BIO 101: DIVERSITY, CLASSIFICATION AND CHARACTERISTICS OF ANIMALS

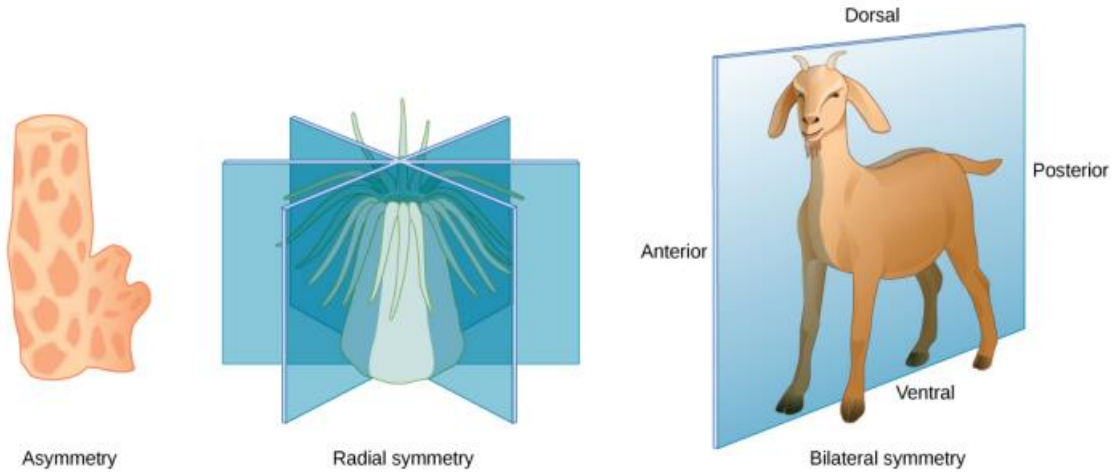
Animals are multicellular, heterotrophic, eukaryotes with tissues that develop from embryonic layers. In the unicellular group and animals, five distinct groups are recognized.

1. **Protoplasmic:** Protoplasmic grade of organization–characterizes unicellular organisms. All life functions are confined within the boundaries of a single cell, the fundamental unit of life. Within a cell, protoplasm is differentiated into organelles capable of performing specialized functions. e.g.., *Paramecium, Amoeba* etc.
2. **Cellular:** Cellular grade of organization is an aggregation of cells that are functionally differentiated. A division of labour is evident, so that some cells are concerned with, for example, reproduction, and others with nutrition. Some flagellates, such as *Volvox,* that have distinct somatic and reproductive cells are placed at the cellular level of organization e.g., Volvox,
3. **Cell-Tissue:** Cell–tissue grade of organization–an aggregation of similar cells into definite patterns or layers and organized to perform a common function, to form a tissue. Sponges are considered by some authorities to belong to this grade, although jellyfish and their relatives (Cnidaria) more clearly demonstrate the tissue plan. Both groups are still largely of the cellular grade of organization because most cells are scattered and not organized into tissue e.g., Jellyfish.
4. **Tissue-organ:** Tissue-organ grade of organization is an aggregation of tissues that form organs in a further step in complexity. Organs are usually composed of more than one kind of tissue and have a more specialized function than tissues. This is the overall organizational level of flatworms (Platyhelminthes), that possess well-defined organs such as eyespots, proboscis, and excretory organs. In flatworms, the reproductive structures are organized into a system that is characteristic of the next level of organizational complexity. e.g., Planaria.
5. **Organ-System:** Organ-system grade of organization-organs working together to perform some function, producing the highest level of organization-an organ system. Systems are associated with basic body functions such as circulation, respiration, and digestion. The simplest animals having this type of organization are nemertean worms, which have a complete digestive system distinct from the circulatory system. Most animal phyla demonstrate this type of organization. e.g., Crabs, Worms, Arthropods, Dogs, Mollusc etc.,

Animal Body Plan: This is referred to as the body symmetry i.e., the arrangement of the body structure in relation to size and shape.

Radial Symmetry: This applies to forms that can be divided into similar halves by more than two planes passing through the longitudinal axis, as might be achieved when slicing a pie. These are tubular, vase, or bowl shapes found in some sponges, hydras, jellyfish, sea urchins, and related groups, in which one end of the longitudinal axis is usually the mouth (the oral surface). Many radial animals are sessile (living attached to a substrate) or planktonic (drifting or weakly swimming.

Bilateral symmetry: applies to animals that can be divided along a sagittal plane into two mirrored portions-right and left halves. The appearance of bilateral symmetry in animal evolution was a major innovation because bilateral animals are much better fitted for directional (forward) movement than radially symmetrical animals. This is associated with Cephalization i.e., differentiation into **Head** with nerves. Bilateral animals typically move actively from place to place. Most bilateral animals have a central nervous system that enables them to coordinate the complex movements involved in crawling, burrowing, flying, or swimming.



Animals exhibit different types of body symmetry. The (a) sponge is asymmetrical and has no planes of symmetry, the (b) sea anemone has radial symmetry with multiple planes of symmetry, and the (c) goat has bilateral symmetry with one plane of symmetry.

TISSUES: Recall that tissues are collections of specialized cells that act as functional units. Sponges and a few other groups lack tissues. In all other animals, the embryo becomes layered during gastrulation. As development progresses, these layers, called germ layers, form the various tissues and organs of the body.

(a) **Ectoderm:** Ectoderm, the germ layer covering the surface of the embryo, gives rise to the outer covering of the animal and, in some phyla, to the central nervous system.

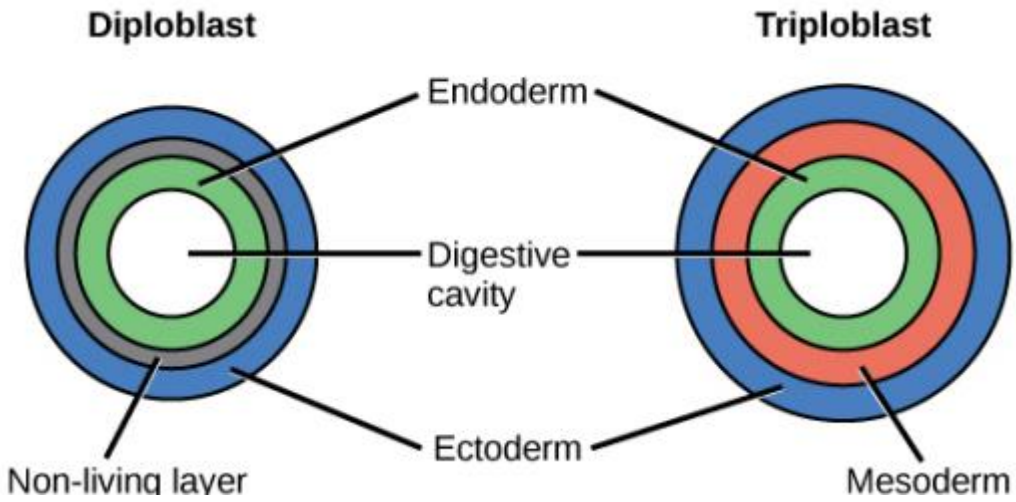
(b) **Endoderm:** the innermost germ layer, lines the pouch that forms during gastrulation (the archenteron) and gives rise to the lining of the digestive tract (or cavity) and to the lining of organs such as the liver and lungs of vertebrates

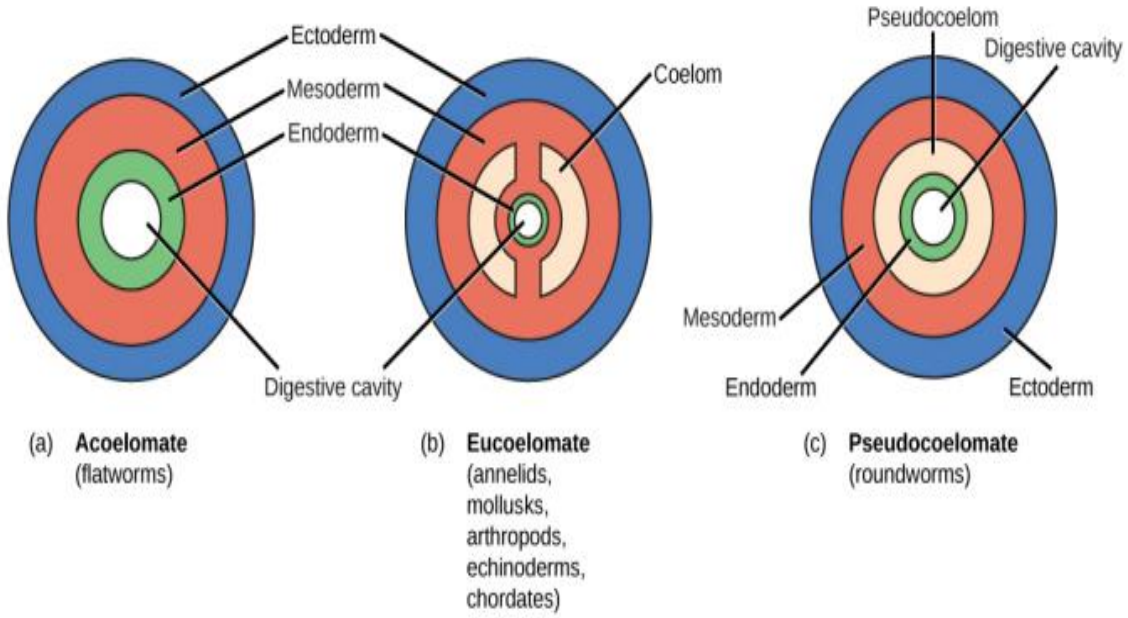
NOTE: Those with two germ layers are called **DIPLOBLASTICS** and **TRIPLOBLASTICS** are those with three germ layers (Ectoderm, Mesoderm and Endoderm). Mesoderm usually forms the muscle in most bilateral organisms.

Most triploblastic animals have a body cavity, a fluid- or air-filled space located between the digestive tract and the outer body wall. This body cavity is also called a coelom (hollow). A so-called "true" coelom forms from tissue derived from mesoderm. The inner and outer layers of tissue that surround the cavity connect and form structures that suspend the internal organs. Animals with a true coelom are known as **coelomates.** Some triploblastic animals have a body cavity that is formed from mesoderm and endoderm Such a cavity is called a "pseudocoelom" e.g., roundworms.

some triploblastic animals lack a body cavity altogether and they are known collectively as acoelomates (without). e.g., molluscs, arthropods, annelids etc.

The general features in life's history of animals include chemical uniqueness; complexity and hierarchical organization; reproduction (heredity and variation); possession of a genetic program; metabolism; development; environmental interaction; and movement.





(a) **Acoelomate** (flatworms)

(b) **Eucoelomate** (annelids, mollusks, arthropods, echinoderms, chordates)

(c) **Pseudocoelomate** (roundworms)

Triploblasts may be acoelomates, eucoelomates, or pseudocoelomates. Eucoelomates have a body cavity within the mesoderm, called a **coelom,** which is lined with mesoderm tissue. Pseudocoelomates have a similar body cavity, but it is lined with mesoderm and endoderm tissue.

GENERAL FEATURES IN ANIMALS

1. **Macromolecules:** Living systems assemble large molecules, known as macromolecules, that are far more complex than the small molecules of non-living matter. These macromolecules are composed of the same kinds of atoms and chemical bonds that occur in the non-living matter and they obey all fundamental laws of chemistry; it is only the complex organizational structure of these macromolecules that makes them unique. There are four major categories of biological macromolecules: nucleic acids, proteins, carbohydrates, and lipids. These categories differ in the structures of their component parts, the kinds of chemical bonds that link their subunits together, and their functions in living systems.

2. **Organization:** In living systems, there is the hierarchy levels that include, in ascending order of complexity, macromolecules, cells, organisms, populations, and species. Each level builds on the level below and has its own internal structure, which is also often hierarchical. Within the cell, for example, macromolecules are compounded into structures such as ribosomes, chromosomes, and membranes, and these are likewise combined in various ways to form even more complex subcellular structures called organelles, such as mitochondria. The organismal level also has a hierarchical substructure; cells combine to form tissues, which combine to form organs, which likewise combine to form organ systems. The appearance of new characteristics at a given level of organization is called emergence, and these characteristics are called emergent properties.

3. Reproduction: Living organisms can reproduce themselves. Life does not arise spontaneously but comes only from prior life, through reproduction. Although life certainly originated from the non-living matter at least once, this origin featured enormously long periods of time and conditions very different from the current biosphere. At each level of the biological hierarchy, living forms reproduce to generate others like themselves. Genes are replicated to produce new genes. Cells divide to produce new cells. Organisms reproduce, sexually or asexually, to produce new organisms. Populations may become fragmented to produce new populations, and species may split to produce new species through a process called speciation. Reproduction at any hierarchical level usually features an increase in numbers. Individual genes, cells, organisms, populations, or species may fail to reproduce themselves, but reproduction is nonetheless an expected property of these individuals. Reproduction at each of these levels shows **heredity** and **variation**. Heredity is the faithful transmission of traits from parents to offspring, usually (but not necessarily) observed at the organismal level. Variation is the production of differences among the traits of different

individuals. The interaction of heredity and variation in the reproductive process is the basis for organic evolution.

4. Possession of a genetic program: Structures of the protein molecules needed for organismal development and functioning are encoded in nucleic acids. For animals and most other organisms, genetic information is contained in DNA. DNA is a very long, linear chain of subunits called nucleotides, each of which contains a sugar phosphate (deoxyribose phosphate) and one of four nitrogenous bases (adenine, cytosine, guanine, or thymine, abbreviated A, C, G, and T, respectively). The sequence of nucleotide bases contains a code for the order of amino acids in the protein specified by the DNA molecule. The correspondence between the sequence of bases in DNA and the sequence of amino acids in a protein is called the **genetic code.**

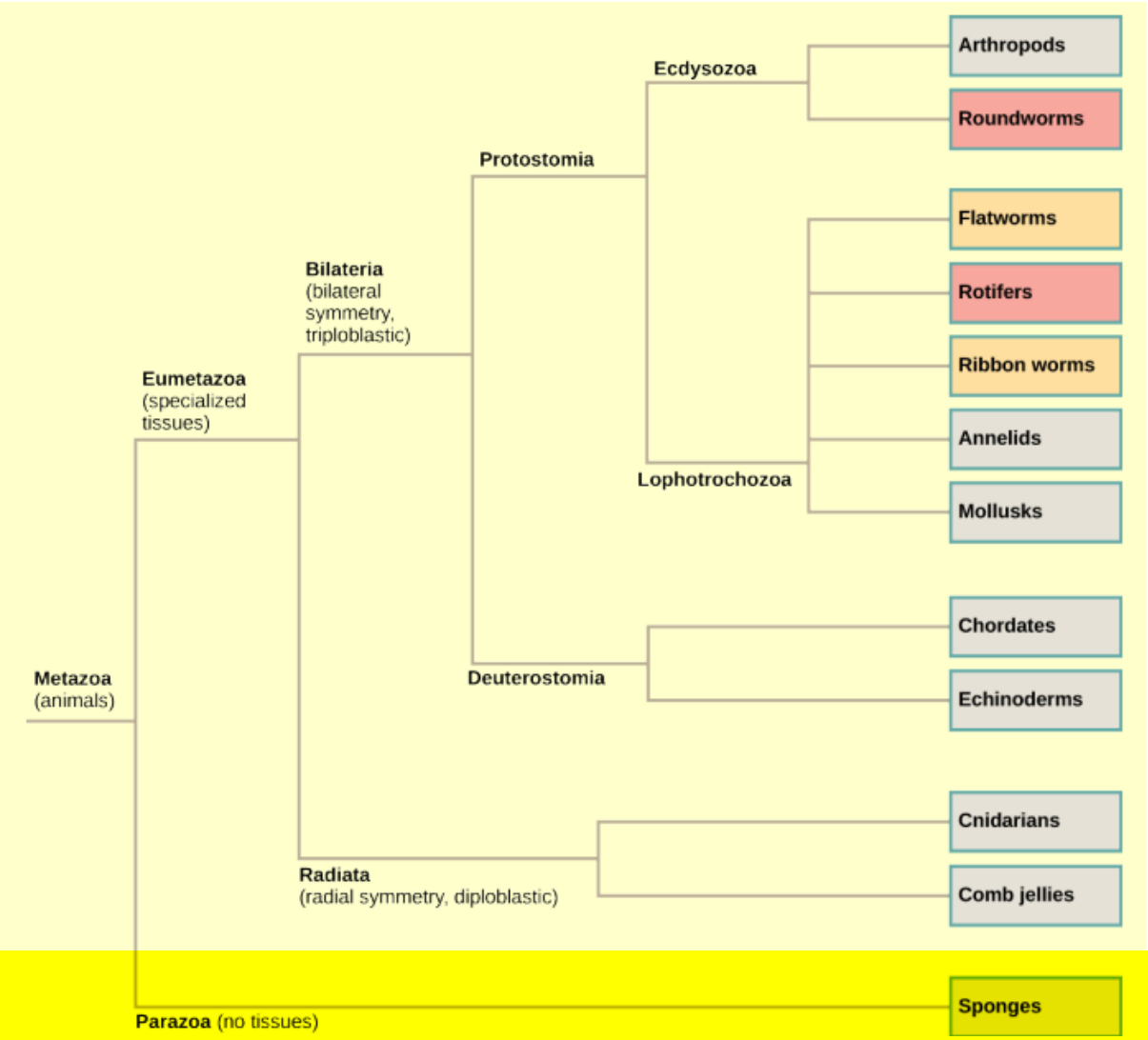
5. Metabolism: Living organisms maintain themselves by acquiring nutrients from their environments. The nutrients are used to obtain chemical energy and molecular components for building and maintaining the living system. They are the essential chemical processes of metabolism They include digestion, acquisition of energy (respiration), and synthesis of molecules and structures. Metabolism is often viewed as an interaction of destructive (catabolic) and constructive (anabolic) reactions. The most fundamental anabolic and catabolic chemical processes used by living systems arose early in the evolutionary history of life, and all living forms share them. These reactions include the synthesis of carbohydrates, lipids, nucleic acids, and proteins and their constituent parts and the cleavage of chemical bonds to recover energy stored in them. In animals, many fundamental metabolic reactions occur at the cellular level, often in specific organelles found throughout the animal kingdom. Cellular respiration occurs, for example, in mitochondria. Cellular and nuclear membranes regulate metabolism by controlling the movement of molecules across the cellular and nuclear boundaries, respectively. The study of complex metabolic functions is called physiology.

6. Development: All organisms pass through a characteristic life cycle. Development describes the characteristic changes that an organism undergoes from its origin (usually the fertilization of an egg by sperm) to its final adult form. Development usually features changes in size and shape, and differentiation of structures within an organism. Even the simplest one-celled organisms grow and replicate their component parts until they divide into two or more cells. Multicellular organisms undergo more dramatic changes during their lives. Different developmental. Stages of some multicellular forms are so dissimilar that they are hardly recognizable as belonging to the same species**. Checkup Metamorphosis.**

7. Environmental interaction: All animals interact with their environments. The study of organismal interaction with an environment is called **ecology**. Of special interest are the factors that influence geographic distribution and abundance of animals. The science of ecology reveals how an organism perceives environmental stimuli and responds in appropriate ways by adjusting its metabolism and physiology. All organisms respond to environmental stimuli, a property called **irritability.**

8. Movement: Living systems and their parts show precise and controlled movements arising from within the system. The energy that living systems extract from their environments permits them to initiate controlled movements. Such movements at the cellular level are essential for reproduction, growth, and many responses to stimuli in all living forms and for development in multicellular ones. On a larger scale, entire populations or species may disperse from one geographic location to another one over time through their powers of movement. Movement characteristic of non-living matter, such as that of particles in solution, radioactive decay of nuclei, and eruption of volcanoes is not precisely controlled by the moving objects themselves and often involves forces entirely external to them. The adaptive and often purposeful movements initiated by living systems are absent from the non-living.

CLASSIFICATION OF ANIMALS



1. Which of the following is not a feature common to most animals? a. development into a fixed body plan b. asexual reproduction c. specialized tissues d. heterotrophic nutrient sourcing

2. Which of the following does not occur? a. radially symmetrical diploblastic b. diploblastic eucoelomate c. protostomic coelomate d. bilaterally symmetrical deuterostome

3. Crustaceans are _____. a. ecdysozoans b. nematodes c. arachnids d. parazoan

4. Diploblastic animals are a. are radially symmetrical b. have true coelom c. are pseudocoelomate d. have a mesoderm e. are duetrostomes

5. All of these animals are protosomes except a. clams b. mosquitoes c. earthworms d. starfish e. squid

TRUE OR FALSE

6. Sponges, jellyfish and flatworms are all classified as eumetazoans

7. In all probability, the original function of the coelom was reproduction

7.