Student Knowledge and Skills - Human Body

The student understands that...

- there is a relationship between structure and function in living systems.
- physical and chemical changes occur in the digestive system.
- digestion breaks larger molecules into smaller molecules.
- energy transformations occur within organisms.
- body systems change in response to internal and external stimuli to maintain equilibrium.

Essential Questions

- How is structure and function related in human body system?
- What are the major functions of the human body systems?
- How do physical and chemical changes in matter in the digestive system compare?
- How does the digestive system break down large molecules into smaller molecules?
- How do energy transformations occur within organisms?
- How does the human body respond to external and internal stimuli in order to maintain homeostasis?

I. Body Systems

Circulatory and Respiratory Systems – working together to take in oxygen and transport it to the cells; then removing wastes such as carbon dioxide.

A. Circulatory system
   - Structures: Heart, blood, and blood vessels
   - Function:
     a) Moves oxygen and nutrients to the cells and removes carbon dioxide and other wastes
     b) White blood cells/immune response

B. Respiratory system
   - Structures: Nose, trachea, lungs, diaphragm
   - Function:
     a) Provides oxygen to the body through breathing
        Breathing – physical process of moving air into and out of the lungs
        Respiration – chemical process of releasing energy from glucose in the cells
     b) Exchange of oxygen and carbon dioxide

Notes:
Respiratory System – Alveoli—where exchange of gases with the blood occurs: CO2 is released from red blood cells and O2 is picked up.

Digestive and Excretory Systems – working together to take in food and nutrients and to get rid of wastes.

C. Digestive system
   - Structures:
     Mouth, esophagus, stomach, small intestine, large intestine, gall bladder, liver, pancreas, rectum
   - Function:
     a) Intake of food
     b) Mechanical and chemical breakdown of food into smaller molecules the body can absorb into the cells, digestion
Mechanical digestion – breaking down of food into smaller pieces
Chemical digestion – breaking large molecules into smaller molecules that can be taken into the cells. Liver makes bile, gall bladder secretes bile, and pancreas secretes enzymes for digestion

c) Absorption of nutrients into the circulatory system through the small intestine
d) Elimination of unusable remains of food as solid waste

Physical changes in the digestive system
a) Mechanical digestions of food in the mouth, teeth crushing and grinding food into smaller pieces
b) Muscle contractions in the stomach churn and mix food
c) Bile breaking fats into tiny droplets of fat
d) Peristalsis throughout the digestive system, pushing and squeezing food

Chemical changes in the digestive system
a) Digesting food – pancreatic juices break down carbohydrates, fats or proteins into simple substances so that enzymes can also chemically react with them to break them down further
b) pH changes in the stomach
c) The breakdown of large molecules into smaller molecules in the digestive system is a chemical change.

Digesting a carbohydrate means breaking down the large starch molecules into smaller sugar molecules

Background:
a) Carbohydrates are large molecules made of carbon, hydrogen and oxygen.
b) Digestion of carbohydrates starts with saliva in the mouth. Salivary amylase is an enzyme that begins the process of breaking the starch into a simple sugar. In the small intestine pancreatic amylase and maltase break the starch molecule down into glucose molecules.
c) Enzyme lactase breaks down milk sugar,
d) Enzyme sucrase breaks down table sugar.
e) Proteins are digested in the stomach and small intestine. Hydrochloric acid and the enzyme pepsin split the protein’s polypeptide chains into smaller polypeptides. Pancreatic enzymes in the small intestine break the polypeptides into small molecules called amino acids.
f) Fats are digested in the small intestine. Bile produced by the liver physically breaks fat into smaller fat droplets because fat is insoluble in water. The enzyme lipase breaks down the fat into fatty acids and glycerol.

D. Excretory system
- Structures:
  Kidneys, bladder
  – lungs and skin assist in the removal of toxins and wastes
- Function:
  a) Remove wastes produced by the activities of cells that have been filtered through the bloodstream
  b) Removes toxic nitrogen waste
  c) Maintains water balance (homeostasis)

Skeletal and Muscular Systems – working together in order for the body to be able to move.

E. Skeletal System
- Structures:
  a) Bones, in general, cartilage, and joints
  b) Connective tissue (tendons and ligaments)
- Functions:
  a) Provides shape and support for the body
b) Protects the internal organs  
c) Provides a frame for the muscles so the body can move  
d) Produces blood cells in the marrow and stores nutrients  

F. **Muscular System**  
- **Structures:**  
  Muscles: skeletal, smooth, and cardiac tissue that can relax and contract  
  - **Voluntary** – muscles that you control  
  - **Involuntary** – muscles that you cannot consciously control  
- **Function:**  
  Working in pairs, muscles allow the body to move  

G. **Integumentary System**  
- **Structures:**  
  Skin, hair, and nails  
- **Function:**  
  a) Provides the body with a protective covering  
  b) Helps the body regulate temperature  
  c) Helps the body excrete waste  
  d) Serves the body as a sensory organ  

H. **Nervous System** – functions as message center for the body transmitting information throughout the body.  
- **Structures:**  
  a) Brain, neurons (nerves), spinal cord  
  b) Sense organs – eyes, ears, nose, tongue, skin  
- **Function:**  
  a) Controls and coordinates the body’s activities  
  b) Coordination of responses to internal and external stimuli  
  c) Sense organs detect external stimuli and respond by transmitting nerve impulses to the brain, which provides stimuli to body organs to respond in ways to maintain homeostasis.  

I. The **immune system** is a good way to connect all of the systems together and with response to stimuli.  
- **Immune System**  
  - **Structures:**  
    White blood cells  
  - **Function:**  
    a) Prevent and fight infection  
    b) Barriers – skin, breathing passages, mouth and stomach chemicals  
    - **Inflammatory response**  
    - **Immune response**  

J. The **Endocrine system** is the message center for the body transmitting information throughout the body.  
- **Structure:**  
  a) Glands- where hormones (chemical messengers) are produced  
  b) Pituitary-produces growth hormone and controls other glands  
  c) Thyroid-regulates metabolism  
  d) Pancreas-regulates blood sugar levels
e) Adrenals - prepared bodies for emergencies, regulates metabolism, controls salt, and water balance, regulates blood pressure.

f) Testes (affects male traits) and Ovaries (affects female traits)

- **Function:**
  
a) Coordination with the nervous system to maintain homeostasis

b) Make hormones to affect the function of other body organs and systems.

II. Define homeostasis and equilibrium in terms of organisms and the human body

**Homeostasis** – an organism or cell’s constant adjustment to maintain stable conditions within itself, despite changes in its environment.

- State of balance maintained by metabolic adjustments to internal and external stimuli.
- Teach response to stimuli in combination with body systems.

Examples -
- **Stimulus:** infection  
  **Response:** Fever
- **Stimulus:** viral or bacterial infection  
  **Response:** Vomiting
- **Stimulus:** cells need energy  
  **Response:** Hunger

c) Negative feedback mechanisms

d) To maintain body temperature

- Shivering
- Sweating
- Panting

e) To maintain blood sugar levels

Glucose levels controlled with insulin

f) Make connections to the nervous system

The response to external stimuli could be a behavioral or physical response.

Example -
- **Stimulus:** temperature  
  **Behavioral Response:** sunning or burrowing
- **Stimulus:** temperature  
  **Physical Response:** shivering, sweating or panting

III. Compare the functions of a cell to the functions of organisms such as waste removal

**Functions of cells and organisms to compare:**

- extracting energy from food to sustain life  
  • waste removal  
  • homeostasis
- response to environment  
  • growth  
  • reproduction

**Organisms require structures** to meet their needs for obtaining, transforming, transporting, and removing the matter and energy used to sustain the organism.

- **Cells** have organelles to perform these functions
- Some cells specialize to become parts of tissues and organs that perform these functions for an organism

**Identify cell organelles that perform the function for the cell that organ systems perform for an organism**

- obtaining matter – vacuoles and cell membranes – digestive system
- transforming energy – chloroplasts or mitochondria – coordination of respiratory, circulatory, and digestive systems
- transporting matter – cytoplasm – circulatory system
- removing waste – vacuoles and cell membranes – excretory system