

## PROPERTIES OF LIFE

- Adaptation
- Growth and Development
- Homeostasis
- Metabolism
- Order
- Regulation
- Reproduction
- Sensitivity or response to stimuli

## ORDER

Living organisms can be organized into different levels e.g. Atoms are organized into molecules, molecules into organelles, and organelles into cells.

- Cell
- Tissue
- Organ
- Organ system
- Organism

## CELLS

It is the basic unit of structure and function of all living things. All living things are made of cells. A Cell is the smallest fundamental unit of structure and function in living organisms. Cells are made of small structures that exist within them called Organelles. These organelles carry out crucial functions e.g. ribosomes, mitochondria and chloroplasts.

- Mitochondria produce energy to power the cell i.e. the powerhouse of the cell
- Chloroplasts enable green plants to utilize the energy in sunlight to make sugars (Photosynthesis).
- Ribosomes are the sites of protein synthesis.

## TYPES OF CELLS

There are two types of cells:

- Prokaryotes- are single-celled microorganisms e.g. Archaea, Bacteria and Cyanobacteria, Amoeba, Paramecium and diatoms.
- Eukaryotes- are characterized by possession of true nucleus e.g. Plants, Fungi, Protozoans, and Animals.

## TISSUE

Group of cells of the same kind and function, which all work together performing similar functions e.g. xylem, the lining of the lungs, muscle, the lining of the intestine. Tissues are absent from unicellular organisms. Tissues are classified into two types - Plant and Animal Tissues.

**Plant Tissues:** In plants, the tissues mainly give structural support to the plant, because plants are stationary e.g.

- Dermal tissue - this forms the outer coverings of plants.
- Vascular tissue - moves water and nutrients through the plant.

- Ground tissue - this makes up most of the plants' bodies and performs the majority of bodily functions, e.g. photosynthesis.

**Animal tissue:** Large multicellular animals are made up of four basic tissue types e.g.

- Epithelial tissue: e.g. skin surface, the lining of your small intestine.
- Connective tissue: e.g. bone, ligaments, tendons, fat and other soft padding tissue.
- Muscle tissue: there are 3 main types of muscle: e.g. skeletal muscle, cardiac muscle, and smooth muscle.
- Nervous tissue: consists of 2 main types of cells: neurons or nerve cells, and glial cells or neuroglia. E.g. nerves, nervous tissues of the brain and spinal cord

## ORGAN

These are structures composed of one or more types of tissues. They are structures made up of two or more tissues organized to work together to carry out a specific function. Plants have vegetative and reproductive organs that help to sustain the life of the plant e.g. roots, stem and leaves, and facilitate reproduction either sexual or asexual e.g. cones, flowers and fruits, respectively. Animal organs include the skin, lung, heart, brain, stomach, kidney, liver. Some of the uses of organs in the human body are:

- Food is broken down in the **stomach**.
- The **heart** pumps blood.
- The **brain** controls thoughts, memory and other organs. It is the most important and essential organ in the human body and it controls all the other parts of the body.
- The **liver** eliminates poisons from the blood, synthesizes protein and aids in the digestion process.
- The **lungs** separate oxygen from the air and remove carbon dioxide from the blood.
- The **adrenal glands** discharge hormones in the body in response to pressure and stress.
- Kidneys filter urine
- Urine is collected in the **bladder**.
- **Gallbladder** or **cholecyst** stores the bile that is produced in the liver and aids in the digestion process.
- **Pituitary glands** or **master glands** produces the homeostatic process hormones.
- During pregnancy, the baby develops in the **uterus**. The uterus also provides basic integrity and support to the pelvic organs, bladder and bowel.

## Organ system

These are groups of organs that work together to perform a certain function. Groups of organs with related functions make up the different organ systems. Examples of organ systems in animals includes the following:

**The Circulatory system** involves:

- Cardiovascular - Transports oxygen, nutrients, and other substances to the cells. It removes waste products. It can also help stabilize body temperature and pH.
- Lymphatic - Returns tissue fluid to blood, Defends the organism against infection and disease.

The Digestive System, which is the food processor, absorbs nutrients, minerals, vitamins, and water into the body.

**The Respiratory system** carries oxygen into the body and gets rid of carbon dioxide. It comprises the larynx, lungs, mouth, nose, pharynx and trachea.

**The Endocrine system** aids in growth, homeostasis, metabolism and sexual development. It exudes and handles hormones and hormonal function. The main parts include pineal gland, thyroid gland, thymus, ovaries and testes.

**The Integumentary system** serves as a barrier to invading organisms and chemicals, protects from injury and fluid loss, controls Temperature.

**The Skeletal system** provides support and moves the body, Protects internal organs, stores minerals, and produces blood cells.

**The Muscular system** is involved in locomotion and heat production and provides support.

**The Nervous system** responds to sensations, Collects, transfers and processes information and coordinates activities of other organ systems.

**The Urinary system** is in charge of the elimination of wastes from the blood and body. It also regulates pH and volume of blood.

**The Reproductive system** produces germ cells (eggs and sperm) and sex hormones. In females, it provides the environment for growth of the fetus.

**The Immune system** defends against microbial pathogens and other diseases.

#### **Organ systems and Organs, tissues, structures involved:**

**Circulatory system** has two divisions: The Cardiovascular division which consists of the Heart, blood, and blood vessels. The Lymphatic division which consists of the Lymph, lymph nodes and lymph vessels.

**Digestive system:** The organs, tissues and structures involved are Mouth, rectum, salivary glands, esophagus, stomach, liver, gallbladder, exocrine pancreas, small intestine and large intestine.

**Endocrine system:** The organs, tissues and structures involved are Pituitary, pineal, thyroid, parathyroid, endocrine pancreas, adrenals, testes, and ovaries.

**Integumentary system:** The organs, tissues and structures involved are Skin, sweat glands, hair and nails.

**Muscular system:** The organs, tissues and structures involved are Skeletal, cardiac and smooth muscles.

**Nervous system:** The organs, tissues and structures involved are Brain, spinal cord, nerves, and sensory organs—eyes, ears, tongue, skin and nose

**Reproductive system:** The organs, tissues and structures involved are classified into two due to gender. The Male reproductive organs which consists of the testes, vas deferens, seminal vesicles, scrotum, penis and prostate. The Female reproductive organs which consists of the vagina, ovary, uterus, Fallopian tubes, and mammary glands.

**Respiratory system:** The organs, tissues and structures involved are Mouth, nose, pharynx, larynx, trachea, bronchi, lungs, and diaphragm.

**Skeletal system:** The organs, tissues and structures involved are Bones, cartilage, joints, tendons, and ligaments.

**Urinary system:** The organs, tissues and structures involved are Kidneys, ureters, urinary bladder, and urethra.

**Immune system:** The organs, tissues and structures involved are Leukocytes, tonsils, adenoids, thymus, and spleen.

## **METABOLISM**

Metabolism is the entirety of the physical and chemical processes that take place in an organism whereby its material substance is produced, maintained, and destroyed, and by which energy is made available for use. It is a biochemical process (enzyme-catalyzed reactions) that allows an organism to live, grow, reproduce, heal, maintain its structures and adapt to its environment. It is a set of processes that all living things use to maintain their bodies i.e. life sustaining chemical reactions.

The 3 main purposes of metabolism

- Conversion of food to energy to run cellular processes.
- Conversion of food substances to building blocks for proteins, lipids, nucleic acids, and some carbohydrates.
- Removal of metabolic wastes.

The 2 metabolic processes or phases

Based on their functions, metabolism can be grouped into two types – Catabolism and Anabolism

- Catabolism – catabolic reactions break down complex molecules (e.g. glycogen, proteins, and triglycerides) into smaller molecules or monomers thereby releasing energy which is available for use. E.g. of catabolic processes are Citric acid cycle, Glycolysis, Lipolysis, Oxidative deamination, Muscle tissue breakdown. Breakdown of triglycerides into fatty acids, proteins to amino acids, glycogen into glucose, Hydrolysis are all catabolic processes.
- Anabolism or Biosynthesis – anabolic reactions build molecules the body needs to function. They are sequences of enzyme-catalyzed reactions. Anabolism provides the substances required for cellular growth and repair. Anabolism usually requires energy, i.e. uses energy for completion. The formation of polypeptides from amino acids, fatty acids forming triglycerides, glucose forming glycogen, Dehydration synthesis are anabolic processes.

### **Differences Between Catabolism and Anabolism**

- Catabolism involves breaking down big complex molecules into smaller, easier to absorb molecules while Anabolism involves building molecules required for the body's functionality.
- Catabolism involves the release of energy while Anabolism involves the use of energy.
- Hormones involved in Catabolism are adrenaline, cytokine, glucagon, and cortisol while Hormones involved in Anabolism are estrogen, testosterone, growth hormones and insulin.
- Anabolic exercises, which are often anaerobic in nature, generally build muscle mass while Catabolic exercises are usually aerobic and good at burning fat and calories.
- During Catabolism, potential energy is changed into kinetic energy while during Anabolism kinetic energy is converted into potential energy.
- Catabolism is required to perform different activities in living entities while Anabolism is required for maintenance, growth, and storage.