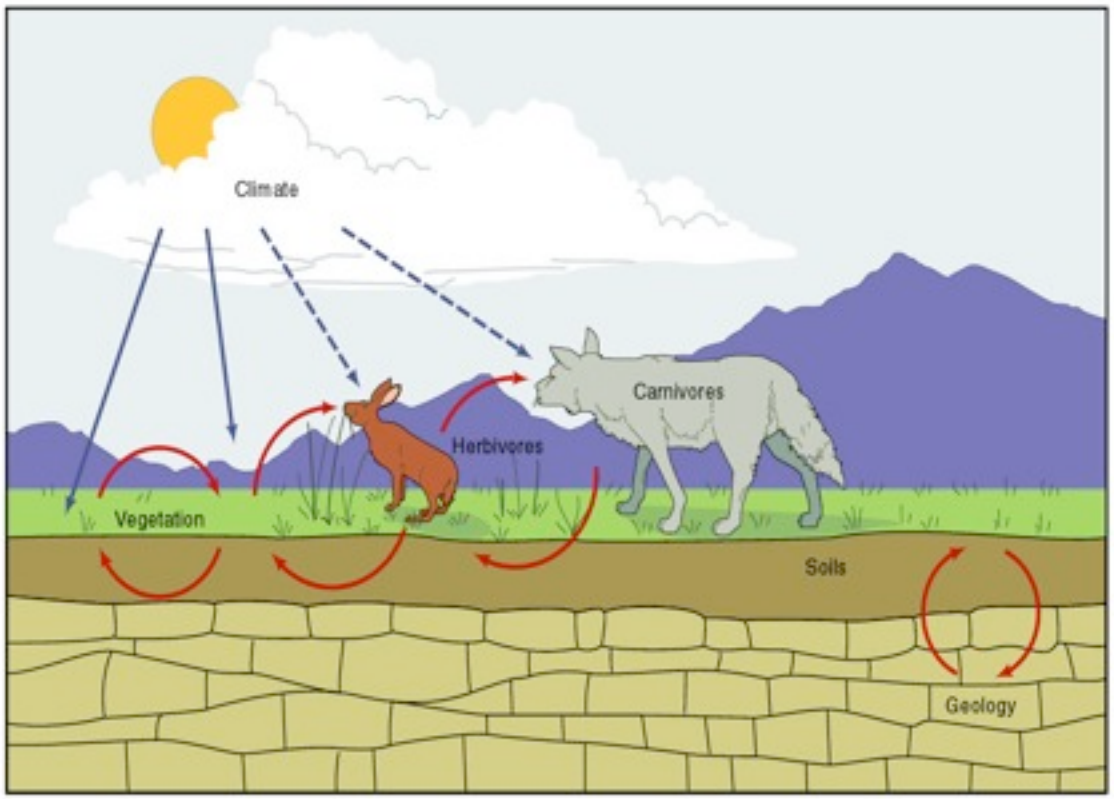
# 1.1.1-.3 Systems

# Environmental Systems and Societies




***Interrelationships among climate, geology, soil, vegetation, and animals.***

# A System

Is an organized collection of interdependent components that perform a function and which are connected through the transfer of energy and/or matter

All the parts are linked together and affect each other.

# Why use Systems Concept

Why do we use Systems?

- Useful for understanding and explaining phenomena
- A holistic  approach that can lead to a deeper understanding and possibly to further discoveries

# Characteristics of Systems

What are the characteristics?

- Component parts (reservoirs, storages, stocks, accumulations)
- Processes (flows, transformations, transfers, reactions, photosynthesis, respiration)
- Negative feedback mechanism for maintaining equilibrium Eg, circulatory system
  - heart, veins, arteries, capillaries, blood cells, plasma etc
  - pumping of the blood, blood pressure, nutrient exchange, vasodilation etc

A system has properties and functions NOT present in the individual components.

The whole (system) is greater than the sum of the parts.

Properties of the whole (system) CANNOT be predicted with the study of the parts on their own.

This is called “Synergy”

# Synergy and Systems

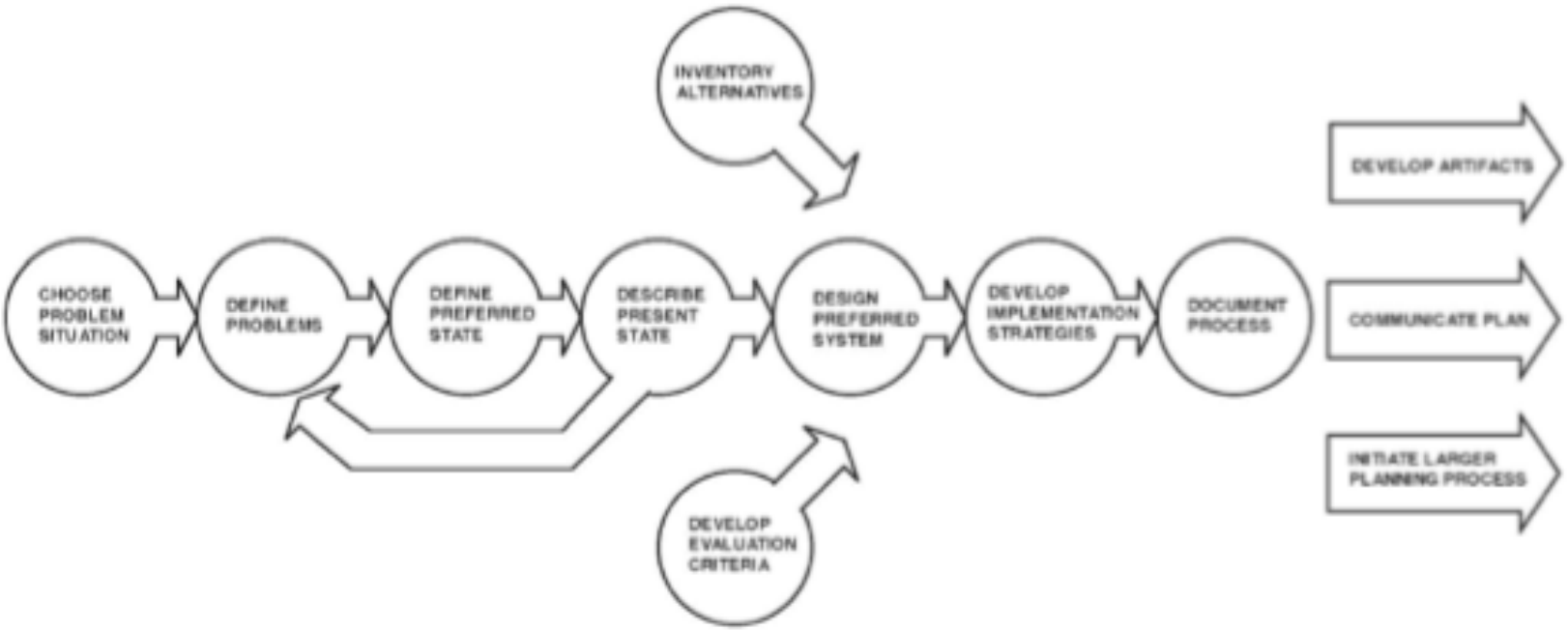
- **Synergy is the only word in our language that means behavior of whole systems unpredicted by the separately observed behaviors of any of the system's separate parts or any subassembly of the system's parts.** There is nothing in the chemistry of a toenail that predicts the existence of a human being.  Buckminster Fuller

# System according to Buckminster Fuller

(a good example of the use of language)

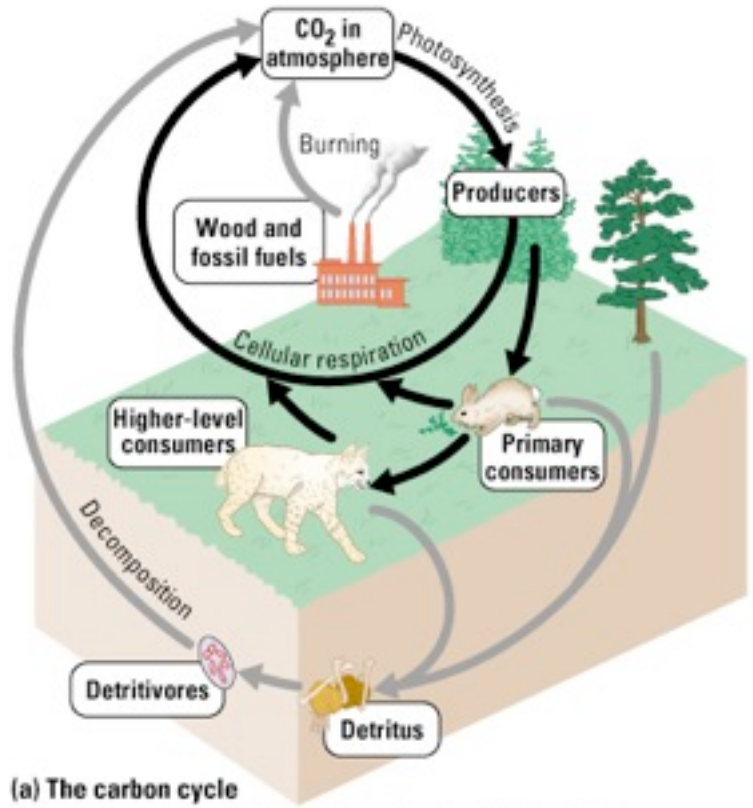
- A system is the first subdivision of Universe. It divides all the Universe into six parts: first, all the universal events occurring geometrically outside the system; second, all the universal events occurring geometrically inside the system; third, all the universal events occurring nonsimultaneously, remotely, and unrelatedly prior to the system events; fourth, the Universe events occurring nonsimultaneously, remotely, and unrelatedly subsequent to the system events; fifth, all the geometrically arrayed set of events constituting the system itself; and sixth, all the Universe events occurring synchronously and or coincidentally to and with the systematic set of events uniquely

# Fuller's Comprehensive Anticipatory Design Science Model



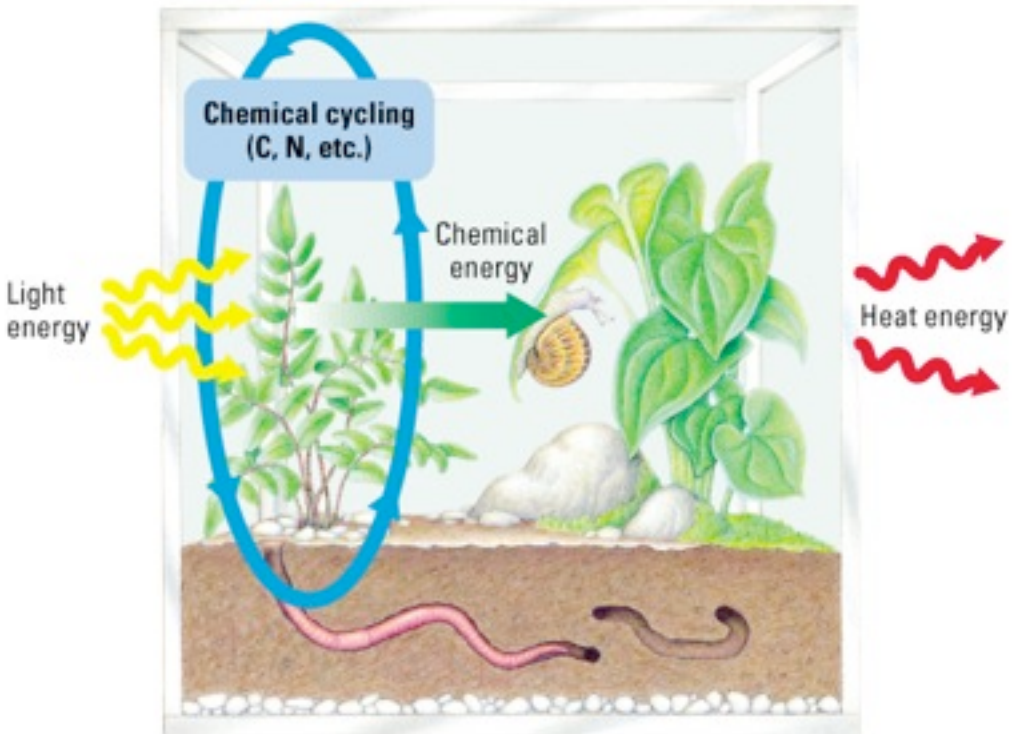
Systems are defined by the source and ultimate destination of their matter and/or energy.

1. OPEN SYSTEM: a system in which both matter and energy are exchanged across boundaries of the system.



(a) The carbon cycle

2. CLOSED SYSTEM: a system in which energy is exchanged across boundaries of the system, but matter is not.



3. ISOLATED SYSTEM: a system in which neither energy nor matter is exchanged across boundaries of the system.

NO SUCH SYSTEM EXISTS!!!

Most natural living systems are OPEN systems.

Two basic processes must occur in an ecosystem:

- A cycling of chemical elements.
- Flow of energy.

TRANSFERS: normally flow through a system and involve a change in location.

TRANSFORMATIONS: lead to an interaction within a system in the formation of a new end product, or involve a change of state.

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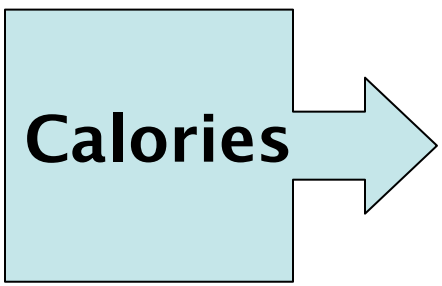

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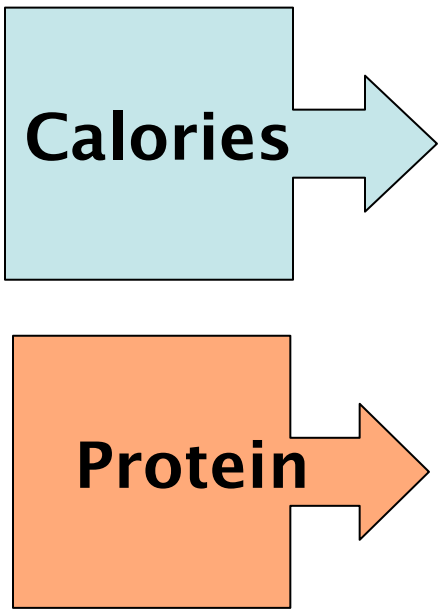

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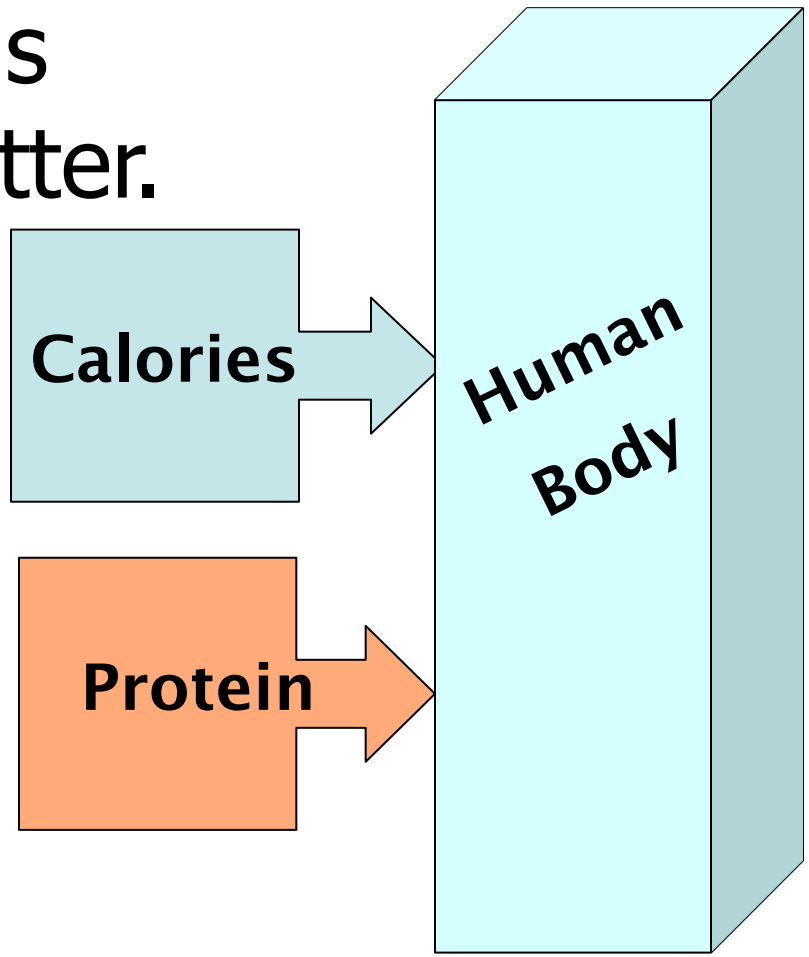

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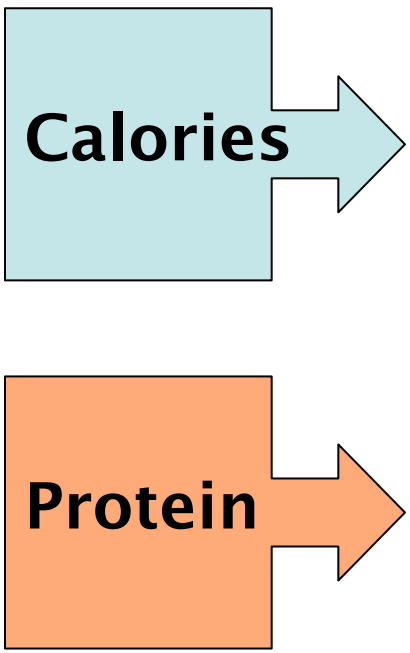

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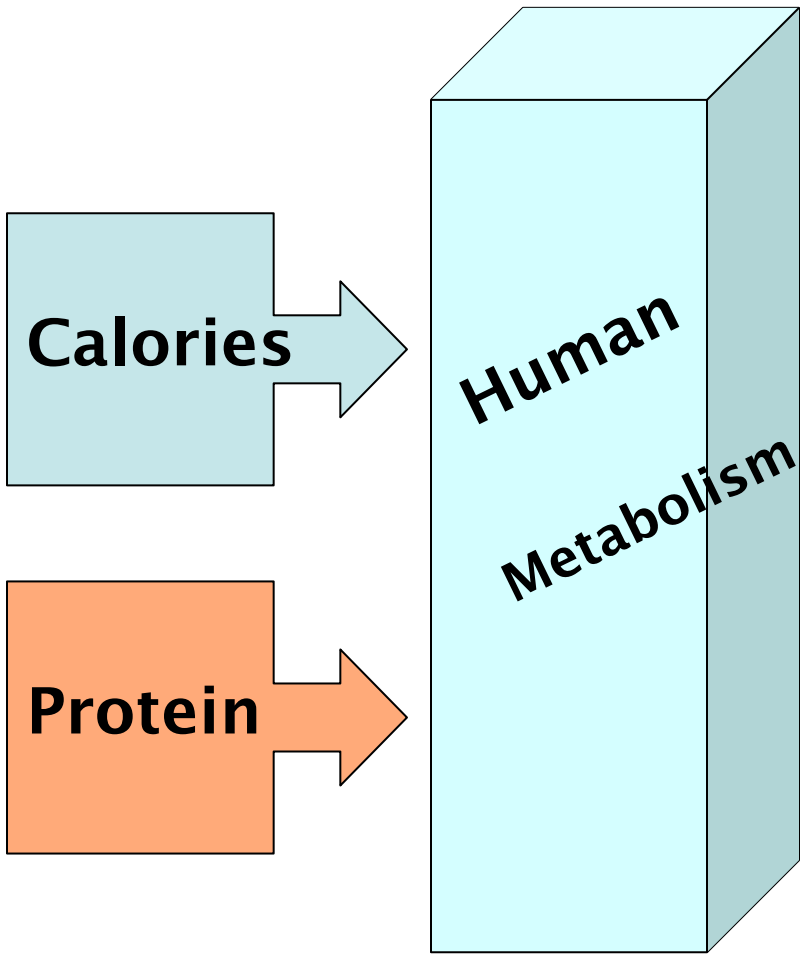

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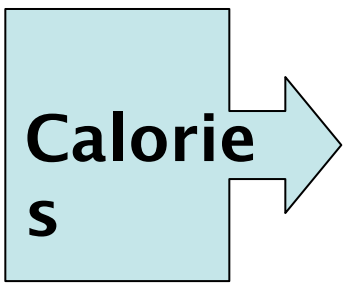


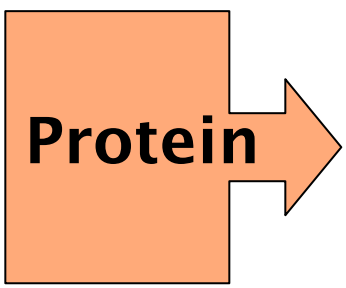

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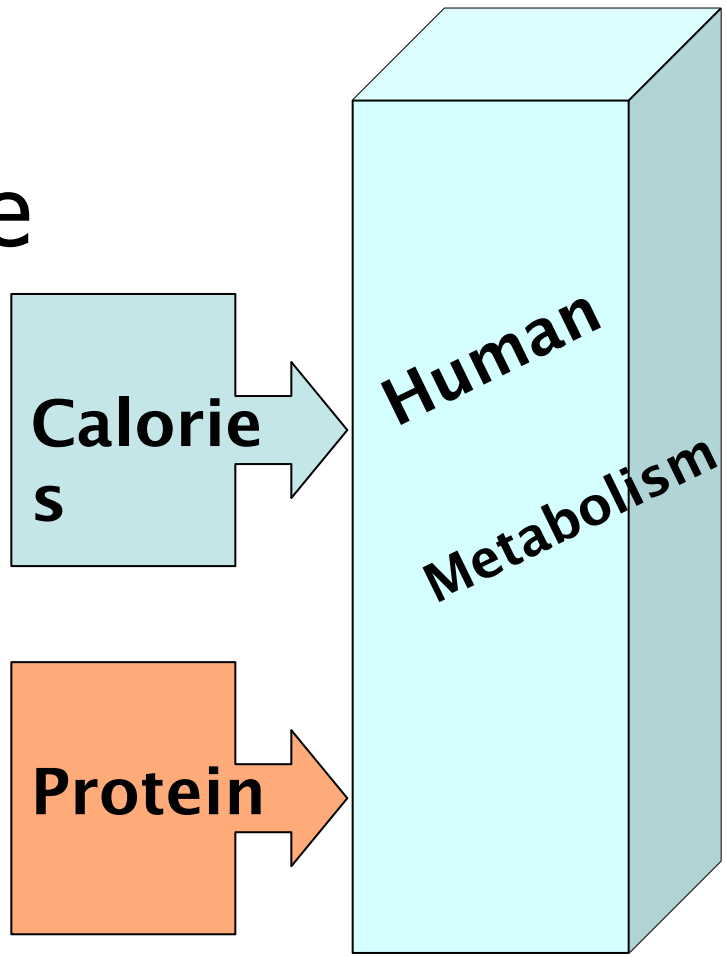

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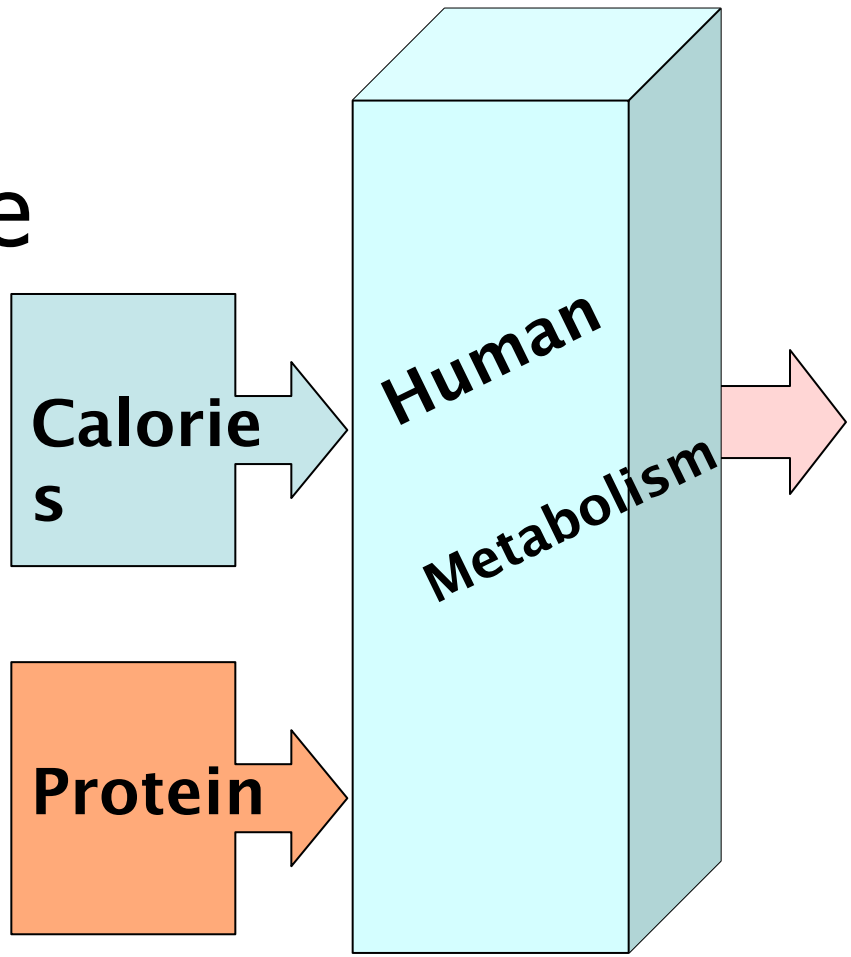

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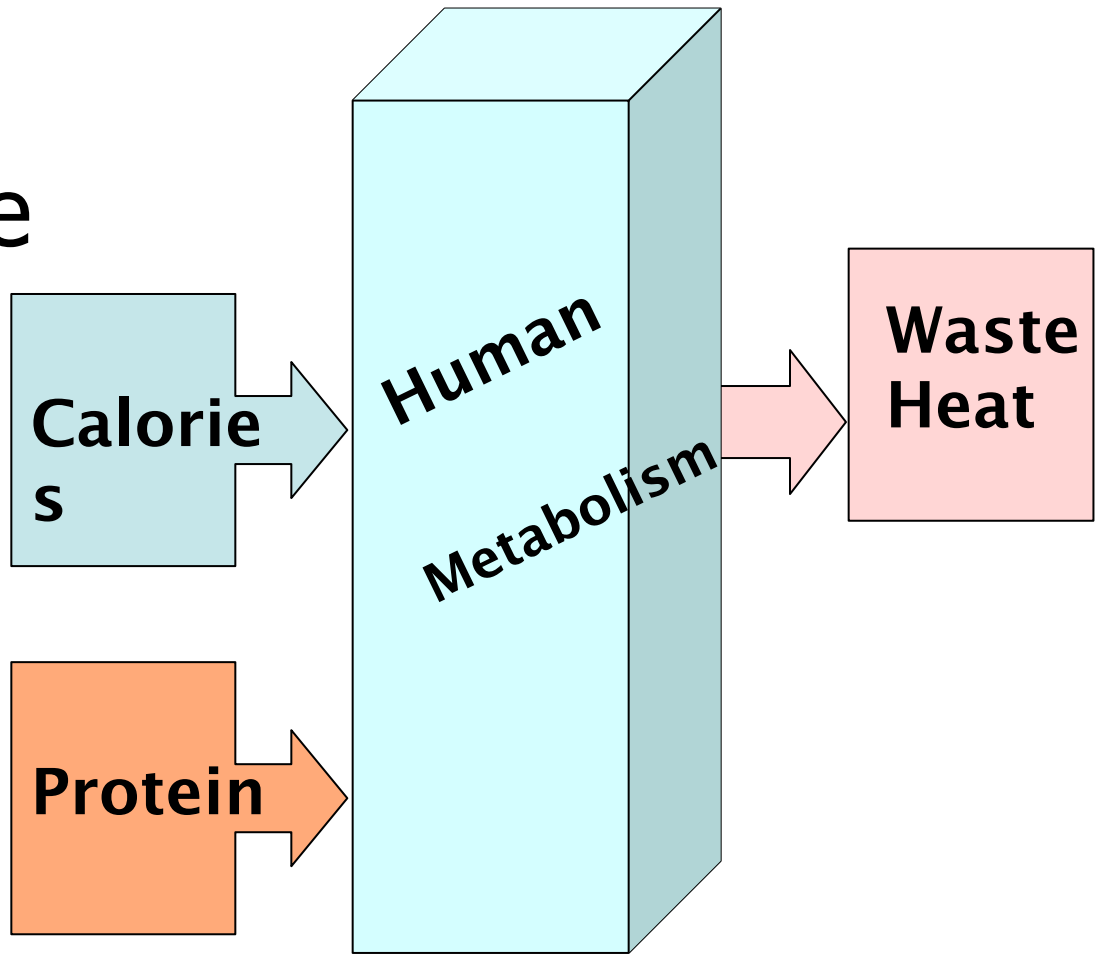

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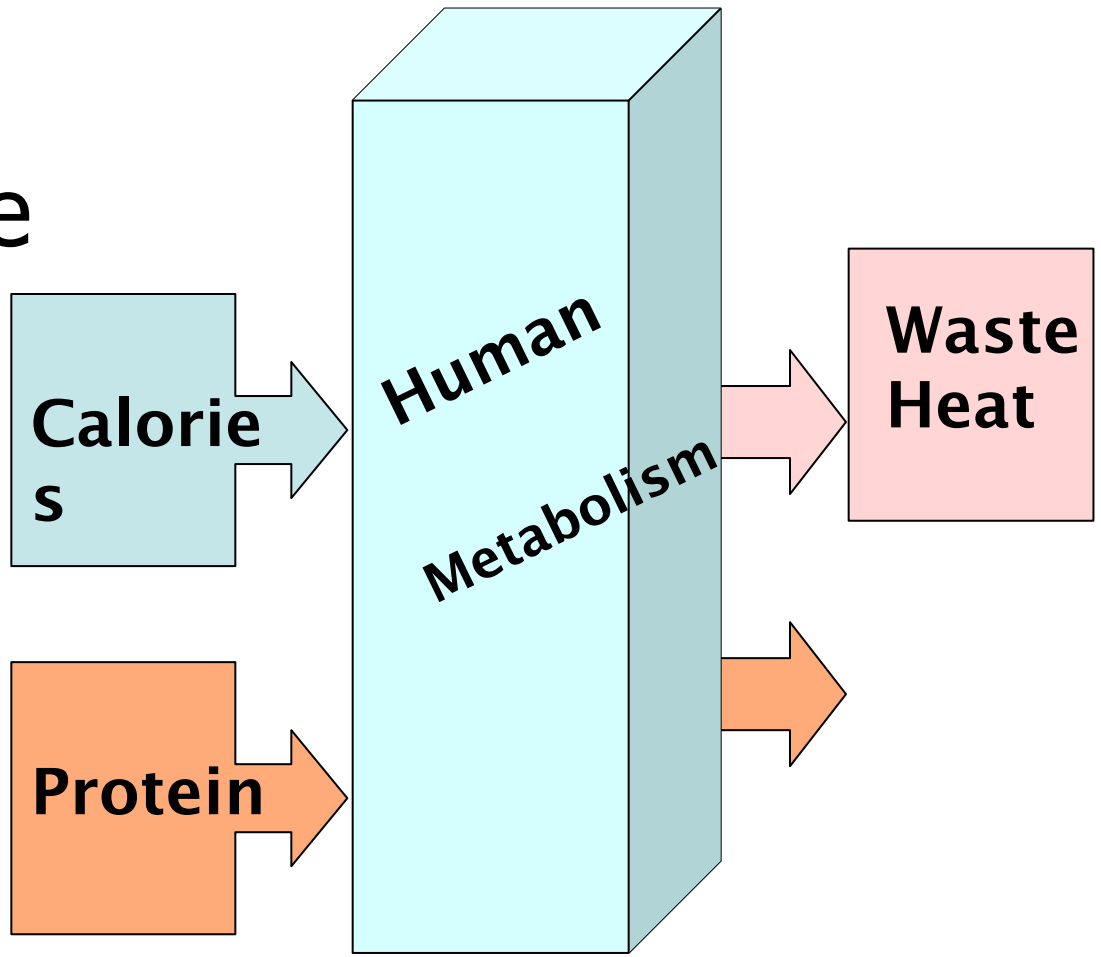

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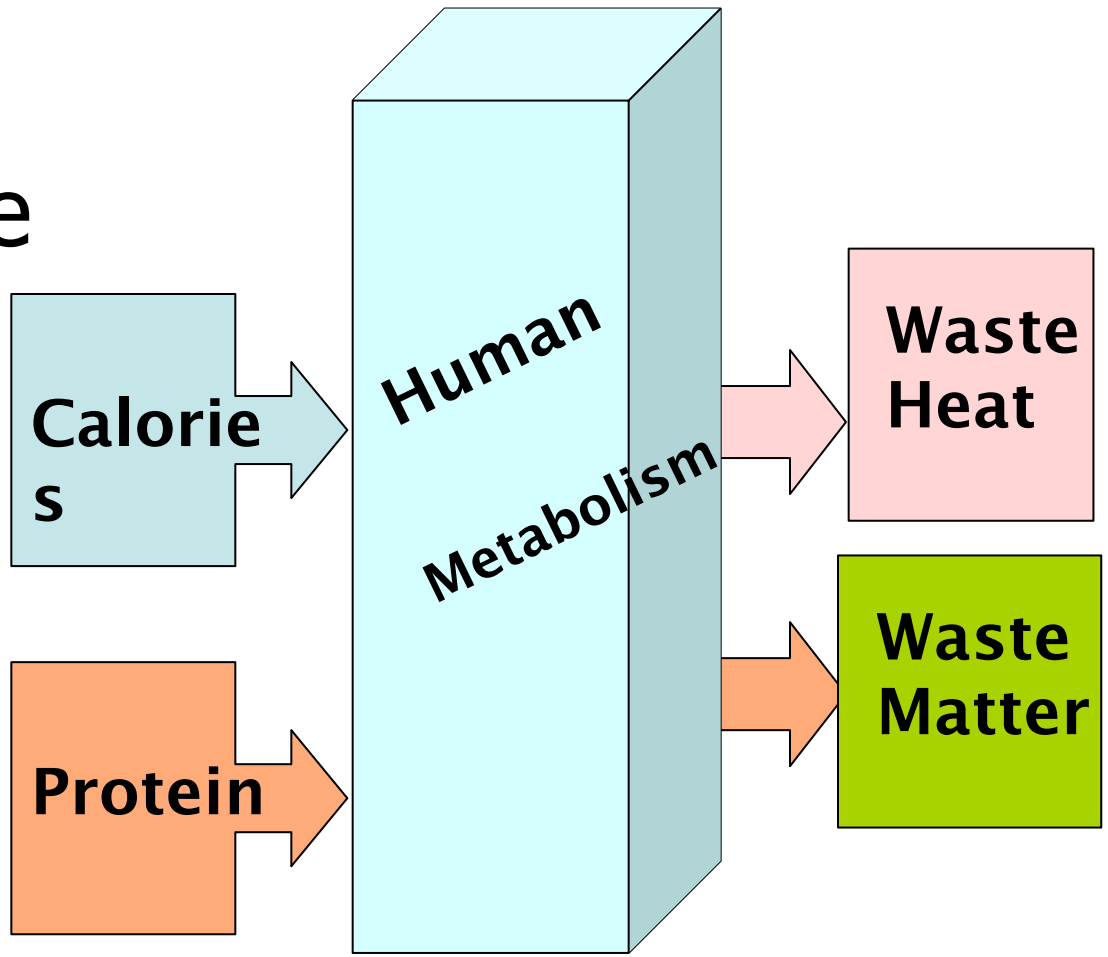

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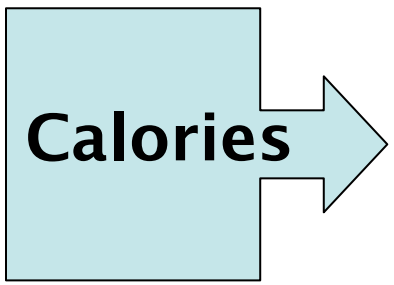


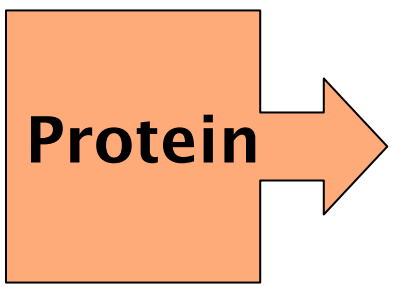

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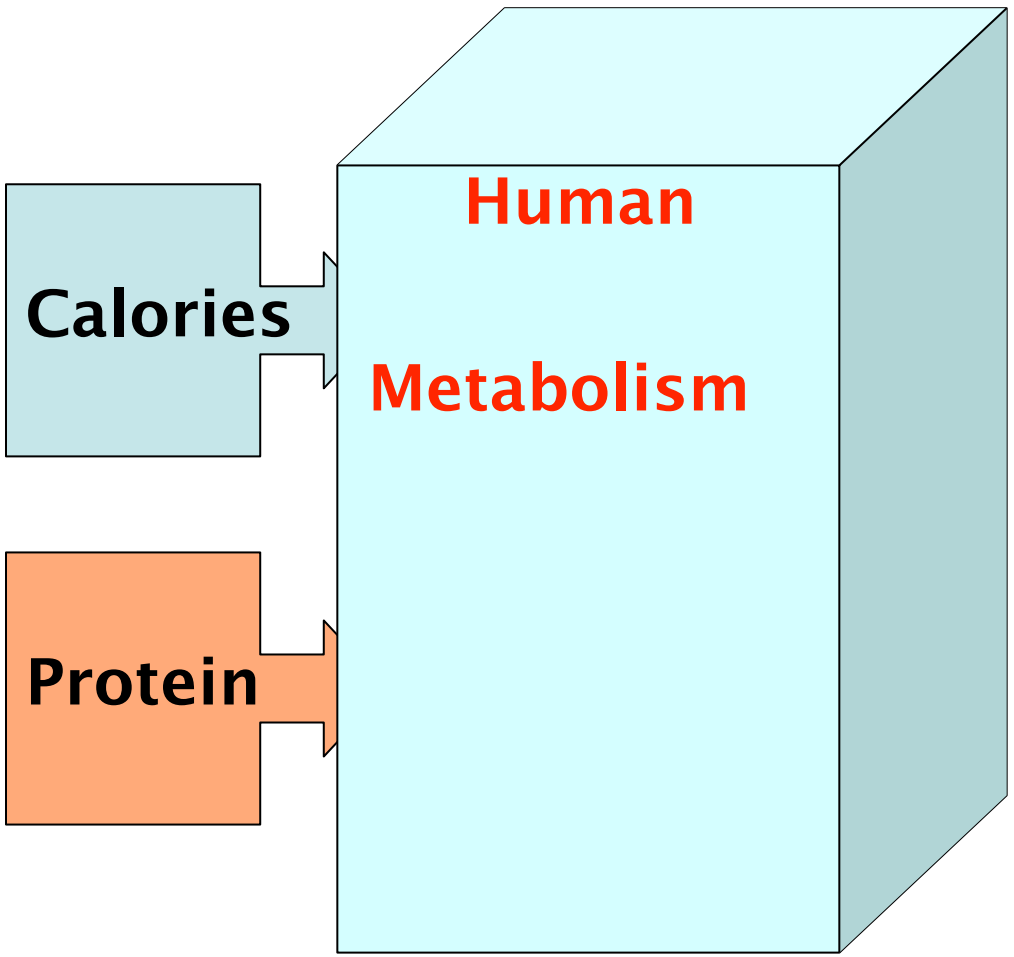

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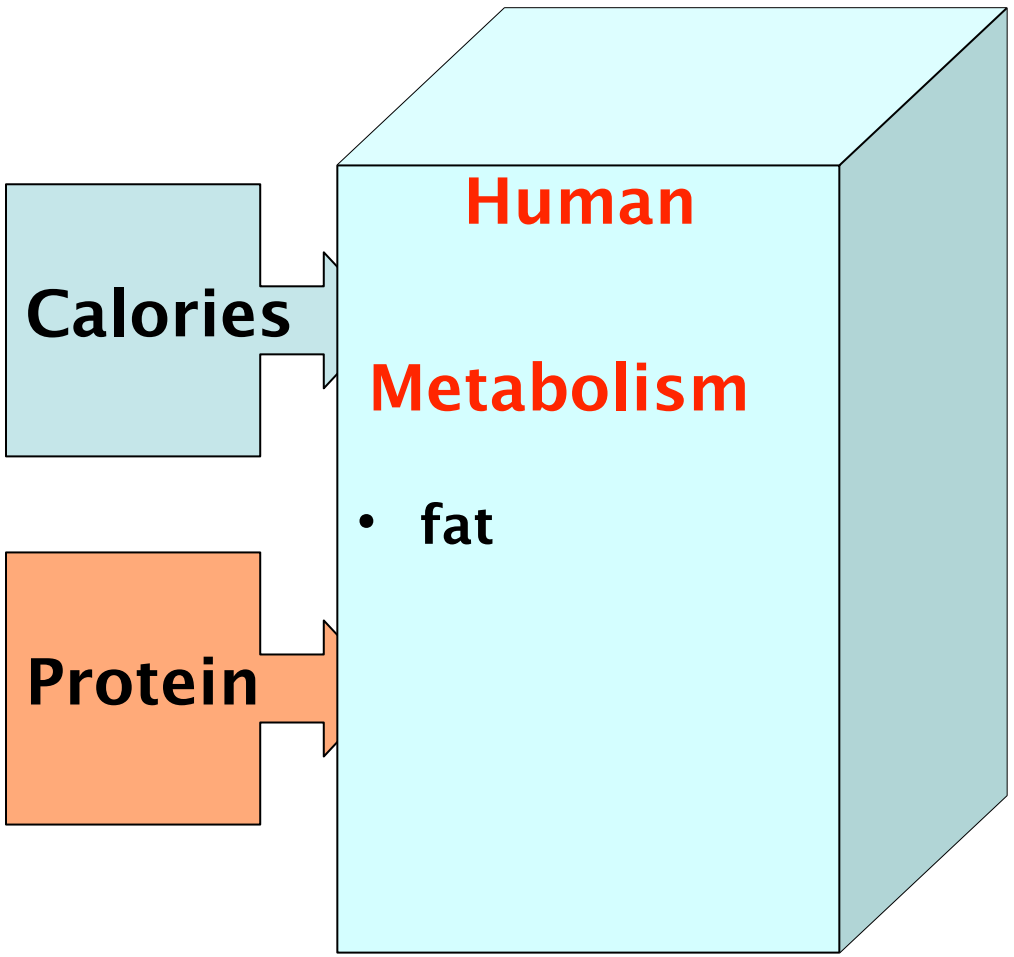

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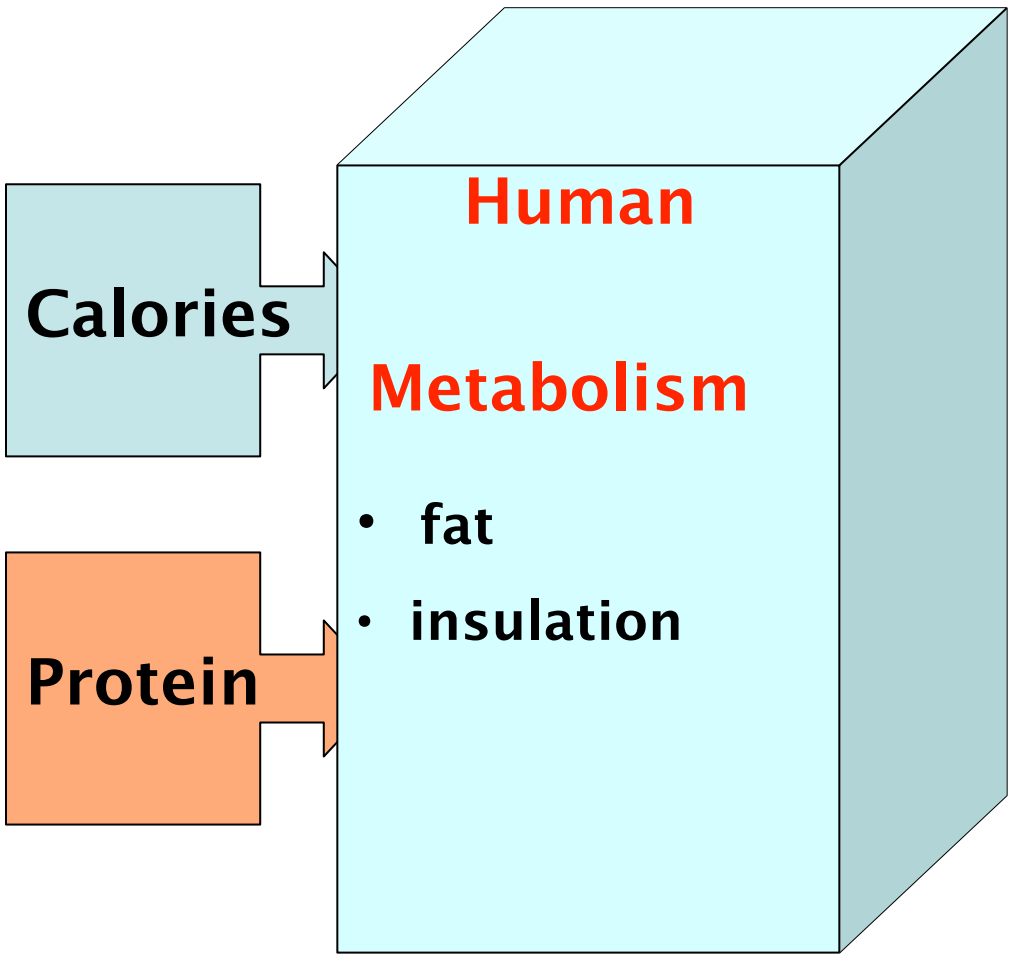

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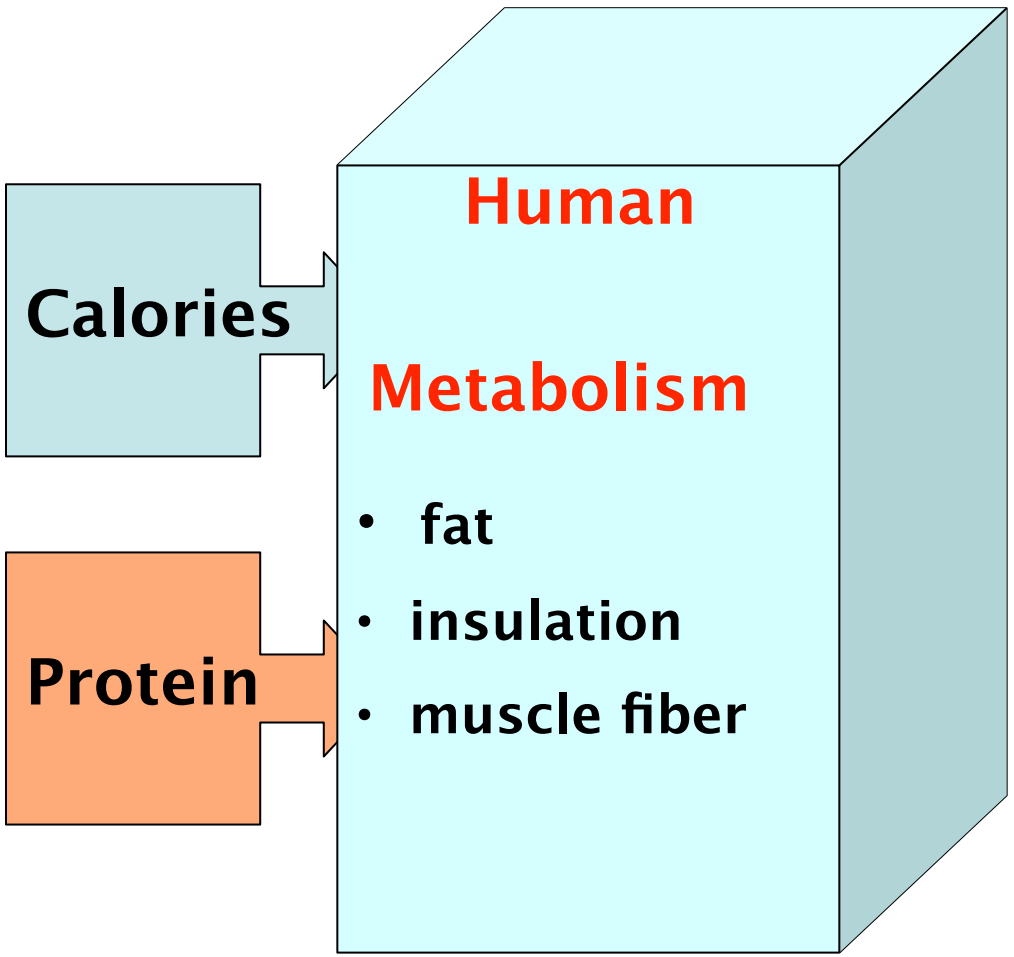

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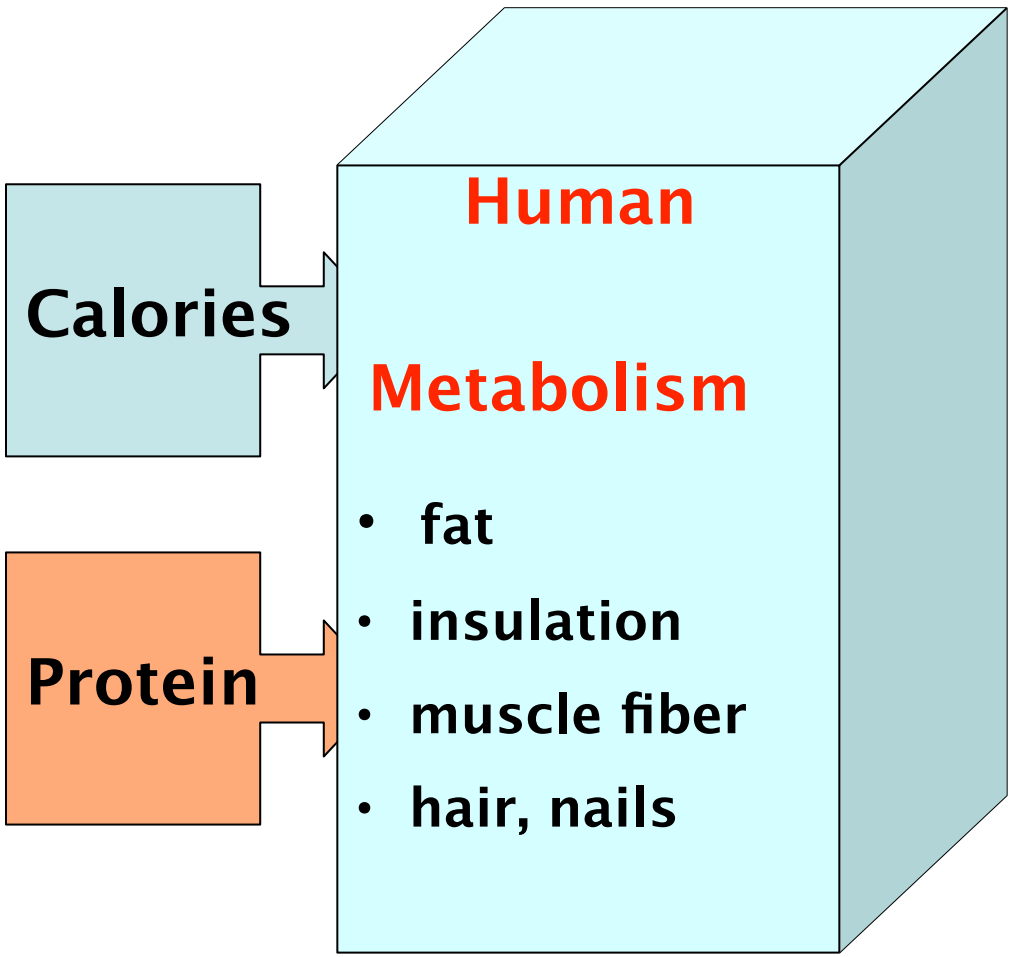

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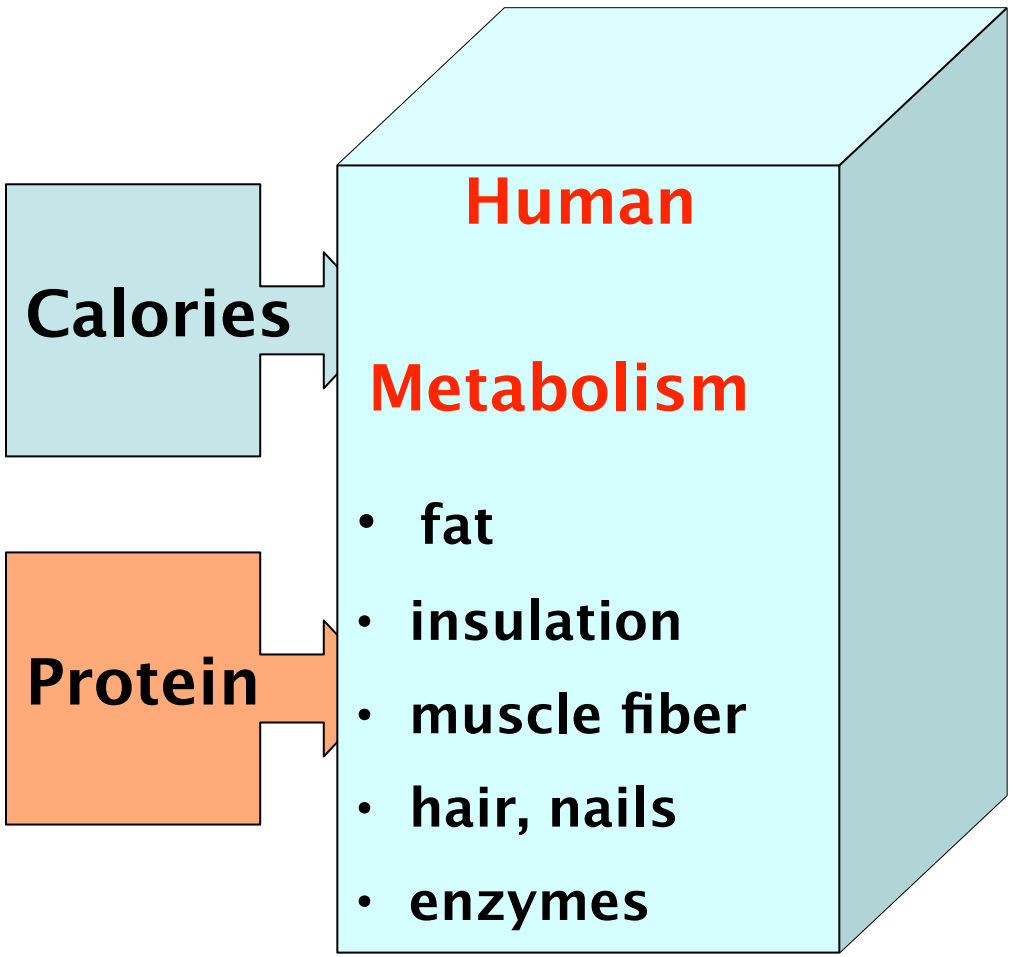
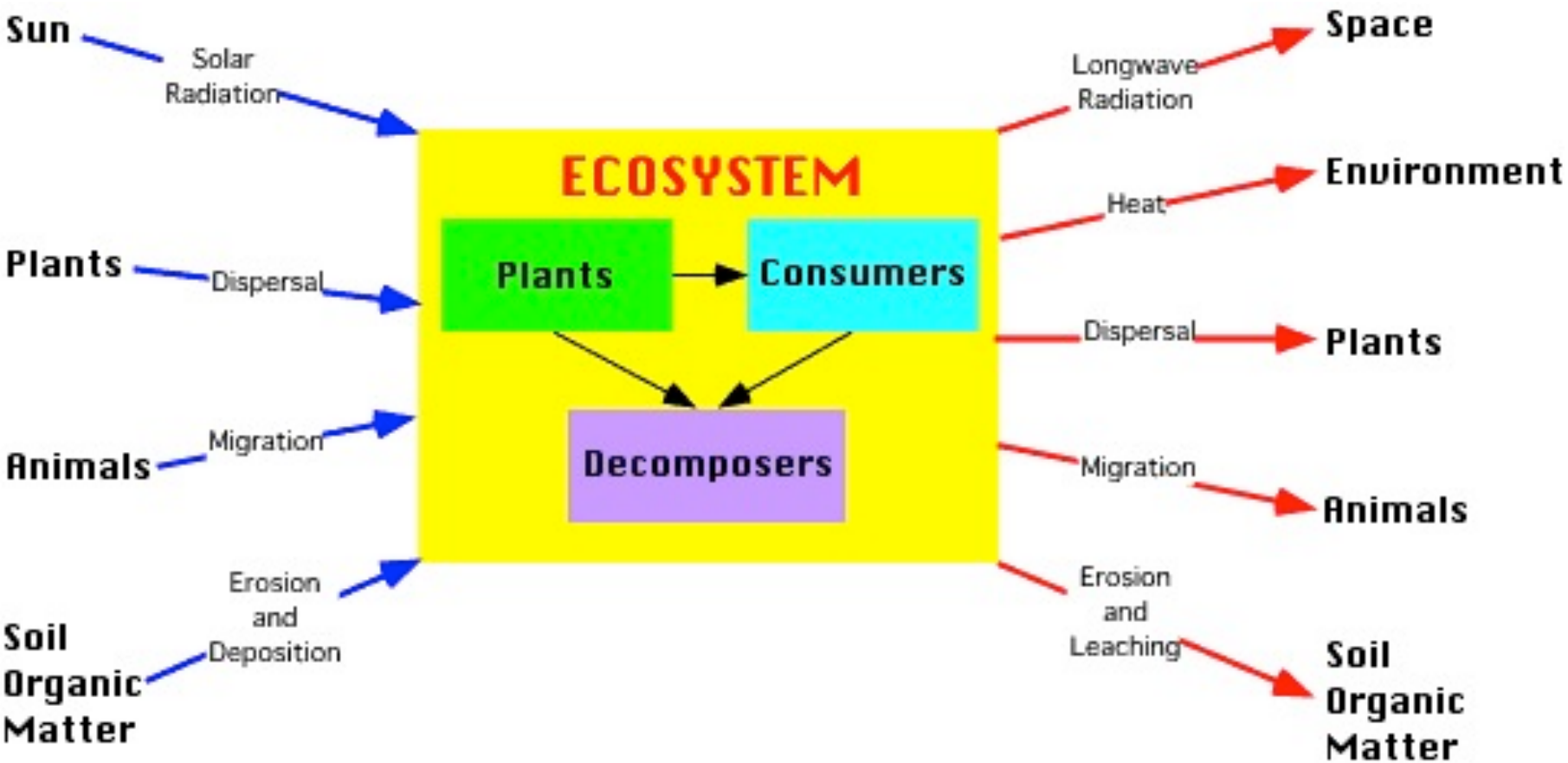
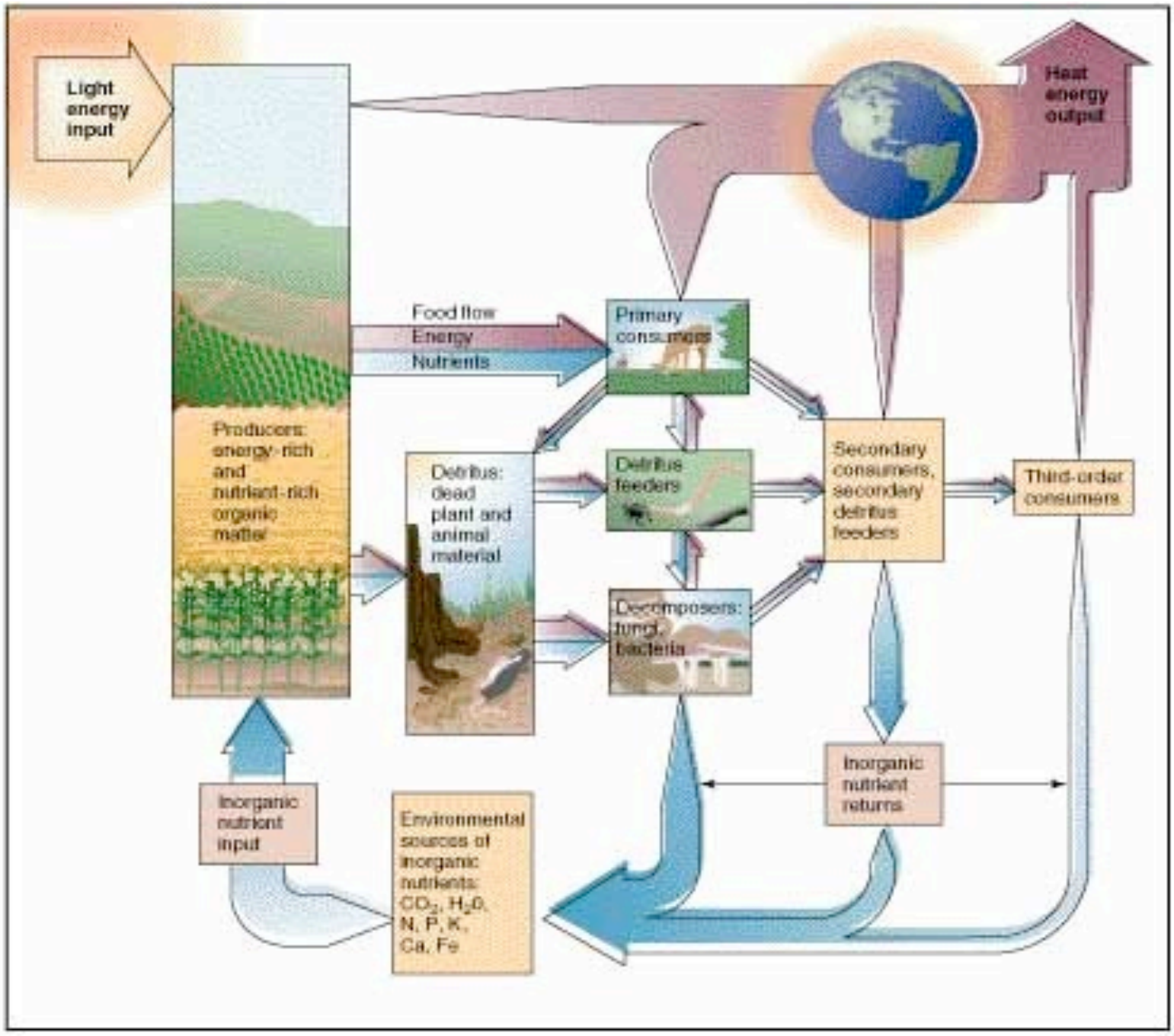
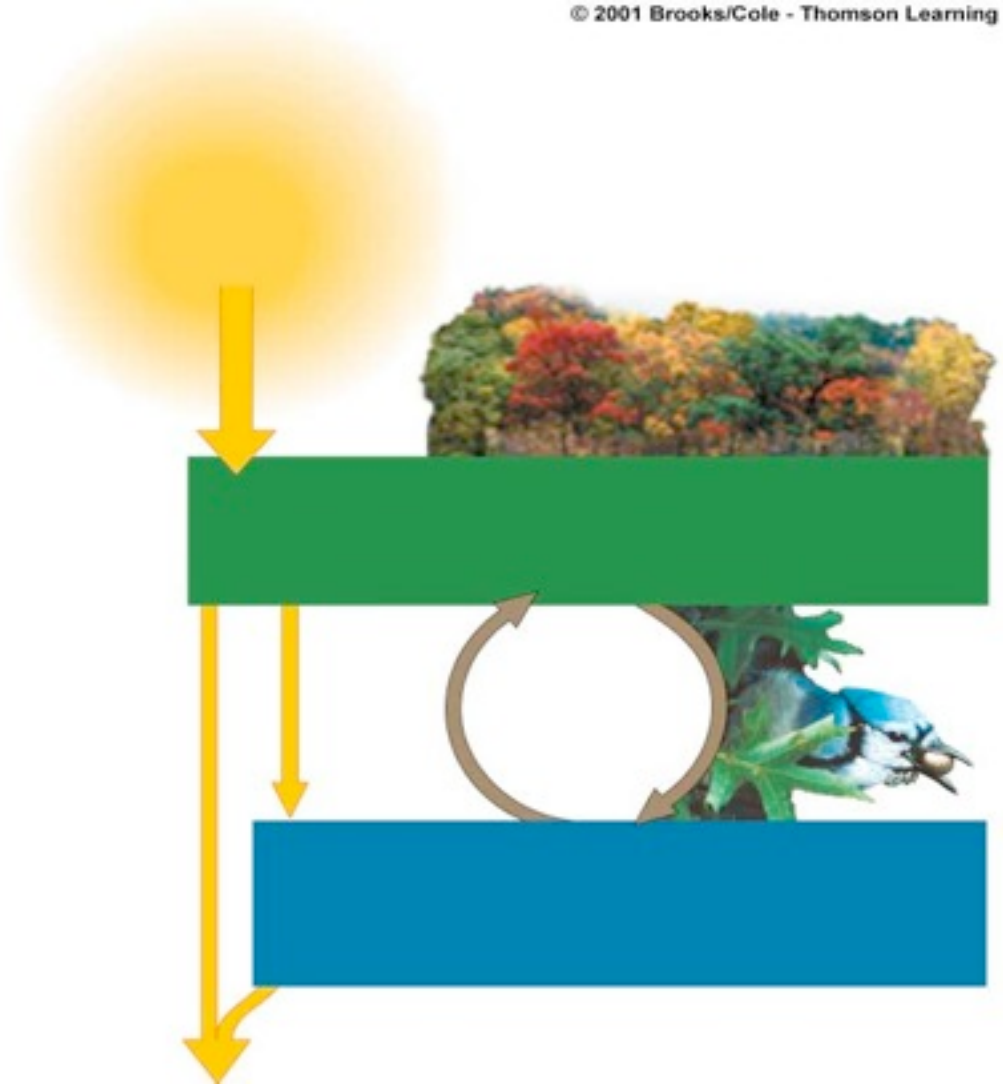
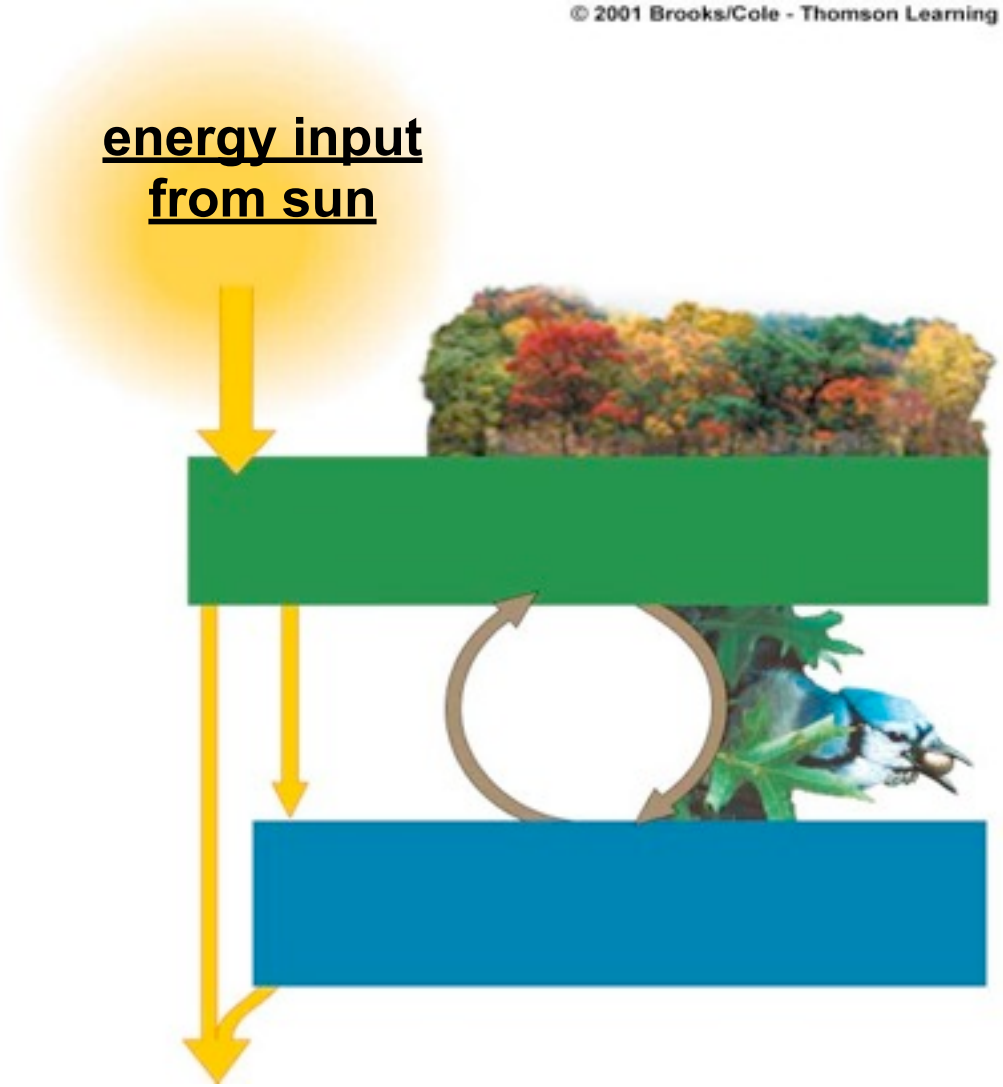


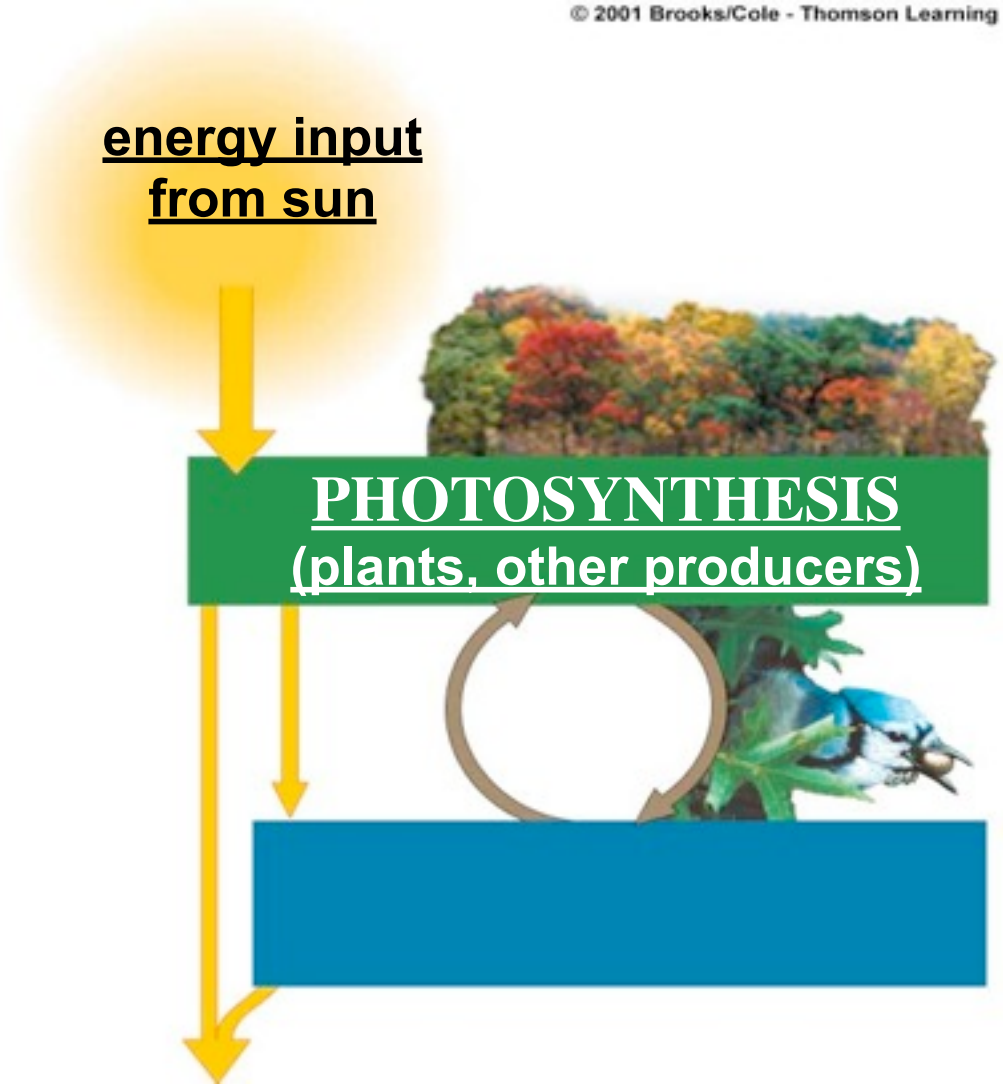
# Inputs and Outputs

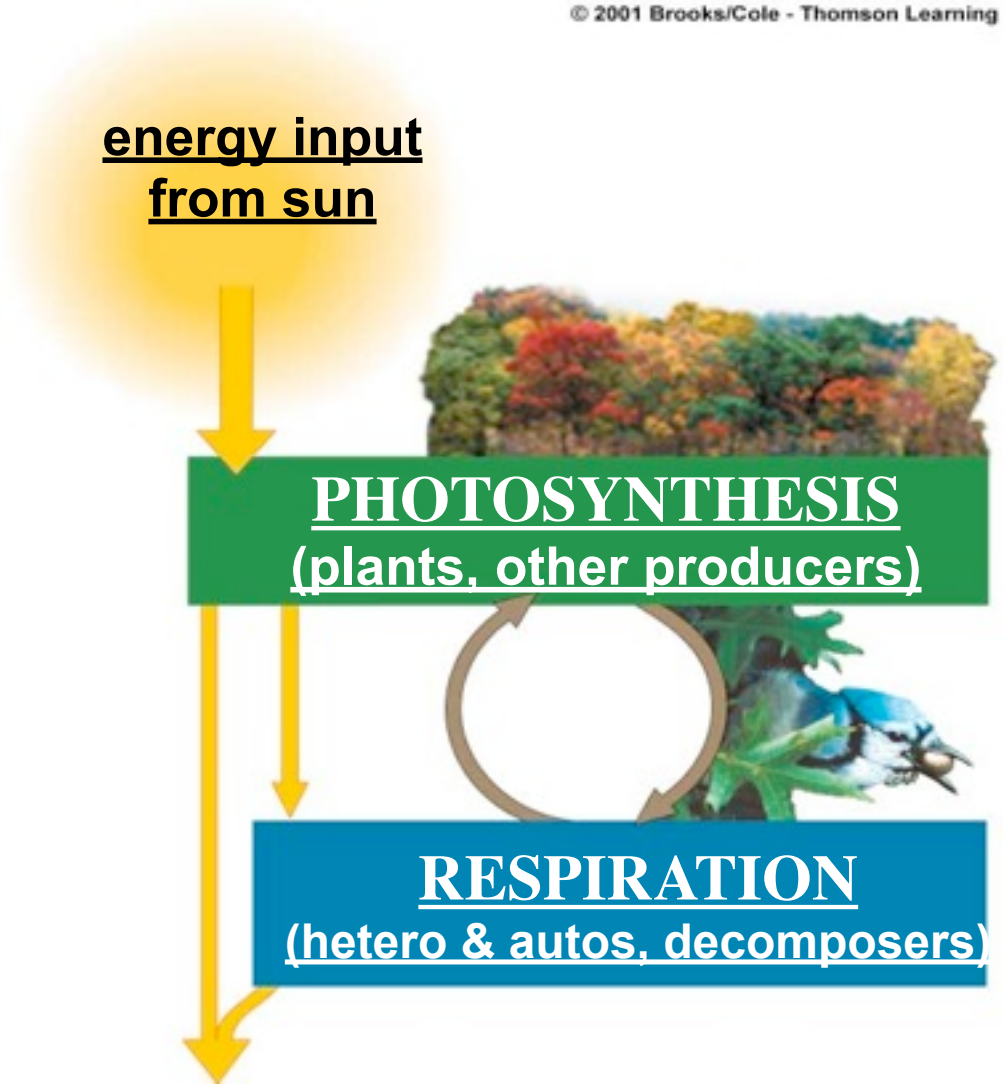


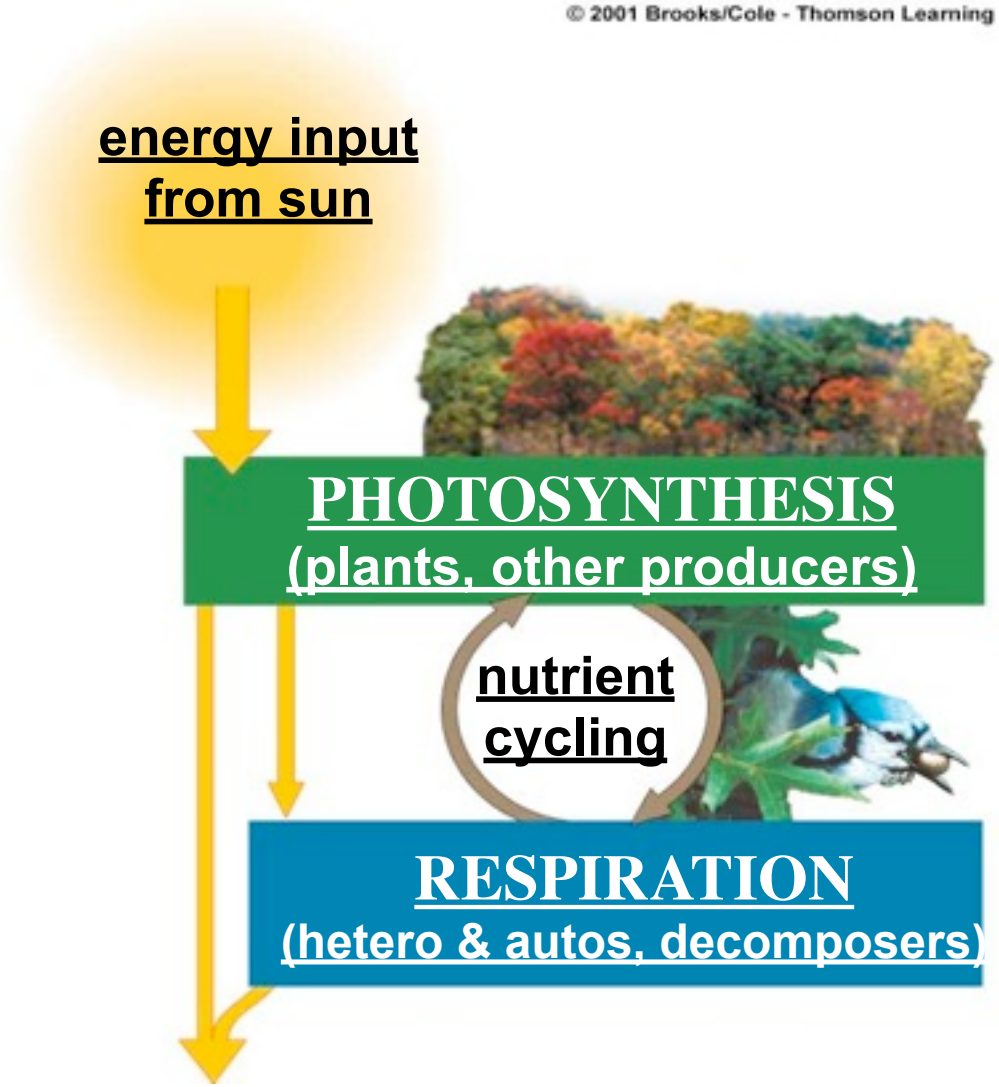

Light energy input
Heat energy output
Food flow
Energy
Nutrients
Primary consumers
Producers: energy-rich and nutrient-rich organic matter
Detritus: dead plant and animal material
Detritus feeders
Secondary consumers, secondary detritus feeders
Third-order consumers
Decomposers: fungi, bacteria
Inorganic nutrient input
Environmental sources of inorganic nutrients: $CO_2$, $H_2O$, N, P, K, Ca, Fe
Inorganic nutrient returns

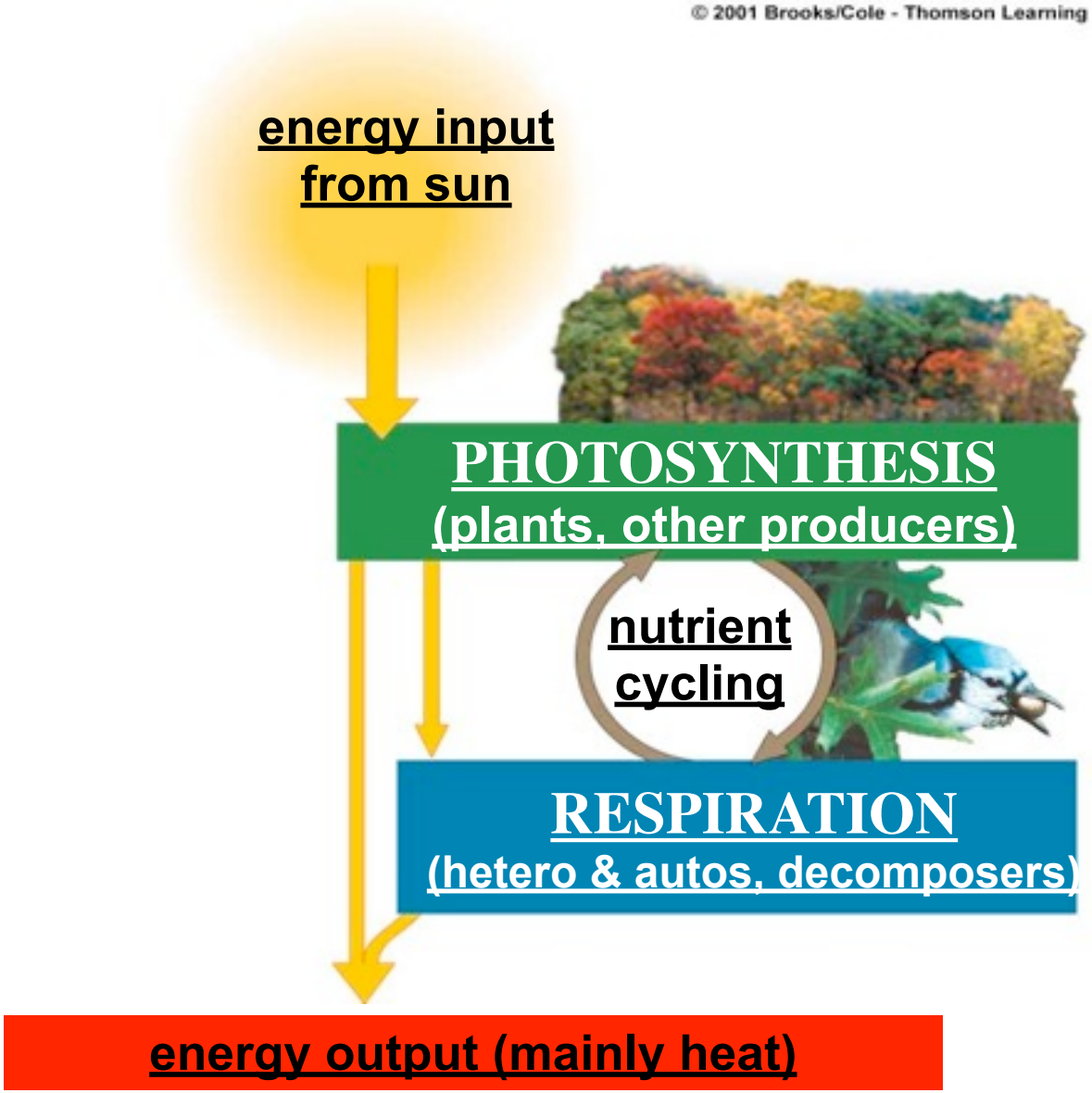


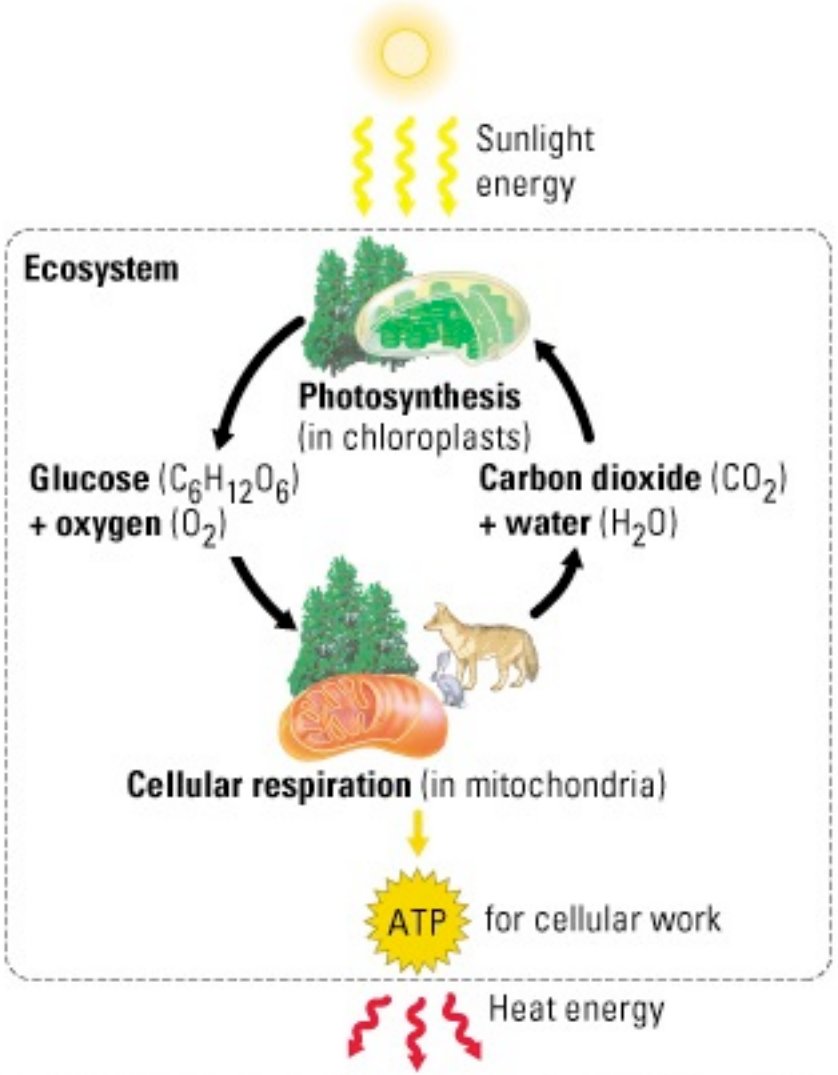












SUSTAINABILITY is the extent to which a given interaction with the environment exploits and utilizes the natural income without causing long-term deterioration to the natural capital.