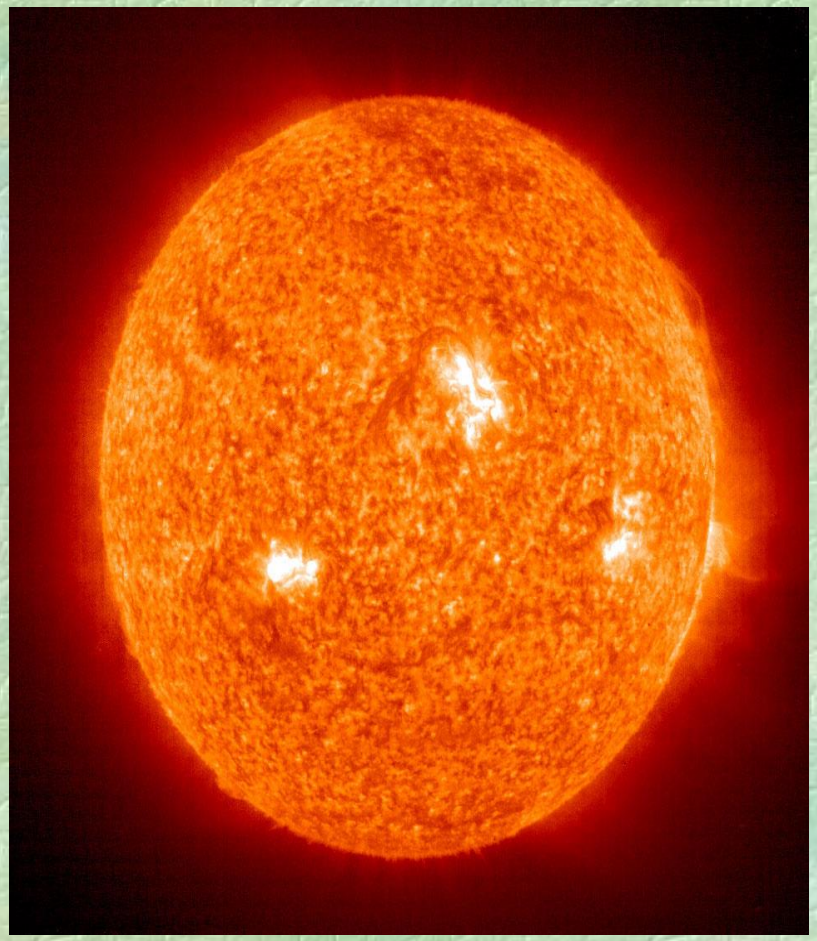
Energy flow in the Ecosystems

Energy in Ecosystems

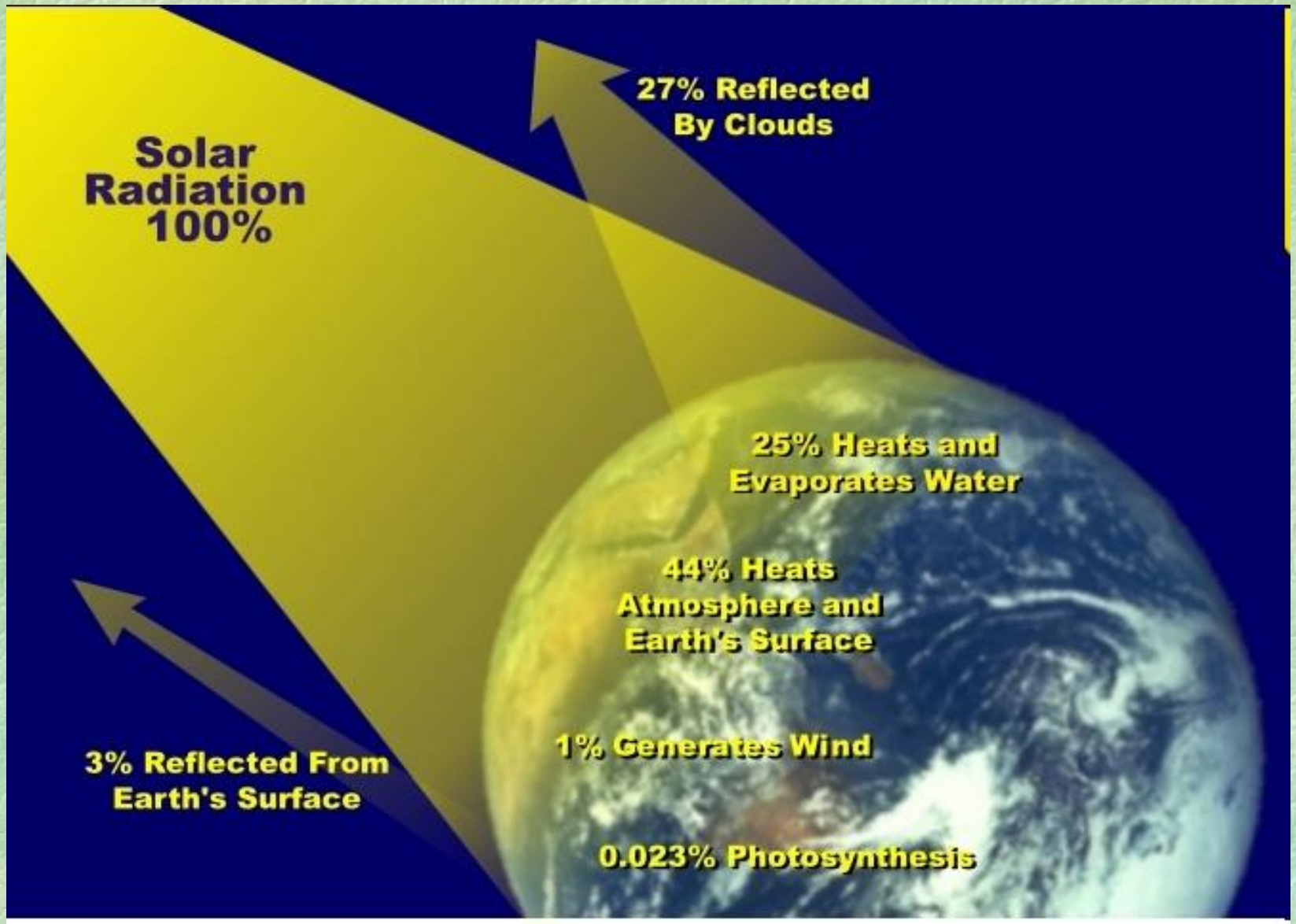
Sunlight:

- Travels 150 million km to reach earth.
- Only 1 billionth (0.000000001%) of the suns energy reaches the earth (most is filtered out before reaching the surface)



Sunlight:

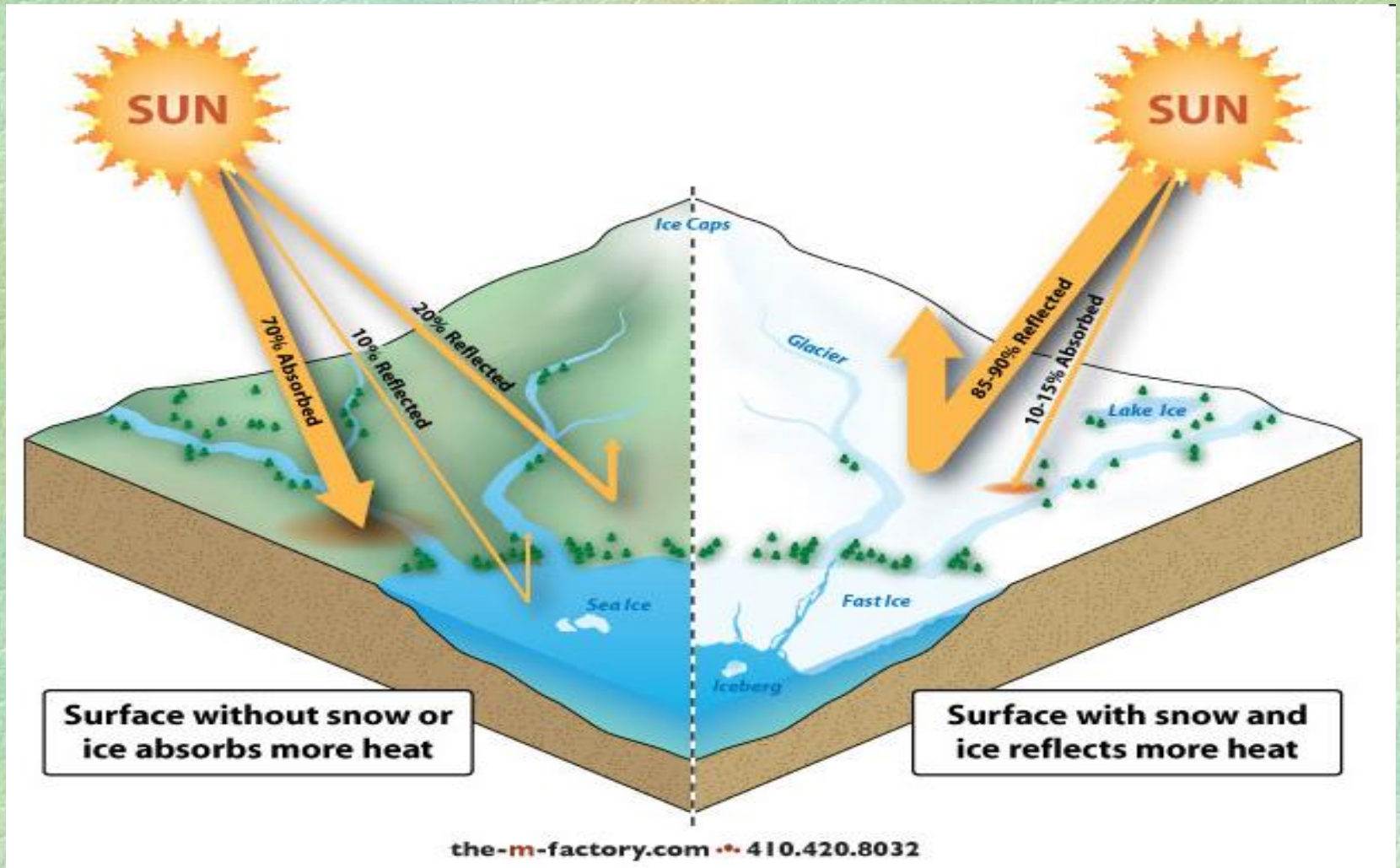
- Harmful rays (x-ray, gamma, cosmic, UV) are either reflected or absorbed by chemicals in the atmosphere


Solar
Radiation
100%
27% Reflected
By Clouds
25% Heats and
Evaporates Water
44% Heats
Atmosphere and
Earth's Surface
1% Generates Wind
0.023% Photosynthesis
3% Reflected From
Earth's Surface

Sunlight in the Lower Atmosphere

- 30% reflected by clouds and earth surface
- 70% warms surface of the planet
- Warming causes evaporation thus generating the water cycle and weather
- 0.023% is used for **photosynthesis** – the process by which green plants use sunlight to produce carbohydrates ($6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$)
- Gases in the atmosphere trap thermal energy rising from the surface back to earth (permit energy from the Sun into ecosystems, prevent energy from leaving)

Albedo Effect



Albedo Effect

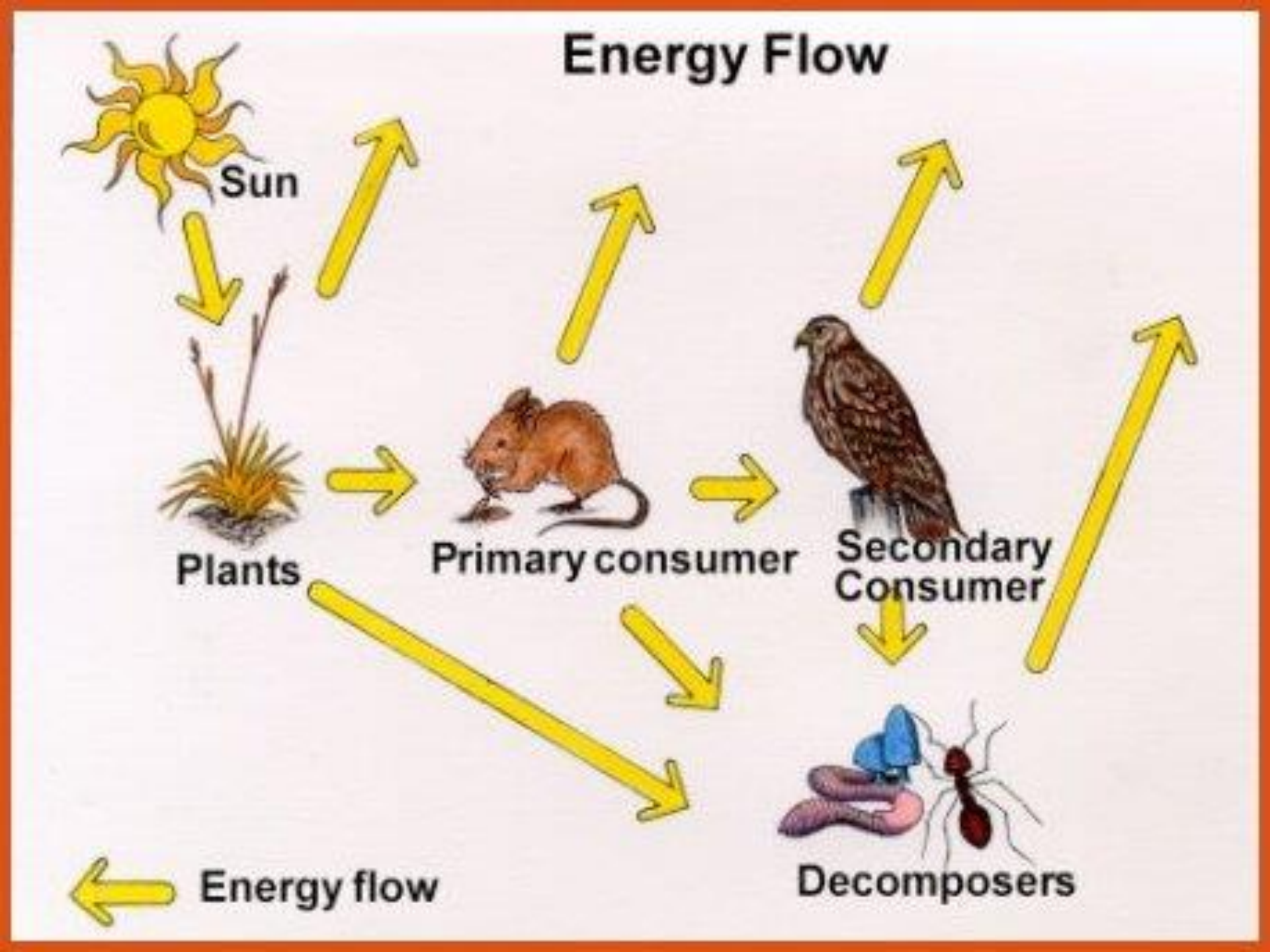
- When sunlight strikes an object, some of the energy is absorbed, some is reflected
- **Albedo** is a measurement of the percentage of light that an object reflects
- The higher albedo, the greater the reflection (ex. **Snow, ice**); the lower albedo, the lower the reflection (ex. **dark rocks, trees, water**)
- Higher albedo = less energy will be absorbed and available for maintaining the global temperature

Video: Energy flows through ecosystem

http://ca.video.search.yahoo.com/video/play?ei=UTF-8&fr=yfp-t-715&p=Ecosystems+flow+of+energy&vid=155710128651&dt=1262419200&l=204&turl=http%3A%2F%2Fts4.mm.bing.net%2Fvideos%2Fthumbnail.aspx%3Fq%3D155710128651%26id%3D36fe345eeee6142035c0fcb54ce0af9c%26bid%3DZ2NRNYzU6%252bgMfw%26bn%3DThumb%26index%3Dch1%26url%3Dhttp%253a%252f%252fwww.youtube.com%252fwatch%253fv%253do_RBHfjZsUQ&rurl=http%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3Do_RBHfjZsUQ&tit=How+Ecosystems+Work&sigr=11aapj0o7&newfp=1

Energy movement in Ecosystems

- Life on Earth cannot exist without a source of energy
- The source of ALL energy on our planet comes from the sun, which plants capture to carry out photosynthesis, which in turn makes food for all other animals
- *How does this energy get passed from one organism to the next?* **by feeding on them**

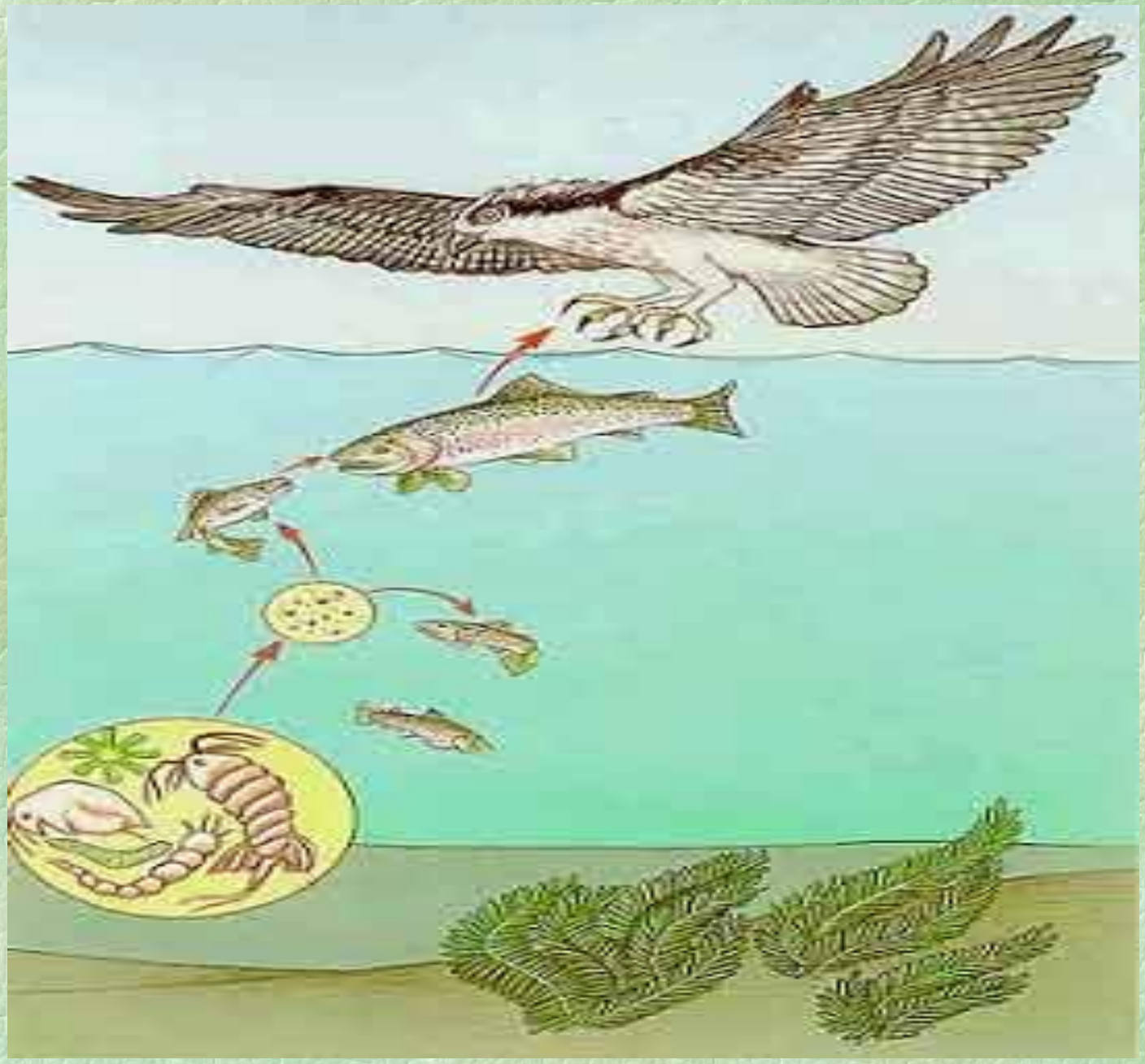

Energy Flow
Sun
Plants
Primary consumer
Secondary Consumer
Decomposers
Energy flow

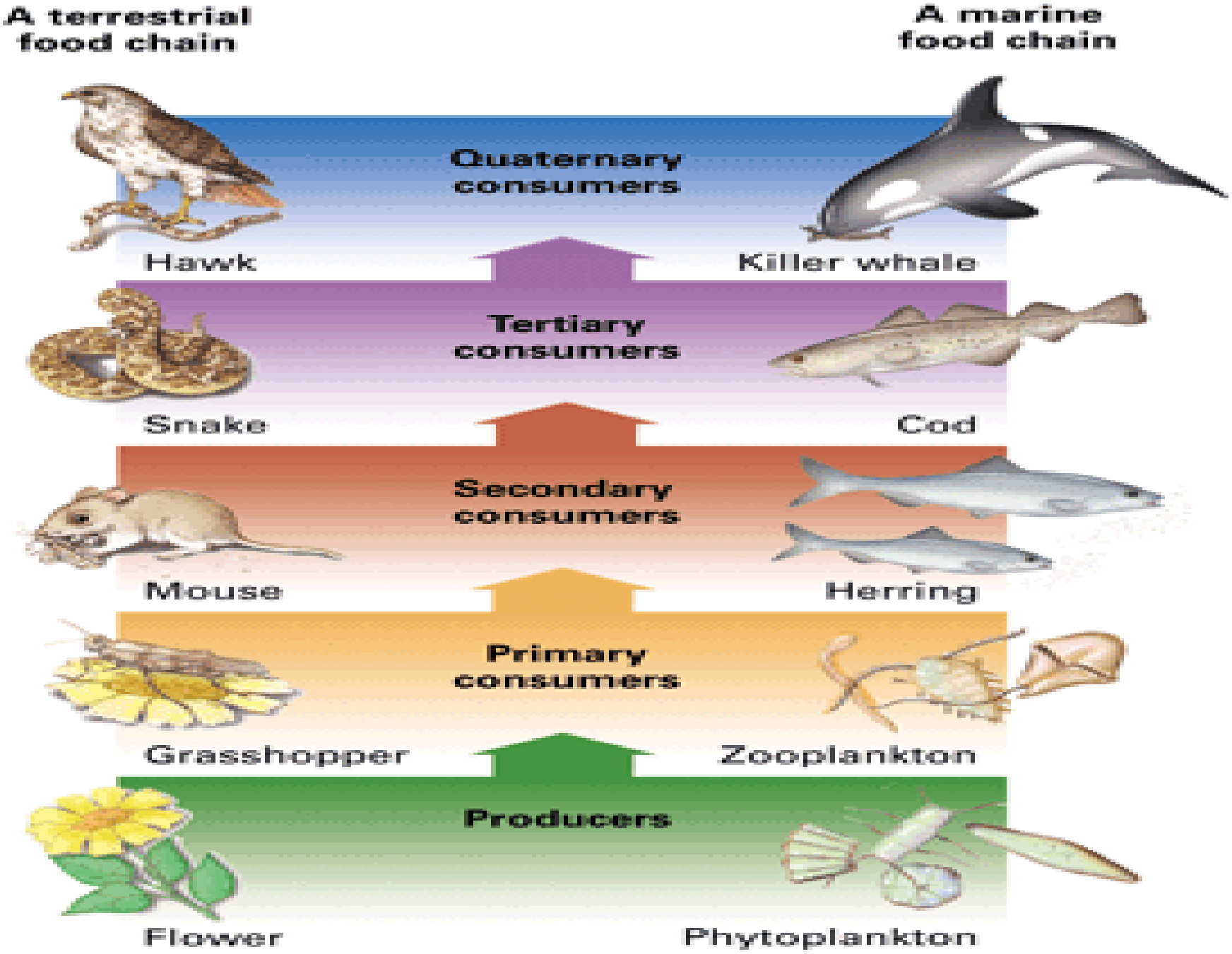
Trophic Levels

- **Trophic Level -** A way of categorizing organisms based upon the way they gain their energy
- **First Trophic Level**
  - **Producers** (autotrophs. Plants, algae, bacteria.
- **Second Trophic Level**
  - "Primary Consumers" Feed on producers. Mice, deer, cow, moose, rabbit , *Caterpiller*

Trophic Levels

- **Third Trophic Level**
  - "secondary Consumers" feed on primary consumers. Bear, wolf, lynx, hawk, Owl, Fox
- **Fourth Trophic Level**
  - "Tertiary Consumer" which is top level carnivore (animals that eat other animals called **carnivores**. Humans for example
- **Omnivores** are both primary and secondary consumers




A terrestrial food chain
A marine food chain
Quaternary consumers
Hawk
Killer whale
Tertiary consumers
Snake
Cod
Secondary consumers
Mouse
Herring
Primary consumers
Grasshopper
Zooplankton
Producers
Flower
Phytoplankton

Energy within the Food Chain

- Every organism in an ecosystem provides energy for other organisms
- Food chains are a way of showing a step-by-step sequence of who eats whom in an ecosystem
- Consumers are placed in categories based on their tropic level in a food chain

Energy within the Food Chain

- The final carnivore in any food chain is called a **top carnivore**; they are not eaten by any other animals
- Each individual organism is involved in many food chains; interconnected food chains that involve all the organisms in an ecosystem are called a food web
- The most stable ecosystems have complex, well-developed food webs that can withstand the removal of one species

Competition Among Organisms:

- Competition for limited food, resources, and habitats are common within an ecosystem
- **Interspecific competition** results when individuals of different species are competing for the same resources (ex. Mice and Voles both compete to eat the same type of grass)

Lynx and the red fox both compete to eat the snow shoe hare)Both the lynx and the red fox prey on the snowshoe hare , this is an example of **interspecific competition.**

Competition Among Organisms:

- **Intraspecific competition** results when individuals of the same species are competing for the same resources (ex. Two mice competing to eat the same type of grass)

Atlantic Salmon

Male salmon will compete with other males for mates during the spawning season. The strongest will be successful, ensuring the fittest genes will be passed on. This demonstrates **intraspecific competition.**

- The effects of competition are lowered in ecosystems with higher biodiversity (more sources of food/resources puts less pressure on one resource, creates stability)

Thermodynamics

- The study of energy transformations
- First law of thermodynamics: although energy can be transformed (changed) from one form to another, it can neither be created or destroyed
- second law of thermodynamics: during any energy transformation, some of the energy is converted into an unusable form (heat) that cannot be passed on
- each time energy is transformed, some energy is lost from the system

Thermodynamics

- Result: amount of energy available in each step of a chain is always less than the amount of energy available in the previous step
- The overall loss of energy at each step sets a limit on the number of trophic levels in a food chain at about five (most ecosystems don’t have enough energy to support higher levels of consumers)

Video

http://ca.video.search.yahoo.com/video/play?ei=UTF-8&fr=yfp-t-715&p=Ecosystems+flow+of+energy&vid=1950854027255&dt=30051438&l=111&turl=http%3A%2F%2Fts2.mm.bing.net%2Fvideos%2Fthumbnail.aspx%3Fq%3D195085402725%26id%3D84a228c190fcf050d83a9b6a3605e546%26bid%3DZYw9F7mdzQiB3Q%26bn%3DThumb%26index%3Dch1%26url%3Dhttp%253a%252f%252fvideos.howstuffworks.com%252fdiscovery%252f27995-assignment-discovery-energy-flow-video.htm&rurl=http%3A%2F%2Fvideos.howstuffworks.com%2Fdiscovery%2F27995-assignment-discovery-energy-flow-video.htm&tit=Assignment+Discovery%3A+Energy+Flow&sigr=12qv1s2bt&newfp=1

Graphing Energy in Ecosystem using Ecological Pyramids

- Graphs called pyramids are used to represent energy flow in an ecosystem
- Help ecologists visualize the relationships in an ecosystem and to easily compare ecosystems

Important facts about Pyramids of Energy

- Every time energy is transferred within an ecosystem, some of the energy changes form
- Ex. Sun's energy changes to chemical energy in the form of starch (photosynthesis)
- Animals gain energy using the chemical energy stored in plants for energy

Continue

- Not all the energy harvested by the plant is used by the animal that eats it (a lot of it is used to maintain the plant during growth); same story as you move up the food chain (some energy will always be used by the organism)
- Only a small fraction of the energy stored in an organism gets passed to the next trophic level
- the farther up the food chain you travel, the less energy is available (ie. Less energy available to secondary consumers than there is to primary consumers)

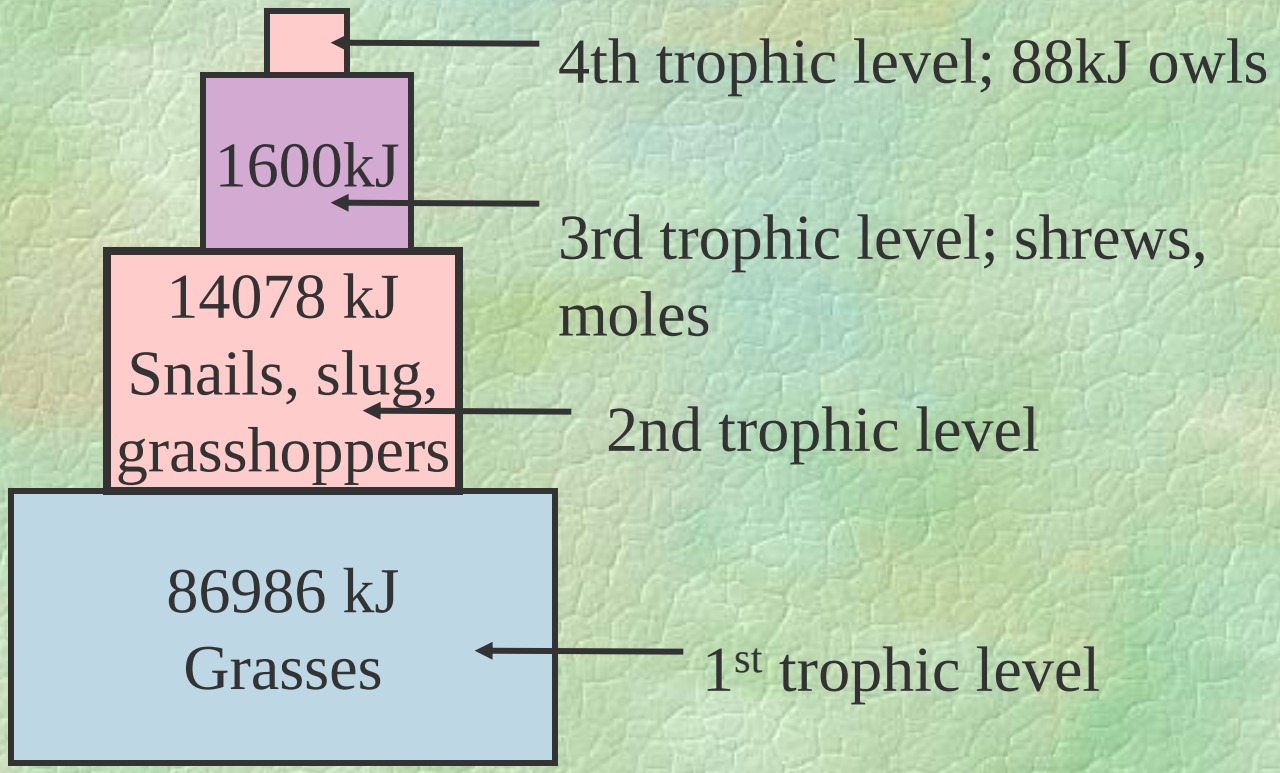
Three main types of ecological pyramid:

Three main types of ecological pyramid:

1) Pyramids of Energy

- Shows the amount of energy available at each trophic level
- Only about 10% gets passed to the next
- The other 90% is energy lost
- This is what limits the number of trophic levels

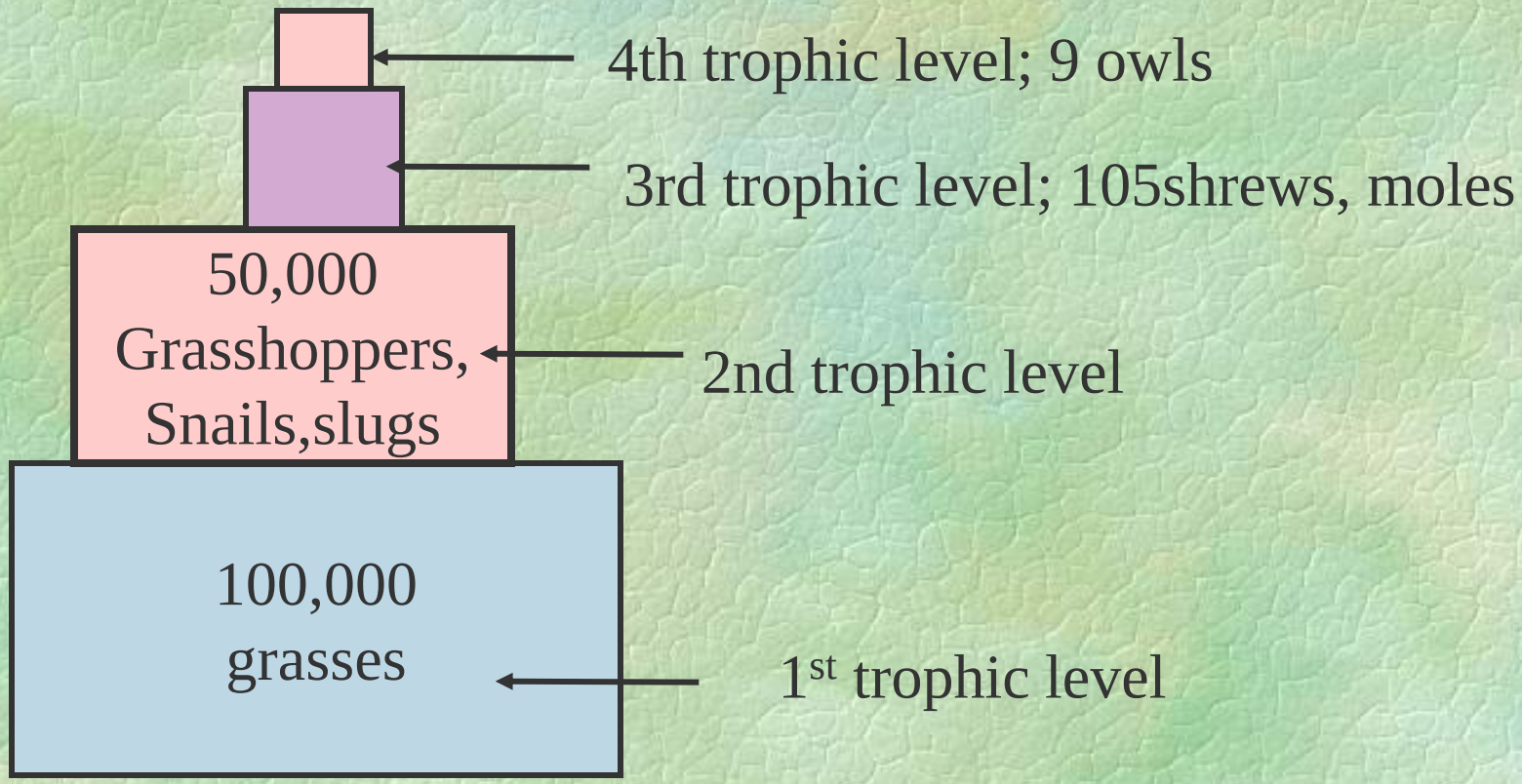
Pyramid of energy (see Fig 6 on pg 37)



2) Pyramid of numbers

- Shows the actual number of organisms at each trophic level in an ecosystem
- May not have a “pyramid” shape due to the size of the organism in the chain

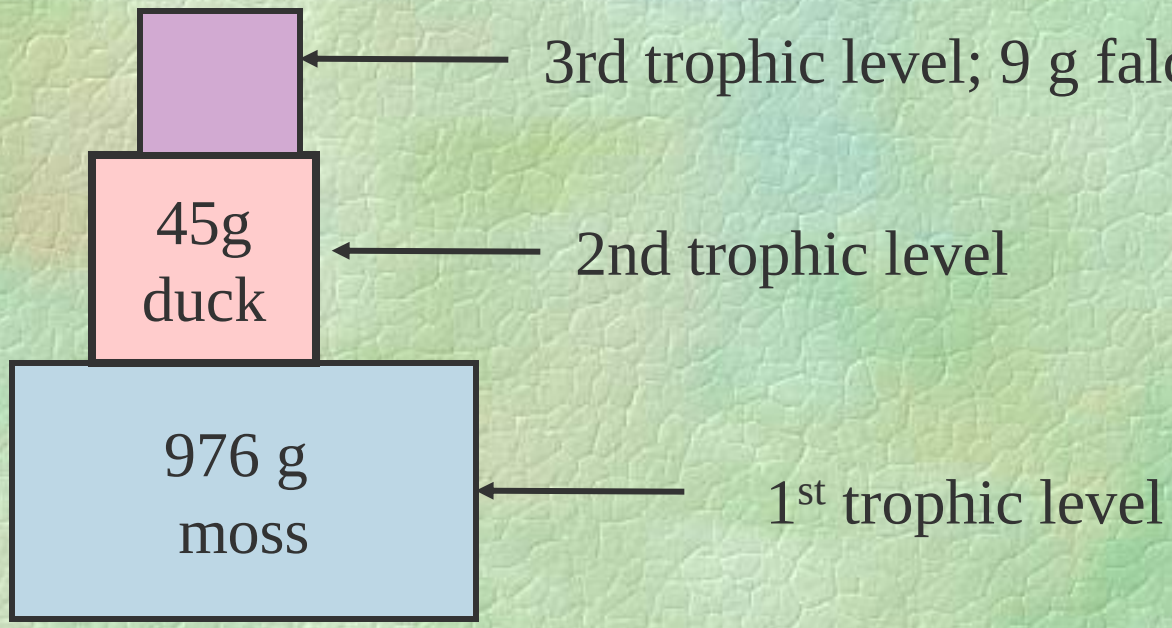
2) Pyramid of numbers (see Fig 7 on pg 37)



3) Pyramid of Biomass

- Shows the weight (dry mass of dry tissue) of organisms at each trophic level in an ecosystem

3) Pyramid of Biomass (see Fig 9 on pg 38)



- Remember: The energy available to maintain a food chain inevitably runs out unless the original energy (sunlight) is continuously fed into the system. Also, every ecosystem has a limit on available energy; primary consumers have access to the most energy.

Assignment 2!