# Energy flow – Ecosystem

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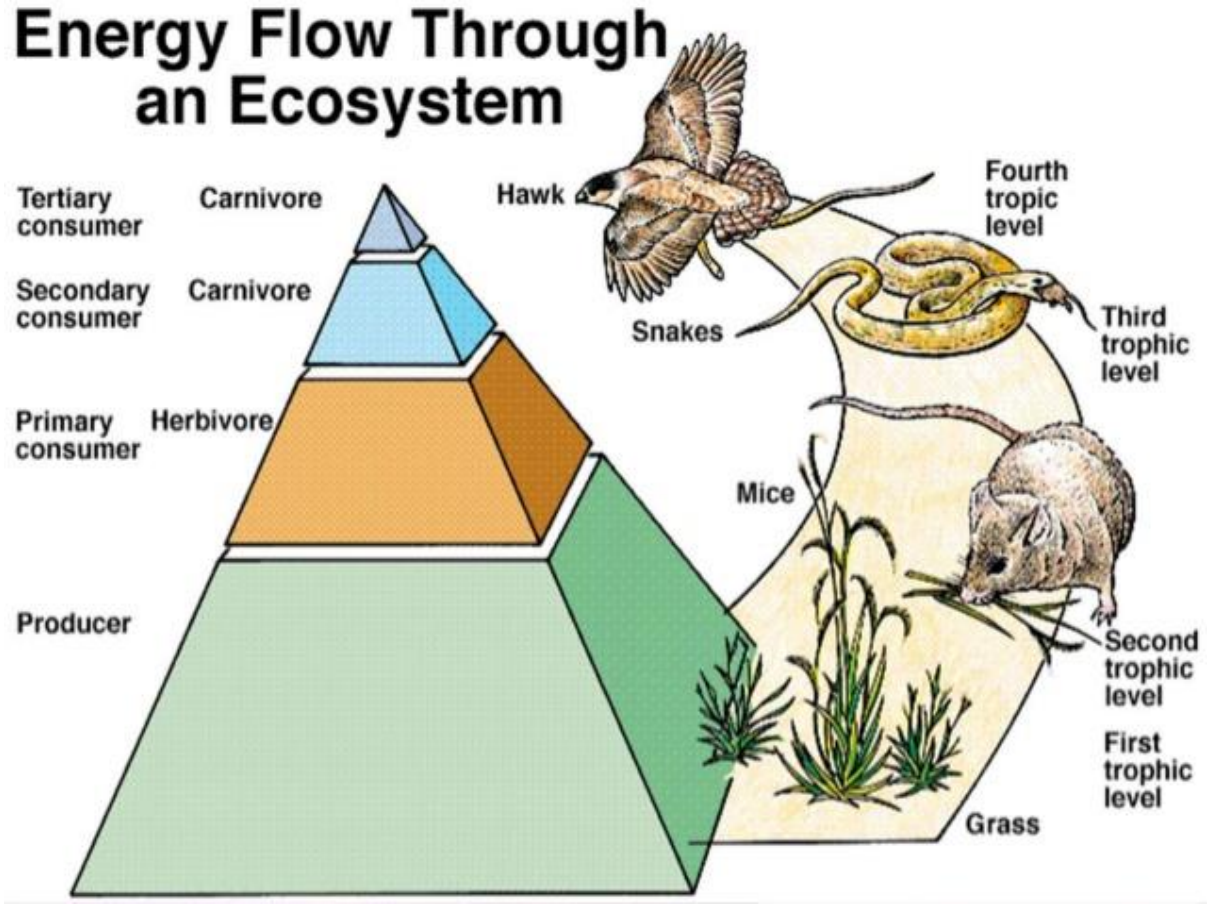
# contents

- Gross primary production
- Net primary production
- First law of thermodynamics
- Second law of thermodynamics

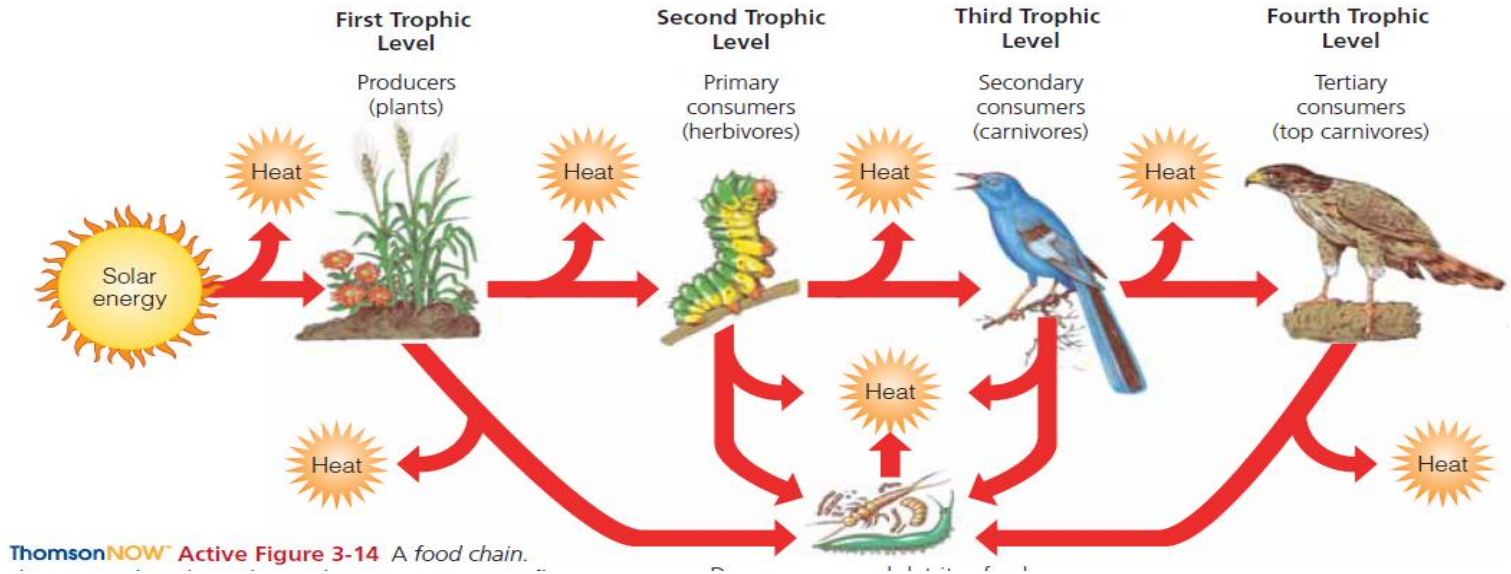
# Energy & types

- In scientific term
  - Work = force x distance (eg: put a object on a table or touch a hot object)
  - Capacity to do work or transfer of heat.
- Two types
  - Kinetic energy : moving energy (wind energy, hydro energy)
  - **Potential energy:** stored energy (water in a dam, hot sand in your palm)
  - Potential energy can be converted into kinetic energy (eg: an object falling down from your hand , an automobile burns on gasoline)

# Energy flow- Food Chain and Food webs



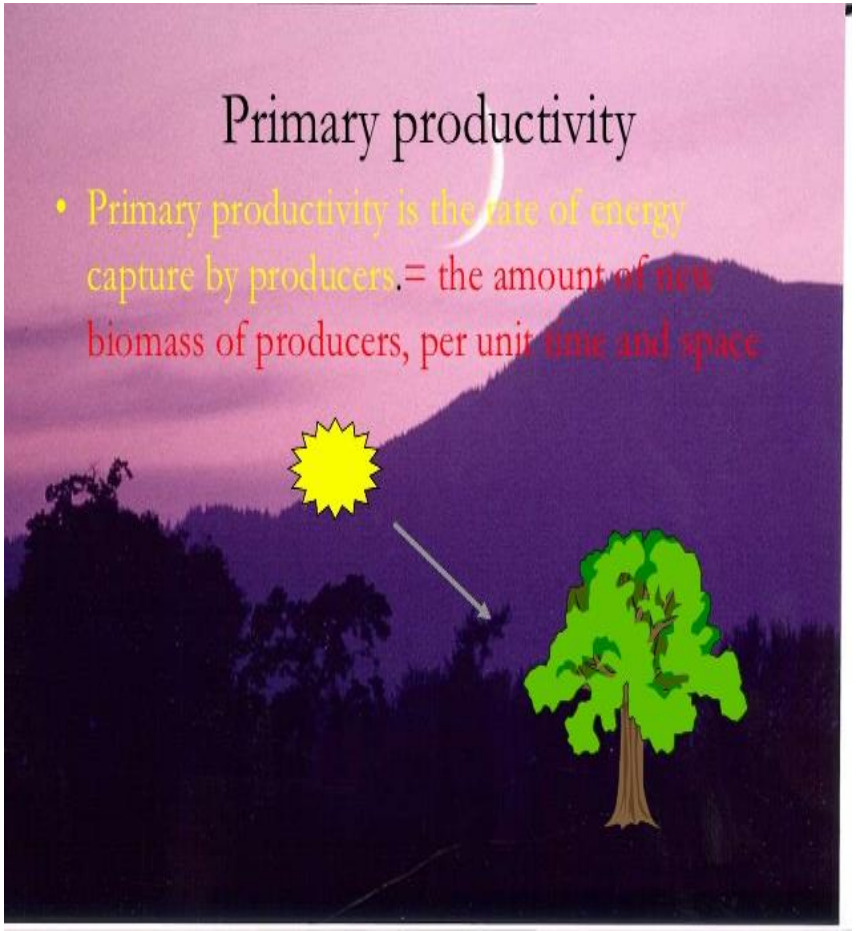
- A sequence of organisms, each of which serves as a source of food for the next, is called a **food chain**
- It helps to determines – chemical energy, nutrients (one to the another)
- Nutrients to soil – reuse by producers.

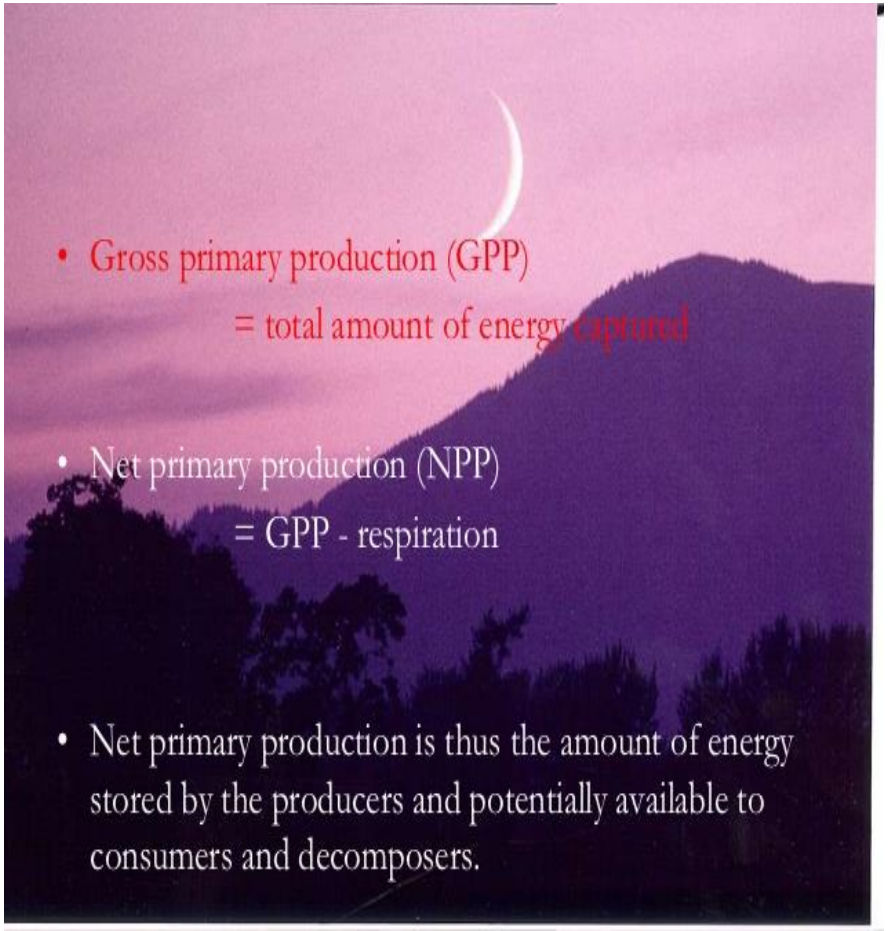


# Gross primary production & NPP

- The amount of biomass that a ecosystem is determined by the amount of energy captured and stored as chemical energy by producers.
- GPP is the rate at which an ecosystem producers **convert solar energy into chemical energy** as biomass.
- Measured in terms of energy production per unit area over time given. (Kcal/$m^2$/yr)
- ***Net primary production (NPP) = GPP- R***
  - R is energy used in respiration

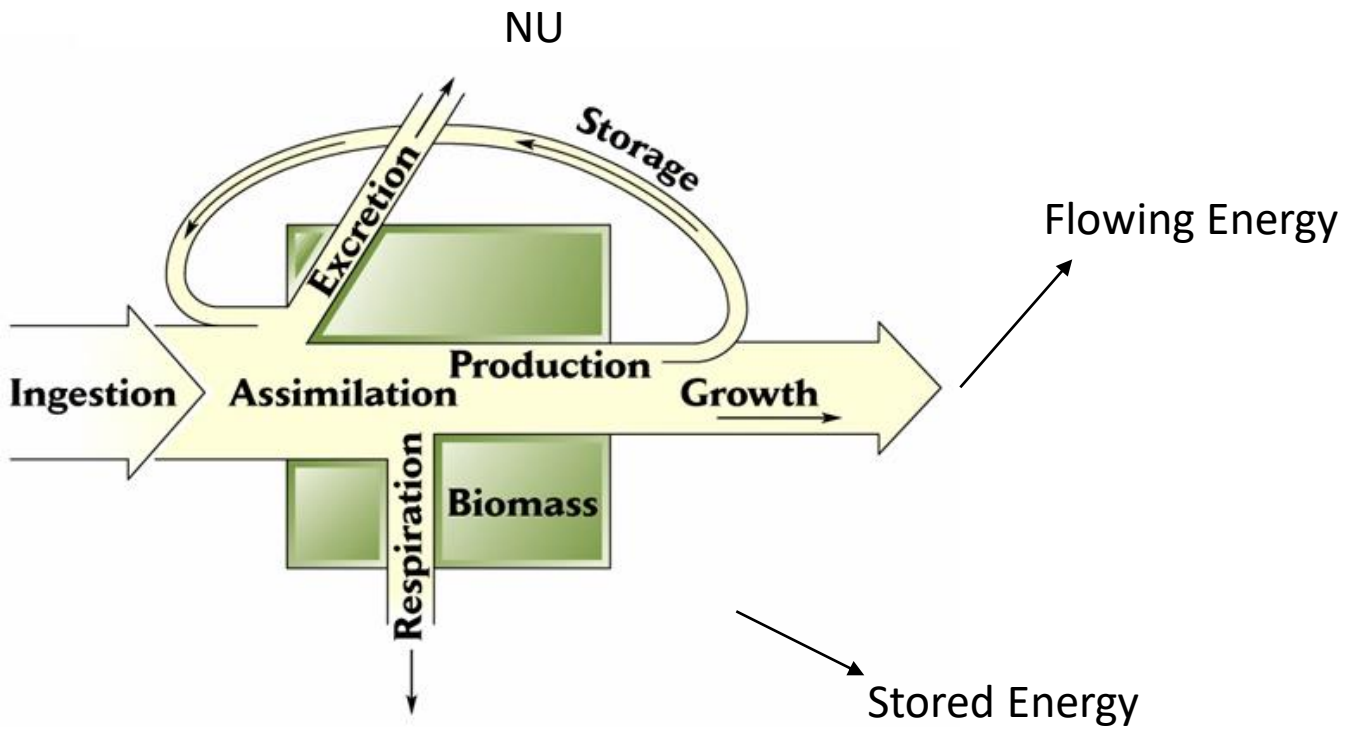
# GPP & NPP


Primary productivity
• Primary productivity is the rate of energy capture by producers.= the amount of new biomass of producers, per unit time and space


• Gross primary production (GPP)
= total amount of energy captured
• Net primary production (NPP)
= GPP - respiration
• Net primary production is thus the amount of energy stored by the producers and potentially available to consumers and decomposers.

# Models of ecological energy flow

## Universal energy flow model

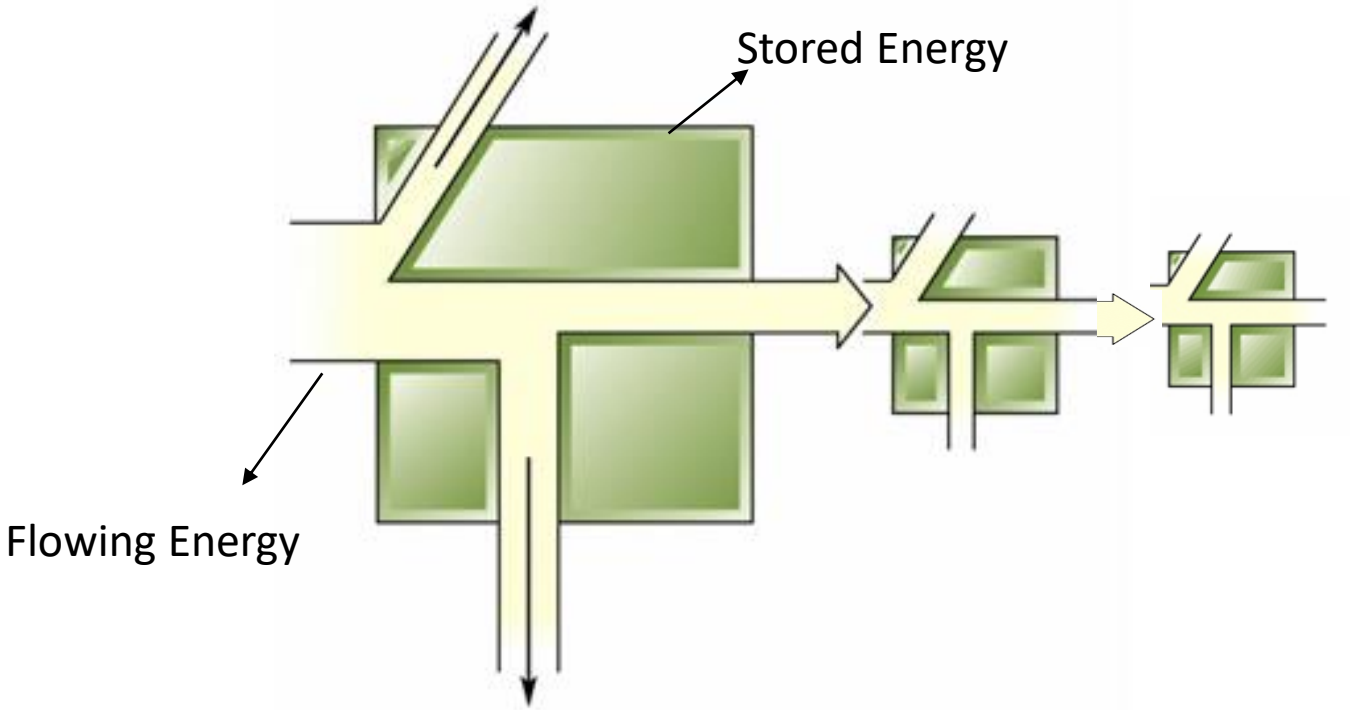



A single trophic level

The loss of energy is due to locomotion, respiration, excretion

# Single channel energy flow model

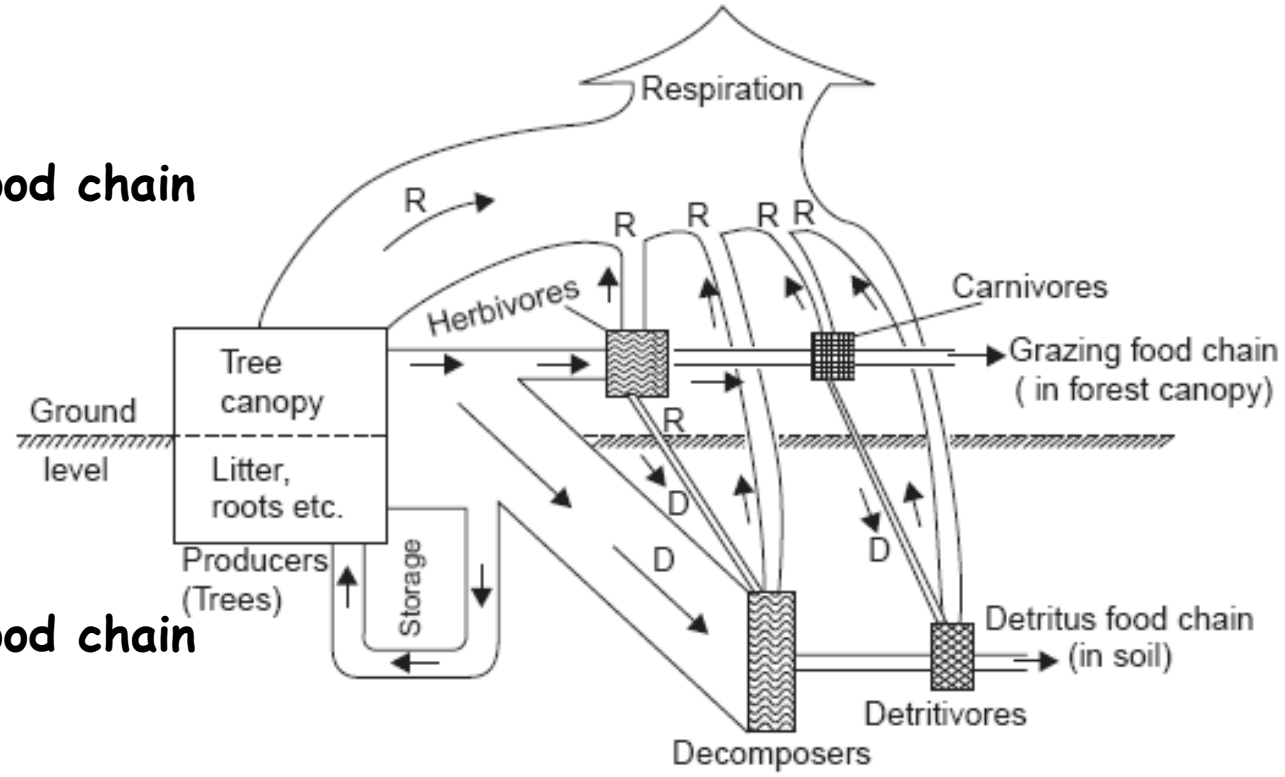
Producers → herbivores → carnivores




A food chain - Unidirectional flow of energy

Both stored energy and flowing energy decrease while moving through a food chain_

# Y-shaped or two channel energy flow model

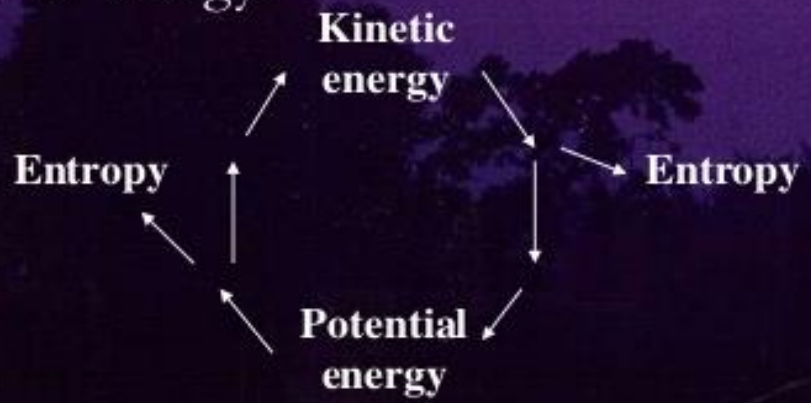



Passage of energy via two food chains

# Energy and the Laws of Thermodynamics

**20.1 – The Laws of Thermodynamics Govern Energy Flow.**

Energy exists in many forms, such as heat, light, chemical energy, and electrical energy. **Energy is the ability to bring about change or to do work.** Thermodynamics is the study of energy.

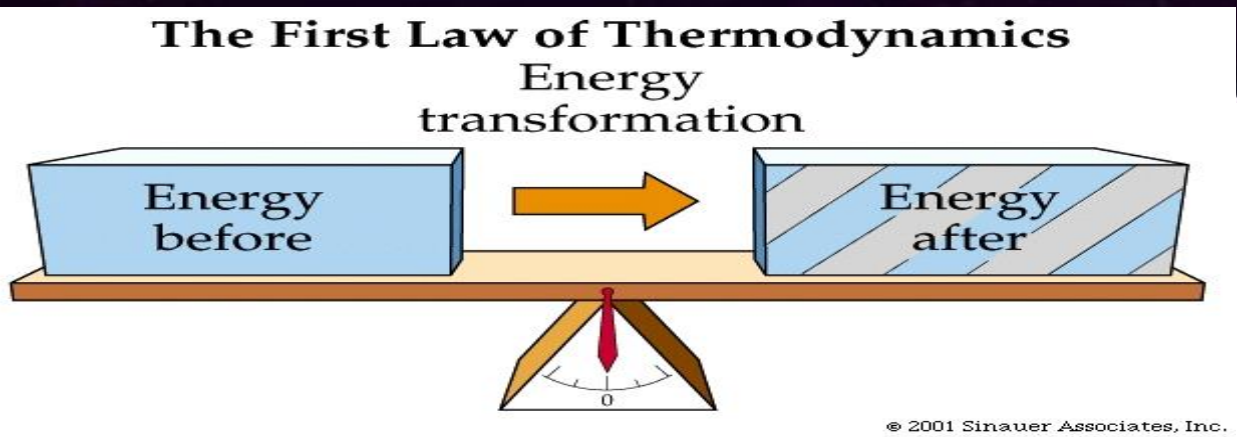



# Energy and the Laws of Thermodynamics

**The 1st Law of Thermodynamics:**
Energy can be changed from one form to another, but it cannot be created or destroyed. The total amount of energy and matter in the Universe remains constant, merely changing from one form to another.

Isaac Newton (1643-1727)

**The First Law of Thermodynamics**

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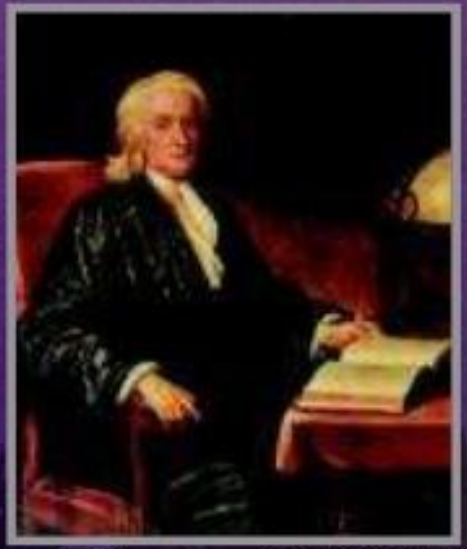
# Energy and the Laws of Thermodynamics

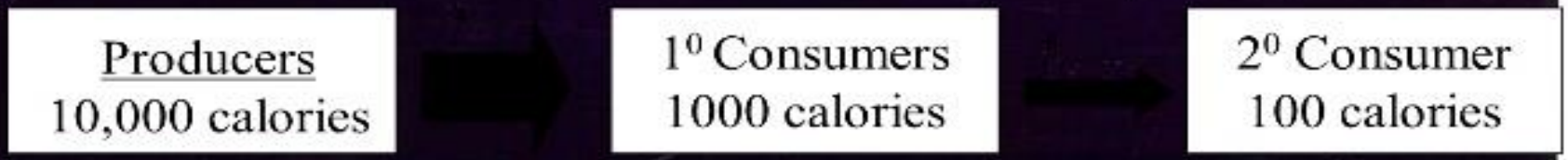
**The 2nd Law of Thermodynamics**: "*in all energy exchanges, if no energy enters or leaves the system, the potential energy of the state will always be less than that of the initial state.*" In energy transfer, some energy will dissipate as heat. The flow of energy maintains order of life.



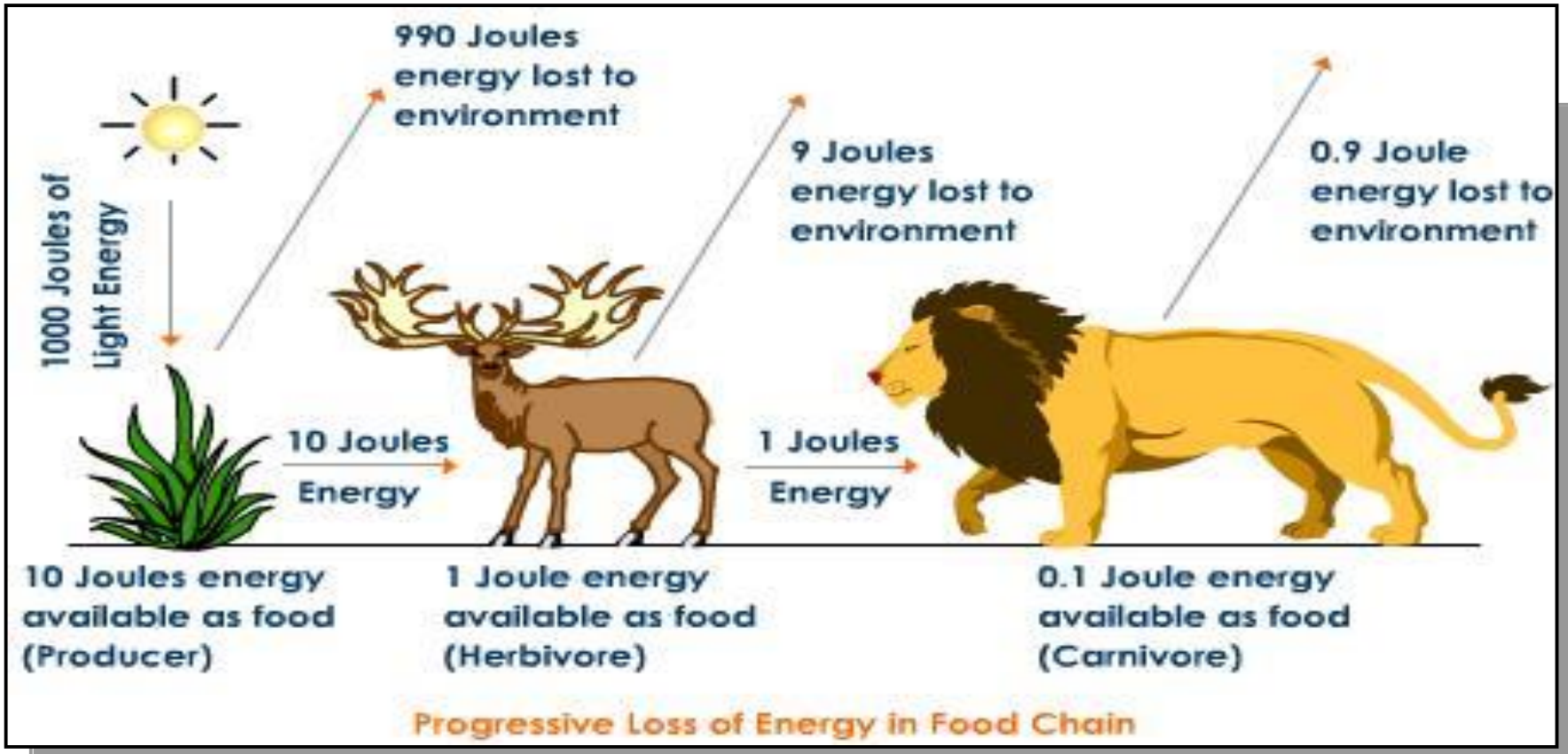
Isaac Newton (1643-1727)

# Second Law of Thermodynamics

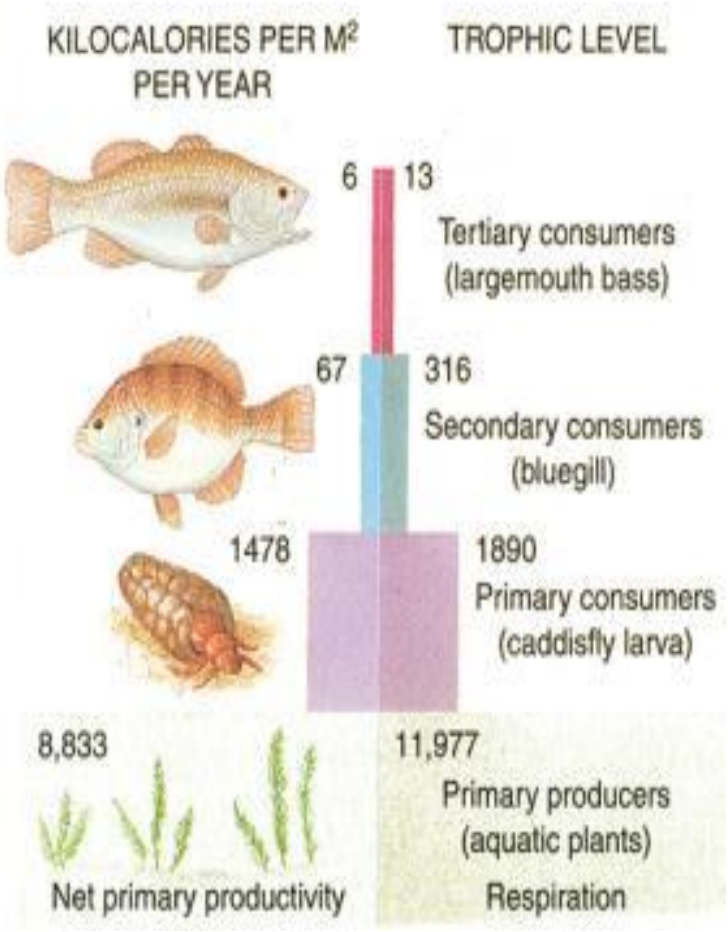
- - Scientists have studied many ecosystems and have concluded that this energy loss is a constant pattern. In fact, scientists have calculated that the percentage (%) of usable energy transferred from one organism to another is 10%.
- !! - That means that 90% of energy is lost as heat!!!
- So…. if producers captured 10,000 calories from the sun, then only bout 1,000 calories will be available to support primary consumers (herbivores), and only about 100 calories to support secondary consumers (carnivores or omnivores).

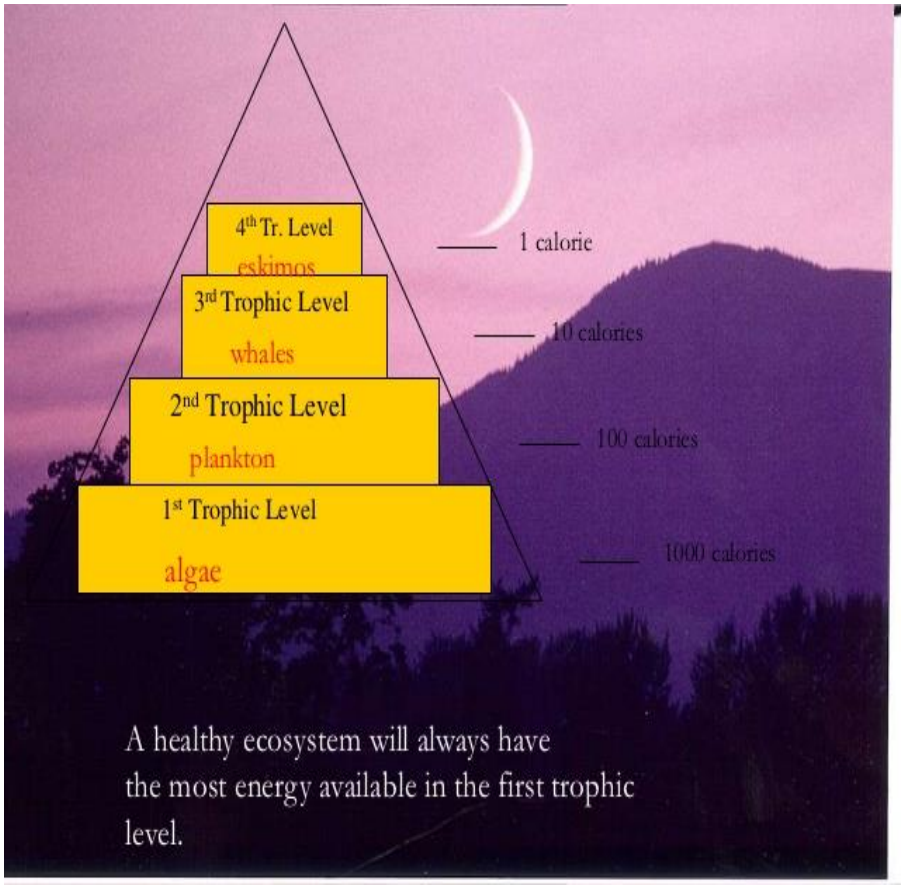


# Loss of energy – respiration/locomotion



# Pyramid of Energy




**Always it is in upright position.**

# Cannot do with matter and energy

- **Law of conservation**: no atoms are created or destroyed. *We cannot change matter, can change only physical state – one form to another*
- **First law of TD**: we cannot get more energy from what we have put in.
- **Second law of TD**: we end in low amount of energy than we start with.

# Thank You