

1. General Information

Single Celled Organisms get nutrients and eliminate wastes by diffusion and active transport
They're thin, small, and are in direct contact with their environment
Small Multicellular organisms, such as hydras, also use diffusion and active transport
Their size eliminates their need for a transport system
Most are aquatic

Complex Multicellular organisms have cells that are not in contact w/ the environment
A circulatory system is needed in order to provide nutrients to all cells
Fat and cholesterol can clog the arteries from the heart, causing the heart to have to work too hard
Heart disease is the leading cause of death in the United States
Lasers are now being used to clear out arteries to prevent heart attacks

2. Transport in Plants

Water must be transported from the roots to all parts of the plant

Glucose must be transported from the leaves to all parts of the plant

Vascular Tissue – cells joined into tubes that transport water and nutrients

Small, aquatic plants such as algae and mosses don't need transport systems

Roots anchor the plant in the ground, as well as absorb water and other nutrients from the soil

Root Hairs – small, extended portions of the root that increases the surface area to absorb water

Lignin – a hard material within the cell walls, provides support for the plant

Xylem – a tube that carries water and minerals up from the roots throughout the plant - nonliving

Phloem – tube that carry nutrients throughout the plant – made of living cells

Mycorrhizae – a fungi that attaches to the root that protects the plant and helps absorb water

Xylem Structure and Water Transport

Tracheids – pointed ends, thick walls, connects to nearby cells to distribute water

Vessels – wider, shorter, thinner walled, less tapered, open at the end, water flows through

The Cohesion Tension Hypothesis – how water moves upward against gravity

Water moves up through constant pressure of the soil on the roots (**Root Pressure**)

The strong hydrogen bonds of water and the evaporation at the top pulls it upward

Transpiration – the evaporation of water from a plant

Phloem Structure and Nutrient Transport

Sieve Tubes – nickname for phloem due to the numerous pores on the walls

The Phloem also contains cytoplasm to transport sugars and some water

Pressure Flow Hypothesis – method of how sugars are moved so quickly through the phloem

The nutrients are transported from **sources** (high pressure) to **sinks** (low pressure)

Sources - cotyledons, endosperm, leaves

Sinks – growing leaves, root tips, flowers, fruits, seeds

When the sugar enters the phloem, water from the xylem is added

The increased water pressure moves the sugar towards lower pressure (sinks)

Water, salts, and other soluble materials can move from the xylem to/from the phloem through **Ray Cells**

The Xylem and the Phloem combined provide nutrients to every cell in the plant

3. Transport Systems in Animals

Small organisms can exchange nutrients and wastes directly w/ their environment

They usually contain either a cavity or a vacuole in order to obtain food

Circulatory System – an organ system that transports materials to and from cells

Usually requires a pump (heart), blood, and blood vessels

Insects – open circulatory system – blood and other fluids are combined, slowly oozes along

Bathes organs, provides nutrients, removes wastes, not very efficient

Earthworm – closed circulatory system – blood remains inside the vessels, pumped by the heart

Closed circulatory systems are more efficient, blood travels much more quickly

Vertebrates and higher animals

Cardiovascular System – the internal transport system used by humans and other vertebrates

Arteries – large blood vessels that carry blood away from the heart to the organs

Aorta – the major artery carry blood away from the heart to the body

Pulmonary Arteries – arteries that carry blood from the heart to the lungs

Only artery that carries deoxygenated blood

Veins – blood vessels that return blood to the heart from the body

Pulmonary veins that carry oxygenated blood

Capillaries – small blood vessels that branch and reach every cell in the body

The Heart – the pump that provides the pressure to move the blood through the body

- Ventricle** – a chamber of the heart that pumps blood out of the heart
- Atrium** – a chamber of the heart that receives blood from the veins
- Fish** – 2 chamber heart, 1 ventricle, 1 atrium. Blood goes from heart – gills – body – heart
- Amphibians** – 3 chambered heart, 1 atria, 1 ventricle. Uses **double circulation**
 - Blood first goes from heart – lungs – skin – heart
 - It is then pumped again everything else except the lungs
 - However, in the end, the oxygenated and deoxygenated blood mix in the single ventricle

The Human Heart – 4 chambers, 2 separate ventricles, 2 separate atria, double circulation

- Cardiac Cycle** – a sequence of muscle contraction and relaxation by the heart
 - Systole** – the contracting phase
 - Diastole** – the relaxing phase
- The increased pressure from atria contractions force the blood into the ventricles
- The ventricles contract, forcing the blood into the aorta and the pulmonary artery
- Valves are present between the atria and ventricles that force open under pressure
- The left atrium appears to be located on the right, and the right appears to be on the left
- Pacemaker** – muscle in the right atrium that creates impulses to trigger heartbeat
- Pulmonary Circuit** - blood vessels that goes from the heart to the lungs and back
- Systemic Circuit** – blood vessels that deliver O₂ and nutrients to the rest of the body

Blood Vessels – “tubes” of cells that blood flows through

- Large arteries are made of muscle and other elastic tissue, so they can expand
- Smaller arteries are also made of muscle tissue, controlling blood flow
- Veins have thin walls due to the lower pressure, much less muscle tissue
- Valves prevent blood from flowing backwards
- Contracting skeletal muscles push blood towards the heart
- Pulse** – a wave of pressure through the arteries due to ventricular contraction
 - Affected by drugs, size, gender, sleep, exercise
- Blood Pressure** – the pressure the blood is exerting on the arteries
- Hypertension** – high blood pressure, forces heart to work harder, can be fatal
 - Can cause heart attacks, ruptured arteries, strokes, etc.

Blood – the fluid that carries nutrients and gasses throughout the body

- Carries gases, nutrients, waste products, hormones, and heat
- Corpuscles** – agents in the blood – Erythrocytes, leukocytes, plasma, and platelets
- Erythrocytes** – red blood cells – small discs that transport oxygen
- Hemoglobin** – a red protein that helps carry oxygen
- Red Blood Cells live only about 120 days, are constantly produced by the bone marrow
- Leukocytes** – white blood cells, 2nd line of defense against invaders behind the skin
 - Surrounds and engulfs foreign material
- Plasma** – the fluid portion of the blood – water, salts, amino acids, sugars
 - Carries digested food, nutrients
- Lymphatic System** – a system that recycles blood
- Platelets** – small cell fragments that aid in blot clotting
- Fibrinogen** – soluble plasma protein. **Thrombin** converts it into **Fibrin** to clot blood
- Coagulation** – the clotting of the blood
 - If blood clots occur in the arteries or the brain, heart attacks and strokes can occur

Homeostasis – the constant and steady environment inside the body

- Different parts of the body regulate different factors, connected by the circulatory system
- Blood also indirectly regulate body temperature control
- See chapter 23 for more information