Introduction to Physiology

Physiology is the study of the functions of living things. Specifically, we will focus on how the human body works.

physiology can be considered at many levels.

Cell physiology examines the processes occurring in cells, and **systemic physiology** considers the functions of organ systems. **Neurophysiology** focuses on the nervous system, and **cardiovascular physiology** deals with the heart and blood vessels.

Physiology focuses on mechanisms of action.

Two approaches are used to explain events that occur in the body; one emphasizes the *purpose* of a body process and the other emphasizes the underlying *mechanism* by which this process occurs. In response to the question "Why do I shiver when I am cold?" one answer would be "to help my body warm up, because shivering generates heat." This approach, which explains body functions in terms of meeting a bodily need, emphasizes *why* body processes occur.

A physiologist's explanation of shivering is that when temperature sensitive nerve cells detect a fall in body temperature, they signal the area in the brain responsible for temperature regulation. In response, this brain area activates nerve pathways that ultimately bring about involuntary, oscillating muscle contractions

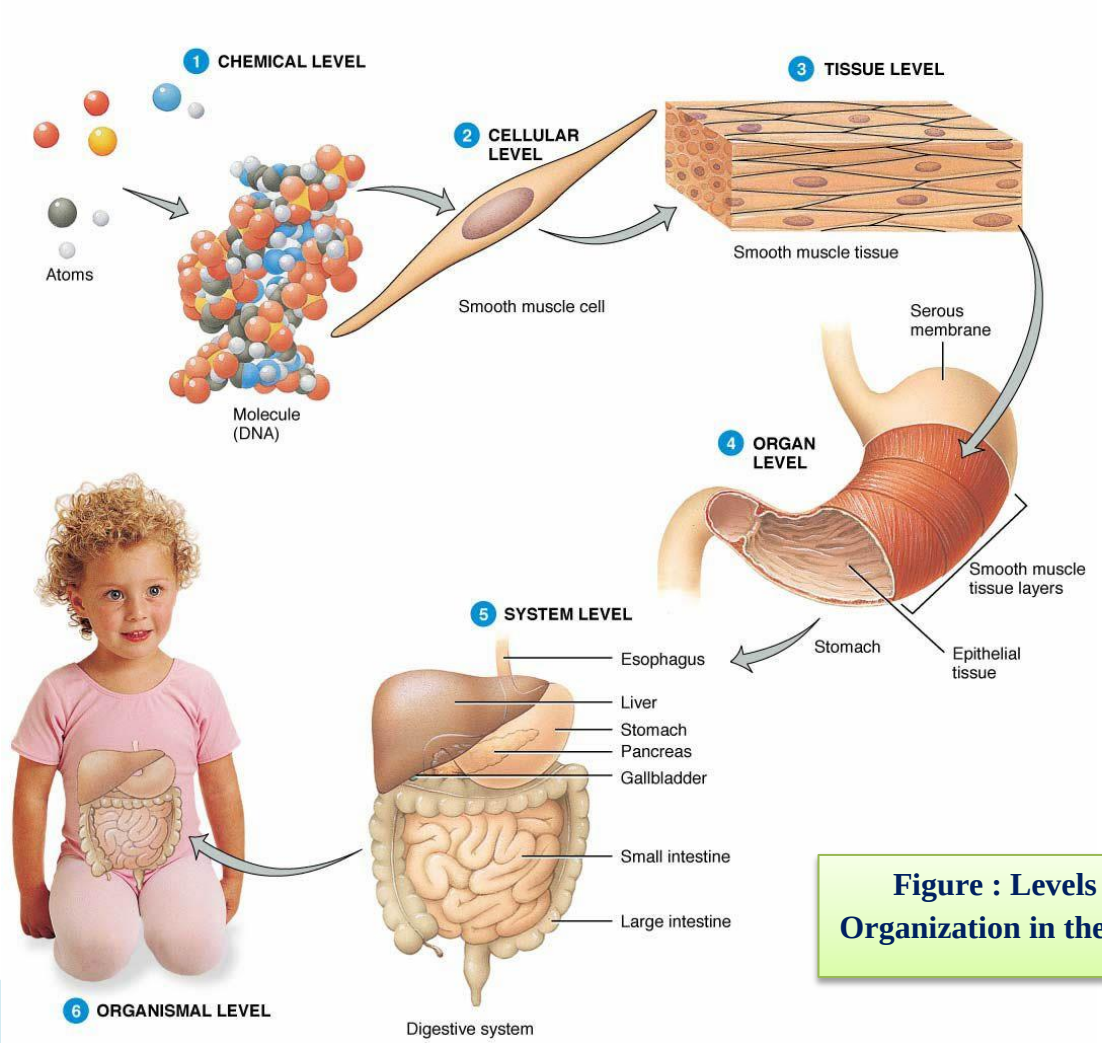

Figure : Levels of Organization in the Body

Levels of Organization in the Body

We now turn to how the body is structurally organized into a total functional unit, from the chemical level to the whole body

1- The chemical level: Various atoms and molecules make up the body.

Like all matter, both living and nonliving, the human body is a combination of specific *atoms*, which are the smallest building blocks of matter. The most common atoms in the body— oxygen, carbon, hydrogen, and nitrogen—make up approximately 96% of the total body chemistry. These common atoms and a few others combine to form the *molecules* of life, such as proteins, carbohydrates, fats, and nucleic acids (genetic material, such as deoxyribonucleic acid, or DNA).

2- The cellular level: Cells are the basic units of life.

The **cell**, the fundamental unit of both structure and function in a living being, is the smallest unit capable of carrying out the processes associated with life.

3- The tissue level: Tissues are groups of cells of similar specialization.

Cells of similar structure and specialized function combine to form **tissues**, of which there are four *primary types:* **muscle, nervous, epithelial, and connective** tissue .

4- The organ level: An organ is a unit made up of several tissue types.

Organs consist of two or more types of primary tissue organized to perform particular functions. The stomach, an example of an organ, is made up of all four primary tissue types .

5- The body system level: A body system is a collection of related organs.

Groups of organs are further organized into **body systems**. Each system is a collection of organs that perform related functions and interact to accomplish a common activity essential for survival of the whole body.

For example, the digestive system consists of the mouth, pharynx (throat), esophagus, stomach, small intestine, large intestine, salivary glands, exocrine pancreas, liver, and gallbladder. These digestive organs cooperate to break food down into small nutrient molecules that can be absorbed into the blood for distribution to all cells.

The human body has 11 systems: circulatory, digestive, respiratory, urinary, skeletal, muscular, integumentary, immune, nervous, endocrine, and reproductive

6- The organism level: The body systems are packaged into a functional whole body.

Each body system depends on the proper functioning of other systems to carry out its specific responsibilities. The whole body of a multicellular organism consists of the various body systems structurally and functionally linked as an entity that is separate from its surrounding environment.

Cells are the highly organized, living building blocks of the body. A cell has three major parts: the **plasma membrane**, which encloses the cell; the **nucleus**, which houses the cell's genetic material; and the **cytoplasm**. The cytoplasm consists of the cytosol, organelles, and cytoskeleton. The *cytosol* is a gel-like liquid within which the organelles and cytoskeleton are suspended. *Organelles* are discrete, well-organized structures that carry out specialized functions. Through the coordinated action of these components, every cell performs certain basic functions essential to its survival and a specialized task that helps maintain homeostasis. Cells are organized according to their specialization into body systems that maintain the stable internal environment essential for the whole body's survival. All body functions ultimately depend on the activities of the individual cells that make up the body.

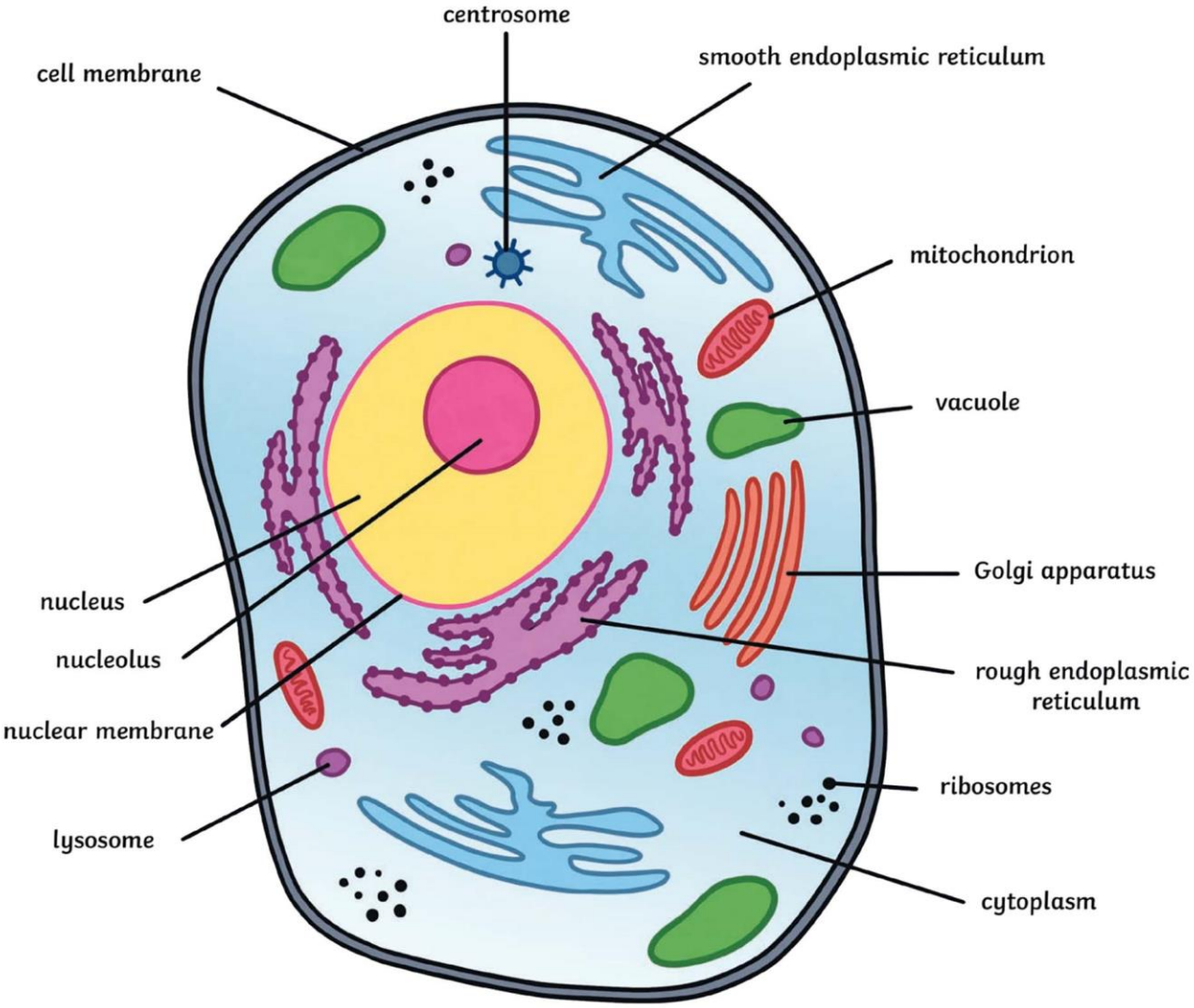

Figure : Human cell

Homeostasis

The cells in a multicellular organism cannot live and function without contributions from the other body cells because most cells are not in direct contact with the external environment. The **external environment** is the surrounding environment in which an organism lives. The **internal environment** is the fluid that surrounds the cells and through which they make life-sustaining exchanges.

The fluid collectively contained within all body cells is called **intracellular fluid (ICF)**. The fluid outside the cells is called **extracellular fluid (ECF)**. Note that the ECF is outside the cells but inside the body. Thus, the ECF is the internal environment of the body. You live in the external environment; your cells live in the body's internal environment.

ECF is made up of two components: the **plasma**, the fluid portion of the blood, and the **interstitial fluid**, which surrounds and bathes the cells (*inter* means "between"; *stitial* means "that which stands") .

Maintenance of a relatively stable internal environment is termed **homeostasis** (*homeo* means "similar"; *stasis* means "to stand or stay").

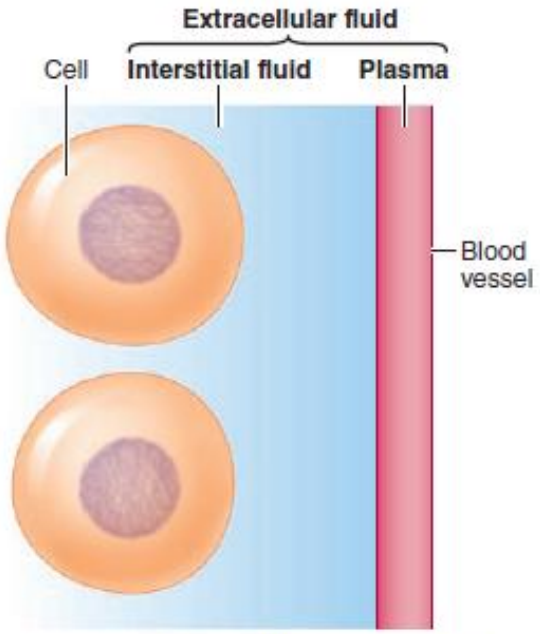

Figure 1-6 Components of the extracellular fluid (internal environment).

Homeostatically Regulated Factors

Many factors of the internal environment must be homeostatically maintained. They include the following:

1. ***Concentration of nutrients***. Cells need a constant supply of nutrient molecules for energy production. Energy, in turn, is needed to support life-sustaining and specialized cell activities.

2. ***Concentration of O2 and CO2***. Cells need O2 to carry out energy-yielding chemical reactions. The CO2 produced during these reactions must be removed so that acid-forming CO2 does not increase the acidity of the internal environment.

3. ***Concentration of waste products***. The end products of some chemical reactions have a toxic effect on body cells if these wastes are allowed to accumulate.

4. ***pH***. Changes in the pH of the ECF adversely affect nerve cell function and wreak havoc with the enzyme activity of all cells.

5. ***Concentrations of water, salt, and other electrolytes***. Because the relative concentrations of salt (NaCl) and water in the ECF influence how much water enters or leaves the cells, these concentrations are carefully regulated to maintain the proper volume of the cells. Cells do not function normally when they are swollen or shrunken.

6. ***Volume and pressure***. The circulating component of the internal environment, the plasma, must be maintained at adequate volume and blood pressure to ensure body wide distribution of this important link between the external environment and the cells.

7. ***Temperature***. Body cells function best within a narrow temperature range. If cells are too cold, their functions slow down too much; if they get too hot, their structural and enzymatic proteins are impaired or destroyed.