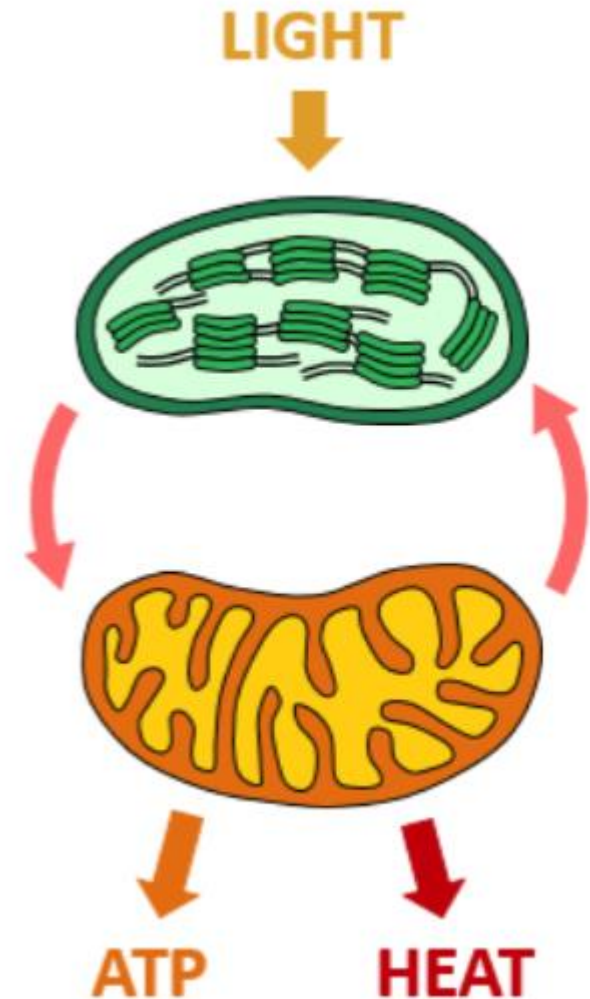


CHAPTER 4.2

Energy Flow

ESSENTIAL IDEA

Ecosystems require a continuous supply of energy to fuel life processes and to replace energy lost as heat.

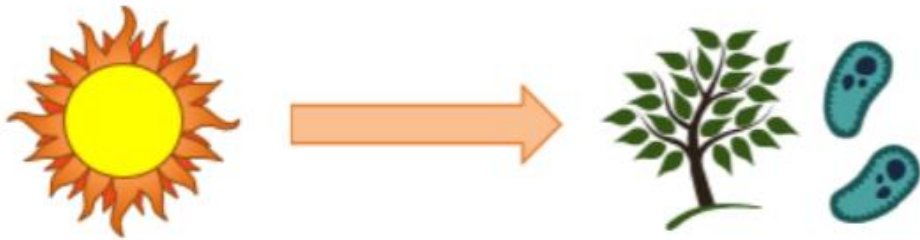


ENERGY SOURCE

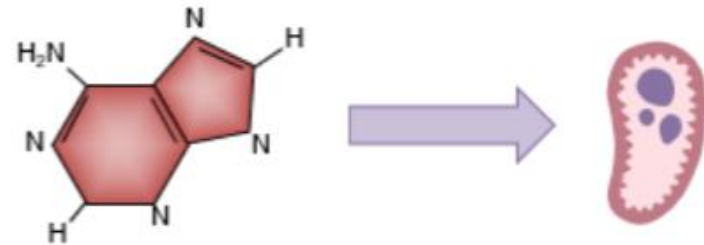
Organisms → chemical energy (*organic compounds*) to fuel cellular processes.

Autotrophs (all plants and some prokaryotes) → external energy supply → produce organic molecules

Light is the initial energy source for almost all communities



PHOTOAUTOTROPHS: *All plants, cyanobacteria*

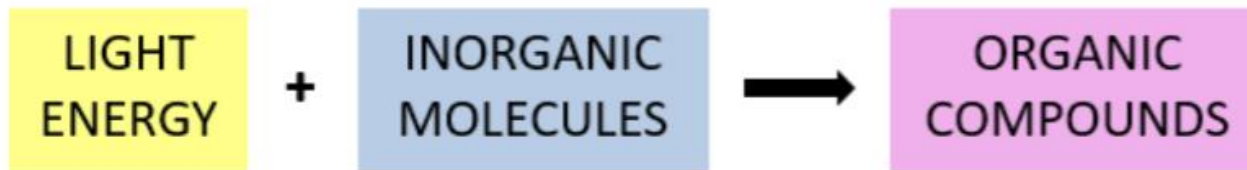


CHEMOAUTOTROPHS: *Some bacteria*

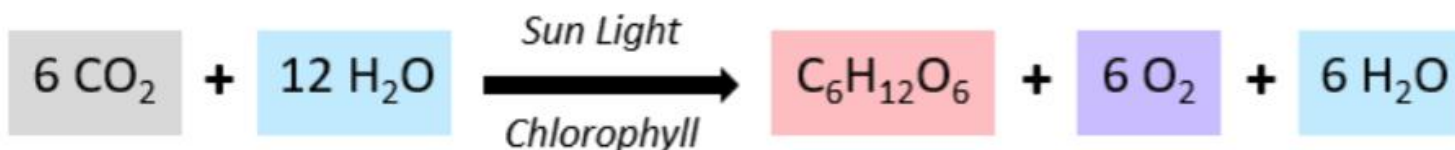
ENERGY CONVERSION: PHOTOSYNTHESIS

Light energy → organic compounds (=chemical energy) → energy stored in carbon compounds

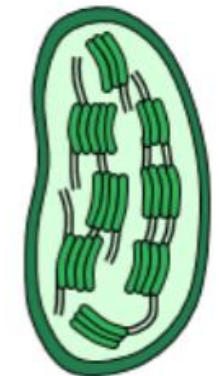
PROCESS:



EQUATION:



LOCATION:



Chlorophyll

ENERGY CONVERSION: CELL RESPIRATION

Energy stored in organic compounds → released via cell respiration → ATP + Heat

PROCESS:



EQUATION:



LOCATION:



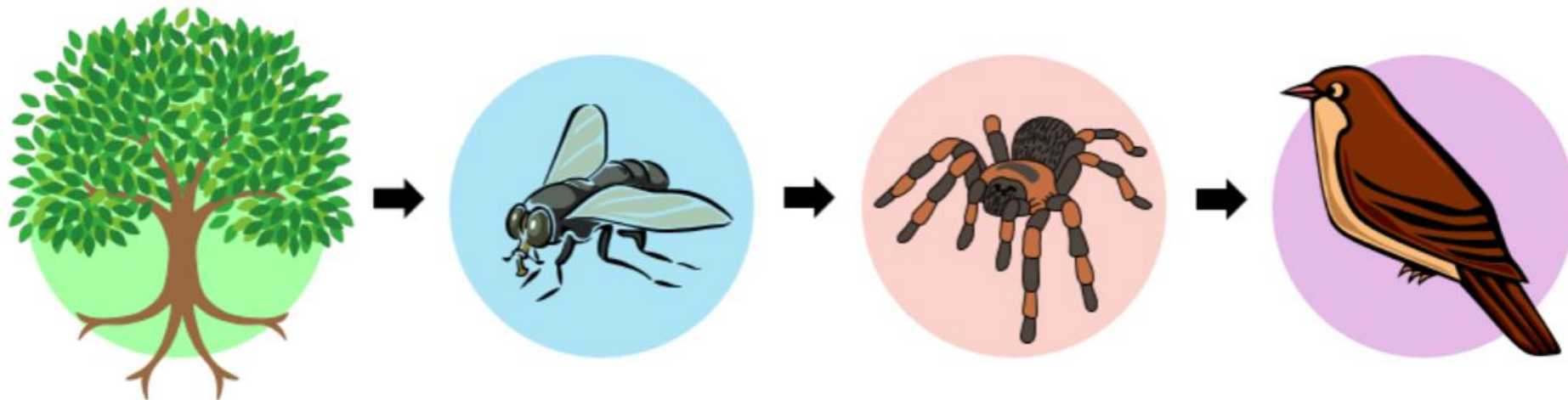
Mitochondria

FOOD CHAINS

Heterotrophs (i.e. consumers) acquire organic compounds by means of feeding

Food chain = linear feeding relationships between species

Arrows = transfer of energy and matter



EXAMPLE: FOOD CHAINS



Pink Shrimp
(*Pandalus borealis*)



Carrot Plant
(*Daucus carota*)



Tiger Mosquito
(*Aedes albopictus*)



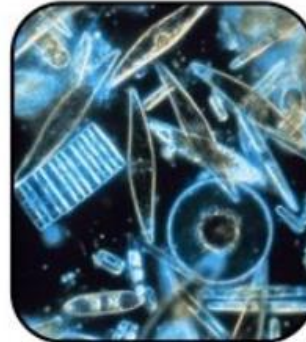
Green Algae
(*Volvox aureus*)



Cottontail Rabbit
(*Sylvilagus floridanus*)



Atlantic Cod
(*Gadus morhua*)



Phytoplankton
(*Bacillariophyceae*)



Grey Seal
(*Halichoerus grypus*)



Horned Frog
(*Ceratophrys cornuta*)



Skimmer Dragonfly
(*Libellula saturata*)

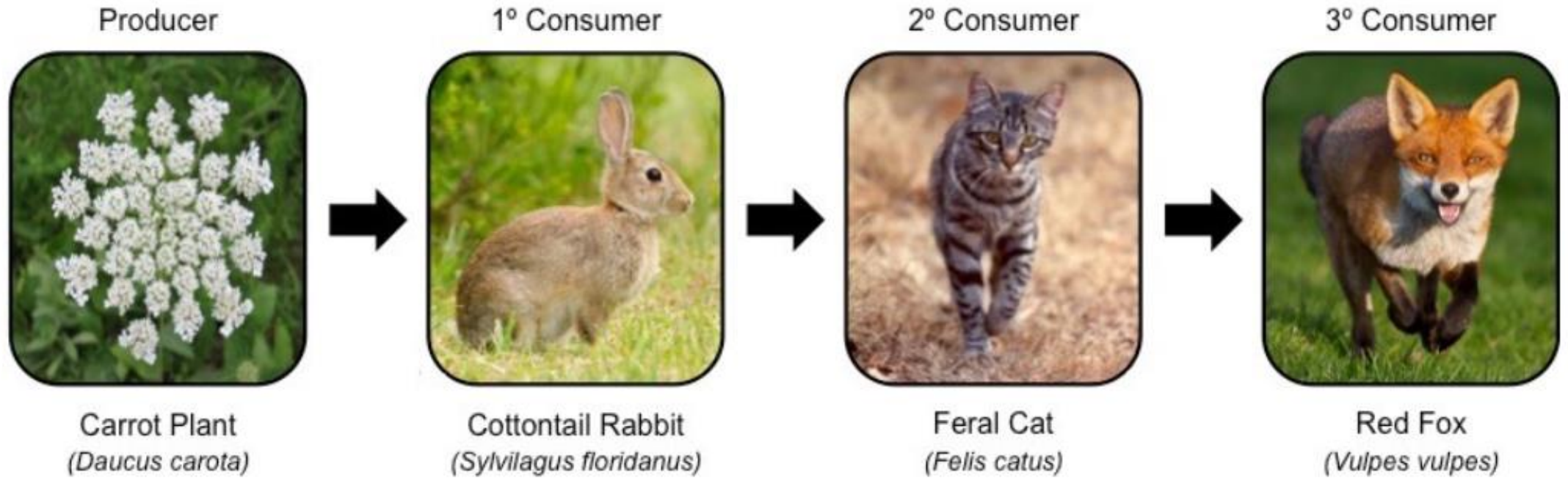


Red Fox
(*Vulpes vulpes*)

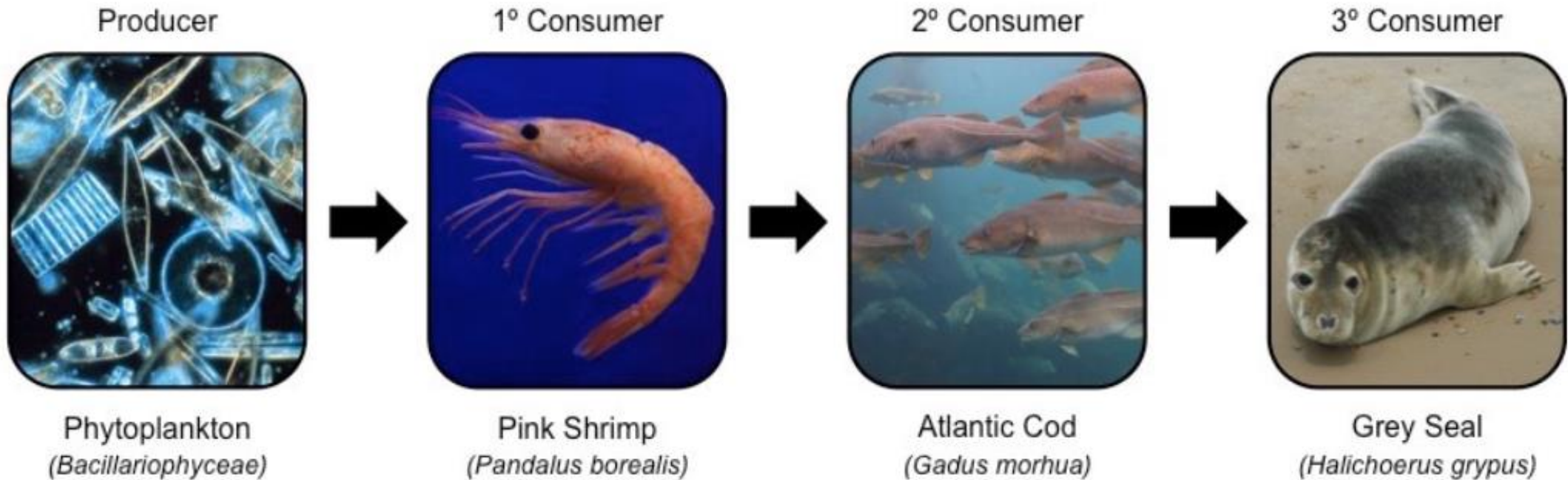


Feral Cat
(*Felis catus*)

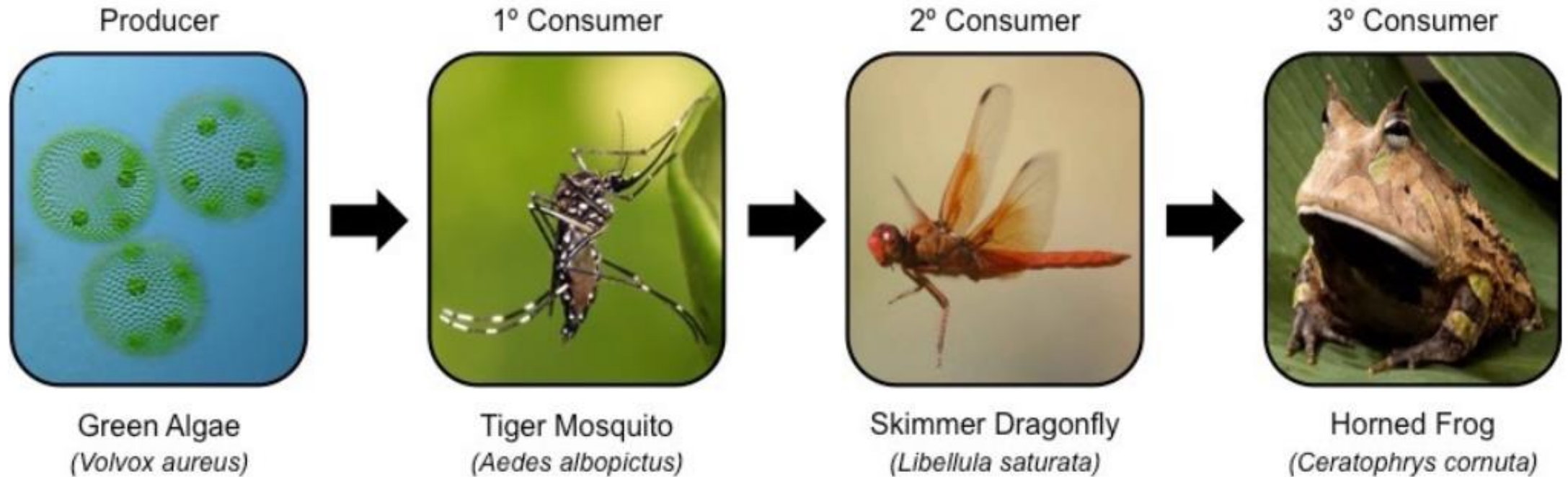
GRASSLAND FOOD CHAIN



MARINE FOOD CHAIN



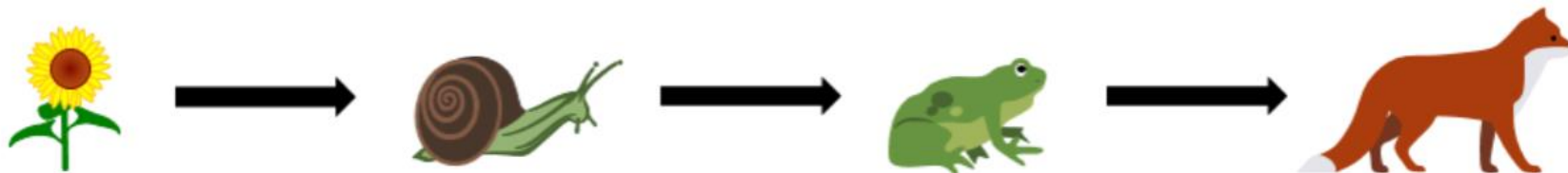
POND FOOD CHAIN



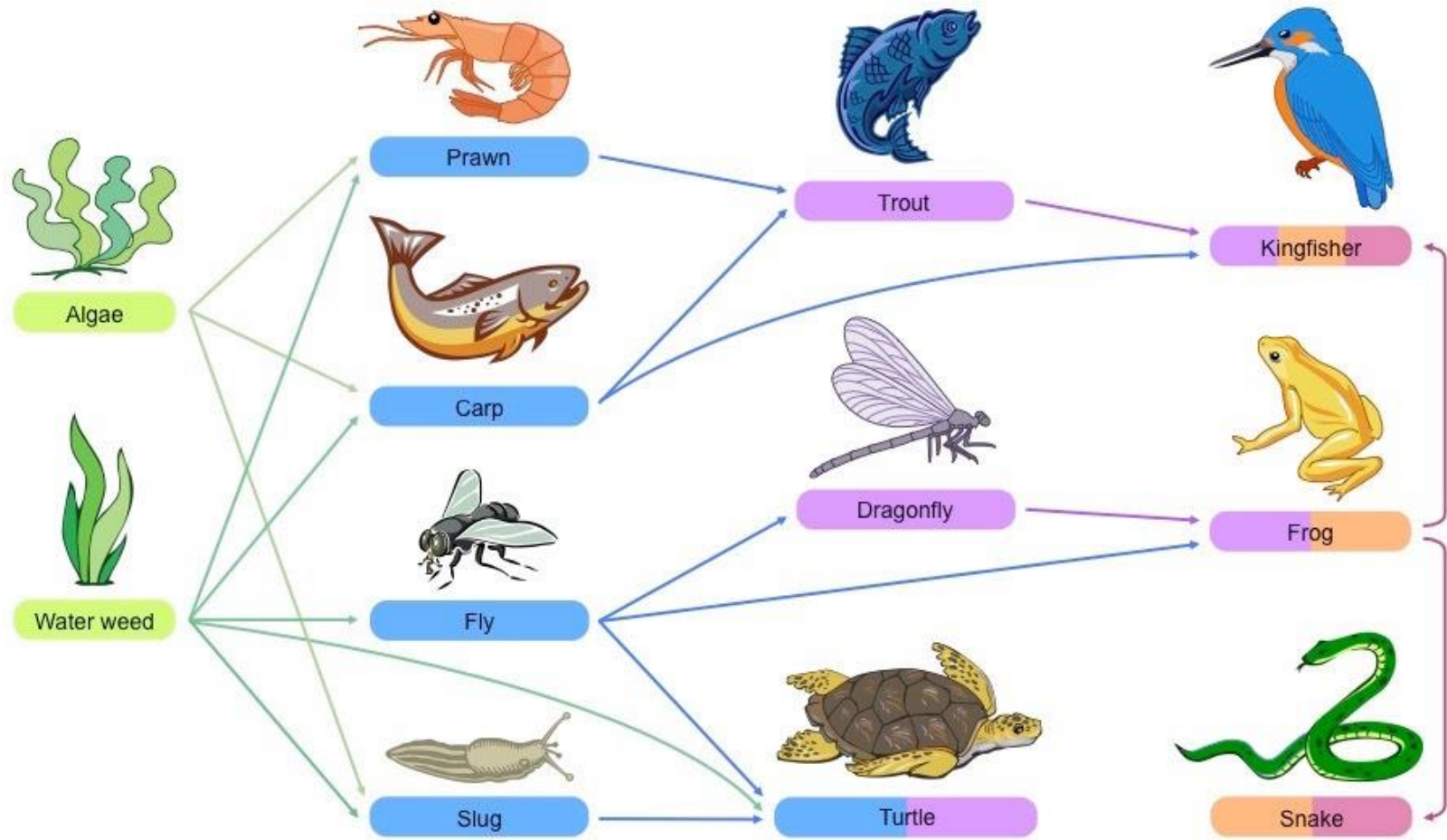
TROPHIC LEVELS

Trophic level = position of an organism in a feeding sequence

Trophic Level 1	Producer	Sunflower
Trophic Level 2	Primary Consumer	Snail
Trophic Level 3	Secondary Consumer	Frog
Trophic Level 4	Tertiary Consumer	Fox



FOOD WEBS

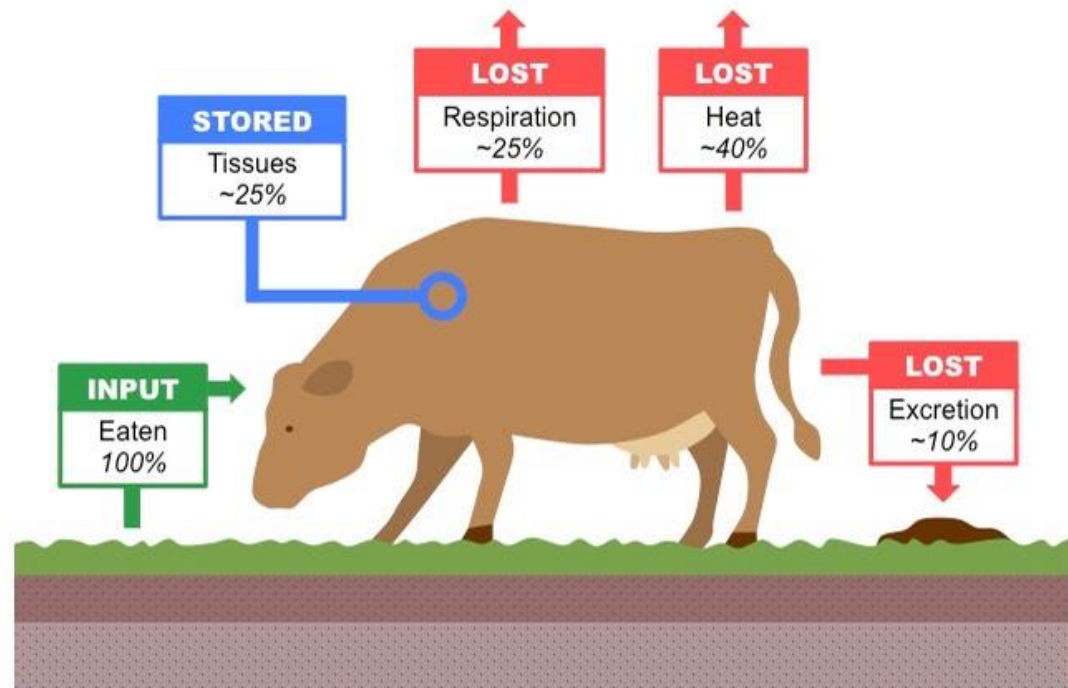


Trophic Level: 1 (Producers) 2 (1° Consumers) 3 (2° Consumers) 4 (3° Consumers) 5 (4° Consumers)

ENERGY LOSS

Living organisms cannot convert heat into other forms of usable energy

→ thermal energy is lost from an ecosystem and must be replaced



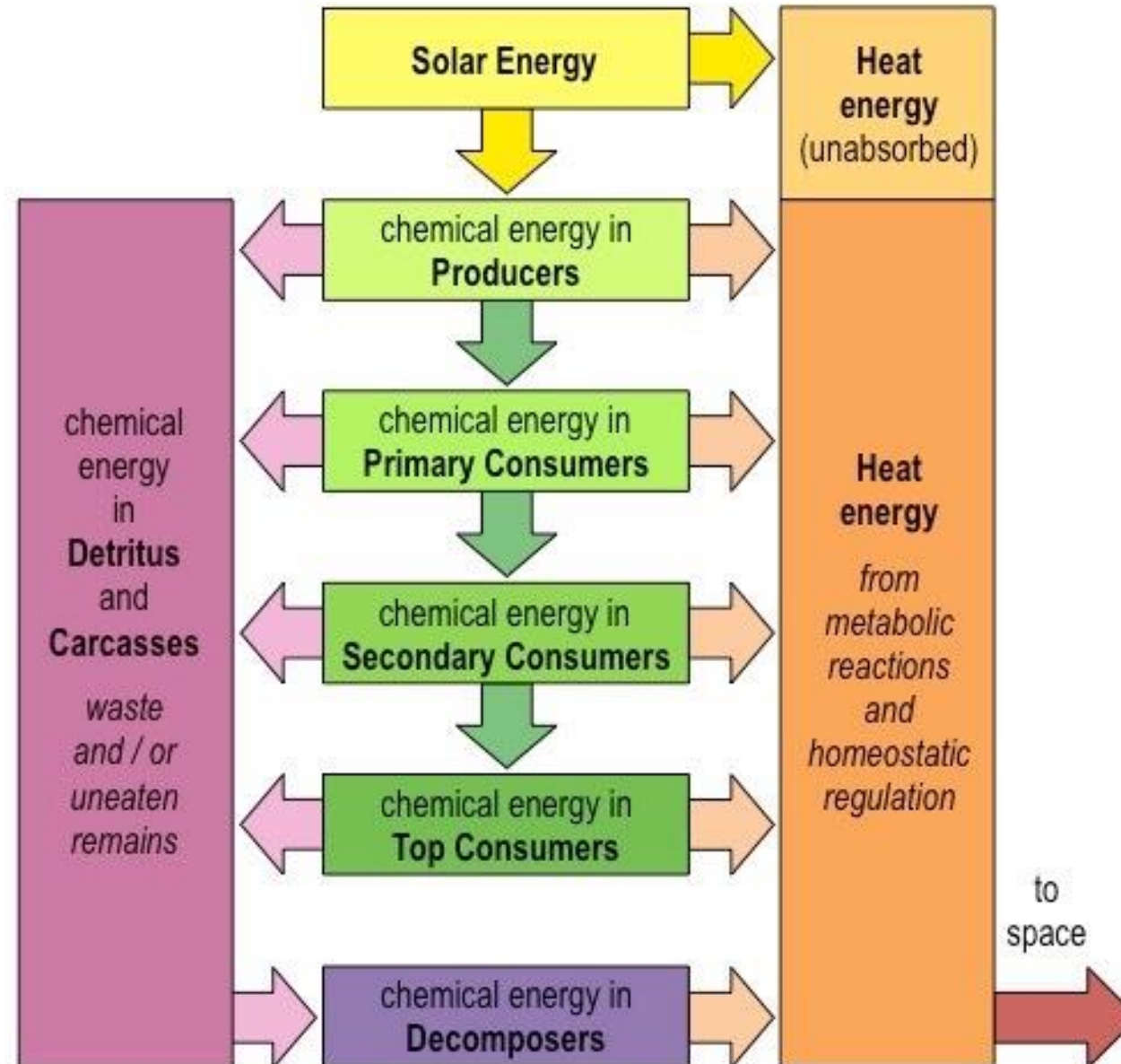
ENERGY LOSS

Chemical energy produced by an organism can be converted into:

- kinetic energy
- electrical energy
- light energy (bioluminescence)

These are exothermic reactions → release thermal energy as a by-product.

ENERGY LOSS



ENERGY EFFICIENCY

Energy transformations only 10% efficient (approx.)

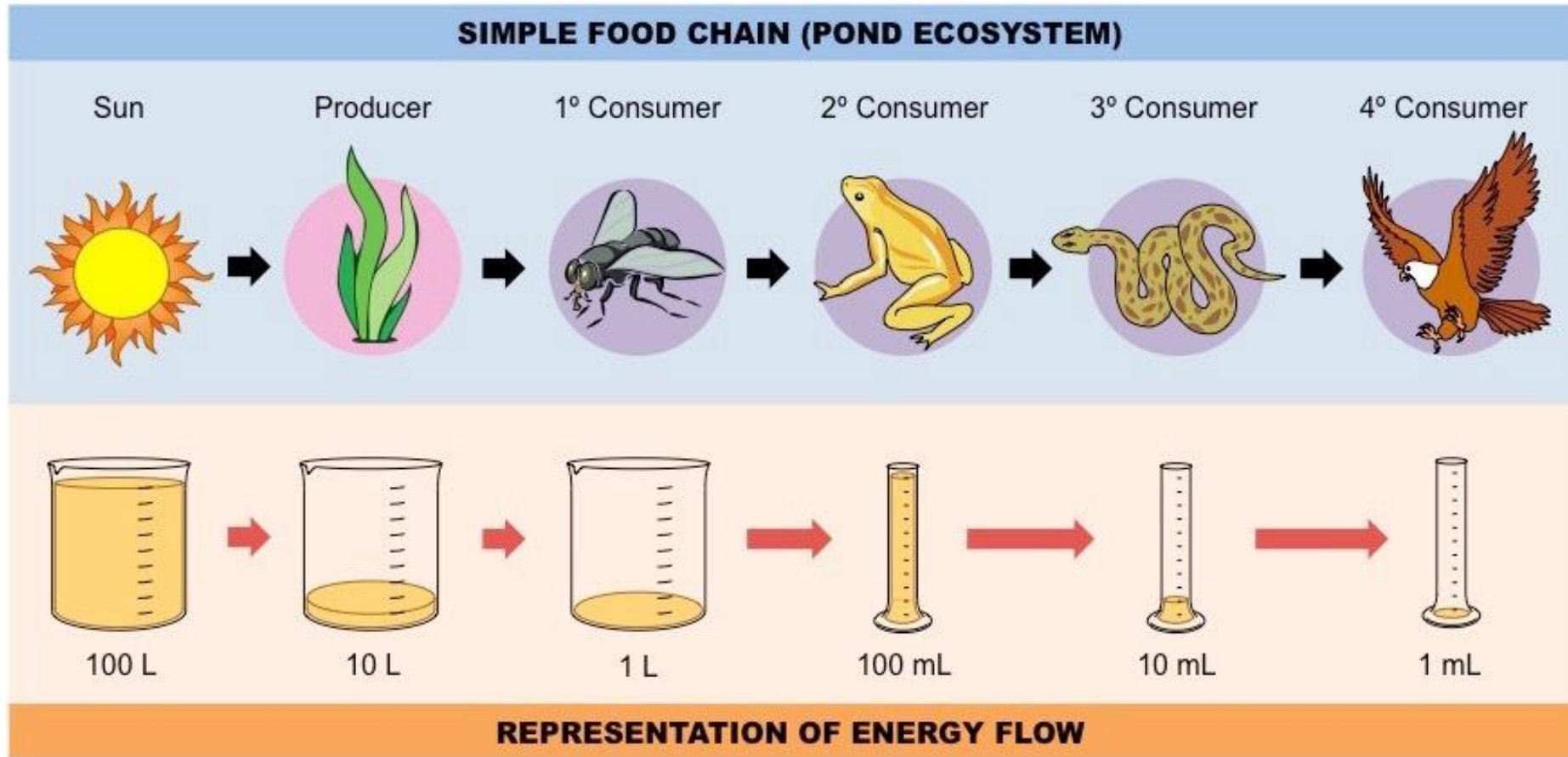
Higher trophic levels can therefore store less energy and will have less biomass

Biomass = total mass of a group of organisms – consisting of carbon compounds in cells and tissues

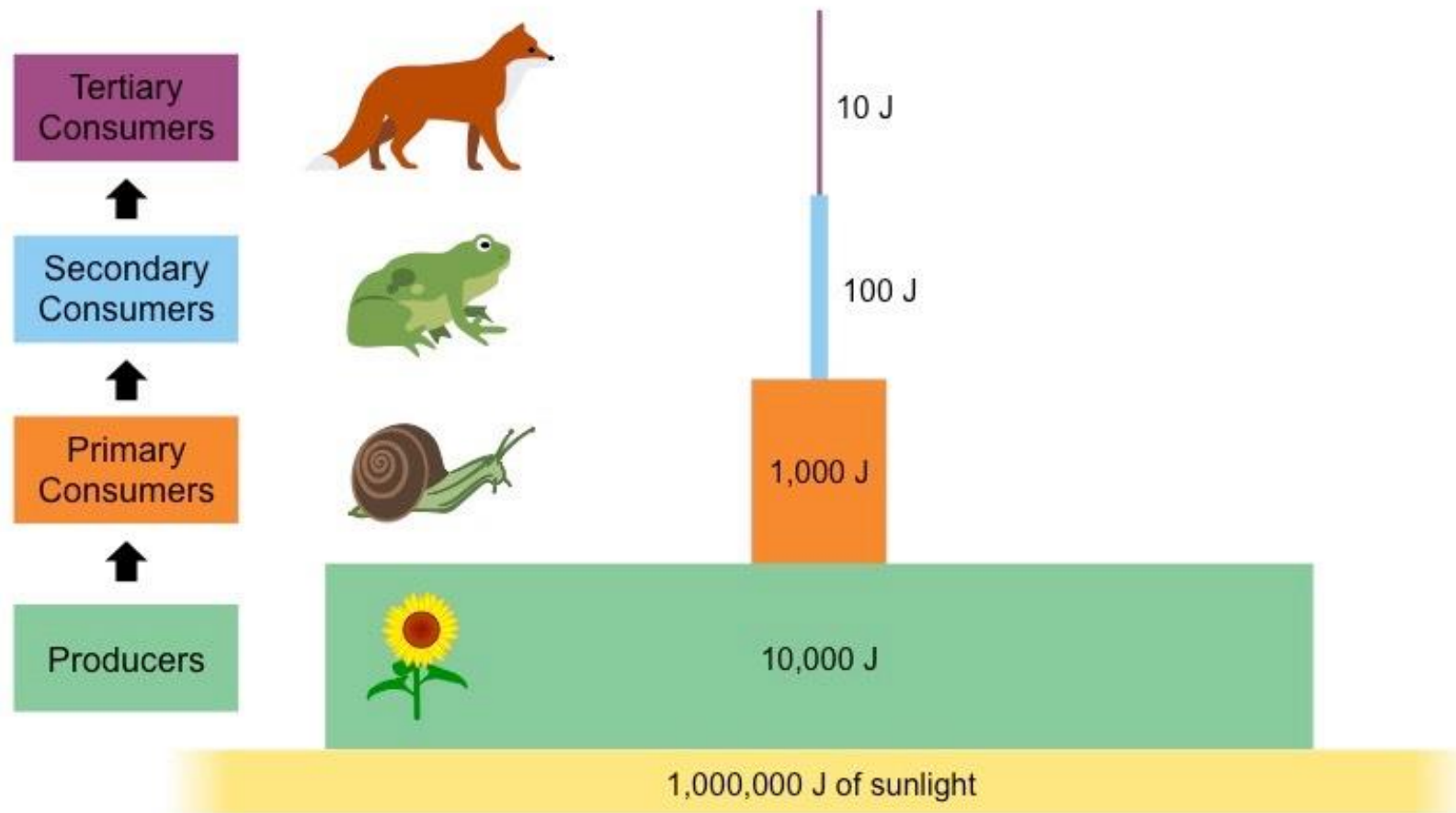


Energy loss between levels will restrict the length of food chains

ENERGY EFFICIENCY



PYRAMIDS OF ENERGY



NUTRIENT CYCLING

