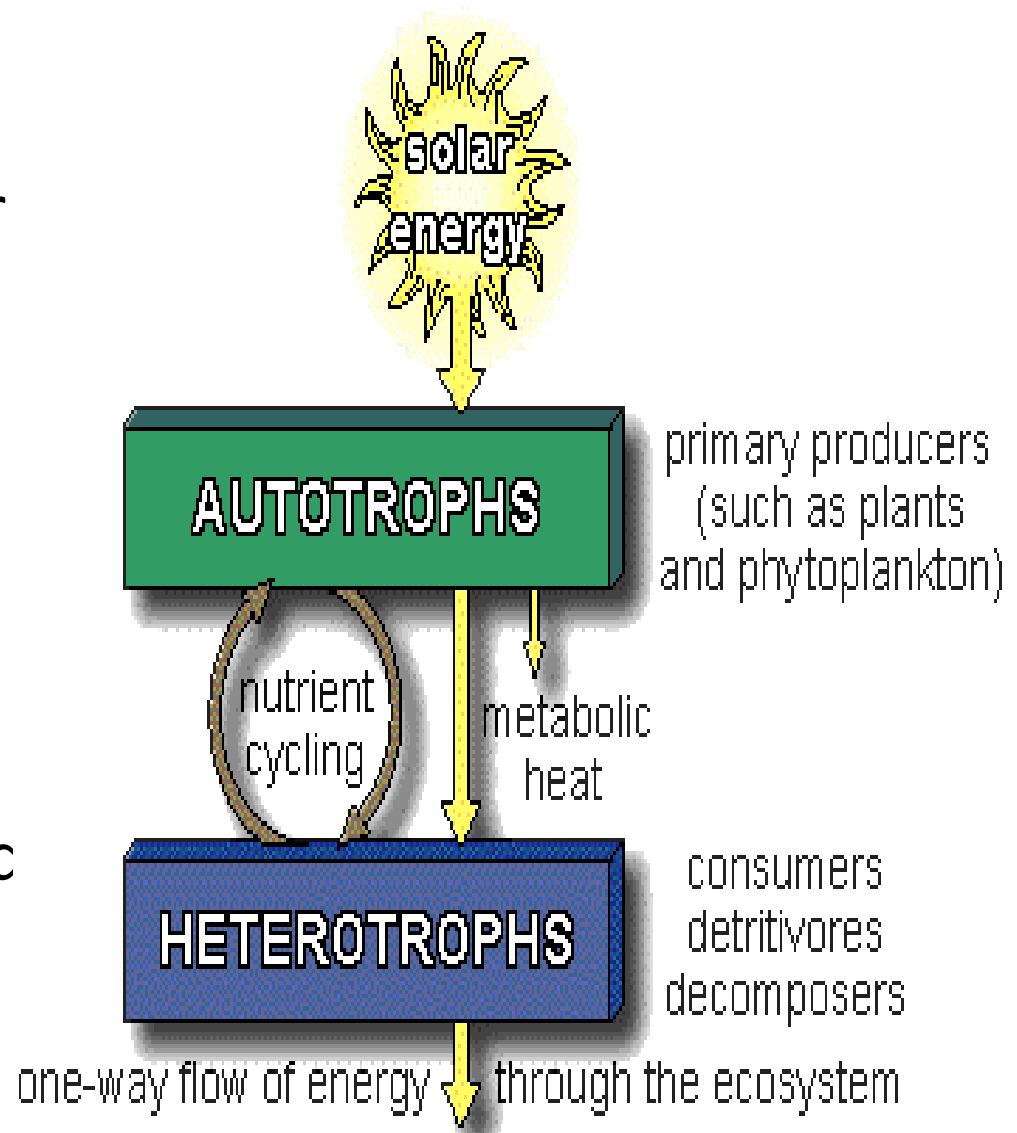


# Energy Facts:

- Non-cyclic, unidirectional flow
- Losses at each transfer from one trophic level to another
  - Due to heat from respiration
  - Inefficiencies in processing
- NOT RECYCLED (nutrients ARE recycled)

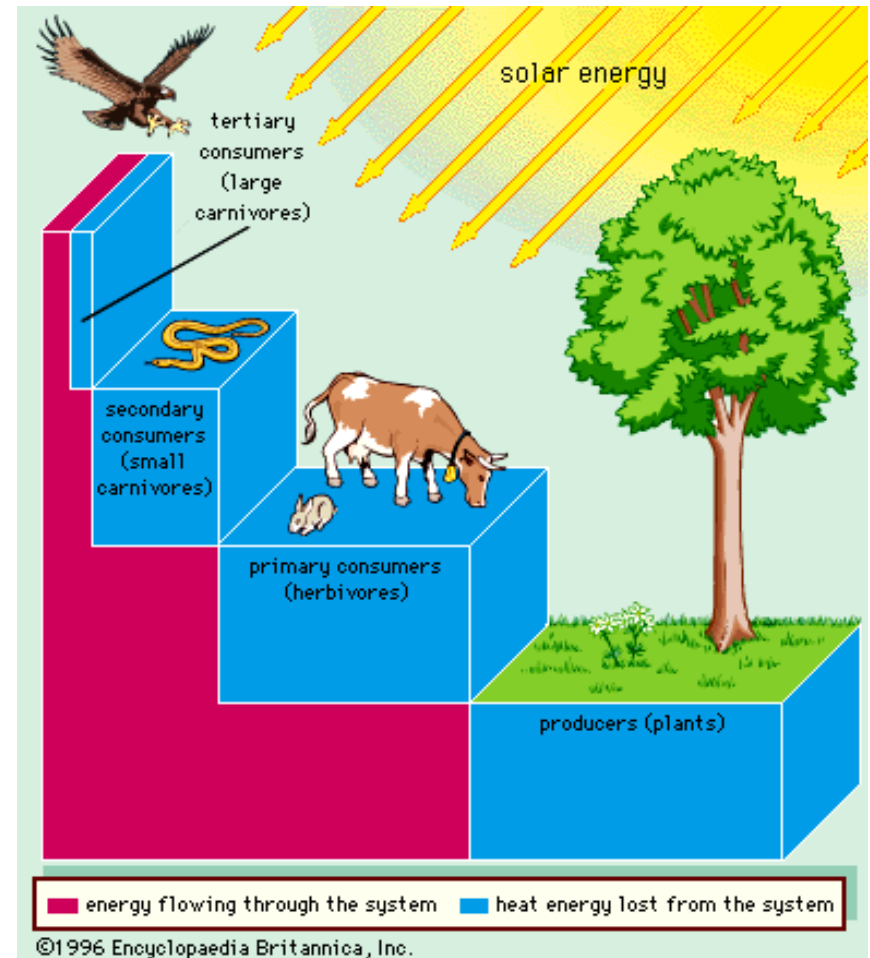


# ENERGY FLOW IN ECOSYSTEM

■ How does energy flow in an ecosystem?

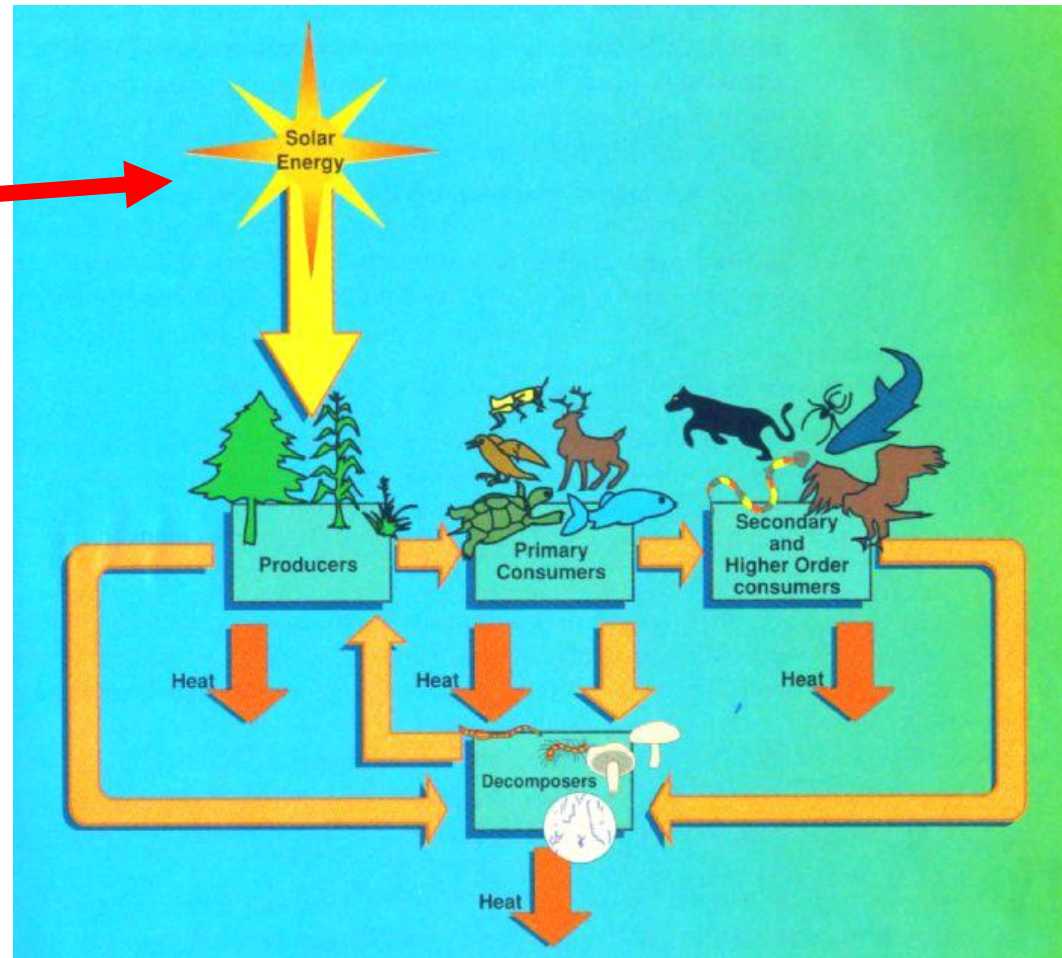
■ What is an energy pyramid?

■ What is a trophic level?



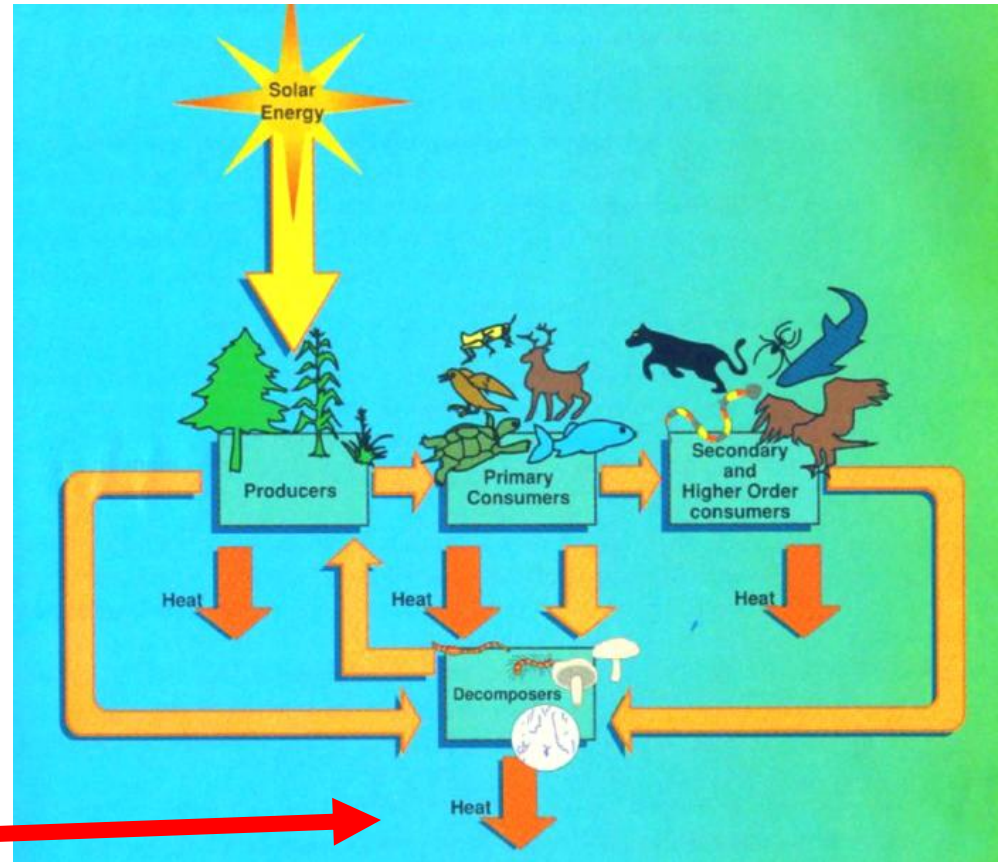
# ENERGY ENTERS ECOSYSTEM

- All energy in ecosystem comes from the sun
- First law of Thermodynamics: Energy cannot be created or destroyed (but it can be transformed into stored energy & heat)



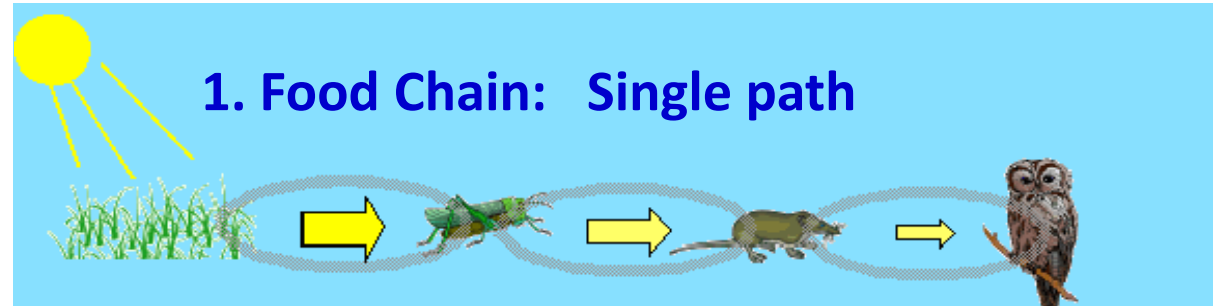
# ENERGY LEAVES ECOSYSTEM

- Second law of thermodynamics: Energy is lost as energy is transformed
- In ecosystem, when energy is transformed, some energy is lost as HEAT

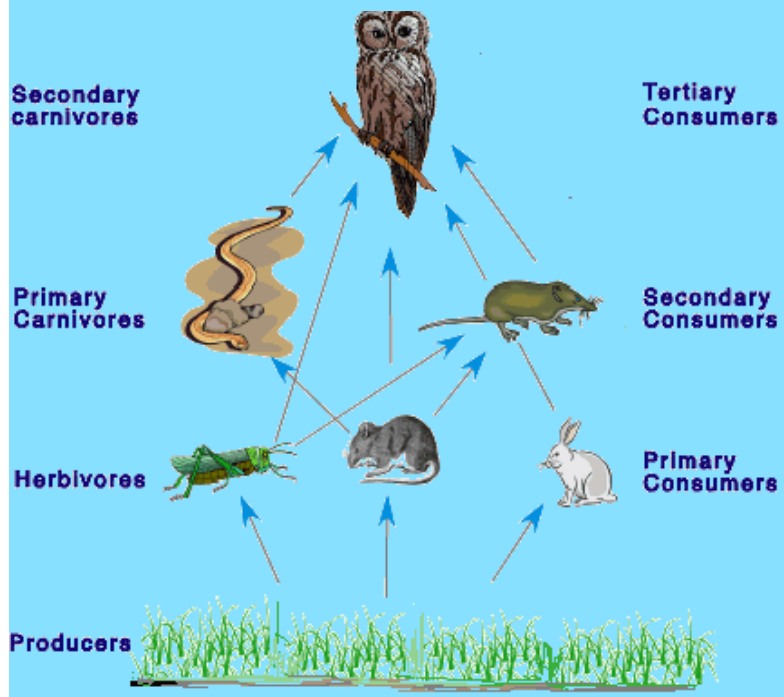


# ENERGY PATHS

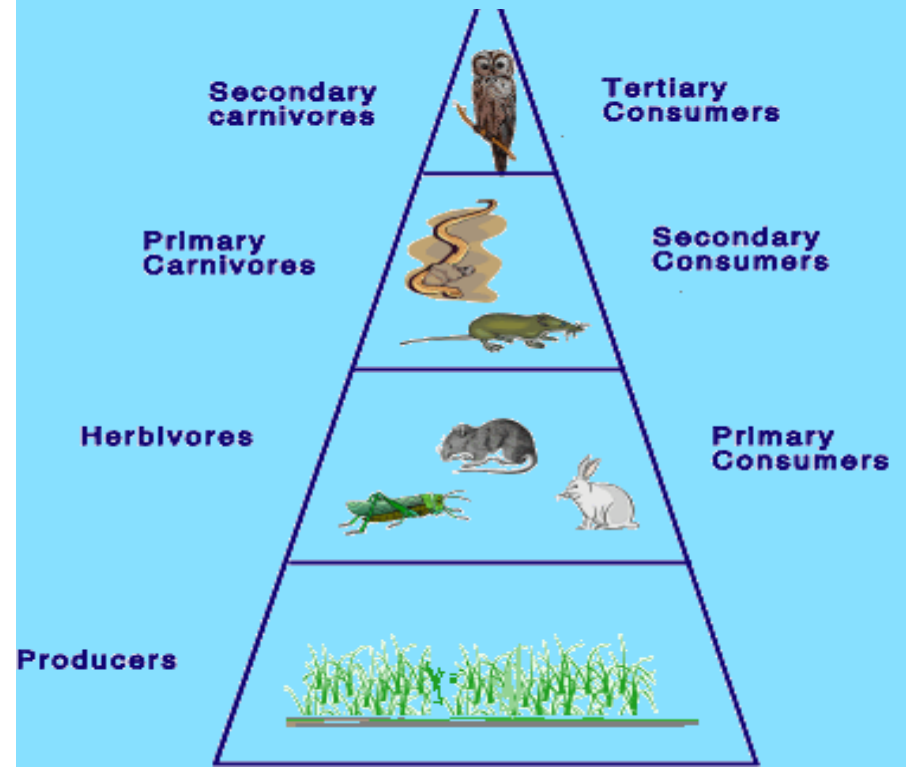
3 ways to  
illustrate  
energy flow



## 2. Food Web: many paths

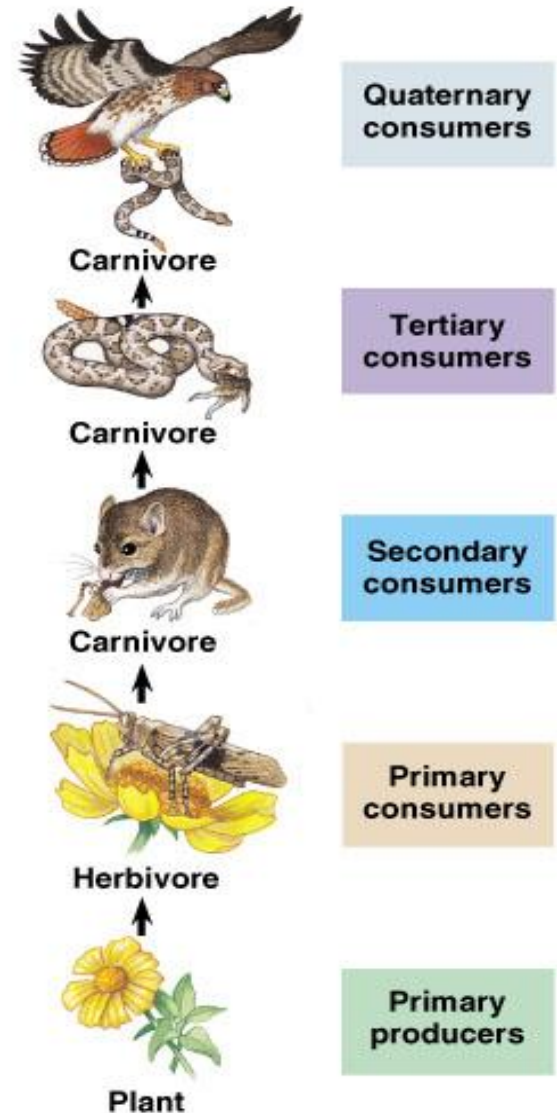


## 3. Food Pyramid



# FOOD CHAINS

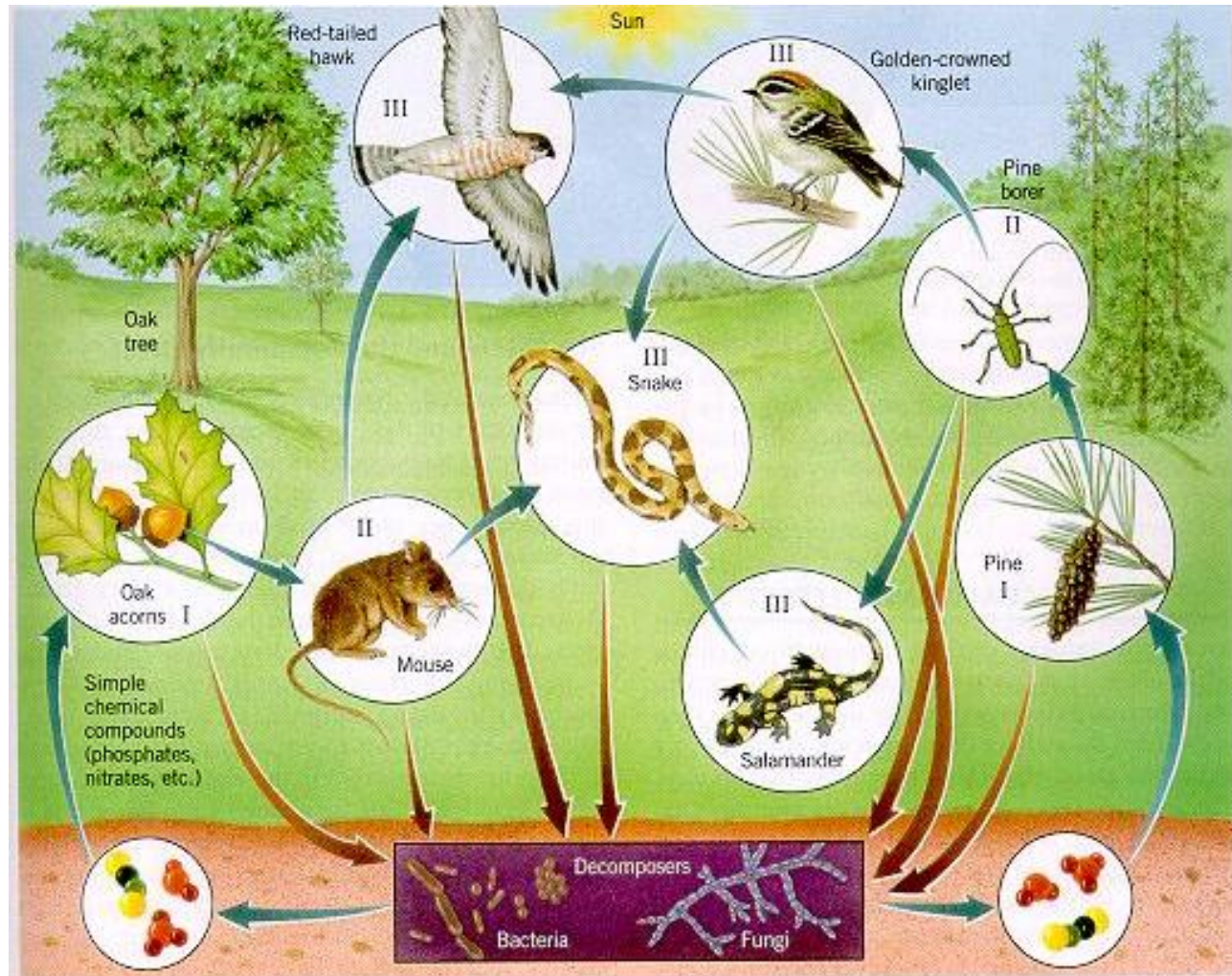
- A **food chain** shows the path of energy from one organism to the next
- energy flows from producers to consumers
- arrows point to who is eating (plant is eaten by herbivore)
- Usually decomposers are left out





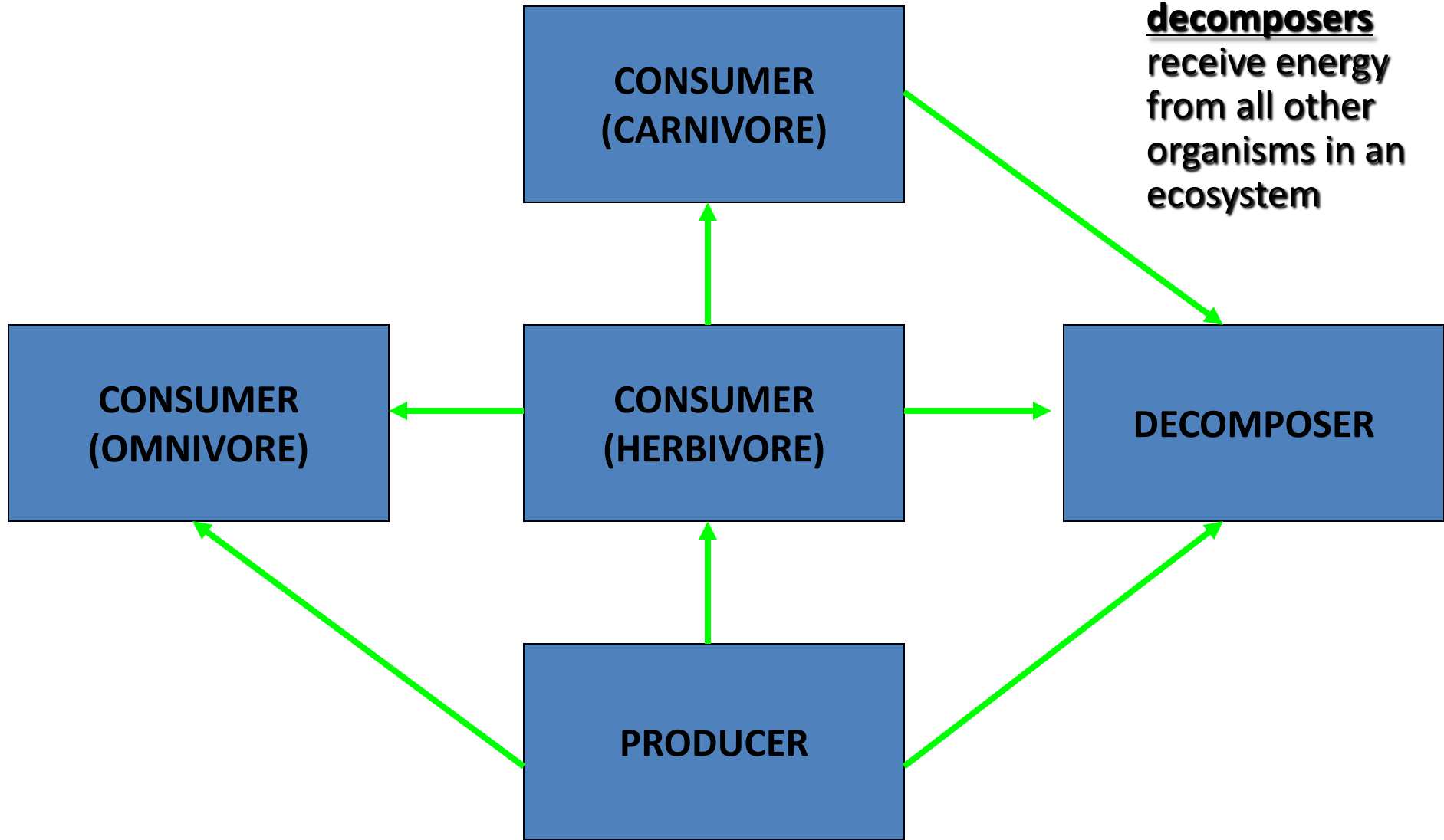
# FOOD WEBS

- A **food web** shows all feeding relationships in an ecosystem (made of many food chains)



# FOOD WEBS

■ Typically, food webs go like this:



remember:  
**decomposers**  
receive energy  
from all other  
organisms in an  
ecosystem



# FOOD CHAINS AND WEBS

- Practice! Draw a food chain that includes the following organisms:

- grasshopper
- mouse
- grass
- owl

- Now label the organisms as producers, consumers (which type?), or decomposers

3<sup>rd</sup> order/tertiary  
CONSUMER  
(CARNIVORE)  
\*top predator

2<sup>nd</sup> order/secondary  
CONSUMER  
(CARNIVORE)

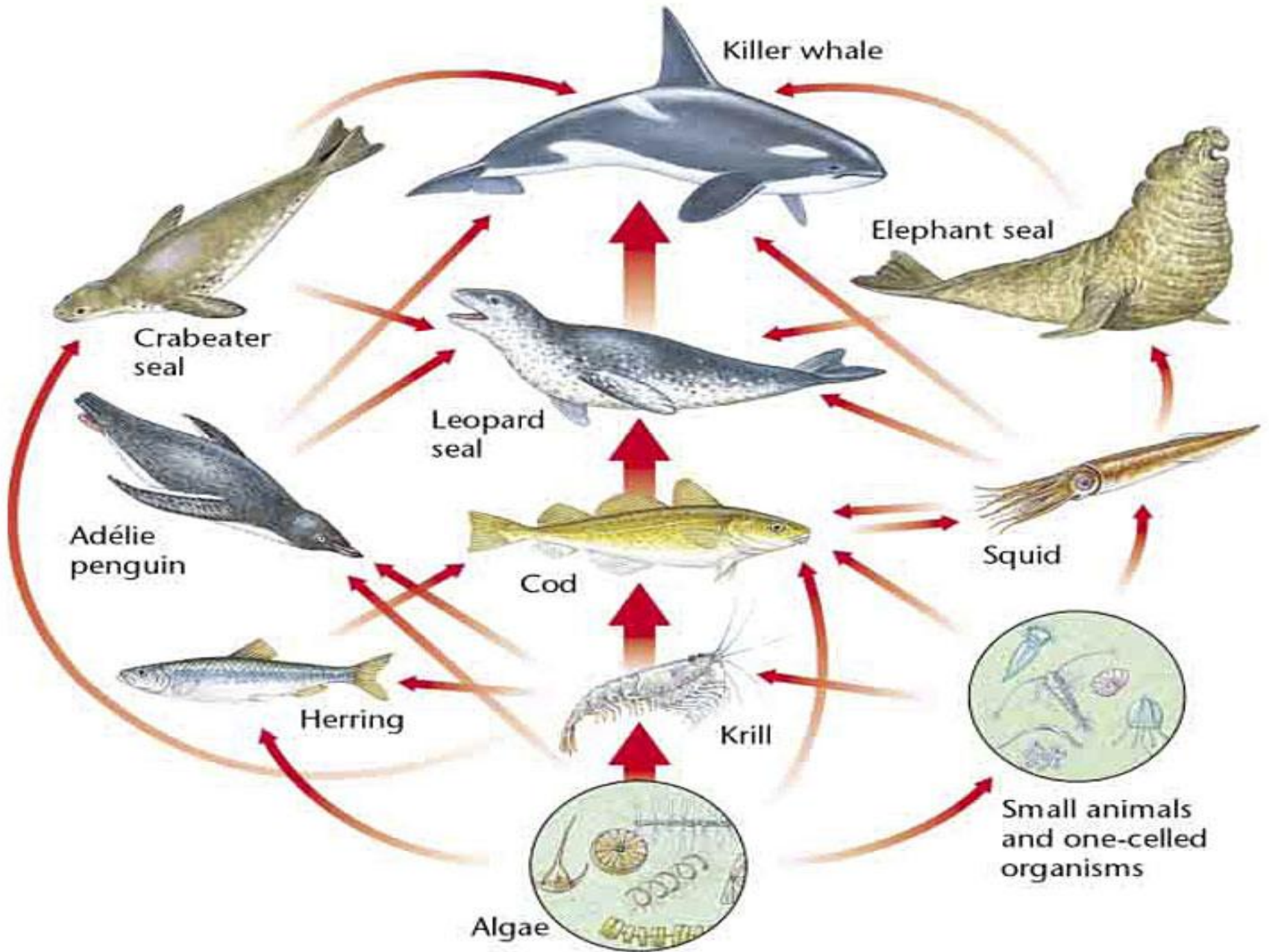
1<sup>st</sup> order/primary  
CONSUMER  
(HERBIVORE)

PRODUCER



# FOOD CHAINS AND WEBS

- Organism's position in food chain/web can vary as their diet differs
- EX: bears
  - Eating berries → primary consumer
  - Eating a plant-eating rodent → secondary consumer
  - Eating salmon → tertiary consumer (salmon eat herring that eat zooplankton that eat phytoplankton)

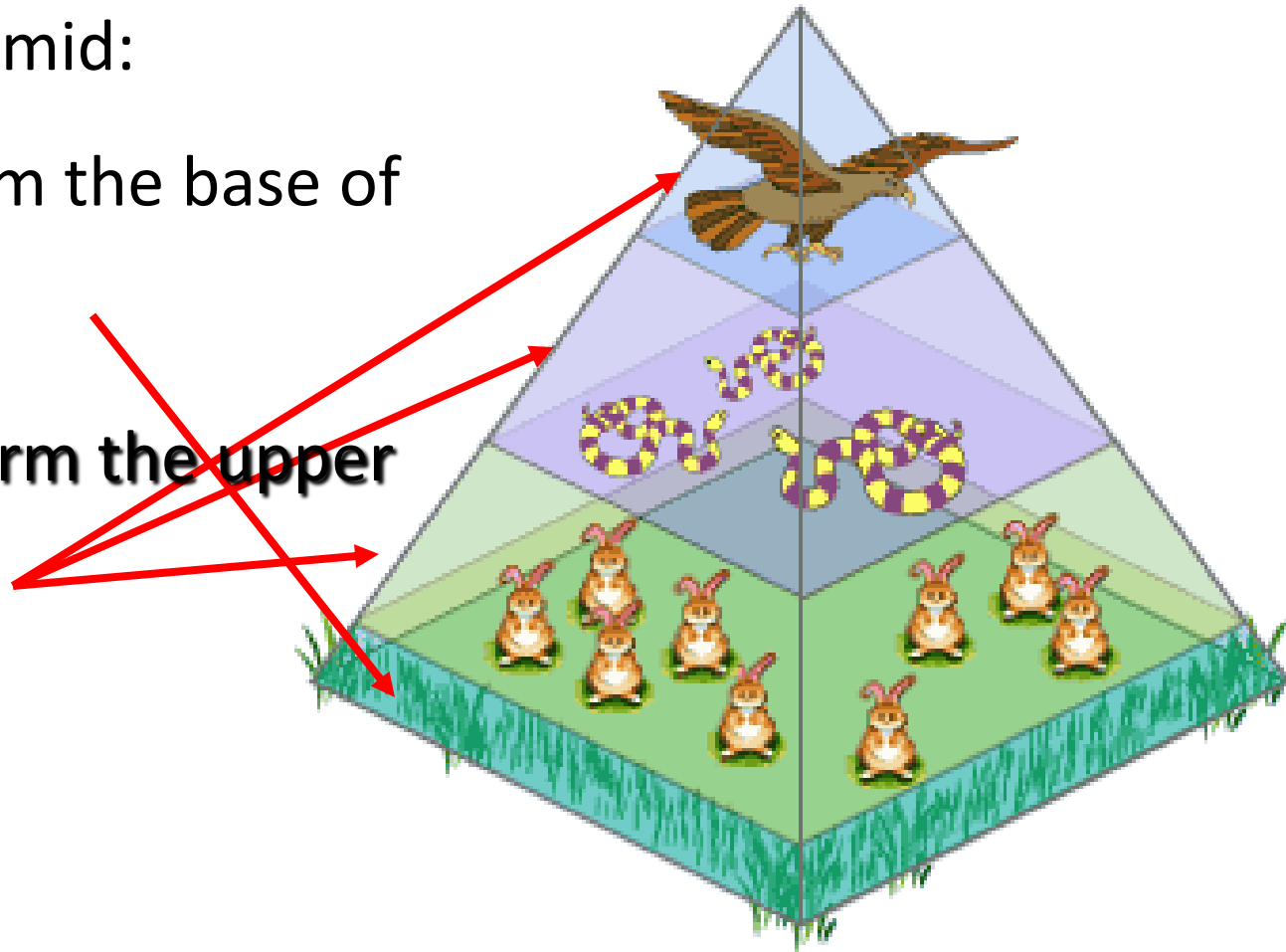


# WHAT'S FOR DINNER PACKET:

- Food Chain Questions (1-12)
- Food Web Questions (1-15)
- Food Chain Word/Definition Matching
- Food Chain Quiz #1
- Food Chain Quiz #2

# FOOD CHAINS/WEBS & ENERGY PYRAMIDS

- Food chains/webs can be written as a pyramid:
- Producers form the base of the pyramid
- ~~Consumers form the upper layers~~

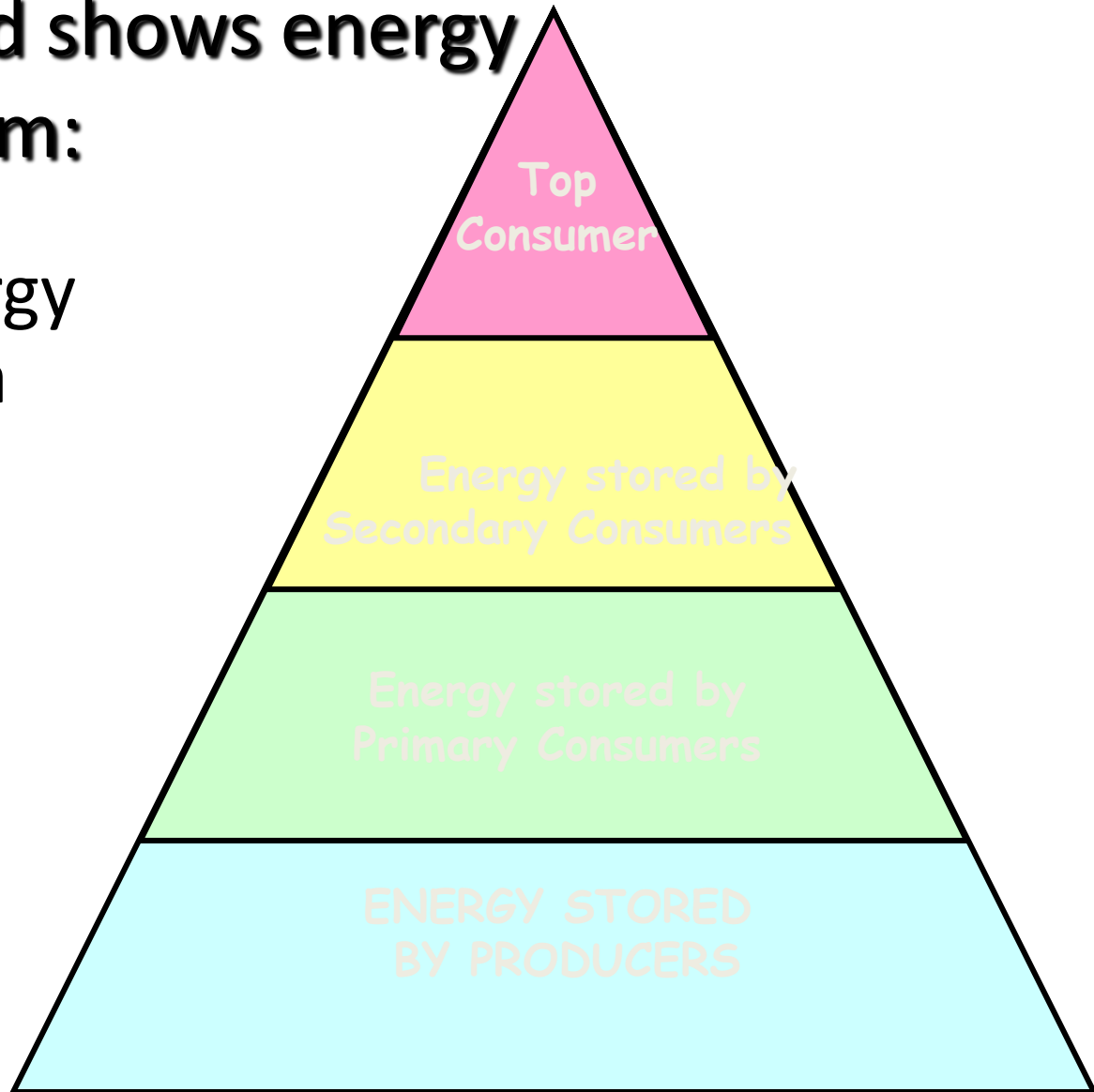


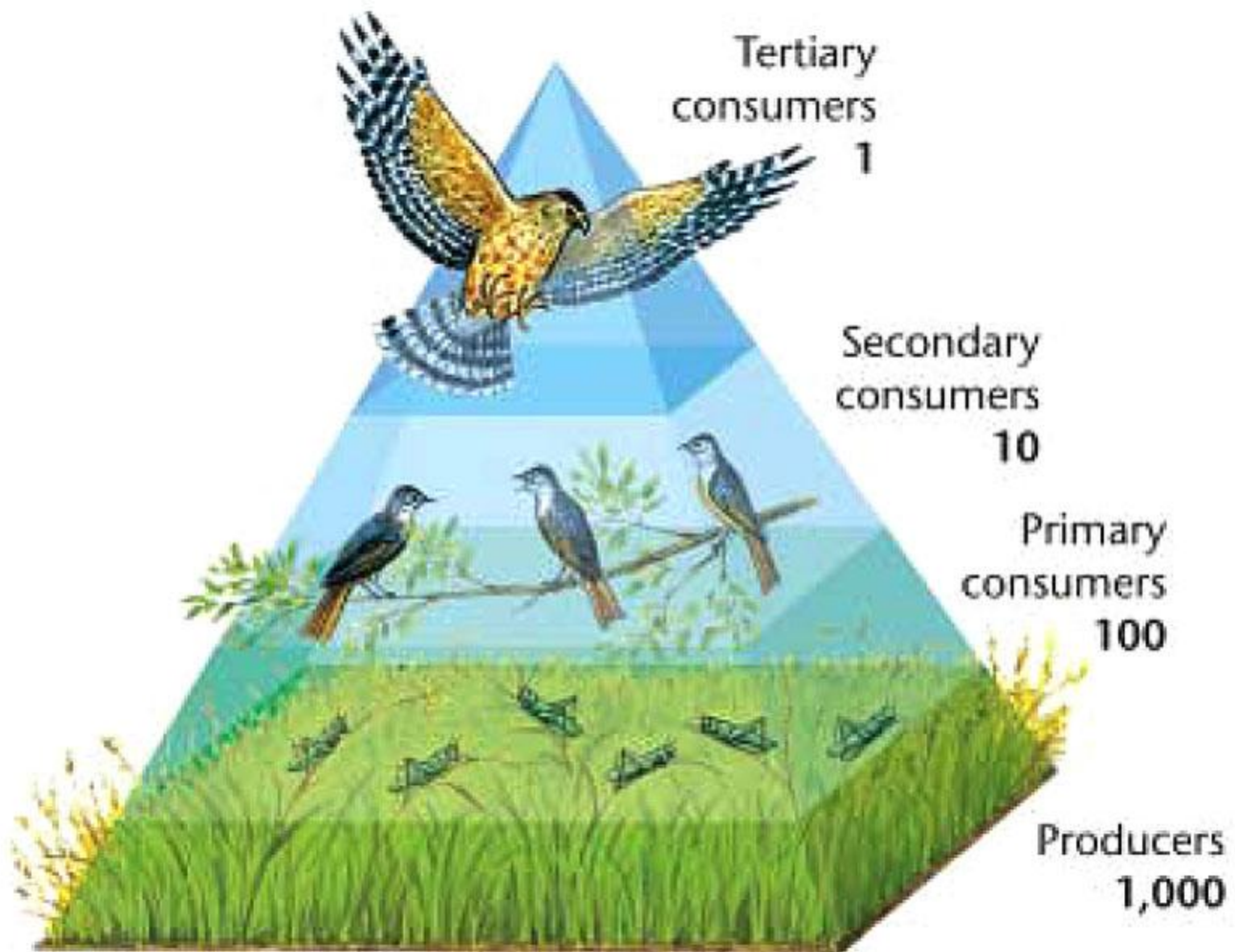


# ENERGY PYRAMIDS

The energy pyramid shows energy flow in an ecosystem:

- A level of the energy pyramid is called a **TROPHIC LEVEL**
- Each **trophic level** represents the energy for those organisms



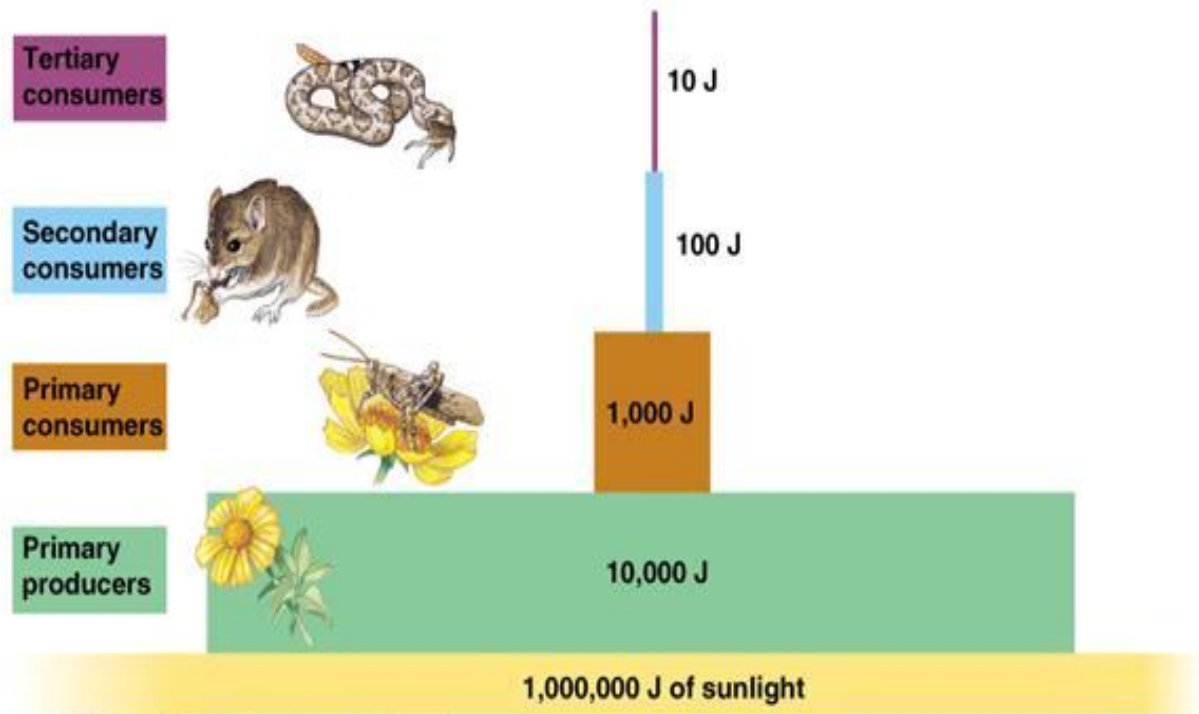


Energy Pyramid

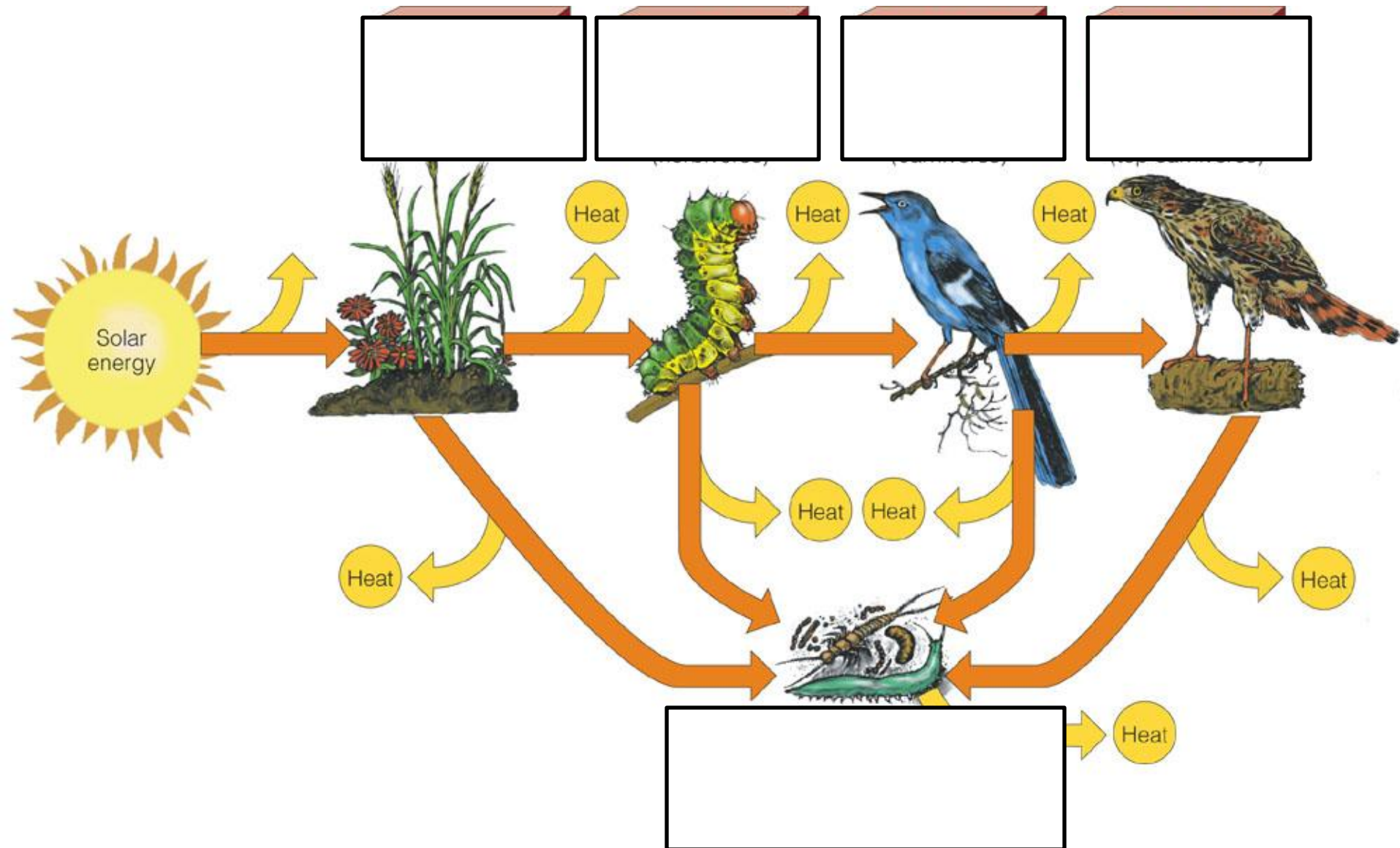
# TROPHIC LEVELS

- Energy is **lost** with each trophic
  - ~90% is released to the environment as heat
  - ~10% of the energy is used

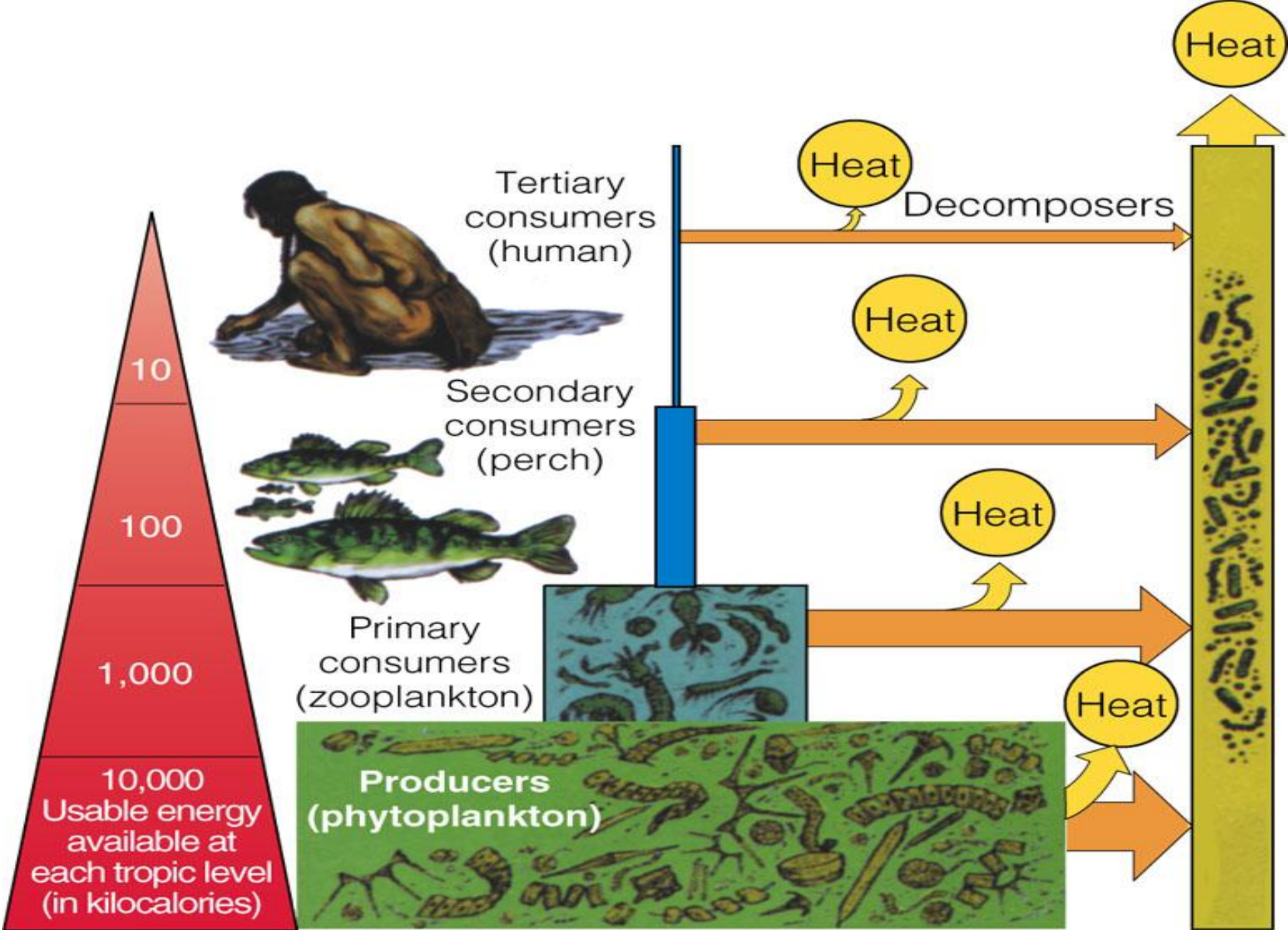
**Only about 10%  
of the energy  
from one level  
is passed on to  
the next level**



What does this diagram show?





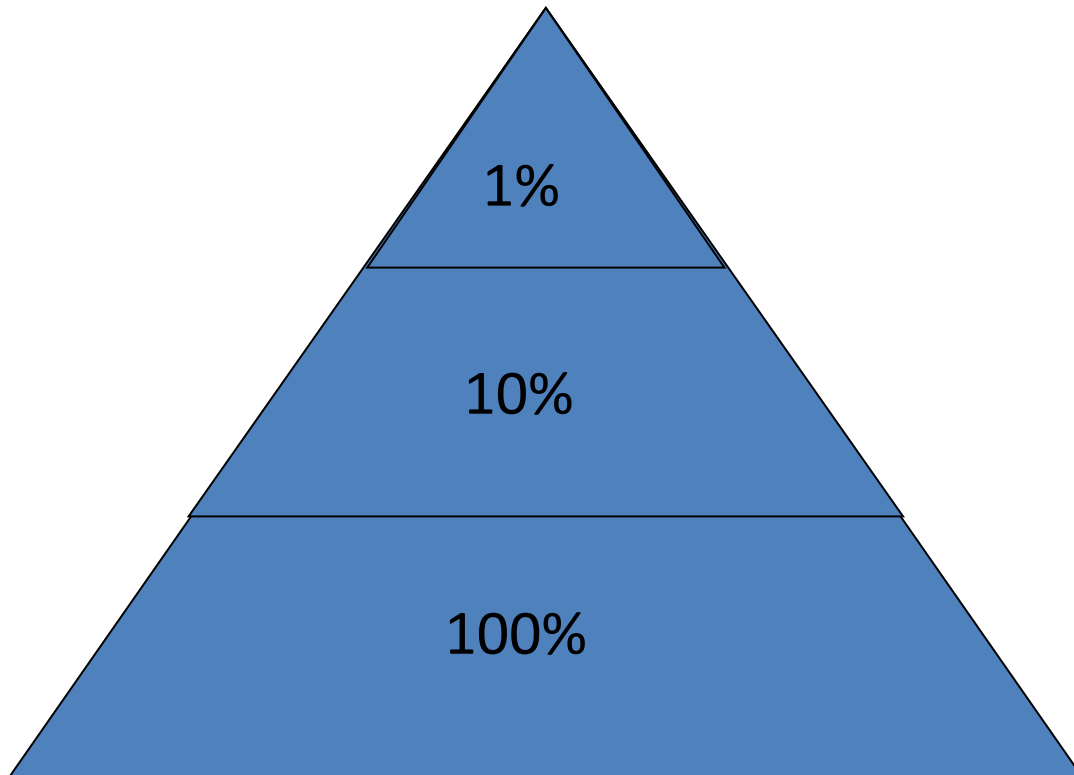




# QUICK REVIEW

## ■ Practice!

If 100% of the energy is available at the first trophic level, what percentages of the energy are available at the second and third trophic levels?



# QUICK REVIEW!

All organisms in an ecosystem need energy from food to live. An energy pyramid shows how much food energy is passed from one organism to another through food chains. Producers have the largest spot at the base of the pyramid. Altogether, only about 10% of the food energy at each level gets passed up to the next level.

# Real Data



## Energy Flow in Communities

Energy transfer from one trophic level to another in a community is only about 10% efficient. In addition to affecting community structure, this inefficiency affects our own “energy footprints.”

1. **Calculate** If 1000 units of energy are available at the producer level of the energy pyramid, about how many units are available for first-level consumers? Second-level consumers? Third-level consumers?

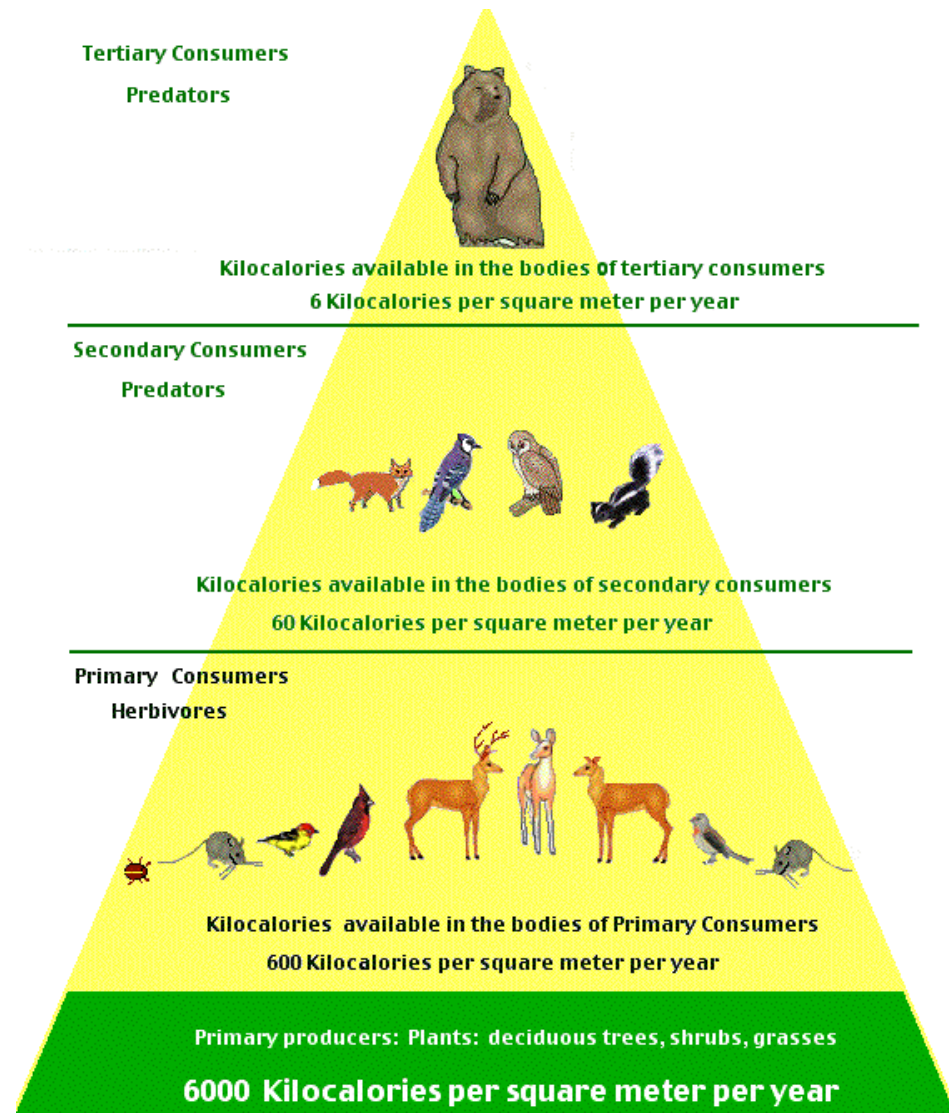
2. **Infer** Use your answer to **Question 1** to explain why most communities have only about three or four trophic levels.

3. **Calculate** How many units of energy would there need to be in the first trophic level to end up with 1000 units of energy in the second? In the third? In the fourth?

4. **Apply Concepts** Use your answer to **Question 2** to explain why eating “down a food chain,” vegetables instead of meat for example, is more energy efficient.

# Energy Flow

- Why are there fewer organisms at the top?  
(Why fewer bears than the fruit they feed on)
- Why aren't there more than 4-5 trophic levels in a energy pyramid?



# Energy Efficiency

- Why is it more energy efficient to eat grains directly, rather than the meat of grain-eating animals?

15lbs. of feed → 1lb. of beef

5lbs. of feed → 1lb. of chicken



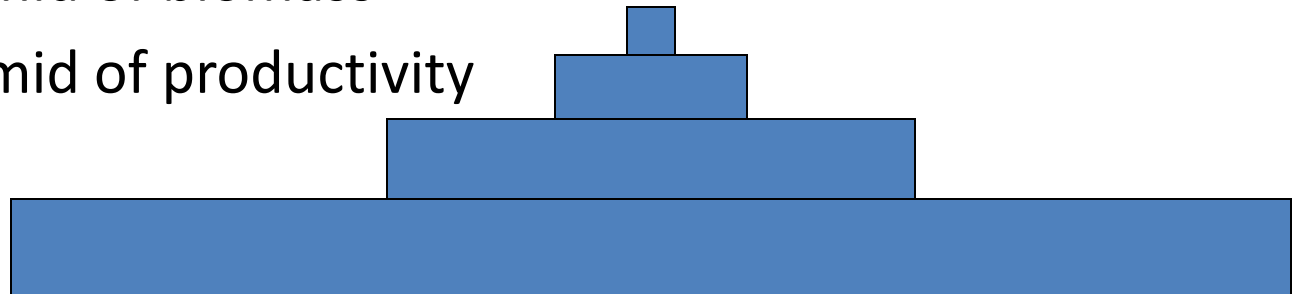
# In packets...

- P. 11 (#1-3)
- Next P.11 (matching)
- P. 9 & 10 (food chain quiz #1, quiz #2)
  - GRADED!!
  - 20 points
- Turn in when finished 😊

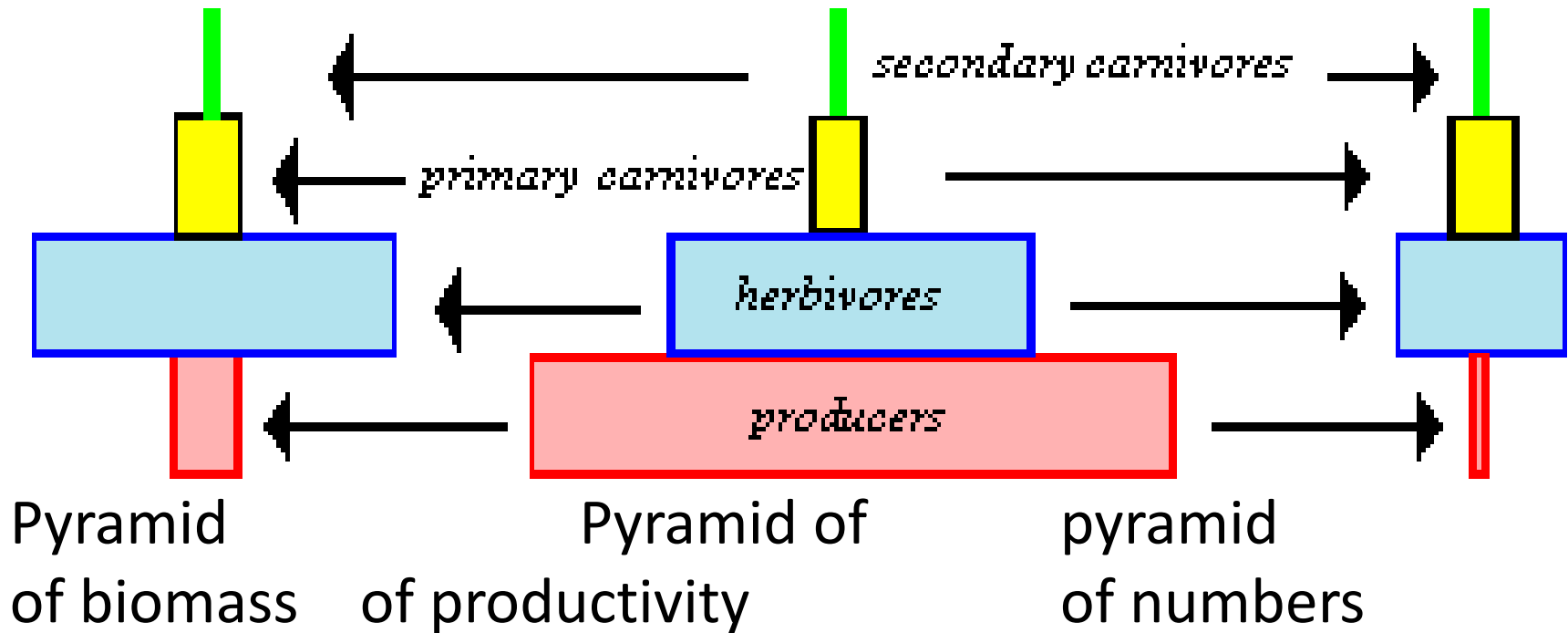
# FOOD CHAINS AND PYRAMIDS

- Pyramid diagrams give information about the organisms in a food chain. There are three types of pyramids:

- Pyramid of numbers
- Pyramid of biomass
- Pyramid of productivity



# Three types of pyramids



# Pyramid diagrams

- are drawn to scale
- the width of each rectangle is proportional to:
  - the number of organisms per square metre
  - or the biomass in grams per square metre
  - or the productivity in joules per square metre per month/year

# PYRAMIDS OF NUMBERS

- These show numbers of organisms at different trophic levels, which depend on:
  - the size of individual organisms
  - the standing crop at the trophic level
- Number pyramid diagrams may be:
  - upright pyramids
  - inverted pyramids



# PYRAMIDS OF BIOMASS

- Biomass = total amount of living tissue
- Measured in  $\text{g/m}^2$
- These show the total biomass of organisms at different trophic levels, which depends on:
  - the energy available at each trophic level
  - the standing crop at each trophic level
- Biomass pyramid diagrams may be:
  - upright pyramids
  - inverted pyramids

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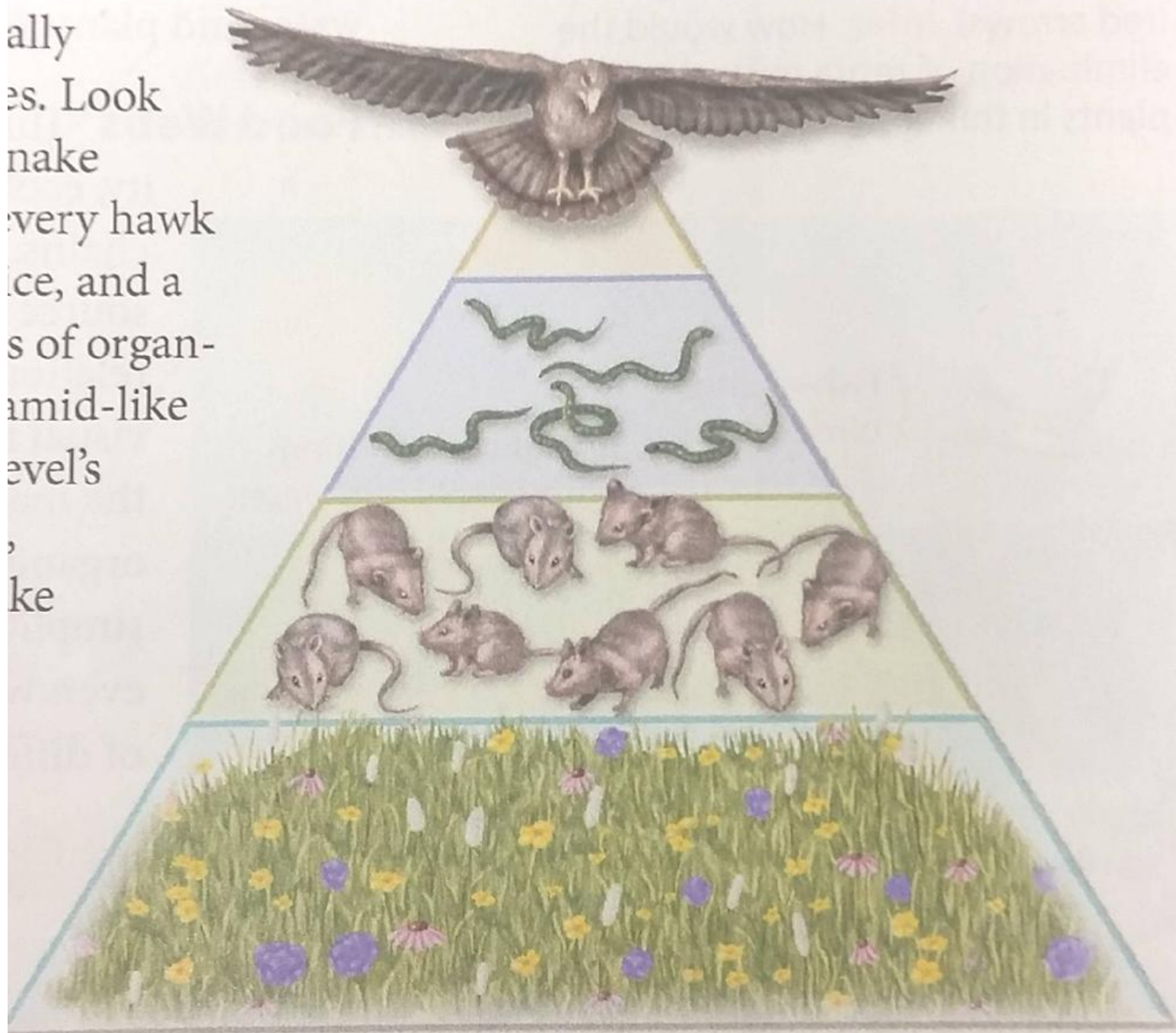
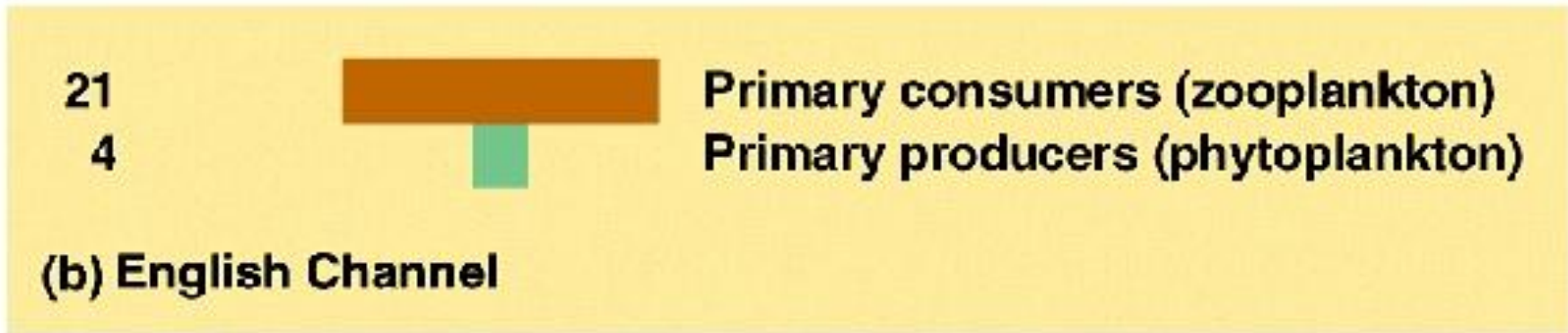
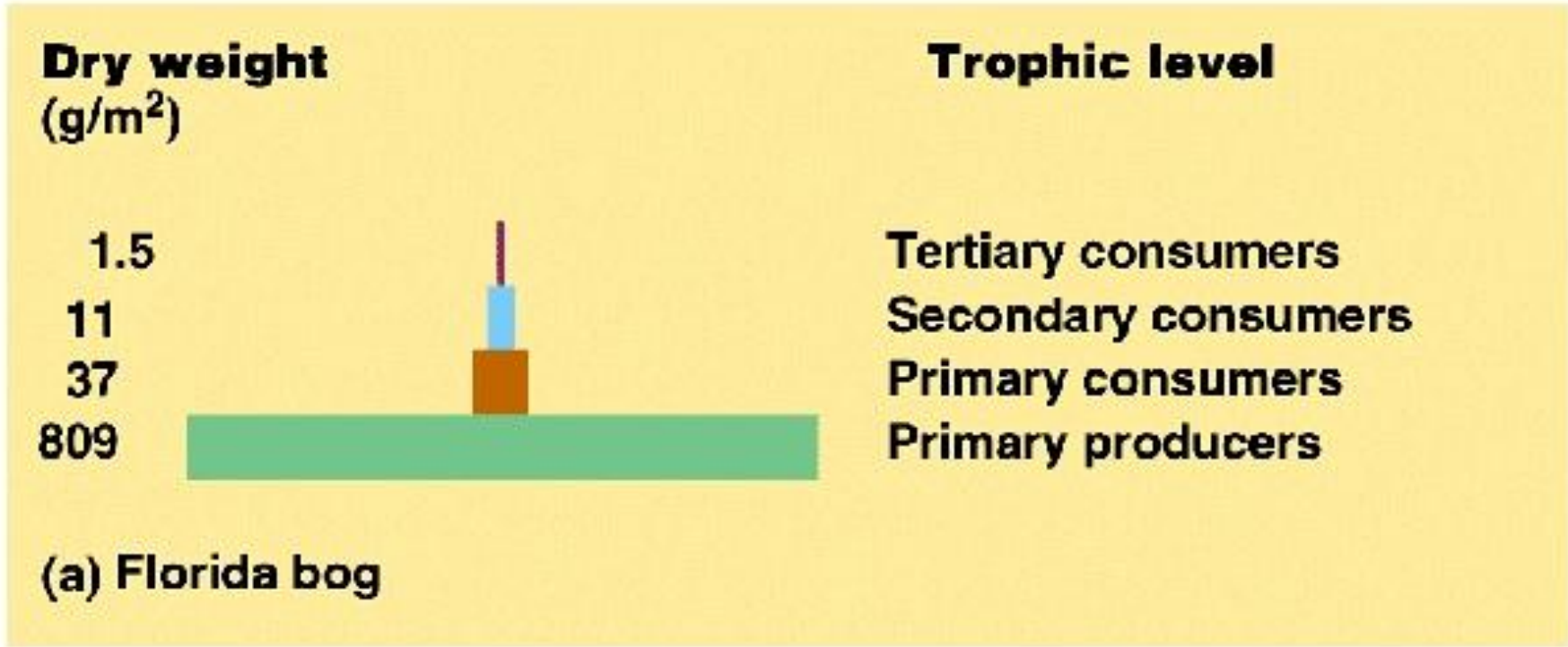


Figure 54.12 Pyramids of biomass (standing crop)



# How can a pyramid of biomass be inverted?

- Pyramids of biomass measure standing crop at a particular moment in time.
- If you collected the cuttings from a garden lawn, mown twice a week during the summer, it would make a huge pile of biomass
- But just after cutting, the biomass stored in the lawn would be quite small
- Exchange your lawn mower for a rabbit and you can see how an inverted biomass pyramid could be produced
- if you measured biomass over the whole summer for lawn and rabbit, the pyramid would look quite different

# PYRAMIDS OF PRODUCTIVITY

These show productivity of organisms at different trophic levels, which depends on:

- the energy available from the previous trophic level
- the efficiency of the organisms

Productivity pyramid diagrams are always:

- upright pyramids

Figure 54.11 An idealized pyramid of net production

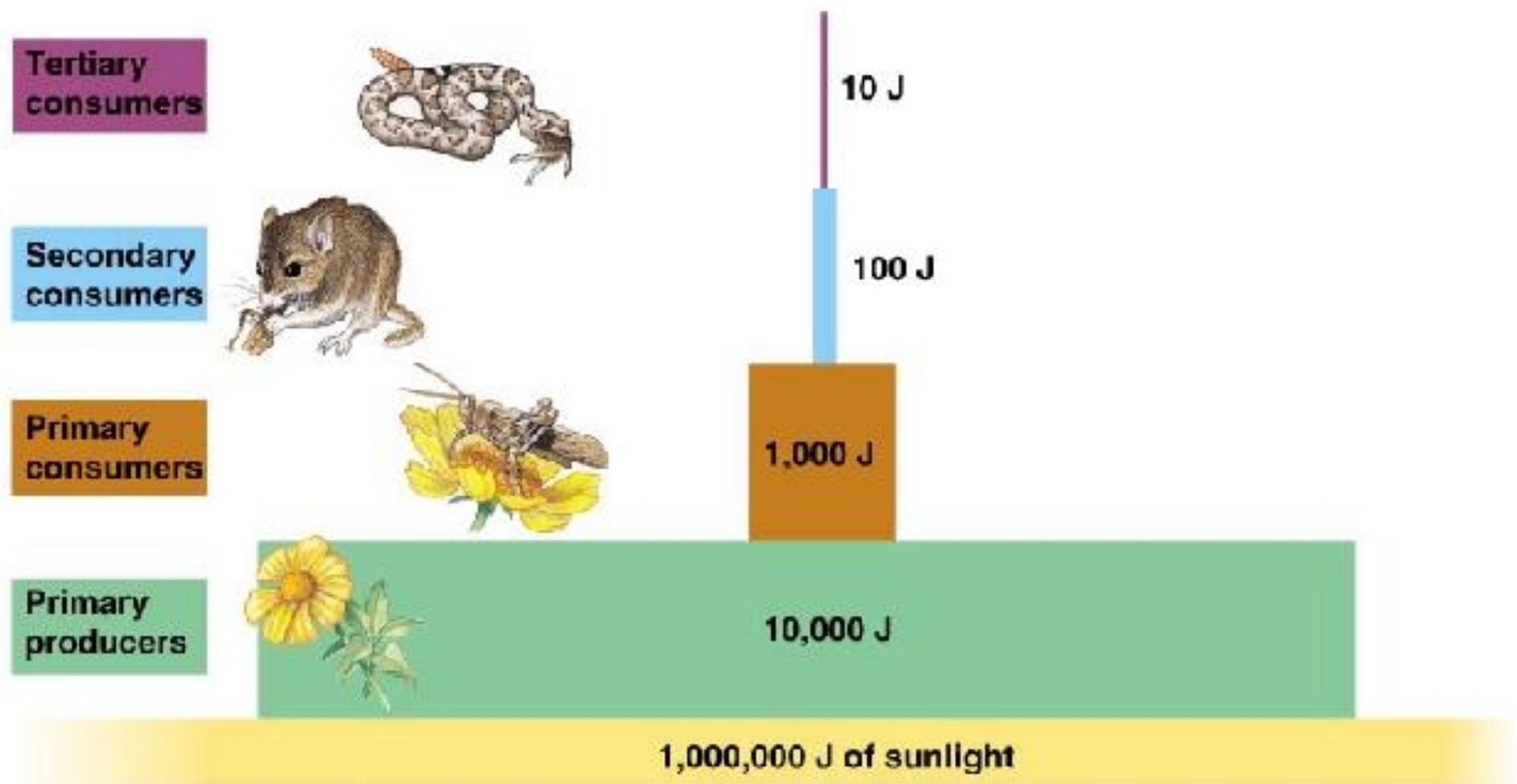


Figure 54.14 Food energy available to the human population at different trophic levels

**Trophic level**

Secondary  
consumers

Primary  
consumers

Primary  
producers

Human  
vegetarians

Human  
meat-eaters

Cattle

Corn

Corn

