million grasshoppers that live off of 1,000 tons of grass.***
 - ***G. Tyler Miller, Jr***



Humans use, waste or destroy approx 27% of the earth's total NPP

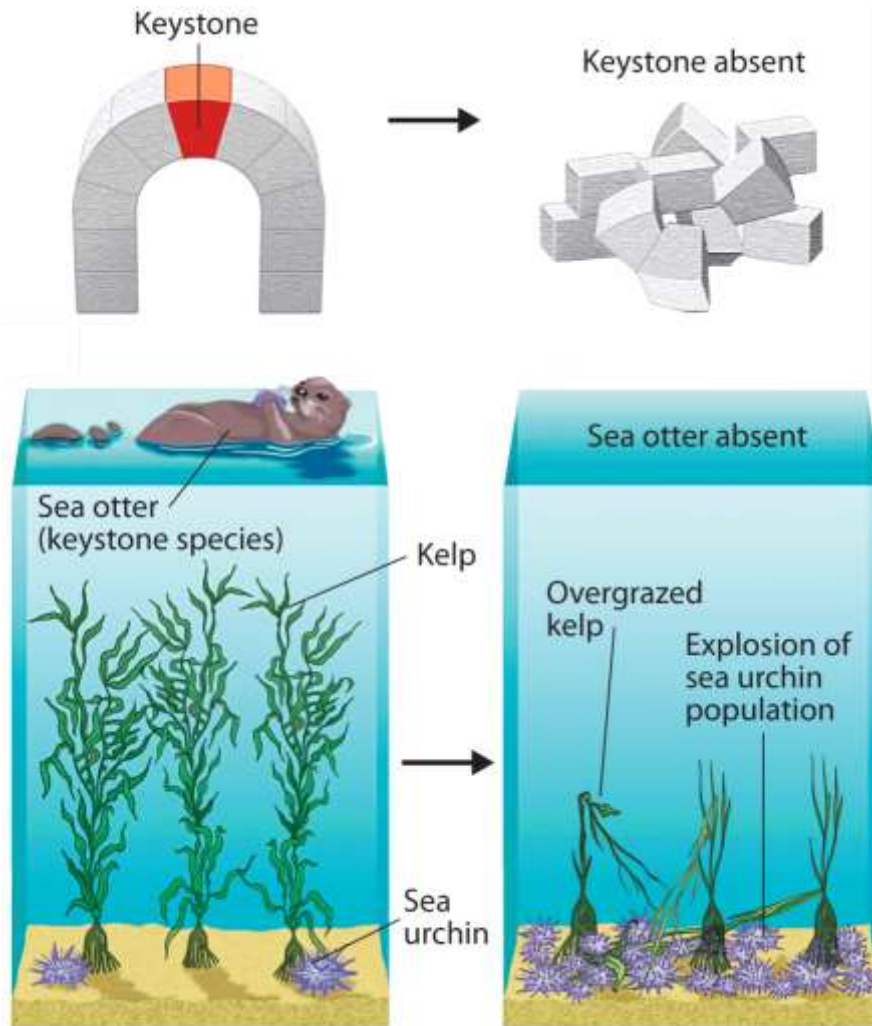
Up to 55% of the terrestrial NPP

✓ There are estimates that humans, their pets and livestock make up 98% of the earth's total vertebrate biomass.

✓ Only 2% of the vertebrate biomass on earth belongs to wild species – thus, severely limiting our biodiversity on earth.



Keystone Species



- Species that have strong and/or wide-reaching effects on a community
- Removal of a keystone species can significantly alter the structure of a community.
- Pollinators
- Top predators

<https://www.youtube.com/watch?v=TY6rziYCDPk>

https://www.youtube.com/watch?v=_IWw8Ruz8Uo

CASE STUDY – Sea Otter and Kelp Forests

- Kelp forests: biologically diverse marine habitat
- Major threats to kelp forests
 1. Sea urchins
 2. Pollution from water run-off
 3. Global warming



Core Case Study: Southern Sea Otters: Are They Back from the Brink of Extinction?

<https://www.youtube.com/watch?v=0UryWICizN4>

- Habitat
- Hunted: early 1900s
- Partial recovery
- Why care about sea otters?
 - Ethics
 - Tourism dollars
 - Keystone species



Core Case Study: Southern Sea Otters: Are They Back from the Brink of Extinction?



- They were over-hunted to the brink of extinction by the early 1900's and are now making a comeback.
- Hunted due to thick fur that keeps them warm and waterproof and due to competition for abalone and other shell fish.

Figure 8-1

Core Case Study: Southern Sea Otters: Are They Back from the Brink of Extinction?



- Sea otters are an important keystone species for sea urchins and other kelp-eating organisms.



Figure 8-1

Case Study: Why Should We Care about the American Alligator?

- Largest reptile in North America
- 1930s: Hunters and poachers
- Importance of gator holes and nesting mounds: a keystone species https://www.youtube.com/watch?v=KyJ4Sb_Cnbo
- 1967: endangered species
- 1977: comeback, threatened species

American Alligator



The Wolves of Yellowstone

- <https://www.youtube.com/watch?v=ysa5OBhXz-Q>



Foundation Species Help to Form the Bases of Ecosystems

- Create or enhance their habitats, which benefit others
- Elephants
- Beavers
- **Prairie Dogs**
<https://www.youtube.com/watch?v=kEh4r4iQiBU>

Foundation Species: Other Major Players

- Expansion of keystone species category.
- Foundation species can create and enhance habitats that can benefit other species in a community.
 - Elephants push over, break, or uproot trees, creating forest openings promoting grass growth for other species to utilize.
 - Beavers as “ecological engineers”
 - Bat’s and birds in regeneration of destroyed forests by depositing seeds in their droppings.