First Year B. Pharmacy (Sem I)

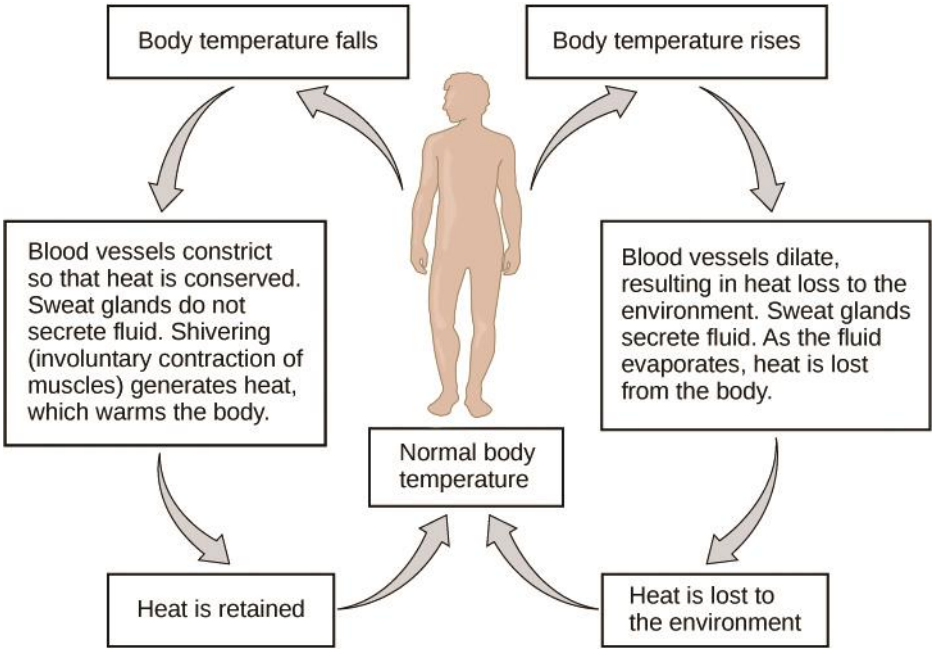
Subject: - Human Anatomy and Physiology-I

Topic :- Introduction to Homeostasis

- **Definition of Homeostasis**
  - The body's ability to maintain a stable internal environment despite external changes.
  - Critical for sustaining life and proper function of cells, tissues, and organs.
- **Importance of Homeostasis**
  - Allows for optimal functioning of enzymes and cellular processes.
  - Maintains physiological variables like body temperature, blood pH, glucose levels, and ion concentrations.
- **Examples of Homeostatic Conditions**
  - Body Temperature (thermoregulation)
  - Blood Glucose Levels
  - Blood Pressure
  - Oxygen and Carbon Dioxide levels in the blood
- **Key Components of a Homeostatic System**
  - **Receptor (Sensor):** Detects changes in a particular variable.
  - **Control Center:** Often in the brain, processes information and sends instructions.
  - **Effector:** Executes the response to bring conditions back to normal

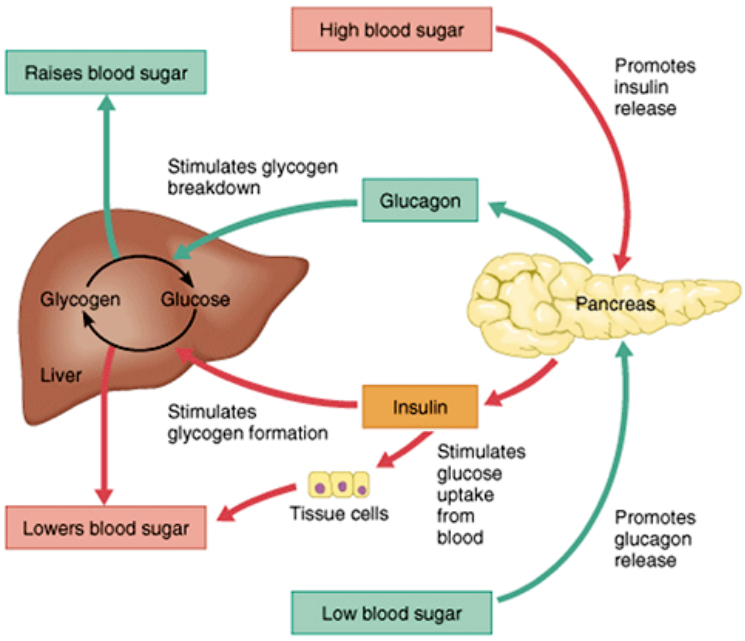
Homeostatic Mechanisms – Negative Feedback

- **Definition of Negative Feedback**
  - The most common homeostatic mechanism, where a change in a variable triggers a response that counteracts the initial fluctuation.
  - Helps to reduce the effect of changes, returning the system to a set point.
- **Detailed Example 1: Thermoregulation (Body Temperature Control)**
  - **Receptor:** Temperature sensors in the skin and hypothalamus detect changes.
  - **Control Center:** The Hypothalamus processes information and triggers a response.
  - **Effectors:** Sweat glands (for cooling) or muscles (for shivering) work to maintain optimal body temperature.
  - **How Negative Feedback Works in Thermoregulation:**
    - An increase in body temperature triggers sweating to cool down.
    - A decrease in body temperature triggers shivering to generate heat.



Reference:- Homeostasis and Feedback – Human Biology (tru.ca)

- **Detailed Example 2: Blood Glucose Regulation**
  - **Receptor and Control Center:** Pancreatic cells detect glucose levels and secrete insulin (high glucose) or glucagon (low glucose).
  - **Effector:** Liver and body cells either absorb glucose (via insulin) or release it (via glucagon) to stabilize blood sugar levels.



4. Regulation of Blood Glucose | ATrain Education (atrainceu.com)

Further Examples of Negative Feedback Mechanisms

- **Blood Pressure Regulation**
  - **Receptor:** Baroreceptors in blood vessels detect pressure changes.
  - **Control Center:** Brain processes information and sends signals.
  - **Effector:** Heart and blood vessels adjust to maintain stable pressure.
- **Osmoregulation (Water Balance)**
  - **Receptor:** Osmoreceptors in the hypothalamus detect blood osmolarity.
  - **Control Center:** Hypothalamus and pituitary gland control release of antidiuretic hormone (ADH).
  - **Effector:** Kidneys adjust water reabsorption to balance water levels in the body.
- **Summary of Negative Feedback in Homeostasis**
  - Negative feedback loops are stabilizing mechanisms and crucial for maintaining equilibrium in bodily functions.

Homeostatic Mechanisms – Positive Feedback

- **Definition of Positive Feedback**
  - A less common mechanism where a change in a variable leads to responses that amplify the initial change, often driving processes to completion.
  - Positive feedback loops are typically part of short-term processes rather than continuous adjustments.
- **Example 1: Blood Clotting**
  - **Process:**
    - Injury to a blood vessel triggers the release of clotting factors.
    - Each clotting factor activates others in a cascade, amplifying the response to form a clot.
    - The process stops once the vessel is sealed, demonstrating a controlled positive feedback loop.
- **Example 2: Childbirth (Labor Contractions)**
  - **Receptor:** Stretch receptors in the cervix detect pressure from the baby's head.
  - **Control Center:** The hypothalamus signals the pituitary gland to release oxytocin.
  - **Effector:** Oxytocin intensifies uterine contractions, increasing pressure and stimulating further release of oxytocin until birth occurs.

Comparing Negative and Positive Feedback in Homeostasis

- **Comparing Characteristics of Negative vs. Positive Feedback**
  - Negative Feedback: Reduces change; stabilizing; more common; example – temperature control.
  - Positive Feedback: Amplifies change; destabilizing in the short term; helps drive processes to completion; example – blood clotting.
- **Significance of Each Type of Feedback**
  - **Negative Feedback:** Ensures continuous homeostatic balance, protecting against extreme fluctuations.
  - **Positive Feedback:** Essential for processes that need a decisive, self-amplifying outcome, like childbirth.
- **Final Summary and Integration**
  - Homeostasis relies primarily on negative feedback for stability but uses positive feedback selectively for special physiological processes.
  - Maintaining homeostasis is a dynamic, continuous process requiring intricate coordination across bodily systems.
- **Diagram (Optional):** Flowchart of a negative feedback loop (e.g., blood glucose regulation) vs. a positive feedback loop (e.g., childbirth), showing how each loop operates in sequence