The Living World

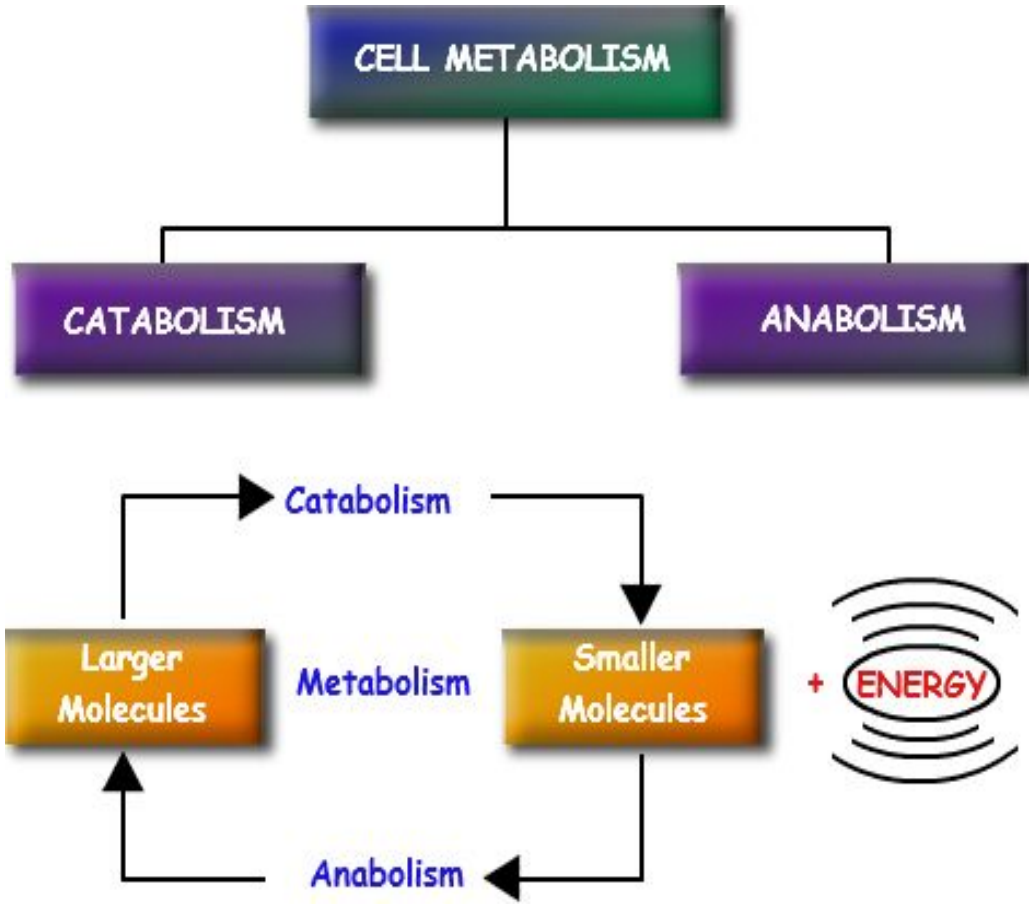
Metabolism and Homeostasis

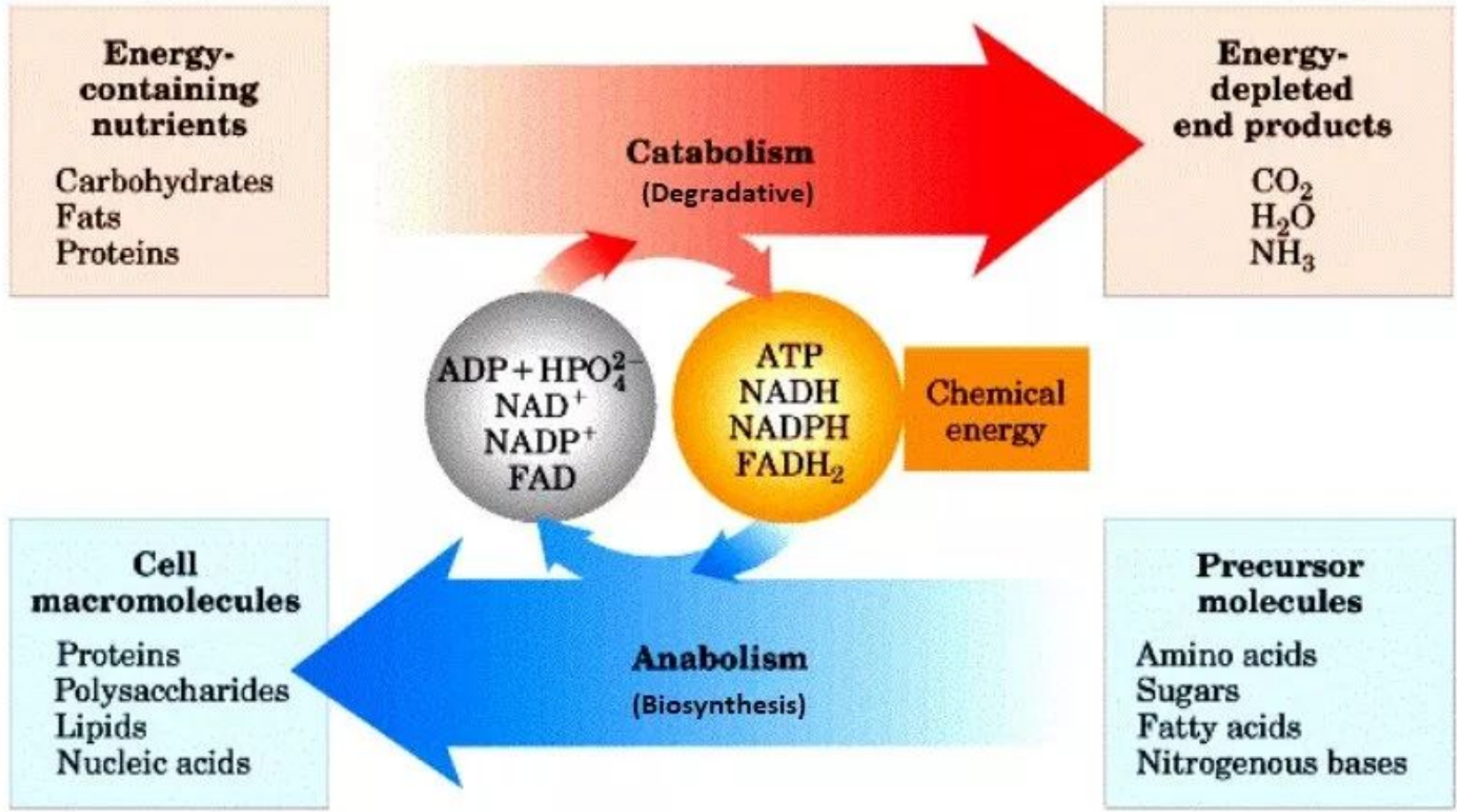
METABOLISM = CATABOLISM + ANABOLISM

- **Metabolism**: A series of chemical reaction taking place in our body to sustain life

Metabolism can be conveniently divided into two categories:

- **Catabolism** – It is the set of metabolic pathways that breaks down molecules into smaller units that are either oxidized to release energy or used in other anabolic reactions.
- **Anabolism** – It is the set of metabolic pathways that construct molecules from smaller units. These processes produce growth and differentiation of **cells** and increase in body size, a process that involves synthesis of complex molecules..



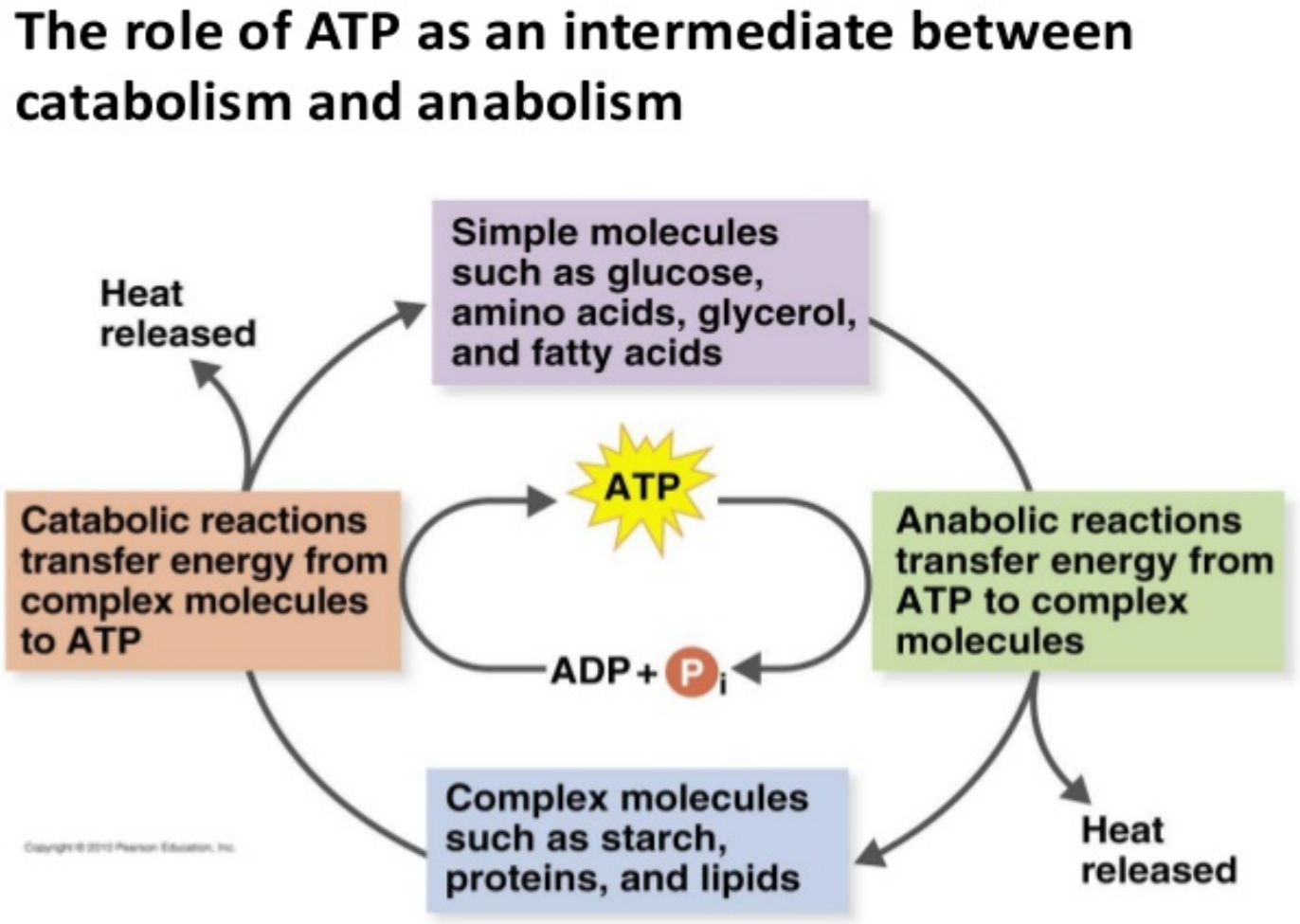

Energy-containing nutrients
Carbohydrates
Fats
Proteins
Catabolism
(Degradative)
Energy-depleted end products
CO_2
H_2O
NH_3
$ADP + HPO_4^{2-}$
NAD^+
$NADP^+$
FAD
ATP
NADH
NADPH
$FADH_2$
Chemical energy
Cell macromolecules
Proteins
Polysaccharides
Lipids
Nucleic acids
Anabolism
(Biosynthesis)
Precursor molecules
Amino acids
Sugars
Fatty acids
Nitrogenous bases

NEED FOR METABOLISM

- Metabolism is a highly coordinated cellular activity in which many multi-enzymes systems (metabolic pathways) cooperate to:

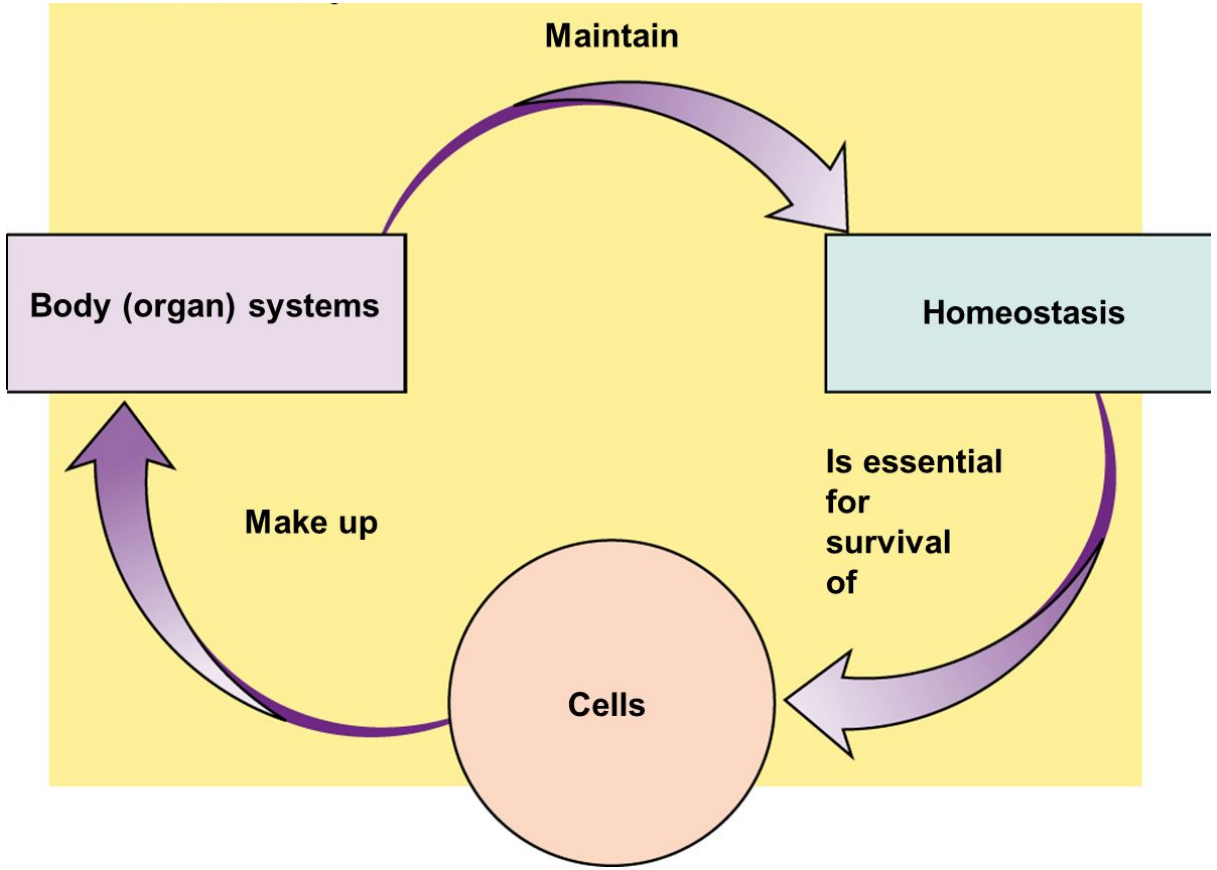
1. Obtain chemical energy by capturing solar energy (autotrophs) or degrading energy rich nutrients from the environment (heterotrophs).
2. Convert nutrient molecules into the cells own characteristic molecules, including precursor macromolecule.
3. Polymerize monomeric precursors into macromolecules : protein, nucleic acid and polysaccharides.
4. Synthesize and degrade biomolecules required for specialized cellular functions such as membrane lipids, intracellular messengers, cell signalling.

ROLE OF ATP IN CELLULAR METABOLISM



Homeostasis

- The body uses so much energy, even during sleep, because it must maintain a constant internal environment.
- This process of keeping things the same is called **homeostasis**.
- A series of automatic control systems ensures that the body maintains a constant temperature, and steady levels of water, ions and blood sugar.
- Homeostasis allows the body's cells to work at their optimum.



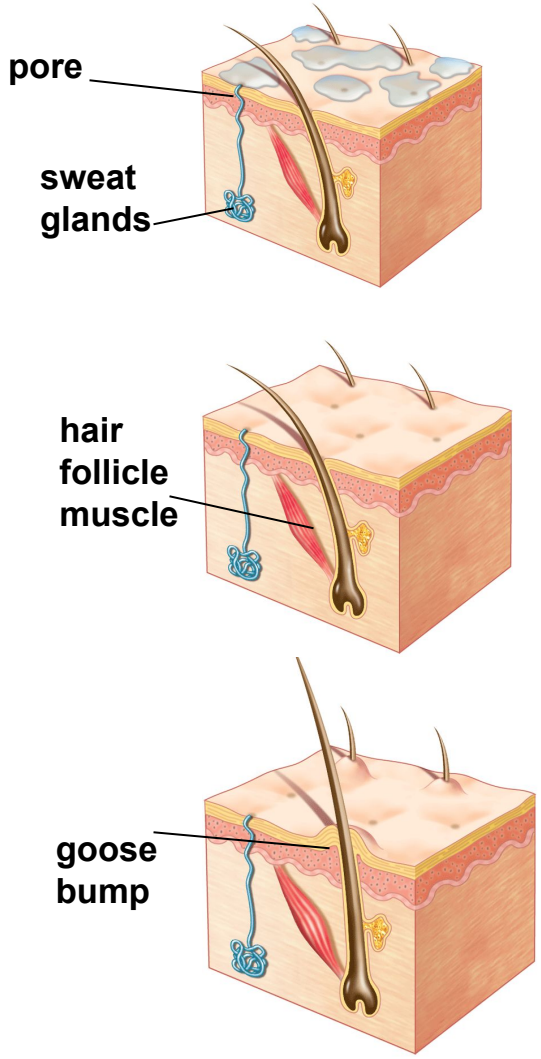
Regulation of Homeostasis

Sensors -gather data and detect changes

Control center - receives data, sends messages, usually the brain

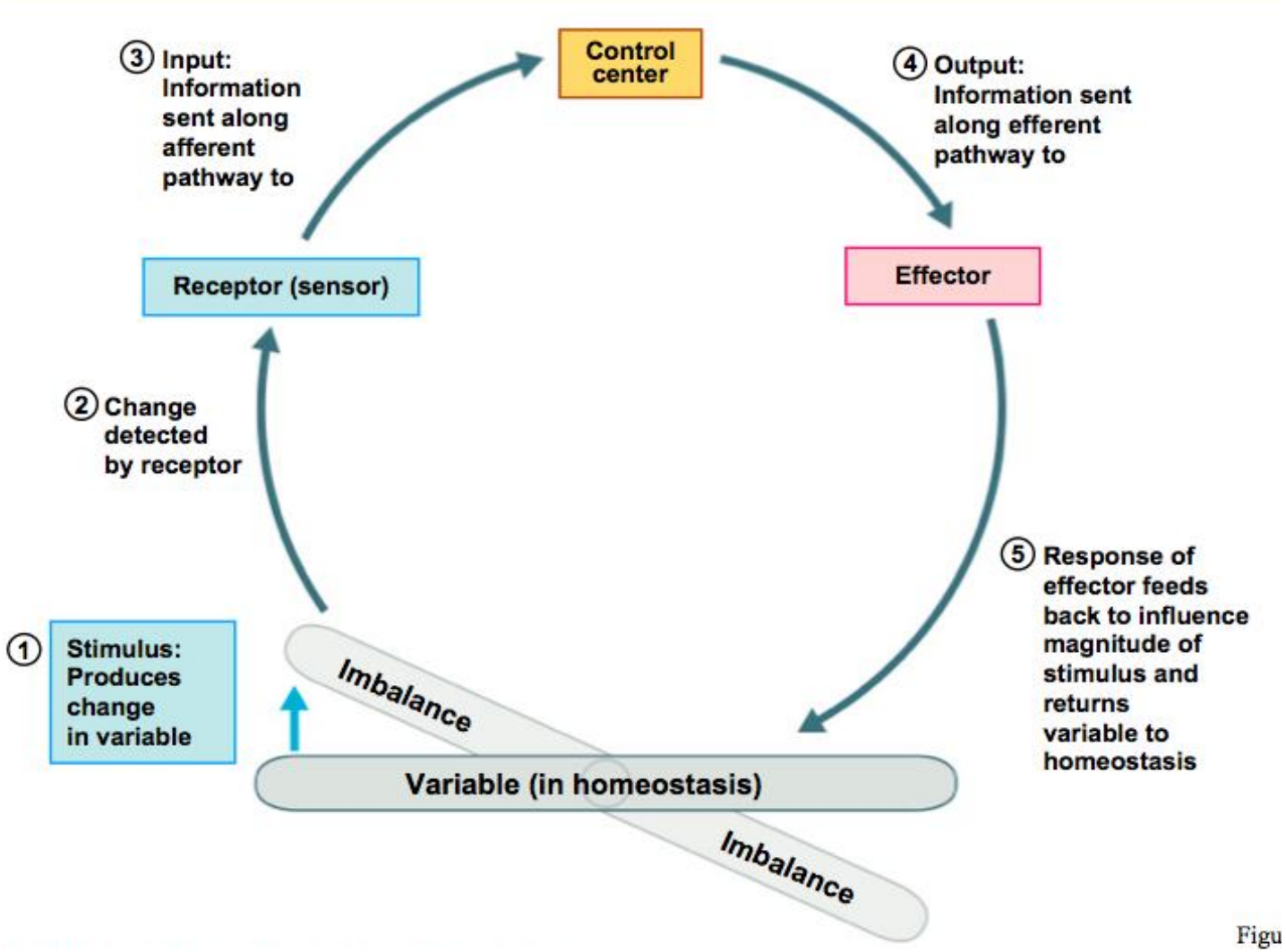
Communication system - delivers messages in form of nerve impulses and hormones to target organs, tissues

Targets – organ, tissue or cell that responds to change



Homeostasis regulation

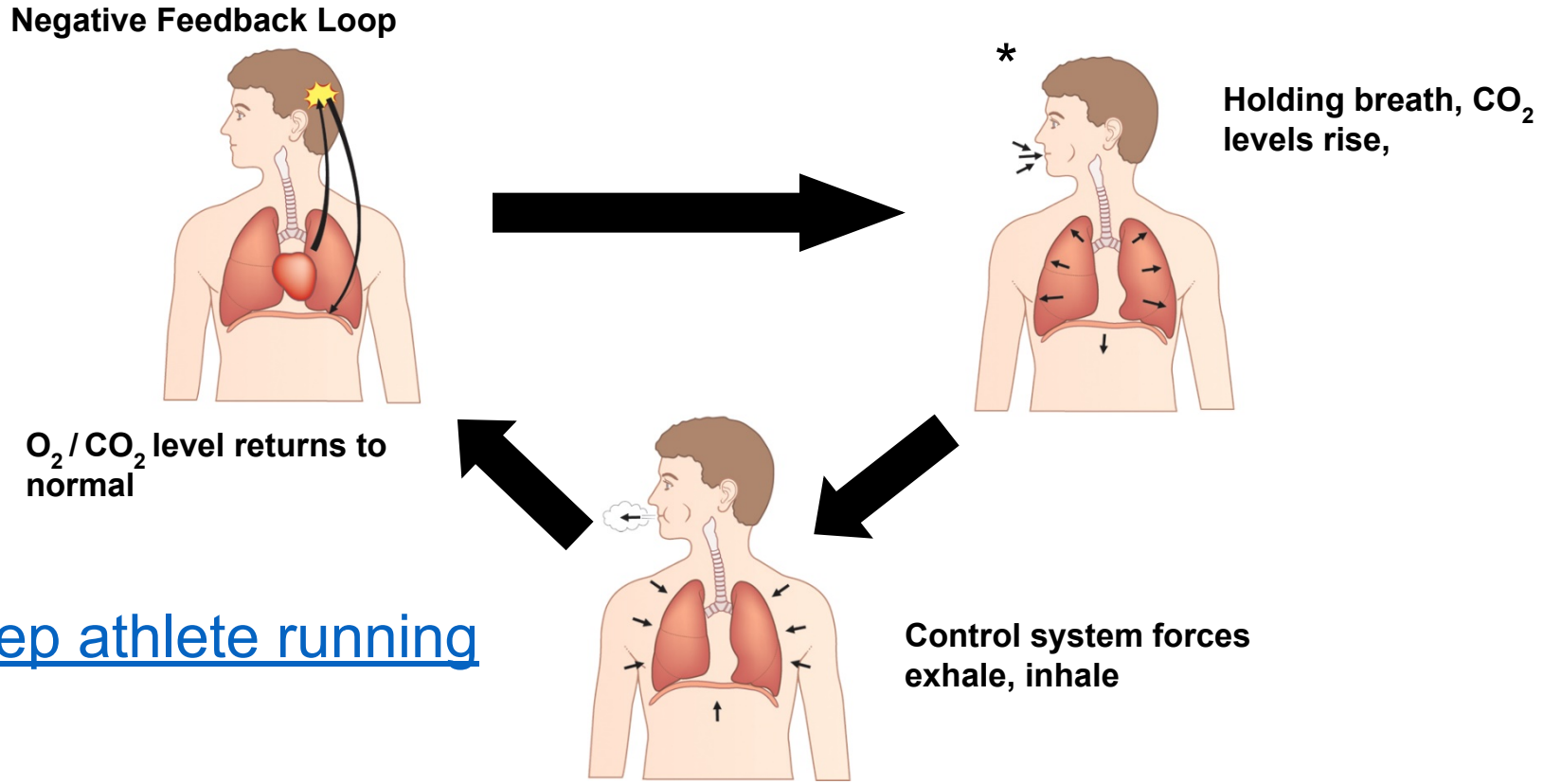
It is the body's attempt to maintain a constant internal environment. Maintaining a stable internal environment requires constant monitoring and adjustments as conditions change. This adjusting of physiological systems within the body is called **homeostatic regulation. This involves 3 parts or mechanisms**



Figu

Negative feedback loops

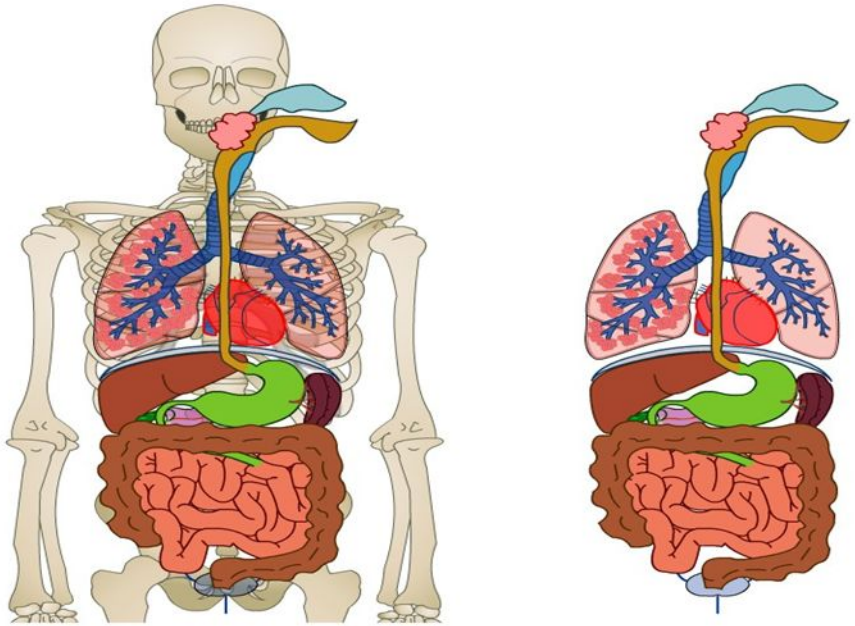
- Feedback compares current conditions to set ranges.
- Negative feedback- **counteracts** change.
- Reverses any change and returns body to set point



Keep athlete running

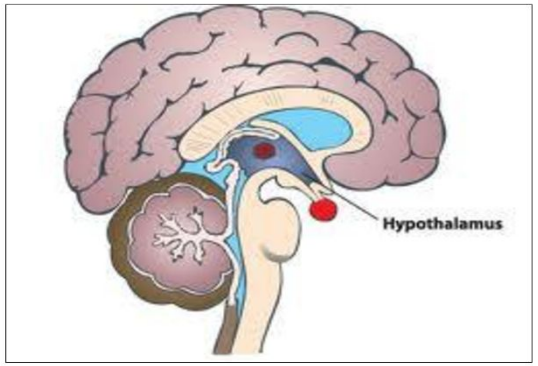
Each organ system affects other organ systems

Organ systems must also work together to keep the organism healthy.
There is no specific organ which controls homeostasis.



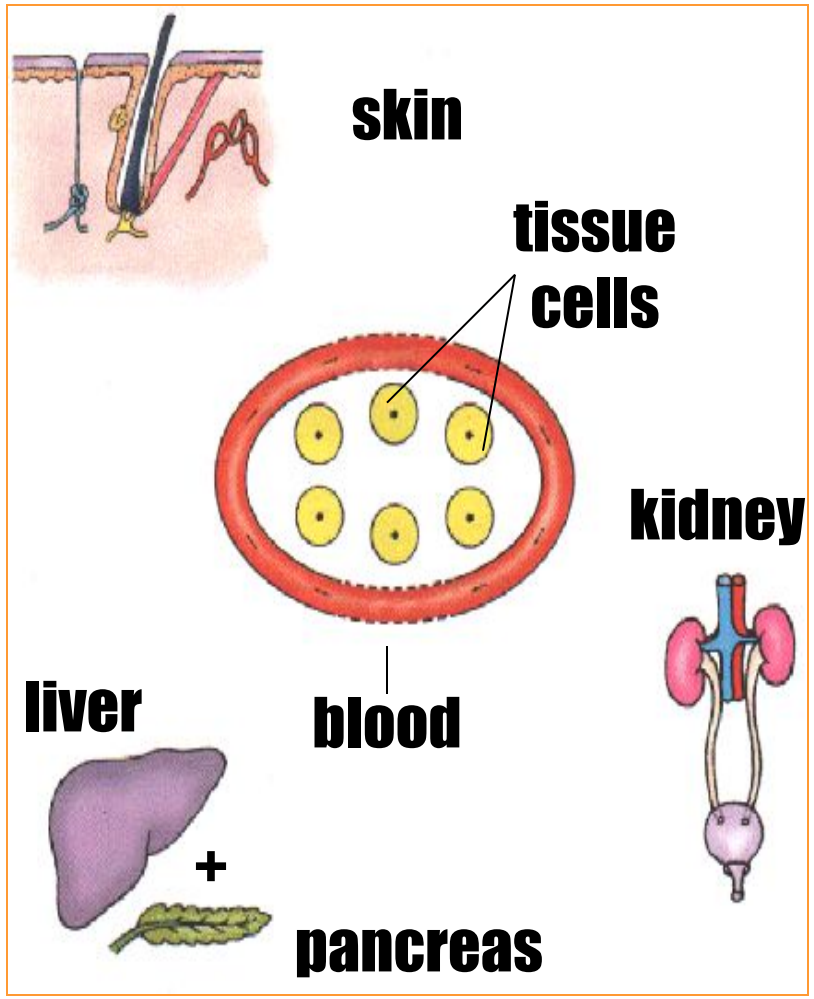
The skin, kidneys, liver, endocrine system, nervous system and sensory system all play a part in maintaining the internal environment within narrow limits.

The hypothalamus is involved to a degree in each of these regulations



Organs and involved

- Water - kidneys :
  - regulate water & mineral salts concentration
- Thermoregulation –skin and muscles :
  - regulate body temperature
- Glucose - liver & pancreas :
  - regulate blood glucose level



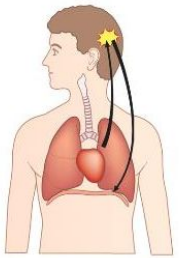
Temperature Regulation By Fever

Homeostasis

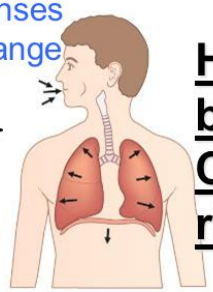
- Ability to maintain stable internal state

Example: Body Temperature

Example:

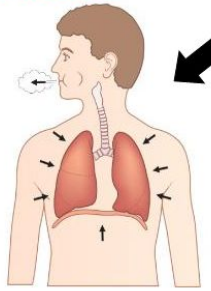


Receptor Senses change



Holding breath, CO_2 levels rise

Nervous
Respiratory
Muscular



Control system gets information

Control system forces exhale, inhale

Effector Responses

O_2 / CO_2 level returns to normal

Regulating Body Temperature - on a Cold Day

Marshall Cavendish

Shivering occurs when insufficient heat is produced

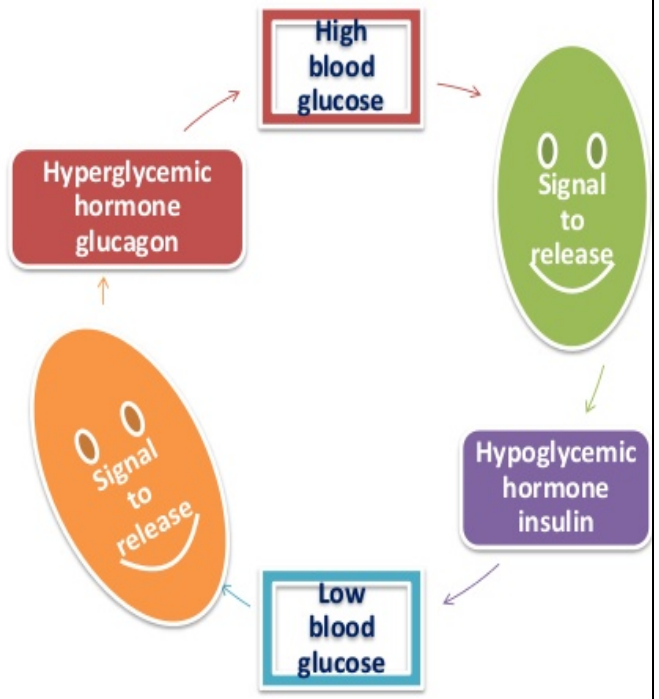
Stimulus
Blood and skin temperatures fall

Receptor
Temperature receptors detect changes and send nerve impulses to the brain

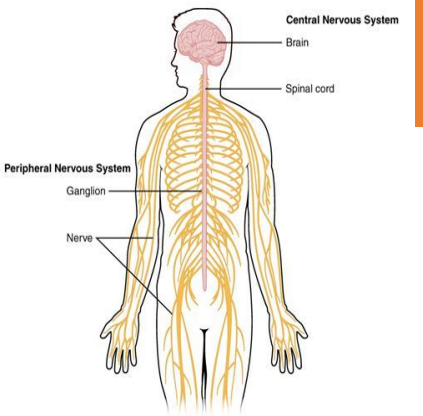
Corrective Mechanism
Decrease in heat loss and increase in heat production

Hypothalamus of brain is
stimulated and sends nerve impulses to relevant body parts

The pancreas detects the change in blood glucose concentration and releases the appropriate hormone

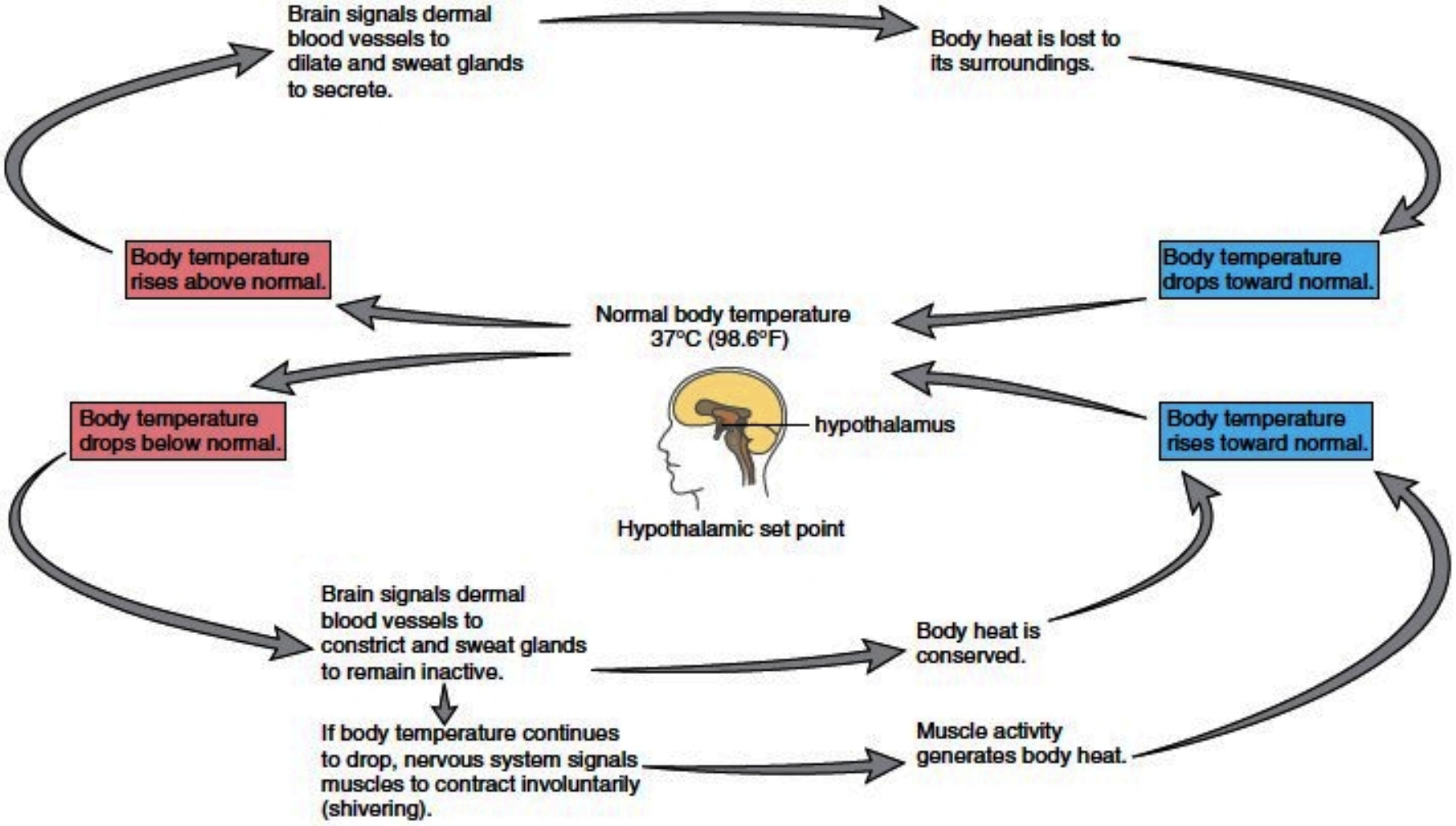


Types of homeostasis



1.Extrinsic homeostatic System:

- **Extrinsic regulation** is when the activities of an outside system (mostly nervous or hormone) regulate homeostasis



2. Intrinsic homeostatic System:

Local controls usually involve only one organ or tissue. When muscles use more O_2, and also produce more CO_2, intrinsic controls cause dilation of the blood vessels allowing more blood into those active areas of the muscles. Eventually the vessels will return to "normal".

Homeostasis

Primary /Secondary / Tertiary

Primary Hemostasis

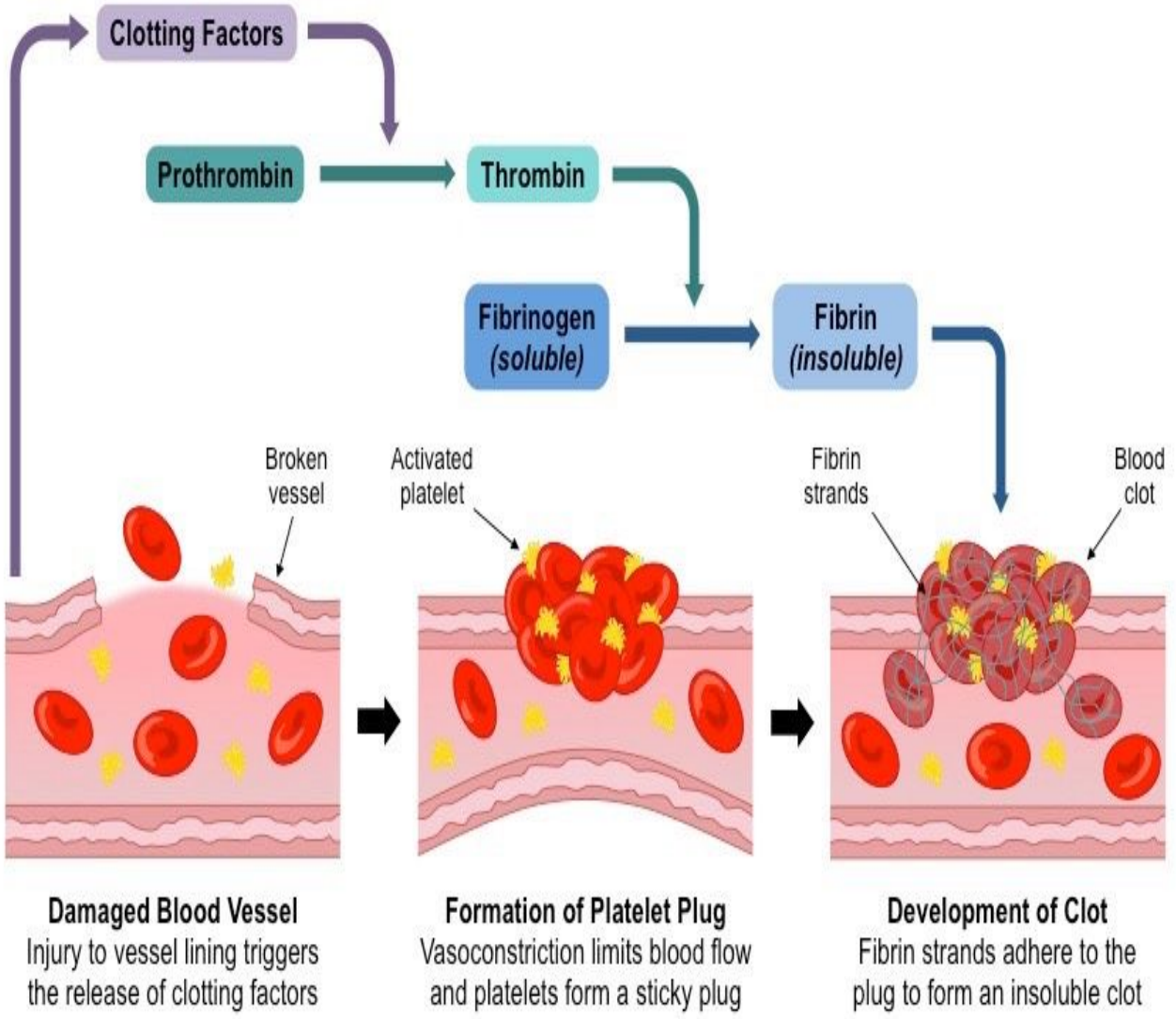
- Platelet Plug Formation
- Dependent on normal platelet number & function
- Initial Manifestation of Clot Formation

Secondary Hemostasis

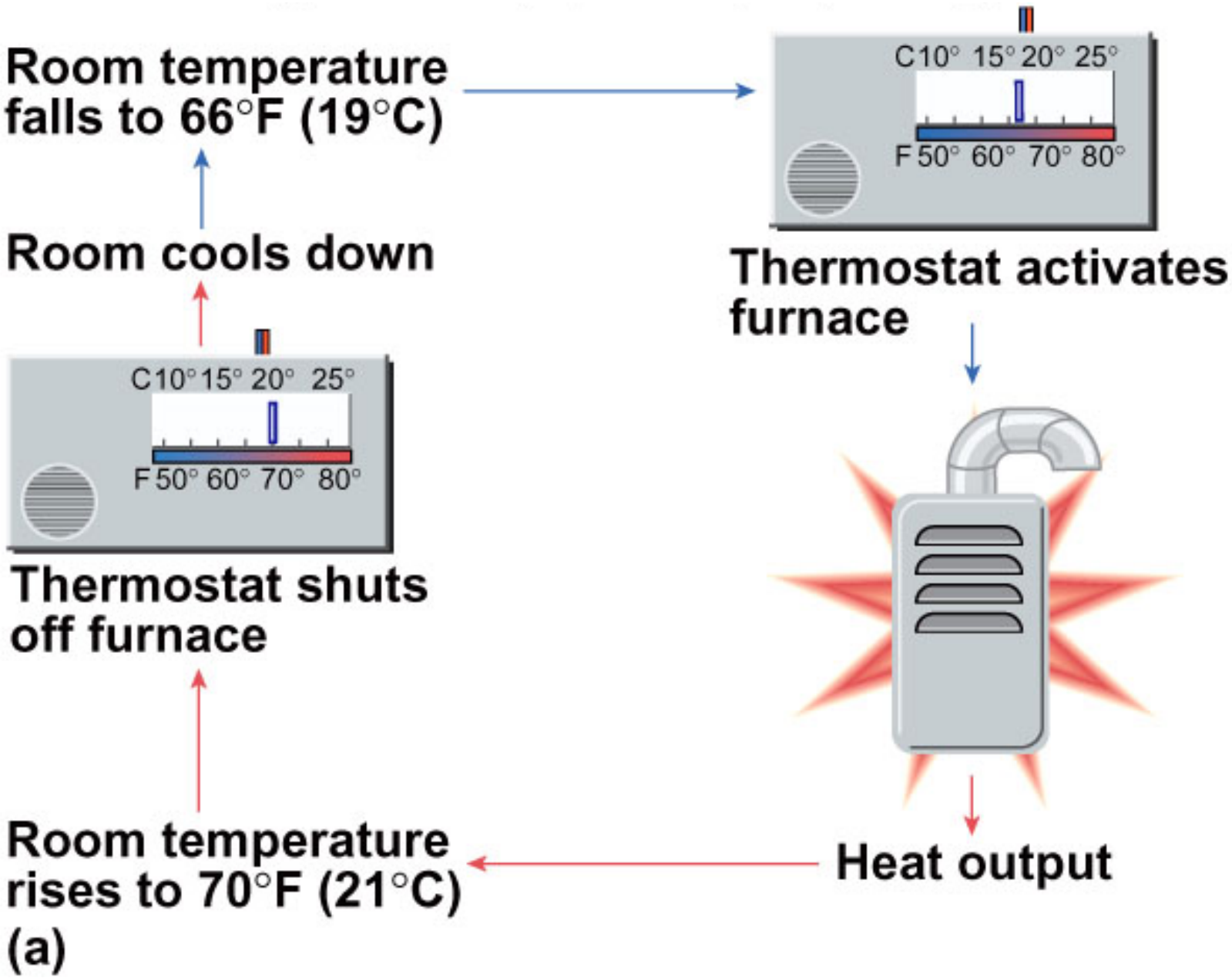
- Activation of Clotting Cascade
- Deposition & Stabilization of Fibrin

Tertiary Hemostasis

- Dissolution of Fibrin Clot
- Dependent on Plasminogen Activation



Thank You


Room temperature falls to 66°F (19°C)
C 10° 15° 20° 25°
F 50° 60° 70° 80°
Thermostat activates furnace
Heat output
Room temperature rises to 70°F (21°C)
(a)
Room cools down
C 10° 15° 20° 25°
F 50° 60° 70° 80°
Thermostat shuts off furnace