Animal physiology-lecture (1)

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Introduction

Physiology (**physio**- =nature; **-logy** =study of) is the science of body functions-how the body parts work. **Animal physiologists** study the structure and function of the various parts of an animal, and how these parts work together to allow animals to perform their normal behaviors and to respond to their environments. One hallmark of animal physiology is **diversity**. Despite this great diversity, there are many commonalities within physiology—unifying themes that apply to all physiological processes.

First of all, physiological processes obey physical and chemical laws.

Second, physiological processes are regulated to maintain internal conditions within acceptable ranges. This internal constancy; known as **homeostasis**.

Third, the physiological state of an animal is part of its **phenotype**, which arises as the product of the genetic makeup, or **genotype**, and its interaction with the environment.

Fourth, the genotype is a product of **evolutionary change** in a group of organisms—populations or species—over many generations.

As a result, there are even more specialties in physiology than in anatomy, which includes:

1. **Cell physiology:** This is the cornerstone of human physiology; it is the study of the functions of cells. It deals with events at the chemical and molecular levels.
2. **Special physiology:** this is the study of the physiology of special organs. For example, renal physiology is the study of kidney function.

3. **Systemic physiology:** includes all aspects of the function of specific organ systems; cardiovascular physiology (functional changes associated with disease and aging), respiratory physiology (Function of the air passageways and lungs) and reproductive physiology are examples of systemic physiology.
4. **Pathophysiology:** is the study of the effects of diseases on organ or system functions or functional changes associated with disease and aging.

Also there are several branches of physiology such as: **Neurophysiology** (functional properties of nerve cells), **Endocrinology physiology** (study of hormones [chemical regulators in the blood] and how they control body functions), **Immunology physiology** (study of body's defenses against disease causing-agents), and **Exercise physiology** (study the changes in cell and organ functions due to muscular activity)…..etc.

The levels of organization

There are different levels of organization (figure 1):

The chemical or molecular level: Atoms, the smallest stable units of matter, can combine to form molecules with complex shapes. To study the chemical level of organization, scientists consider the **simplest** building blocks of matter: **subatomic** particles, atoms and molecules. Atoms are made up of **subatomic** particles such as the proton, electron and neutron. Two or more atoms combine to form a molecule, such as the water molecules, proteins, and sugars found in living things. Molecules are the chemical building blocks of all body structures.

The cellular level: Molecules can interact to form organelles, such as the protein filaments found in muscle cells. Each type of organelle has specific functions. Cells are the smallest living units in the body, and organelles are their structural and functional components. It's independently functioning unit of a living organism. **Cell** is defined as the structural and functional unit

of the living body. A human cell typically consists of flexible membranes that enclose cytoplasm, a water-based cellular fluid together with a variety of tiny functioning units called **organelles**. In humans, as in all organisms, cells perform all functions of life. And **each cell in the body:**

1. Needs nutrition and oxygen,
2. Produces its own energy necessary for its growth, repair and other activities,
3. Eliminates carbon dioxide and other metabolic wastes,
4. Maintains the medium, i.e. the environment for its survival,
5. Shows immediate response to the entry of invaders like bacteria or toxic substances into the body,
6. Reproduces by division. There are some exceptions like neuron, which do not reproduce.

The tissue level: A tissue is a group of cells working together to perform one or more specific functions. Heart muscle cells, or cardiac muscle cells, interact with other cell types and with extra-cellular materials to form muscle tissue. There are many types of tissues in the body. All the tissues are classified into **four** major types which are called the **primary tissues**. **The primary tissues include:**

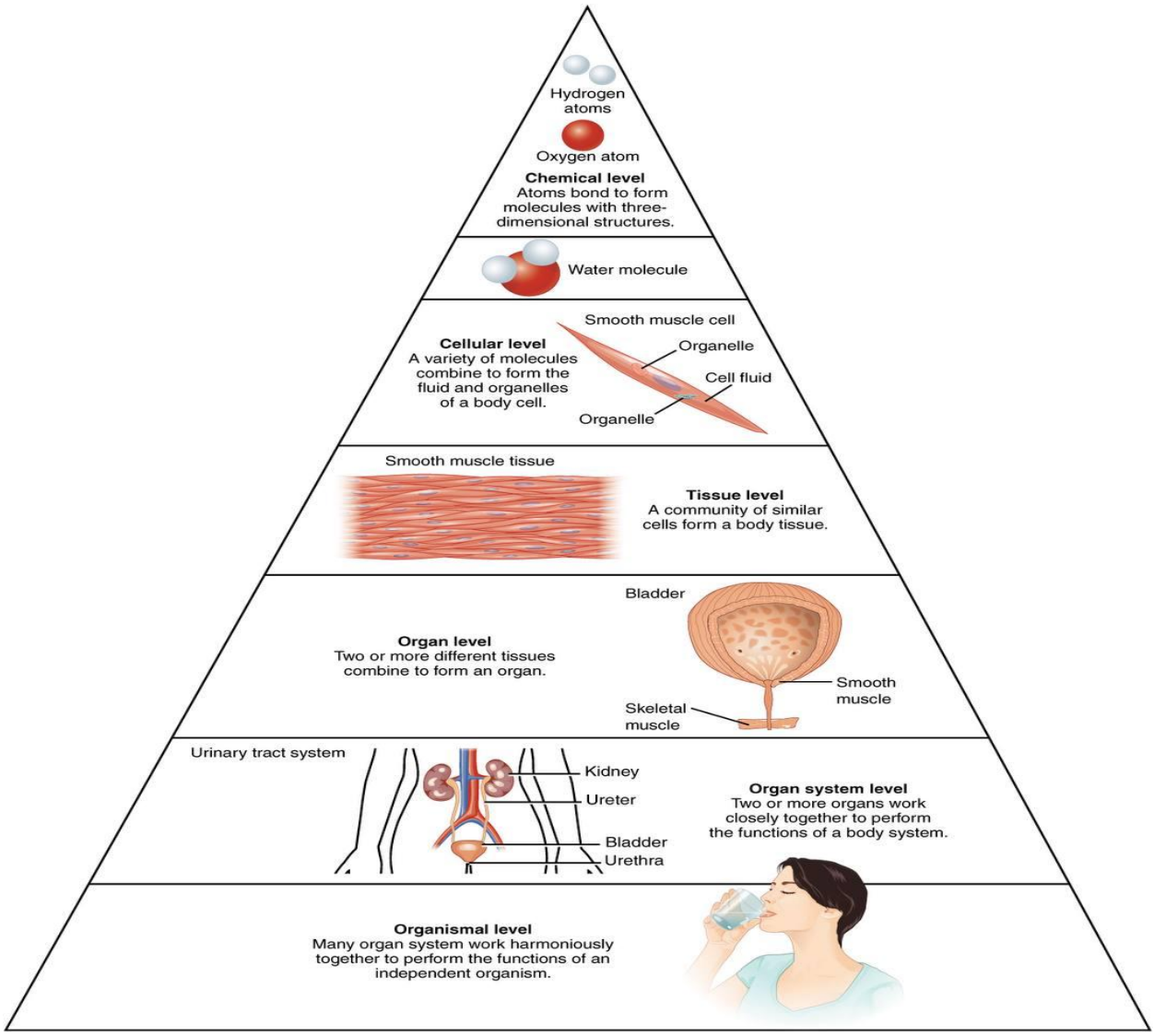
1. **Muscle tissue** (skeletal muscle, smooth muscle and cardiac muscle),
2. **Nervous tissue** (neurons and supporting cells),
3. **Epithelial tissue** (squamous, columnar and cuboidal epithelial cells),
4. **Connective tissue** (connective tissue proper, cartilage, bone and blood).

The organ level: An organ is defined as the structure that is formed by two or more primary types of tissues, which execute the functions of the organ. Some organs are composed of all the **four** types of primary tissues. The organs are of **two** types, namely tubular or **hollow organs** and compact or **parenchymal organs.** Some of the organs in the body are brain, heart, lungs, stomach, intestine, liver, gallbladder, pancreas, kidneys, endocrine glands, etc.

The organ system level: An **organ system** is a group of organs that work together to perform major functions or meet physiological needs of the body. Each system performs a specific function. Digestive system is concerned with digestion of food particles. Assigning organs to organ systems can be imprecise since organs that ―belong‖ to one system can also have functions integral to another system. In fact, most organs contribute to more than one system. Organs interact in organ systems. **These systems have been characterized as follows:**

A. **Support, movement, and protection**.
B. **Integration and coordination**.
C. **Maintenance of the body**.
D. **Reproduction and development**.

Figure 1: Levels of Structural Organization of the Human Body



The organism level: All organ systems of the body work together to maintain life and health. This brings us to the highest level of organization, that of the organism – in this case, a human being. The organism level is the highest level of organization. An **organism** is a living being that has a cellular structure and that can independently perform all physiologic functions necessary for life.

Each human being begins as a **single cell**, a fertilized egg, which divides to create two cells, each of which divides in turn to result in four cells, and so on. During development, however, each cell becomes specialized for the performance of a particular function, such as producing force and movement or generating electrical signals. The process of transforming an unspecialized cell into a specialized cell is known as **cell differentiation**, the study of which is one of the most exciting areas in biology today. Cell differentiation is the process of cells becoming specialized as they body develops. When cells are classified according to the broad types of function they perform, however, **four major categories emerge:**

1. Muscle cells,
2. Neurons or nerve cells,
3. Epithelial cells, and
4. Connective cells.

Differentiated cells with similar properties aggregate to form **tissues**. Corresponding to the four general categories of differentiated cells, **there are four general types of tissues:**

1. Muscle tissue (allows the body to move),
2. Nervous tissue (propagate information),
3. Epithelial tissue (act as coverings controlling the movement of materials across the surface), and
4. Connective tissue (integrates the various parts of the body and provides support and protection to organs).

All cells and tissues in the body derive from **three** germ layers in the embryo: the ectoderm, mesoderm, and endoderm.