BIO1APM

Animal Life

All Animals are heterotrophs and must ingest plants, algae or other animals for nourishment.

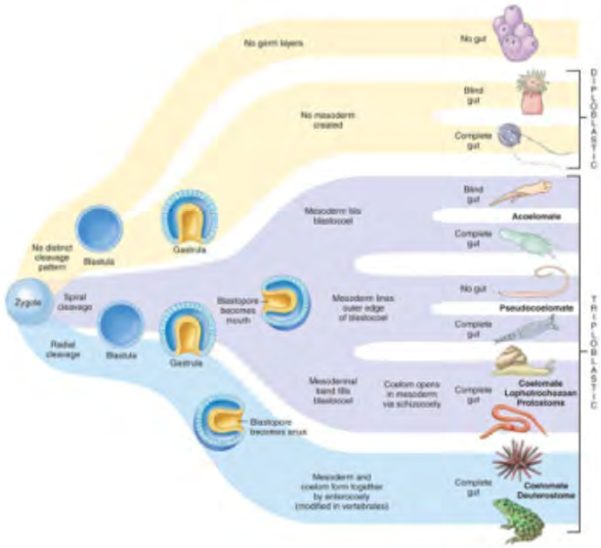
All animals are multicellular, and unlike plants and protists and cells lack cell walls.

Animals are able to actively move from place to place and are very diverse in form and habitat.

Most animals reproduce sexually, and have characteristic pattern of embryonic development, and possess unique tissues.

	Aquatic	Terrestrial
Respiration	Skin &/or gills	Tracheae or lungs
Waste products	Mainly ammonia	Mainly urea &/or uric acid
Water turnover	High	Low
Locomotion	Swimming	Running, crawling flying
Temperature	Poikilothermy (most)	Homeothermy (most) & Poikilothermy (some)

Embryology:

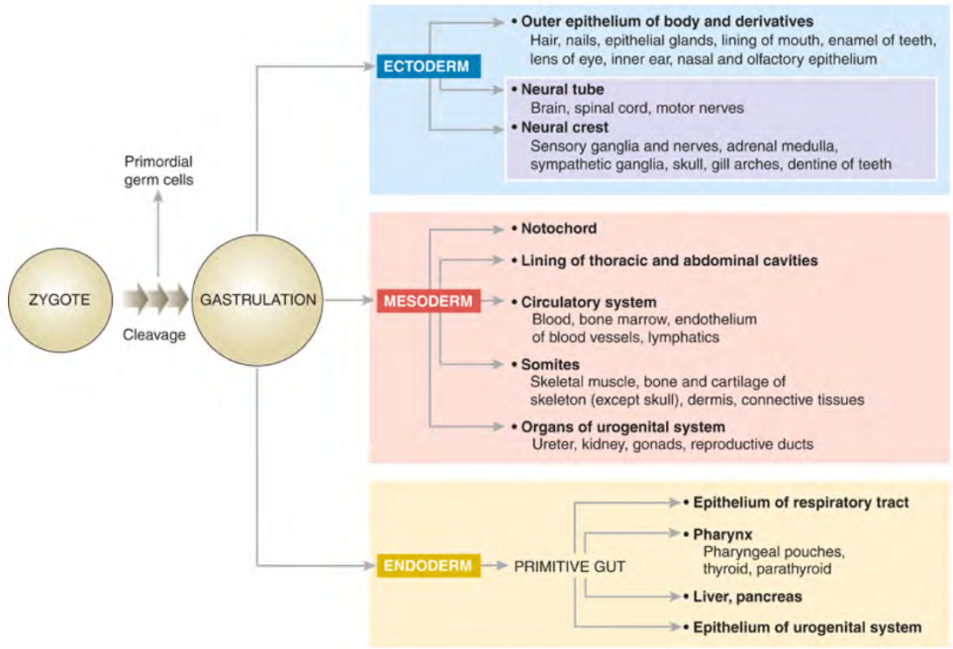


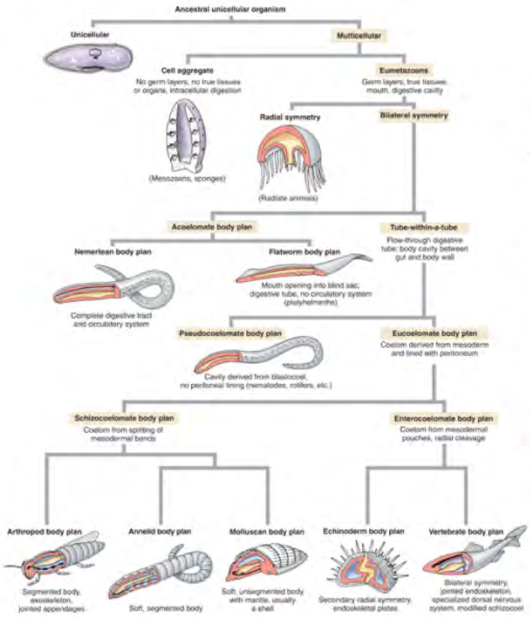
Development of animal body plans beginning with a zygote

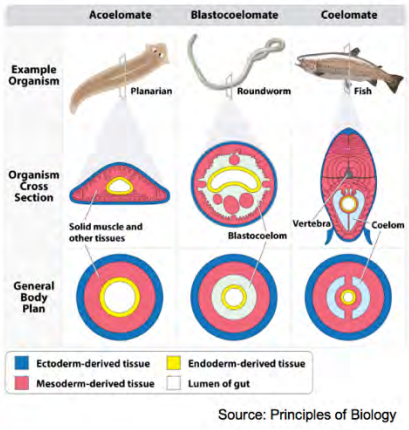
Sponges develop only to blastula stage, then reorganise to form adult.

Gastrulation allows animals to proceed to tissue level organization.

- Diploblastic – 2 germ layers Cnidarians, Ctenophores
- Triploblastic – 3 germ layers (has mesoderm)



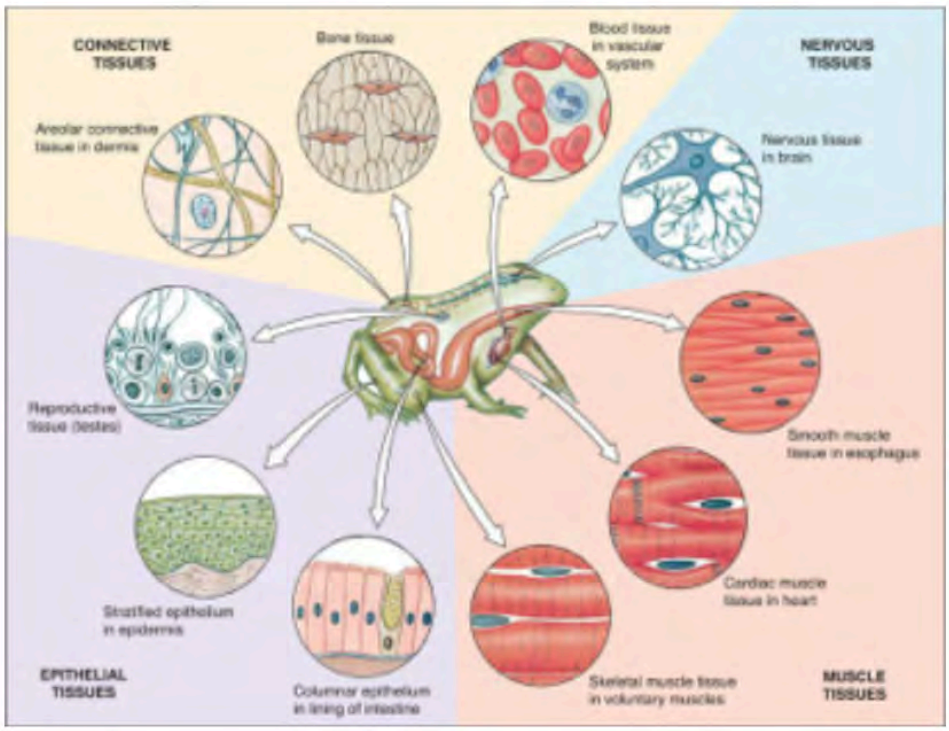




Source: Principles of Biology

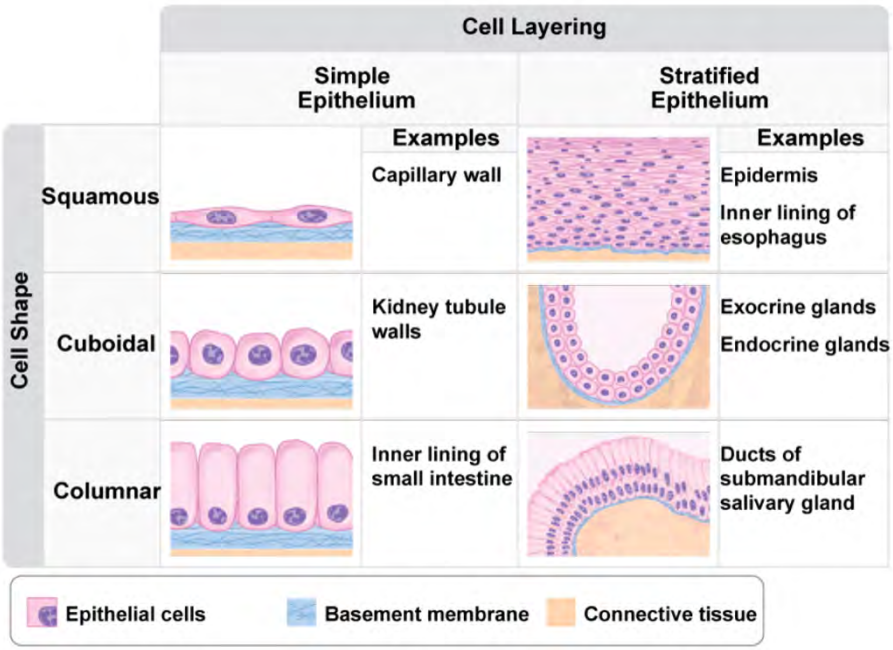
Tissues:

A group of cells specialised for performing a common function



Epithelial Tissues

Covers the outside of the body and lines organs and cavities within the body.
Can be one or more cell layers thick and anchored by basement membrane.
Functions include; providing a physical barrier, controlling permeability, providing sensations, and producing secretions



Connective tissues

Extracellular matrix. Functions include; mainly to bind and support other tissues. These tissues contain sparsely packed cells scattered throughout an extracellular matrix. They can be loose connective, dense connective, adipose (fat storage), cartilage, bone, and blood.

Muscular tissues

Contracts to allow movement. Most abundant tissues in most animals. Muscle cell is called a muscle fibre. Specialised for contraction.

3 types of muscle tissues

- Skeletal (striated)
- Smooth (unstriated)
- Cardiac (striated branched)

Functions include; motion, posture maintenance, joint stabilization, and thermoregulation.

Nervous tissues

Transmits information. 2 cell types;

- Neurons
- Neuroglial

Specialised for reception of stimuli and conduction of impulses from one region to another.

Size and Shape

Increased complexity allows for larger body sizes. Size and shape affect the way an animal interacts with its environment.
Many different animal body plans have evolved, physical law constrain strength, diffusion, movement and heat exchange.
Larger size decreases the surface area to volume ratio.

Energy Metabolism

Energy is obtained from the oxidation of foodstuffs (carbohydrates, fats, and proteins) through metabolic pathways.
Metabolism - the sum of all reactions occurring within an organism.

Catabolic pathways (energy generating)
Metabolic reactions that lead to the release of energy by breaking down compounds into smaller molecules are termed catabolic pathways.

Anabolic pathways (energy consuming)
Metabolic reactions that lead to the synthesis of larger molecules from smaller ones.

In the absence of external work or storage of chemical energy, all the energy released during metabolic processes appears as heat.

Metabolic rate - the rate at which animals use energy to accomplish work.

Metabolism varies with the number and intensity of activities the animal is performing. It also varies with temperature, type of food eaten, time of day, body mass, body shape, age, sex, and reproductive status.
Metabolic rates ramp up when energy demand increases and then ramps down when the energy demand decreases or when the environment demands drastic energy cuts.

Resting metabolic rate (RMR) - the rate of energy metabolism when the animal is inactive.

Basal metabolic rate (BMR) - mammals and birds

Standard metabolic rate (SMR) - reptiles, amphibians, fish

Active metabolic rate (AMR) - the rate of energy metabolism when the animal is performing one or more normal activities

Maximal metabolic rate (MMR) - the rate of energy metabolism when the animal is performing a strenuous activity

Metabolic scope is an indication of the range of metabolic rates an animal is capable of.
It is defined as the ratio of maximum sustainable metabolic rate to the resting metabolic rate.

Field metabolic rate (FMR) - the average rate of energy utilisation when the animal is in its natural environment performing normal activities (including periods of rest and activity).

Measuring metabolic rate;

Directly by calorimetry - measuring the amount of energy released as heat production over a given period

Directly by energy uptake - measure energy of food consumed and energy of waste products and calculate the difference

Indirectly - measurement of a variable other than heat production that is related to energy utilisation

Respirometry - is measured by obtaining the rate of oxygen consumption per mass per time.

Radioisotopes - measures water fluxes within the animal using deuterium-labelled water injected into the animal. The radioactivity of blood or other body fluids declines over time. Changes in deuterium concentration are directly related to water turnover via urination, defecation, and respiration.

Heart rate telemetry - operate under the assumption that a change in heart rate is a major component of the response of an animal to increase oxygen demand.

Factors affecting metabolic rates;

Body size

larger animal have higher total metabolic rate. Smaller animals have higher mass specific metabolic rates.

Digestive state

Metabolic rate increases during the digestive process, this can be dependant on the size of the meal, type of meal, and ease of digestion.

Activity

Temperature

The rates of enzymatic reactions are highly temperature dependent; consequently, tissue metabolism depends upon an animal maintaining it internal environment at a suitable temperature.

Reproductive state

Circadian rhythms

Digestion and Nutrition

The small intestine in most vertebrate is the organ most responsible for absorption of nutrients - large increase in surface area.

Digestion is a chemical process that releases chemical energy. It utilises special enzymes to catalyse breakdown of large molecules to small molecules to cross cell membranes to be absorbed.

Nutrients are substances that serves as sources for;

Metabolic energy
Growth or repair of tissues
Maintenance of body functions.

Eating (Heterotrophs) - a process of eating another organism involves three sub-processes.

- Feeding - acquisition and ingestion of food.
- Digestion - breakdown of food into small molecules to absorb.
- Absorption - uptake of small molecules by the body through diffusion, facilitated diffusion or active transport.

Feeding Strategies

Across body surface

Passive or active uptake with small molecules.

Endocytosis

Large molecules , the vesicle (food vacuole) fuses with lysosome. Food particle are engulfed and undigested.
Phagocytosis - Cell eating
Pinocytosis - Cell drinking

Filter feeding

Aquatic environments, most are sessile and trap particulate matter.

Piercing and sucking

Have a specialised apparatus. Often associated with secretions.

Jaws, beaks and teeth

Many animals, wide diversity of forms. The primary function is to capture and breakdown food.

Digestion

Animals must digest their food in specialised compartments where enzymes can attack the food without damaging the animal's own cells.

Intracellular Digestion

This process occurs inside the cell. Food particles are engulfed and places it in the vesicle where it can breakdown and fuses with the lysosome. The lysosome

transport the vesicle to the golgi apparatus. Once digested the nutrients are transported through the cell.

Extracellular Digestion

This process occurs outside the cell, in a body cavity. The final products are absorbed into an internal transport system. This takes place in a specialised region, often with increased surface area.

The digestive system is an alimentary canal with separate entrance and exit allows for one way flow of ingested food and ordered processing.

Receiving Region

Mouth cavity. These organs are for feeding, chewing and swallowing. They produce digestive enzymes in the salivary glands.

Conducting and Storage Region

Oesophagus. Conducts chewed food from mouth cavity to the stomach.

Digesting and Absorbing Region

Two major divisions are the stomach and small intestine. Has a strong muscular tube for mechanical churning and initial stages of digestion.

Water-Absorbing and Waste-Elimination Region

Small animals have a higher energy requirement per unit body weight than larger animals - this has implications for the type of diet they eat and the amount of times they have to eat.

Large animals:

Low energy requirement per unit mass
Large food intake
Eat everything, poor quality items
Slow throughput
Low rate of digestion

Small animals:

High energy requirement per unit mass
Require food always in small intakes of high quality items
Fast throughput
High rate of digestion.

Exocrine Glands

Exocrine glands are distinguished by the secretion that flow through a duct into a body cavity.
Secretions include: mucus, enzymes, water, and ions.
Examples;