TROPHIC LEVEL, FOOD CHAIN AND ECOLOGICAL PYRAMIDS; ENERGY FLOW IN ECOSYSTEM

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KEY TERMS

Term	Meaning
Autotroph (producer)	An organism that produces its own food using sunlight or chemical energy
Heterotroph (consumer)	An organism that consumes another organism for food
Food chain	A series of organisms in which energy is transferred to another
Food web	A network of feeding interactions, usually consisting of multiple food chains
Trophic level	Each step in a food chain or food web
Biomass	The total amount of living tissue within a trophic level

Key points:

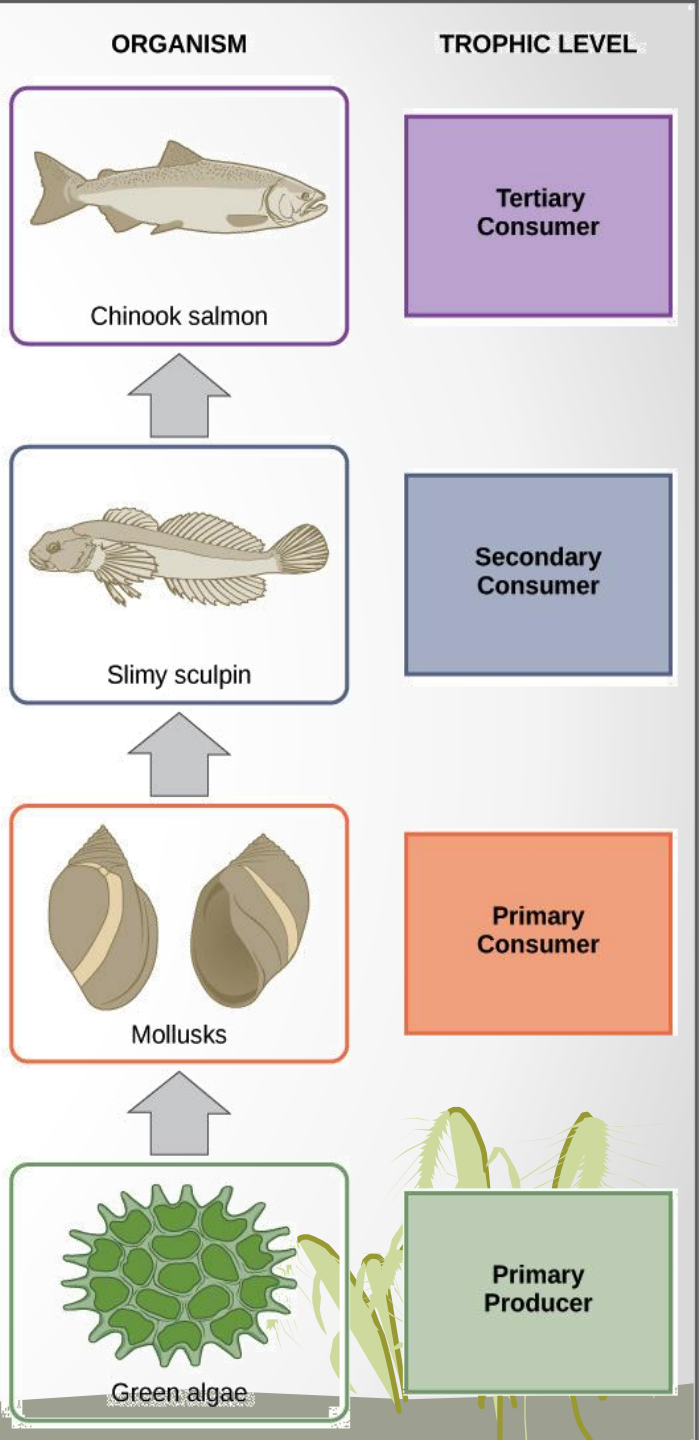
- **Producers**, or autotrophs, make their own organic molecules. **Consumers**, or heterotrophs, get organic molecules by eating other organisms.
- A **food chain** is a linear sequence of organisms through which nutrients and energy pass as one organism eats another.
- In a food chain, each organism occupies a different **trophic level**, defined by how many energy transfers separate it from the basic input of the chain.
- **Food webs** consist of many interconnected food chains and are more realistic representation of consumption relationships in ecosystems.
- Energy transfer between trophic levels is inefficient (with a typical efficiency around 10\%10%10, percent). This inefficiency limits the length of food chains.

Key points:

- **Primary producers** (usually plants and other photosynthesizers) are the gateway for energy to enter food webs.
- **Productivity** is the rate at which energy is added to the bodies of a group of organisms (such as primary producers) in the form of biomass.
- **Gross productivity** is the overall rate of energy capture. **Net productivity** is lower, adjusted for energy used by organisms in respiration/metabolism.
- Energy transfer between trophic levels is inefficient. Only 10, percent of the net productivity of one level ends up as net productivity at the next level.
- **Ecological pyramids** are visual representations of energy flow, biomass accumulation, and number of individuals at different trophic levels.

Food Chain

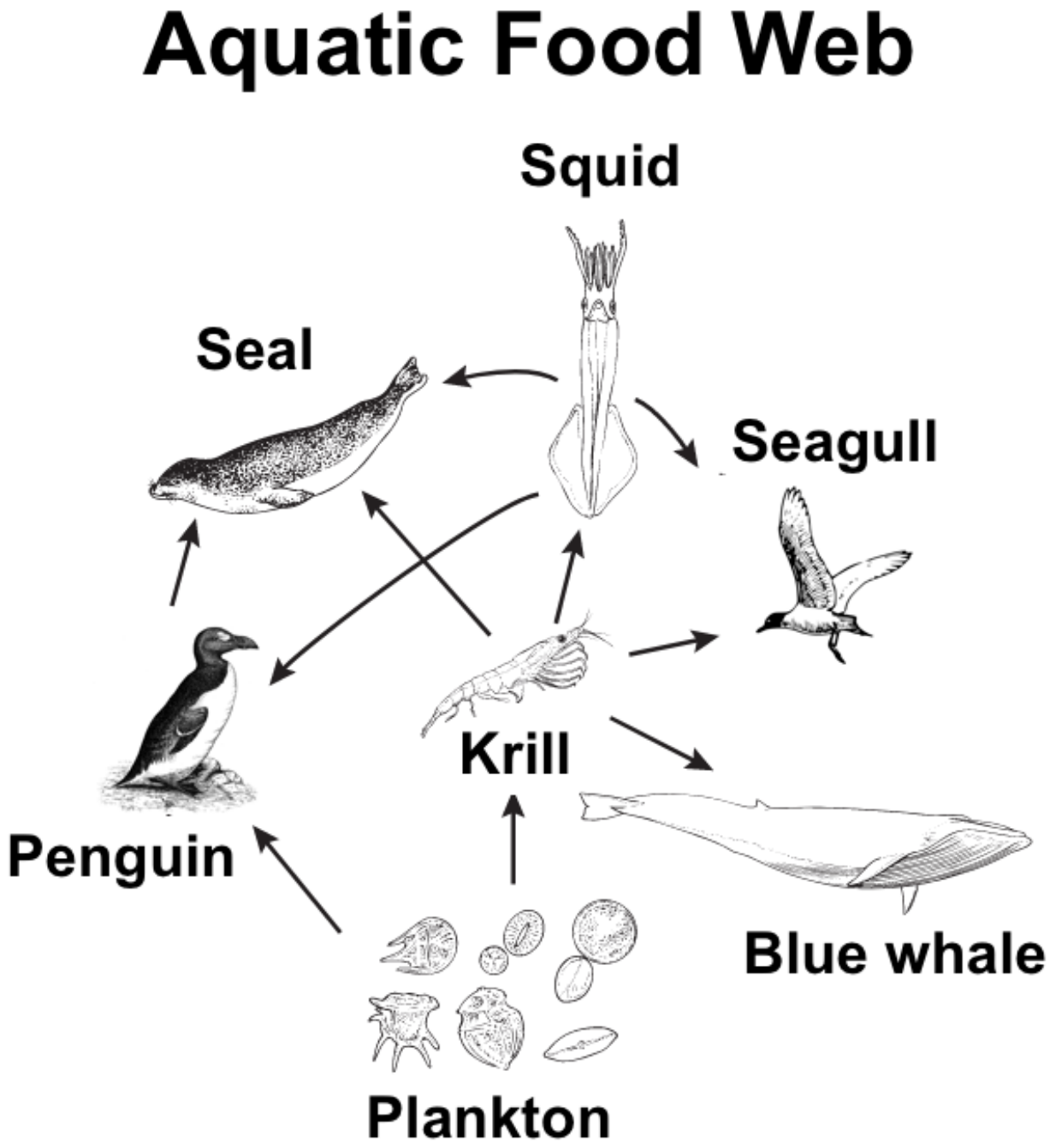
In ecology, a **food chain** is a series of organisms that eat one another. Producers form the base of food chains and food webs, and the energy they capture from light or chemicals sustains all the other organisms in the community. Consumers play many different ecological roles, including herbivorous insects, carnivorous animals, and decomposing fungi.



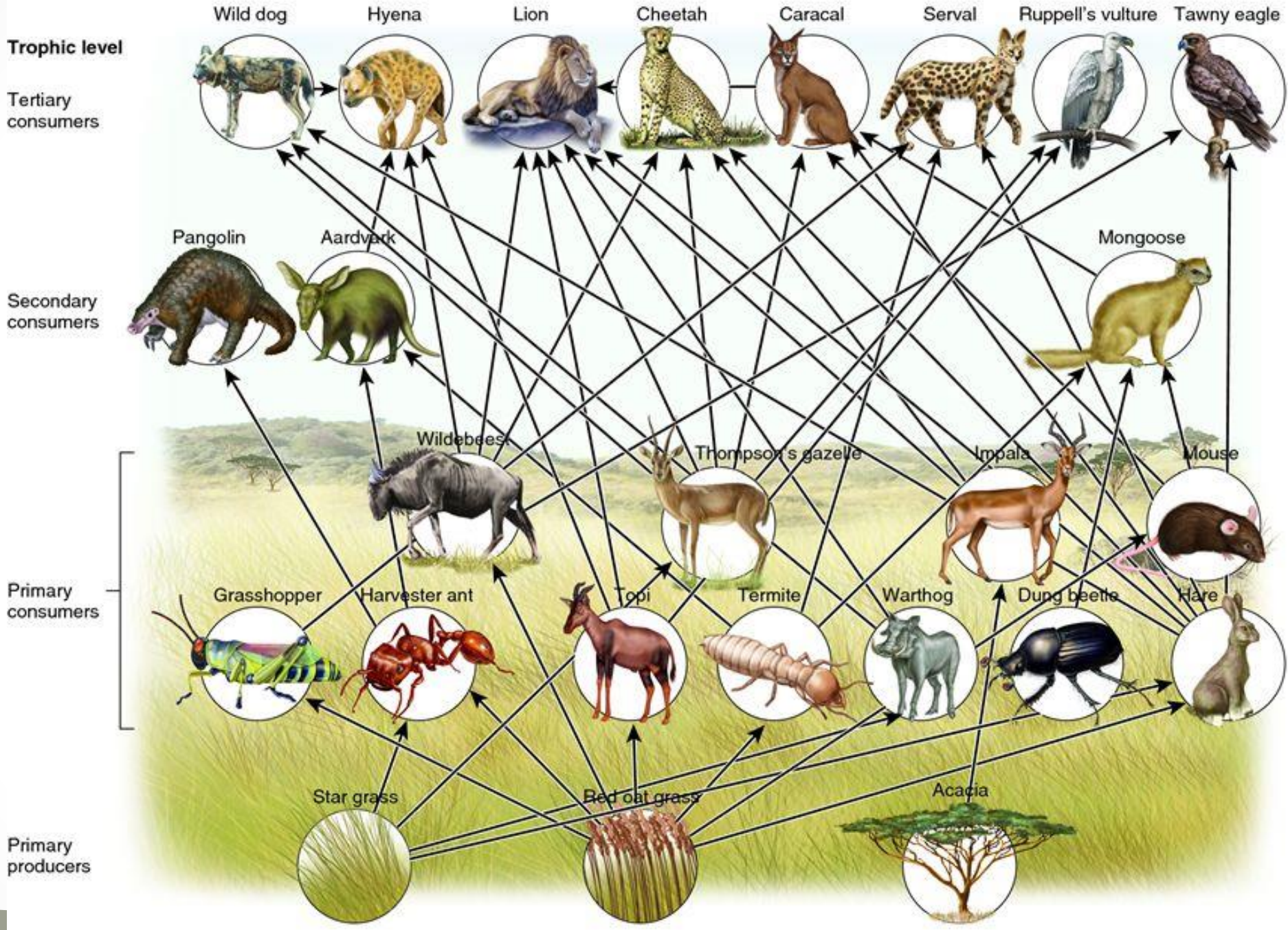
Food chain. Image from OpenStax, CC BY 4.0.

Aquatic food web containing multiple trophic levels, from producers (plankton) through tertiary consumers (seals, penguins, seagulls).

- Each of the categories above is called a **trophic level**, and it reflects how many consumption steps separate an organism from the food chain's original energy source, such as light. However, in most ecosystems, energy flow is much more complicated than a linear chain. In this case, a **food web** can be used to represent these feeding interactions between trophic levels.



Food Web in Savana Biome



- **Ecological pyramids**
- We can look at numbers and do calculations to see how energy flows through an ecosystem. But wouldn't it be nice to have a diagram that captures this information in an easy-to-process way?

- **Energy pyramids**
- **Energy pyramids** represent energy flow through trophic levels. For instance, the pyramid below shows gross productivity for each trophic level in the Silver Springs ecosystem. An energy pyramid usually shows *rates* of energy flow through trophic levels, not absolute amounts of energy stored. It can have energy units, such

Energy Pyramid

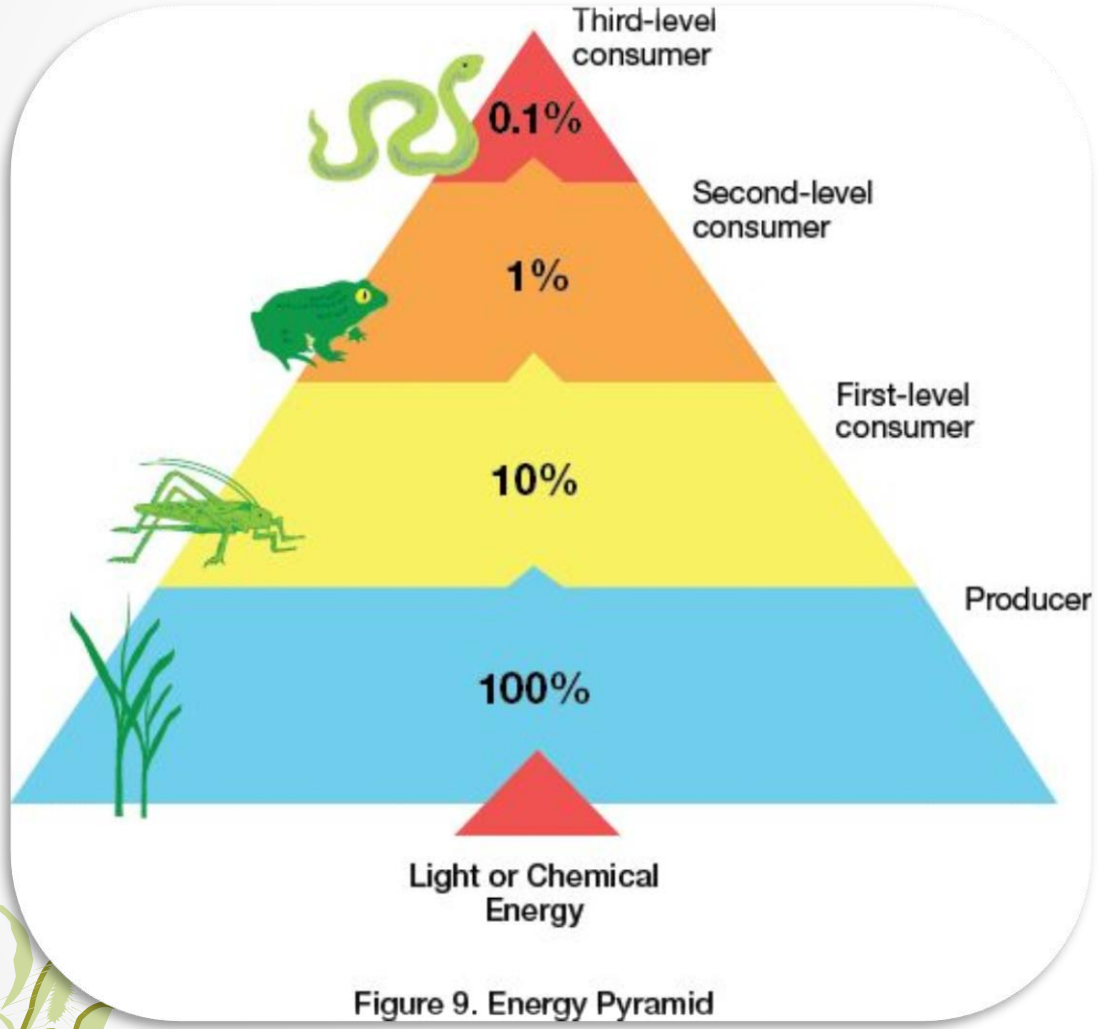
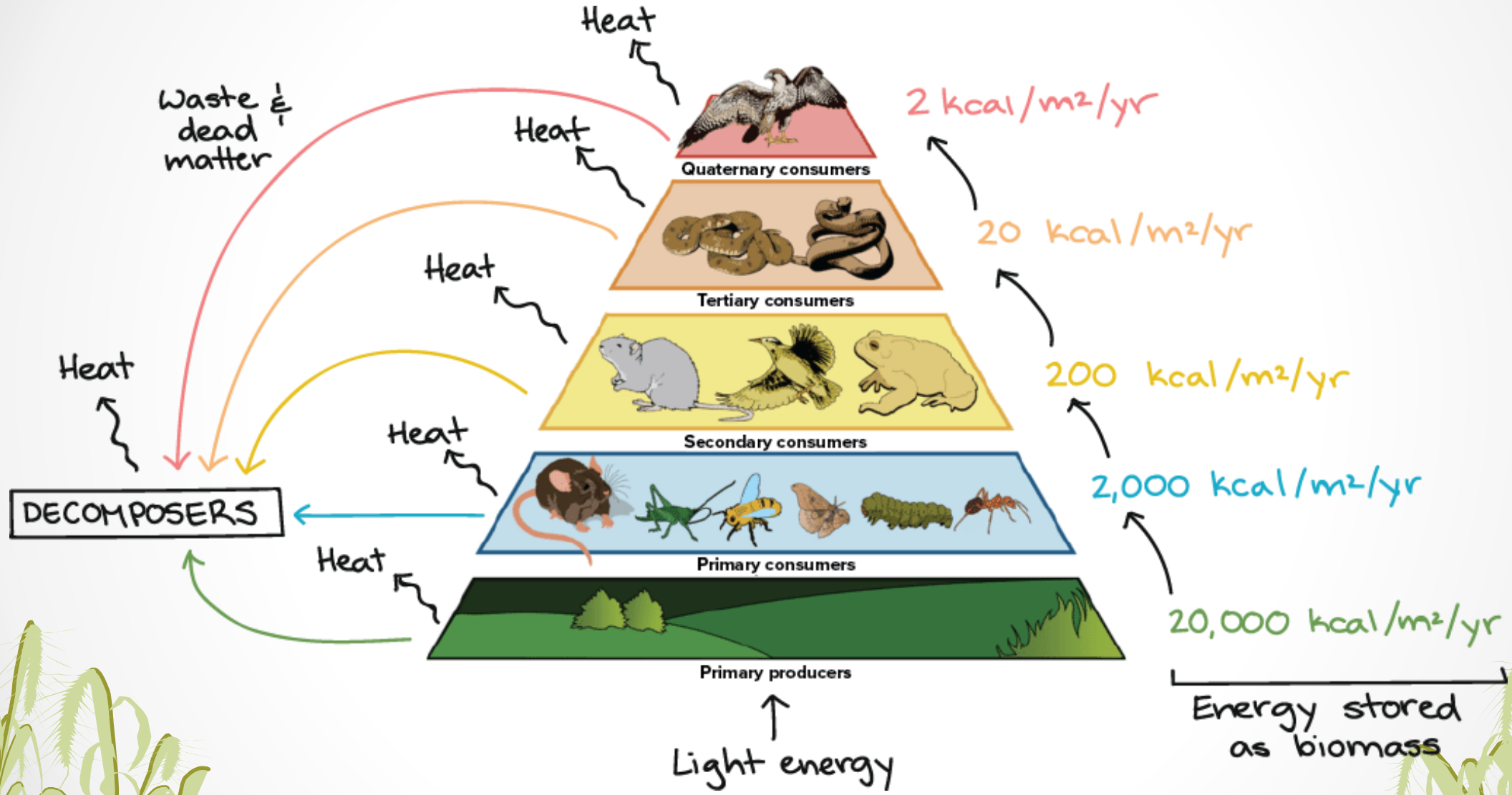


Figure 9. Energy Pyramid

- Producers
- First Level
- Second level
- Third level
- Apex predators
- Decomposers

Ecological pyramid



Energy Flow in Different Biomes

Trophic Level	Desert Biome	Grassland Biome	Pond Biome	Ocean Biome
Producer (Photosynthetic)	Cactus	Grass	Algae	Phytoplankton
Primary Consumer (Herbivore)	Butterfly	Grasshopper	Insect Larva	Zooplankton
Secondary Consumer (Carnivore)	Lizard	Mouse	Minnow	Fish
Tertiary Consumer (Carnivore)	Snake	Snake	Frog	Seal
Quaternary Consumer (Carnivore)	Roadrunner	Hawk	Raccoon	Shark

Thank you