Homeostasis

7Th Lecture

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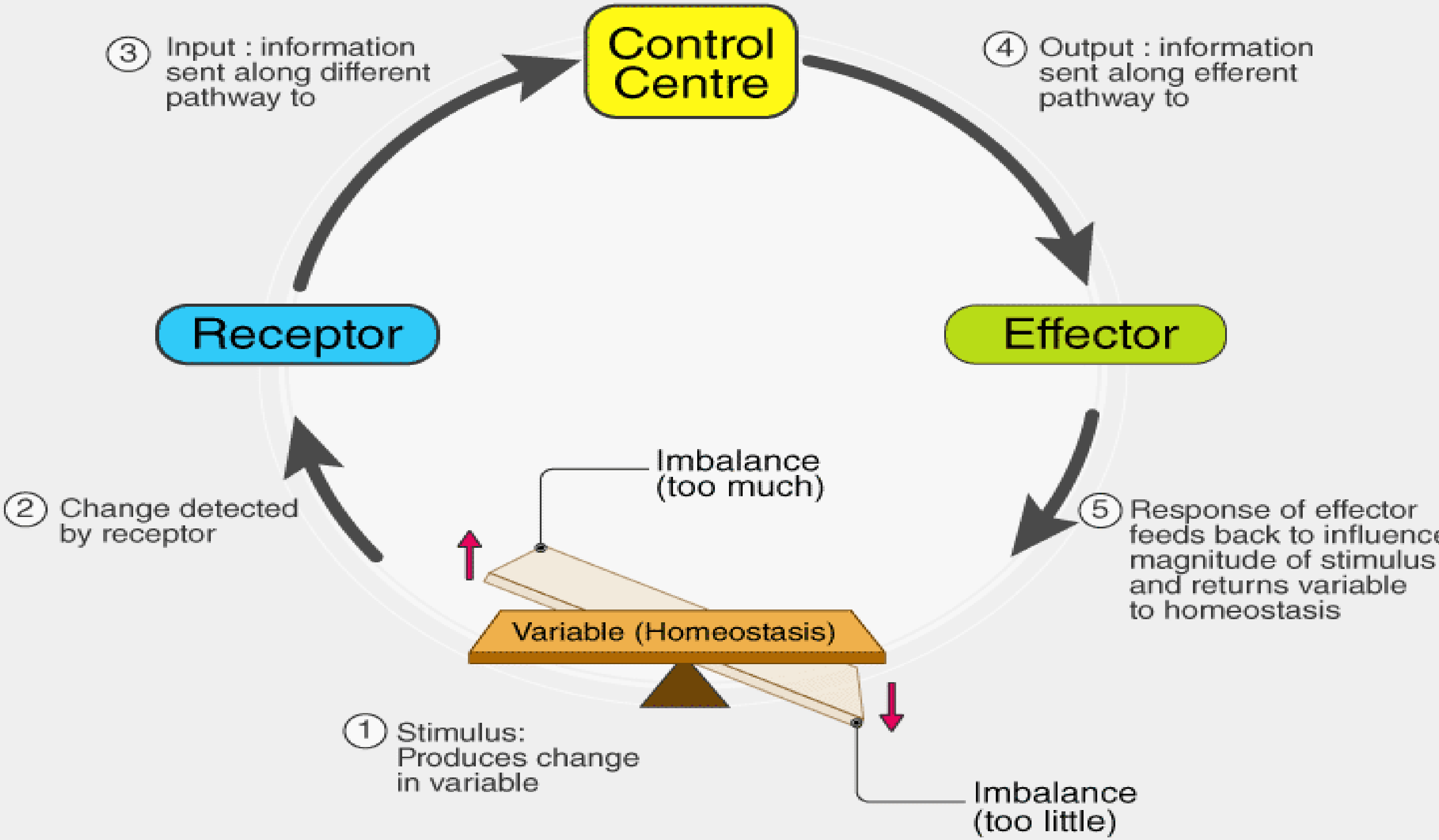
Homeostasis is defined as a self-regulating process by which a living organism can maintain internal stability while adjusting to changing external conditions.

Homeostasis Meaning and Etymology

The theory of homeostasis was first introduced by Claude Bernard, a French Physiologist in the year 1865, and the term was first used in 1926 by Walter Bradford Cannon. Bradford derived Homeostasis from the ancient Greek words *ὅμοιος* (pronounced: hómoios) and *ἵστημι* (pronounced: hístēmi). The combination of these words translates to “similar” and “standing still” respectively.



Homeostasis is a property of a human biological system where the self-regulating process tends to maintain the balance for the survival. The regulation takes place in a defined internal environment

Homeostasis is quite crucial for the survival of organisms. It is often seen as a resistance to changes in the external environment. Furthermore, homeostasis is a self-regulating process that regulates internal variables necessary to sustain life.

In other words, homeostasis is a mechanism that maintains a stable internal environment despite the changes present in the external environment.

The body maintains homeostasis by controlling a host of variables ranging from body temperature, blood pH, blood glucose levels to fluid balance, sodium, potassium and calcium ion concentrations.

Regulation of Homeostasis

The regulation of homeostasis depends on three mechanisms: Effector, receptor, control center.
The entire process continuously works to maintain homeostasis regulation.

Receptor

the receptor is the sensing component responsible for monitoring and responding to changes in the external or internal environment.

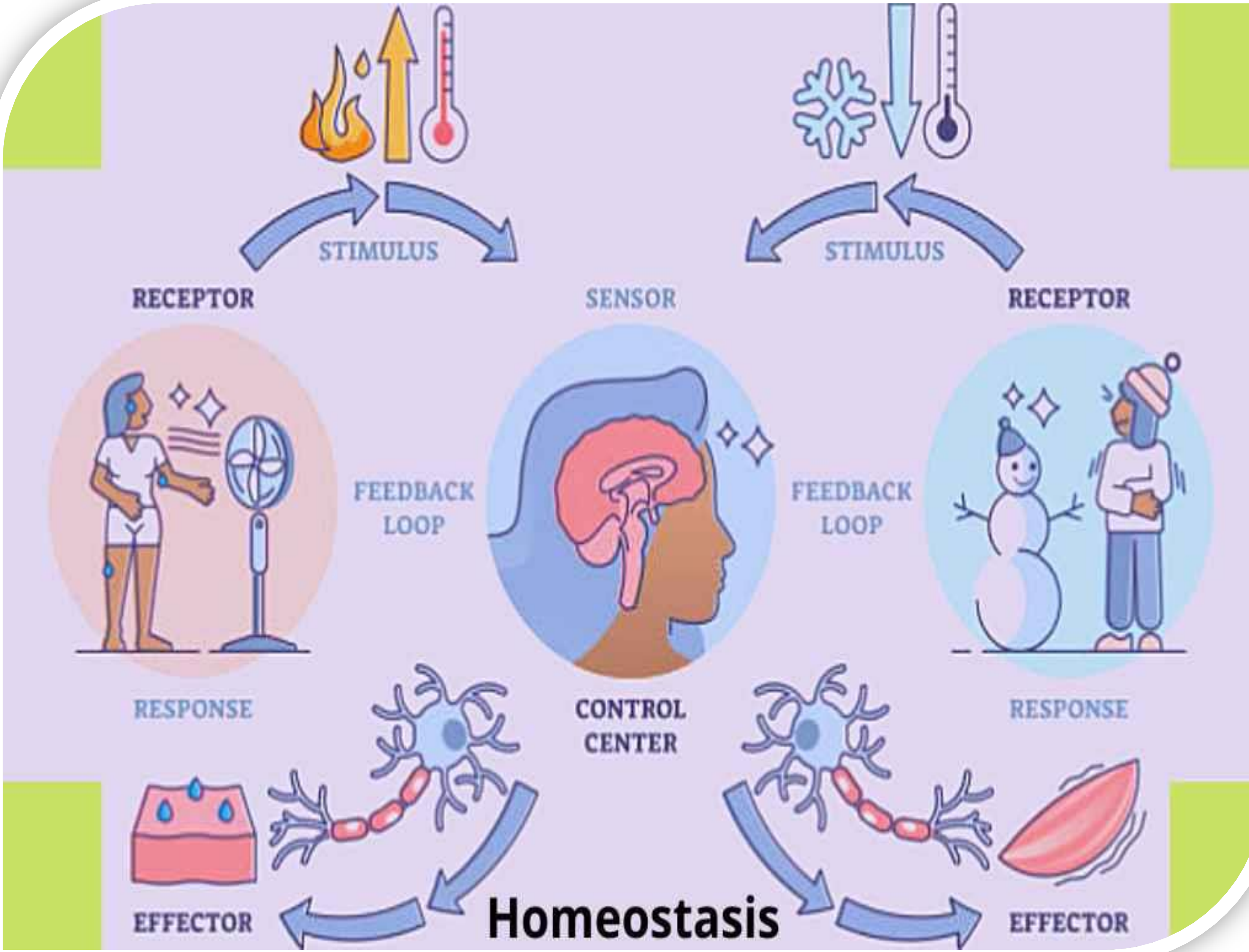
Control center

The control center is also known as the integration center. It receives and processes information from the receptor.

Effector

The effector responds to the commands of the control center. It could either oppose or enhance the stimulus.

An Example of Homeostasis in Action	
Receptor	Cutaneous receptors of the skin.
Control center	Brain
Effector	Blood vessels and sweat glands in the skin
The skin has receptors that detect changes in temperature. If the external temperature rises or drops below the equilibrium, the control center sends signals to the blood vessels and sweat glands in our skin to react accordingly. If the temperature is too hot, the blood vessels dilate (vasodilation) and cause a drop in the body temperature. Moreover, sweat glands produce sweat to accompany vasodilation. If the external temperature is too cold, the blood vessels constrict (vasoconstriction) and enable the body to retain heat.	



Homeostasis

Homeostasis Breakdown

The failure of homeostasis function in an internal environment will result in illnesses or diseases. In severe cases, it can even lead to death and disability.

Many factors can affect homeostasis. The most common are:

- **Genetics**
- **Physical condition**
- **Diet and nutrition**
- **Venoms and toxins**
- **Psychological health**
- **Side effects of medicines and medical procedures**

Examples of Homeostasis

- Blood glucose homeostasis.
- Blood oxygen content homeostasis.
- Extracellular fluid pH homeostasis.
- Plasma ionized calcium homeostasis.
- Arterial blood pressure homeostasis.
- Core body temperature homeostasis.
- The volume of body water homeostasis.
- Extracellular sodium concentration homeostasis.
- Extracellular potassium concentration homeostasis.
- Blood partial pressure of oxygen and carbon dioxide homeostasis.

Glucose Homeostasis: the balance of insulin and glucagon to maintain blood glucose .

Regulation of glucose in the body is done autonomically and constantly throughout each minute of the day. Normal BG levels should be between 60 and 140 mg/dL in order to supply cells of the body with its required energy.

Too little glucose, called hypoglycemia, and too much glucose (hyperglycemia). Euglycemia, or blood sugar within the normal range, is naturally ideal for the body's functions. A delicate balance between hormones of the pancreas, intestines, brain, and even adrenals is required to maintain normal BG levels.

The Role of Insulin

Insulin is a peptide hormone made in the beta cells of the pancreas that is central to regulating carbohydrate metabolism in the body. After a meal, insulin is secreted into the bloodstream.

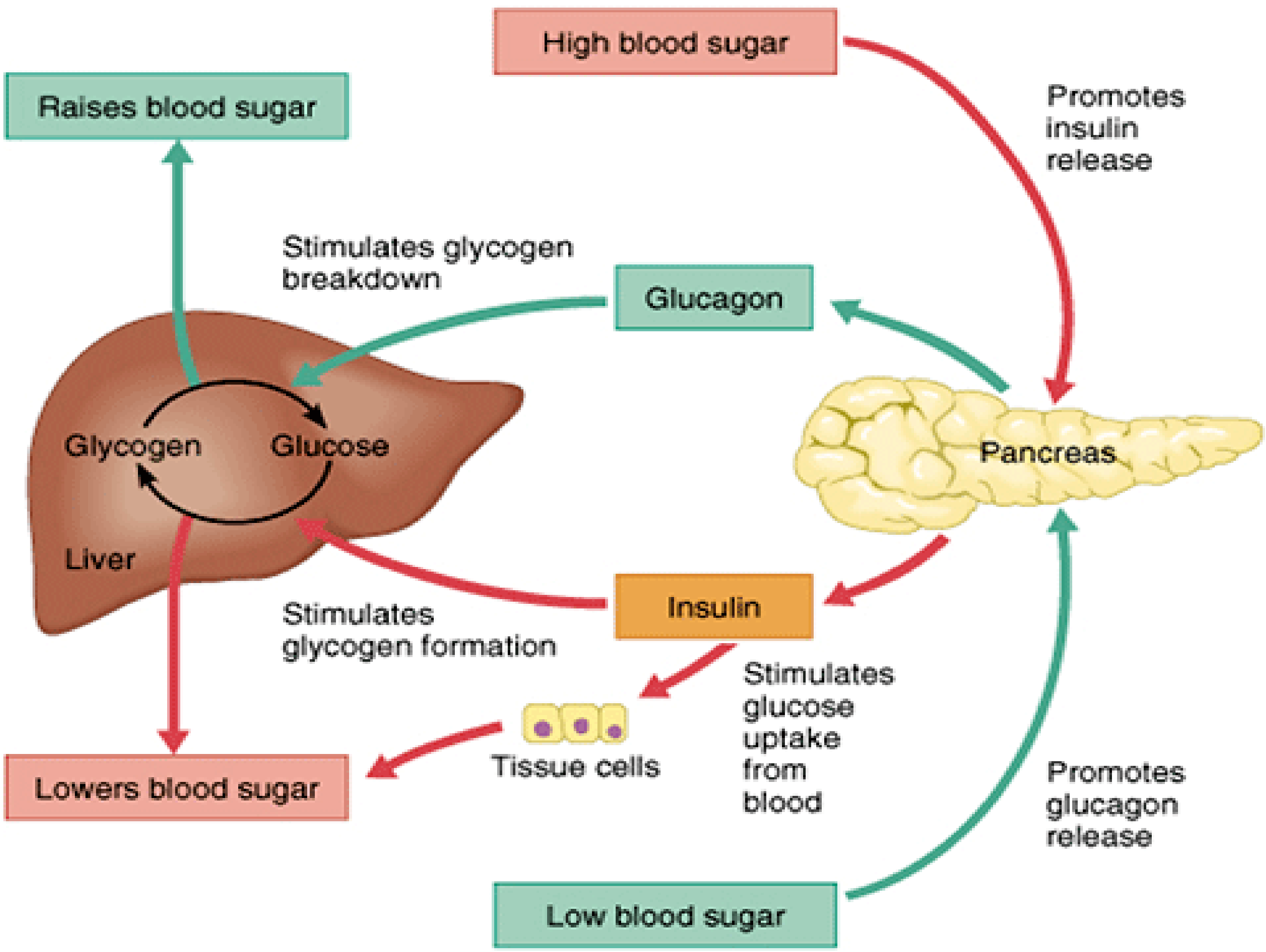
When it reaches insulin-sensitive cells—liver cells, fat cells, and striated muscle—insulin stimulates them to take up and metabolize glucose. Insulin synthesis and release from beta cells is stimulated by rising concentrations of blood glucose. Insulin has a range of effects that can be categorized as anabolic, or growth-promoting.

The Role of Glucagon

Glucagon, a peptide hormone secreted by the pancreas, raises blood glucose levels. Its effect is opposite to insulin, which lowers blood glucose levels. When it reaches the liver, glucagon stimulates glycolysis, the breakdown of glycogen, and the export of glucose into the circulation. In these ways, the effects of glucagon are catabolic, breaking down cells—the opposite of insulin's anabolic effects.

The pancreas releases glucagon when glucose levels fall too low. Glucagon causes the liver to convert stored glycogen into glucose, which is released into the bloodstream.

Complementary Roles of Insulin and Glucagon



Thermoregulation refers to how the body maintains its internal temperature. If your body temperature becomes too cold or hot, it may lead to severe symptoms and even death.

Thermoregulation is a process that allows your body to maintain its core internal temperature. All thermoregulation mechanisms help return your body to homeostasis. This is a state of equilibrium.

Hypothalamus is a section of your brain that controls thermoregulation. When the hypothalamus senses internal temperature becoming too low or high, it sends signals to your muscles, organs, glands, and nervous system. They respond in various ways to help return your temperature to its typical levels.

Internal body temperature

A typical internal body temperature falls within a narrow window. The average person has a baseline temperature between 98°F (37°C) and 100°F (37.8°C). Your body has some flexibility with temperature. However, getting to the extremes of body temperature can affect your body's ability to function.

For example, if your body temperature falls lower than 96°F (35°C)Trusted Source or lower, you have hypothermia. This condition can lead to cardiac arrest, brain damage, or even death.

You can experience heat stroke if your body temperature rises above 104°F (40°C)Trusted Source. Heat stroke is considered a medical emergency. If your body temperature rises to high, you can experience brain damage or even death.

Many factors can affect body's temperature, such as spending time in cold or hot weather.

Factors that can raise your internal temperature include:

- fever
- exercise
- digestion

Factors that can lower your internal temperature include:

- drug use
- alcohol use
- metabolic conditions, such as an under-functioning thyroid gland

If the body needs to cool down, these mechanisms include:

Sweating: Sweat glands release sweat, which cools your skin as it evaporates. This helps lower your internal temperature.

Vasodilatation: The blood vessels under the skin get wider. This increases blood flow to your skin where it is cooler — away from warm inner body. This lets your body release heat through heat radiation.

If the body needs to warm up, these mechanisms include:

Vasoconstriction: The blood vessels under the skin become narrower. This decreases blood flow to the skin, retaining heat near the warm inner body.

Thermogenesis: the body's muscles, organs, and brain produce heat in various ways. For example, muscles can produce heat by shivering.

Hormonal thermogenesis: Thyroid gland releases hormones to increase the metabolism. This increases the energy of the body creates and the amount of heat it produces.