Biology Reviewer

Animal Form and Functions (Overview)

When you look at stories from **Philippine mythologies** (yes, plural), you will see similarities across the regions. A creator god or gods crafting the world out of loneliness or due to conflict; humans carved from the earth or descending down to earth, otherwise originating from bamboo shoots or other plants; divinities that are neither male nor female but can and may also be both; concepts which share notions with other mythologies around the world and yet are unique and distinct as being our own.

Myths that are passed on, often told as stories, with their plot taking shape and developing a pattern through generations serve another function: preserving the culture. In a similar way, **the form of any living organism tells us of how and why they function or how they came to be the way they are now, in the present.**

When discussing structure and function, biologists distinguish *anatomy* from *physiology*. The former deals with the organism's structures; the latter studies the functions of those structures. In previous lessons, we understood that life follows a hierarchical organization.

As a review, ***cells*** are the basic structural units of life. When cells come together and share a common function, ***tissues*** are formed. When two or more tissues perform a specific task, an ***organ*** is formed. Multiple organs that together perform one or more vital body functions compose an ***organ system***. And so, because living beings are composed of these different organ systems, we are referred to as an ***organism,*** and this also forms the final level of this hierarchy.

Types of Animal Tissues.

Just as different fabrics are woven from different materials, specialized body parts are constructed from varied combinations of limited sets of cells and tissue types.

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1. Epithelial tissues.

Epithelial tissues or *epithelia* are sheets of closely packed cells that cover the surface of the body and line the internal organs and cavities. The closely-knit cells form a protective barrier but may still allow fluid exchange on the other side. The side of the epithelium which faces the outside environment or the inside of a tube or passageway is referred to as the **apical surface**.

Epithelial tissues are named according to the number of cell layers or the shape of the cells on their apical surface: **simple epithelium** has a single layer of cells while multiple layers make up a **stratified epithelium**. Based on shape, the cell can be **squamous** (flat and looks like fried eggs), **cuboidal** (like dice), or **columnar** (brick-like). The combination of the number of layers and cell shapes tells us of their function.

For example, a simple squamous epithelium is thin and leaky, so it allows the exchange of materials through diffusion. This type can be seen lining the capillaries and the air sacs of the lungs. Cuboidal and columnar epithelial cells have larger cytoplasm, and often function for secretion or absorption of materials. The many layers of a stratified squamous epithelium make it well suited for areas subject to abrasion, that is why they compose our outer skin, and they also regenerate rapidly as new cells form near the extracellular matrix and move towards the apical surface while older cells are sloughed off.

2. Connective tissues.

Connective tissues are cells scattered throughout a matrix. The cells produce and secrete the matrix which usually consists of a web of fibers embedded in a liquid, jelly, or solid. Six major types of connective tissues form our body:

- **Loose connective tissues** are the most widespread in the body and are made up of a matrix with a loose weave of fibers suspended in a watery fluid. Many of the fibers are made of collagen while others are elastic, making the tissue resilient as well as it is strong. This tissue binds epithelia to underlying tissues and holds organs in place.
- **Fibrous connective tissues** have a matrix made up of densely packed collagen, and this maximizes strength. This tissue forms our tendons, which attach to bone, and ligaments, which connect bones at joints.
- **Adipose tissue** stores fat in large, closely packed adipose cells held in a very sparse matrix of loose fibers and fluid. This tissue pads and insulates the body as well as stores energy in the form of fat.
- **Cartilage** forms a strong but flexible skeletal material. Its matrix is made from collagen fibers embedded in a rubbery material. Cartilages commonly surround the ends of

bones, providing shock-absorption; support the ears and nose; and lastly, provide cushioning disks between our vertebrae.
- **Bone** is made up of collagen fibers embedded in a hard mineral substance made of calcium, magnesium, and phosphate. This combination of materials makes our bones strong without being brittle.
- **Blood** transports substances throughout the body and thus functions differently from other connective tissues. Its matrix is called the plasma and suspended in it are the different types of blood cells.

3. Muscle tissues.

Muscle tissues are the most abundant in nearly all animals. It's made of long cells called muscle fibers, each having contractile proteins. Muscle tissues can be classified as follows:

- **Skeletal muscles** are attached to bones by tendons and are responsible for voluntary movements of the body. The cells are arranged in a way that they appear striped or *striated*.
- **Cardiac muscles** are the contractile tissues of the heart. It is striated like the skeletal muscle but it is involuntary or cannot be consciously controlled. Cardiac muscles are branched, interconnected at special junctions called *intercalated disks* that help relay signals to contract from cell to cell during a heartbeat.
- **Smooth muscles** lack striations. They are found in the walls of the digestive tract, arteries, and other internal organs. They are responsible for involuntary body activities such as the movement of food in the digestive system.

4. Nervous tissues.

Nervous tissues sense stimuli and help transmit information. They are found in the brain, spinal cord, and the nerves throughout the body.

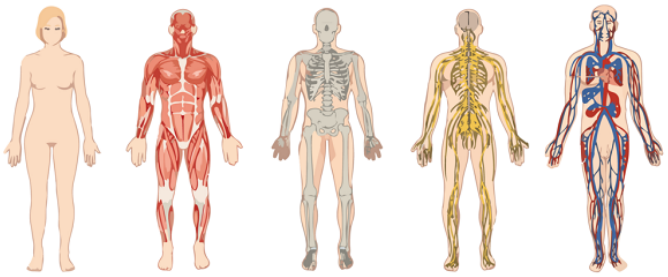
The structural unit of the tissue is a nerve cell, or a **neuron**, which is specialized for conducting electric nerve impulses. A neuron is composed of a **cell body**, which contains the nucleus and other organelles; and extensions that may receive a nerve impulse from other neurons, referred to as the dendrite, or those that transmit signals to other neurons, referred to as **axons**, or effector cells such as muscle cells that respond to the stimuli.

In the next topic, we will have an overview of the different organ systems these tissues form.

Organs and Organ Systems.

An organ represents a higher level of structure than the tissues composing it, and it performs functions that none of its components can carry out alone. These functions emerge from the coordination between the tissues. Just as it takes several different tissues to build an organ, it requires the integration of organs into organ systems to perform the functions of the body.

Remember that the ability of the organ systems to carry out life's functions is a result of the properties stemming from the organization, interaction, and coordination of all the body's organ systems working together. Here is an overview of the 11 different organ systems in the human body and the functions they perform:



1. Integumentary System.

The **integumentary system** protects against physical injury, infection, excessive heat or cold, and drying out.

2. Digestive System.

The **digestive system** ingests and digests food, absorbs nutrients, and eliminates undigested food material.

3. Respiratory System.

The **respiratory system** is responsible for exchanging gases with the environment, supplying the blood with O_2, and disposing of CO_2.

4. Circulatory System.

The **circulatory system** delivers oxygen (O_2) and nutrients to the cells of the body and transports carbon dioxide (CO_2) to the lungs and metabolic wastes to the kidneys.

5. Immune System.

Although technically not an organ system, the **immune system** functions in defending against infections and cancer.

6. Lymphatic System.

The **lymphatic system** returns excess body fluids to the circulatory system and functions as part of the immune system.

7. Urinary System.

The **urinary system** removes waste products from the blood and excretes urine. It also regulates the chemical and water balance of the blood.

8. Endocrine System.

The **endocrine system** secretes hormones that regulate body activities, thus maintaining homeostasis.

9. Reproductive System (and the Embryonic Development).

The **reproductive system** produces the sex cells and sex hormones with the female system supporting the developing embryo and producing milk.

10. Nervous System.

The **nervous system** coordinates body activities by detecting stimuli, integrating information, and directing responses.

11. Musculoskeletal System (Muscular and Skeletal Systems).

The **skeletal system** supports the body and protects the organs. It provides a framework for muscle movement. On the other hand, the **muscular system** moves the body, maintains posture, and produces heat.