Introduction to Animals

Characteristics of Animals

multicellular

- Except for sponges, animal cells are arranged into **tissues**. Tissues are necessary to produce **organs** and **organ systems**.
- Tissues, organs, and organ systems enabled the evolution of large, multicellular bodies.

Lack cell walls

- A **skeleton** supports the tissues of large animals.

Period of embryonic development occurs

- During embryonic development, cells become specialized and tissues form. The growth of tissues, organs, and organ systems therefore requires a period of embryonic development.

Heterotrophs

- Heterotrophs consume their organic food. Except for sponges, they ingest food and digest it in a central cavity.

Motile

- Heterotrophy often requires motility to capture prey.
- Animals have motility during at least some part of their life cycle.

Nervous and Muscle tissue present (except sponges)

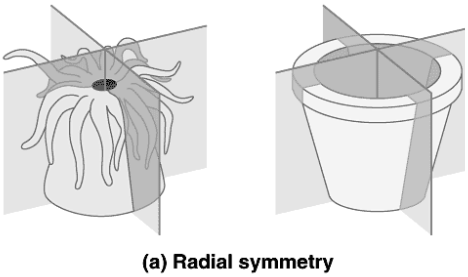
- Muscle tissue allows animals to move. Nervous tissue allows rapid intercellular communication and enables coordinated movement and response to stimuli.

Diploid

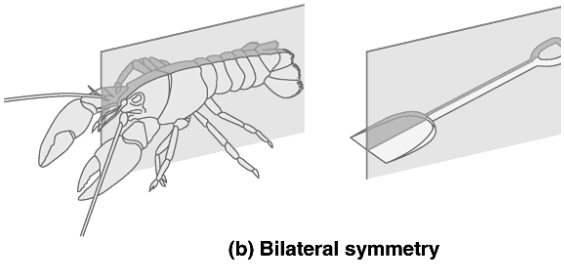
- Their gametes are different sizes; eggs are larger than sperm and they are haploid
- The sperm are flagellated.
- Gametes are produced by meiosis.
- The development of some animals includes one or more larval stages. The term **larvae** refers to immature individuals of species in which the body form of the immature individuals (the larvae) is very different than the body form of the adult. Because larvae and adults have different forms, they often eat different food and may live in different habitats. Larvae are transformed into adults by a developmental process called **metamorphosis.**

Symmetry

Types of Symmetry



(a) Radial symmetry



(b) Bilateral symmetry

i. Radial Symmetry

The body parts of a radially symmetrical animal are arranged around a central axis so that each part extends from the center. The animal can be cut along the axis in more than one plane to produce identical halves. Animals that exhibit radial symmetry tend to be sessile (immobile). Radial symmetry allows them to reach out in all directions.

ii. Bilateral Symmetry

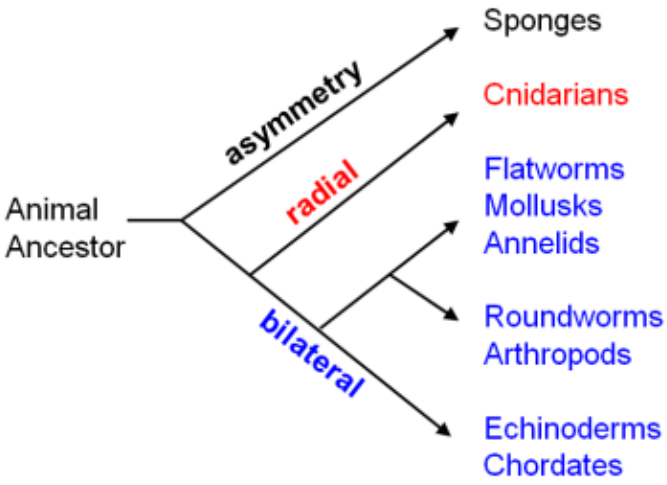
Only one cut along the longitudinal axis will produce identical halves of a bilaterally symmetrical animal. Bilateral symmetry is best for motile animals.

iii. Asymmetry

Asymmetrical animals have no pattern of symmetry. The simplest animals (sponges) are asymmetrical.

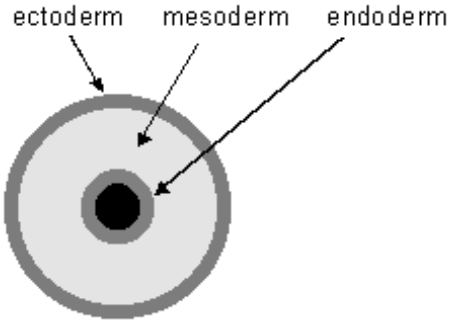
Evolution of Symmetry

Sponges lack symmetry, and Cnidarians exhibit radial symmetry. The remainder of the phyla listed below have bilateral symmetry.



BODY PLAN

Embryonic Germ Layers



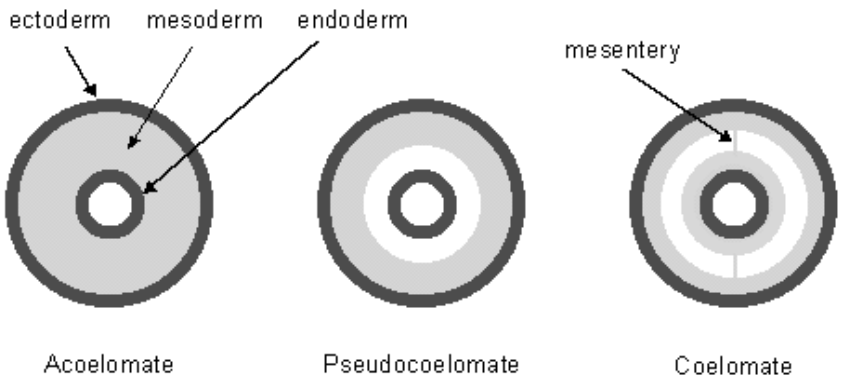
- The three layers of tissues that become established during early embryonic development are called **germ layers**. They give rise to the body tissues. These layers are **ectoderm, mesoderm**, and **endoderm**.
- This diagram shows a cross section of an animal embryo
- The **ectoderm** forms from the outer layer of cells. It gives rise to the **skin and nervous system**.
- The cells that formed the tube-like structure in the gastrula (see the diagram above) are **endoderm**. These cells will form the lining of the gut and the organs derived from the gut.
- **Mesoderm** forms between the ectoderm and endoderm. It becomes the muscles, connective tissues, skeleton, kidneys, circulatory and reproductive organs

Body Cavity

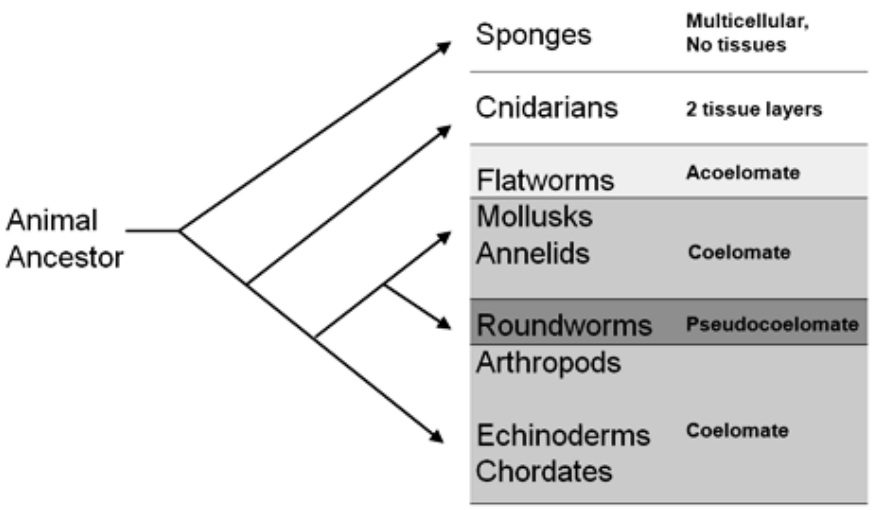
The body cavity is a **fluid-filled space** that separates the gut and internal organs from the rest of the body.
It isolates the internal organs from body-wall movements.
It also bathes the internal organs in a liquid through which nutrients and wastes can diffuse.

Arrangement of Ectoderm, Mesoderm, and Endoderm

- An **acoelomate** animal does not have a body cavity.
- A **pseudocoelomate** animal has a body cavity (called a pseudocoelom) located between endoderm and mesoderm (mesoderm is only on one side).
- The body cavity of a **coelomate** animal (called a coelom) is located within the mesoderm (surrounded by it)
- The mesentery holds the gut in place.



- The diagram below shows the body plans for nine major phyla of animals.

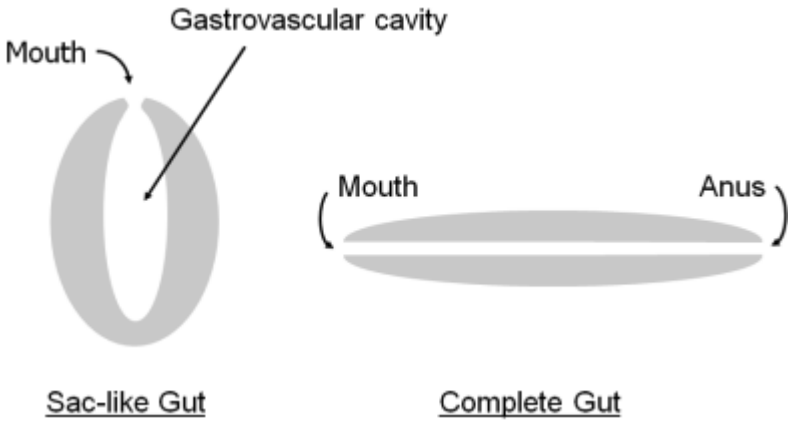


Gut

- The gut is the **digestive tract**. It enables the animal to digest food outside of the cells (**extracellular digestion**). In animals without a digestive tract, food items are brought into the cell for digestion (**intracellular digestion**).
- A **sac-like gut** has one opening. Food enters and leaves through the same opening.

- A **complete gut** has two openings, a mouth and an anus. It is sometimes referred to as a tube-within-a-tube.

    - This type of gut allows for the specialization of parts along the tube. For example, part of the gut can become specialized for food storage, other parts can become specialized for secreting digestive enzymes and other parts for absorbing nutrients.

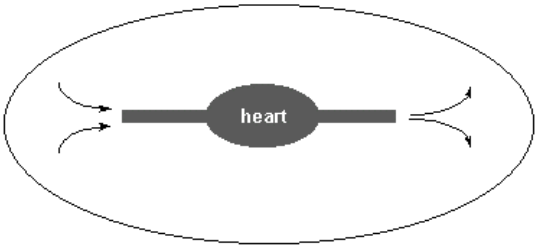


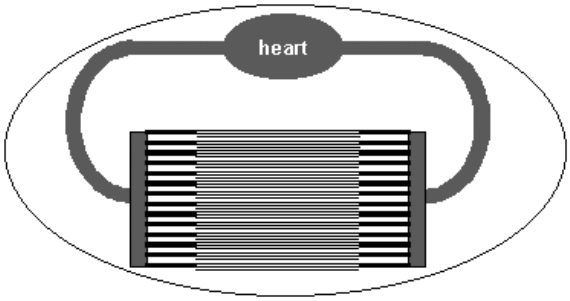
Large, Active Animals

Small animals do not require any special means to distribute nutrients and gasses or to collect wastes because every cell in the body is near a source of food. If the cells are in contact with the external environment, it is not necessary to collect wastes for removal. As evolution proceeded toward larger forms however, special structures evolved to facilitate these processes.

Circulatory System

- Larger animals require a circulatory system to transport nutrients, gasses, and wastes. Fluid within the body cavity can act like a circulatory system and distribute nutrients and gasses.
- In an **open circulatory system**, blood leaves the blood and flows freely within the tissues. This system is not very efficient because there is no blood pressure to move blood rapidly through the tissues. The oval line in the diagram below represents an animal's body.
- Blood does not leave the blood vessels in a **closed circulatory system**. In this type of system, the heart can pump blood through the tissues rapidly





Gas Exchange (Respiration)

- All animals need to **take in O_2** and **eliminate CO_2**. Lungs are membranous structures designed for gas exchange in a terrestrial environment. Gills are designed for gas exchange in an aquatic environment.
- Oxygen **must be dissolved in water** before it can be absorbed by the respiratory structures (gills,lungs, etc.). Therefore, the respiratory surfaces of animals must always be moist. Oxygen is absorbed from the water coating the surface.

Respiratory (Oxygen-Carrying) Pigments

- The oxygen-carrying capacity of blood can be increased if the blood contains molecules that are capable of binding to oxygen. These molecules are referred to as **pigments** because they are colored. For example, hemoglobin is a red, iron-containing pigment found in the blood of vertebrates. Hemocyanin is a bluish-colored copper-containing pigment found in many mollusks and arthropods.

Nervous System

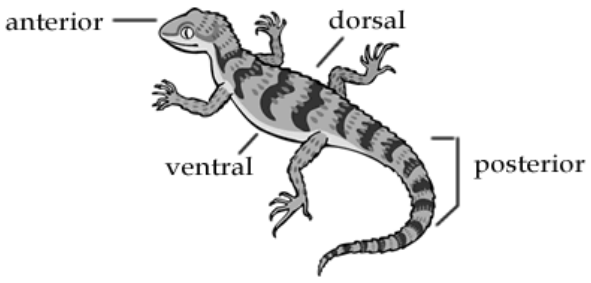
- A nervous system receives information from sensory receptors and it is responsible for stimulating the muscles and glands. Muscle movement requires stimulation by the nervous system.

- Animals that are attached (**sessile**) do not need sophisticated sense organs and consequently do not need an elaborate nervous system to service the sense organs. Animals that move (**motile**), however, need sense organs located on the **anterior end** (head region) so that they can sense the environment that they move into.

- A concentration of sense organs requires a concentration of nervous tissue to receive the information and decide what to do with it. The brain is a concentration of nervous tissue near the sense organs. **Cephalization** refers to the degree of development of the brain. The evolutionary trend is more elaborate and sensitive sense organs and increased cephalization.

Terms you should know:

- **Symmetry** (asymmetry, radial and bilateral)
- **Tissue**: An integrated group of cells with a common structure and function
- **Organ**: A specialized center of body function composed of several different types of tissues.
- **Organ system**: A group of organs that work together to perform a certain task.
- **Segmentation**: refers to the division of some animal body plans into a series of repetitive segments.
- **Anterior**: Referring to the head end of a bilaterally symmetrical animal.
- **Posterior**: Of or pertaining to the rear, or tail, end.
- **Dorsal:** Pertaining to or situated near the back; opposite of ventral.
- **Ventral**: Pertaining to the undersurface of an animal that holds its body in a horizontal position; to the front surface of an animal that holds its body erect.



- **Sac Like Gut**: food enters and wastes leave from the same opening.
- **Complete Gut**: has two opening, a mouth and an anus. It is sometimes referred to as a tub-within –a-tube. Food enters the mouth and undigested food exits via the anus.: A heterotrophic mode of nutrition in which other organisms or detritus are eaten whole or in pieces.
- **Digestion**: The process of breaking down food into molecules small enough for the body to absorb.

- **Elimination**: The disposal of undigested food molecules.
- **Excretion**: The disposal of nitrogen-containing waste products of metabolism (all the chemical reactions within the body)
- **Thorax**: In crustaceans and insects, the fused, leg-bearing segments between head and abdomen.
- **Abdomen**: in arthropods, the posterior portion of the body, made up of similar segments and containing the reproductive organs and part of the digestive tract.
- **Sessile**

- **Motile**

- **Circulation:**

- **Respiration**

- **Body cavity**

- **Germ layers**

- **Exoskeleton**

- **Endoskeleton**

- **Head**

- **Cephalization:**

- **Oral surface**

- **Aboral surface**