Transport (Defined)

the passage of materials into the cells of an organism (absorption) and the distribution of materials within the cells and throughout the organism (circulation).

A. ABSORPTION:

1. The passage of materials through a cell membrane into the cytoplasm of the cell.

B. THE CELL MEMBRANE:

1. Structure of the cell membrane:
   a. consists mainly of lipids and proteins
   b. lipids form a layer 2 molecules thick with protein molecules in it.
   c. fluid - mosaic model is the currently accepted model of the structure of the cell membrane.
      1. model - used as a representation of a structure or process that cannot actually be observed.

2. Properties of the cell membrane:
   a. allows the passage of many small particles, such as molecules of water, gases, dissolved solids and ions (charged particles).
   b. these pass through by the process called diffusion
   c. larger molecules (ie: proteins and starch - large and insoluble) can not pass through the membrane.
      1. they must first be chemically digested.
   d. size alone does not determine if it can pass through a cell membrane.

3. Functions of the cell membrane:
   a. selectively regulates the passage of materials into and out of the cell.
   b. helps to regulate homeostasis of the cell
4. **Passive transport:**
   a. some materials can pass through the membrane by the process of **diffusion**.
      1. process does not require energy
      2. occurs because of the energy of motion (**kinetic energy**) of the particles.
      3. diffusion occurs both ways however the net change or movement of material is always from a region of higher concentration to that of a lower concentration.

   **HIGHER --------> LOWER**

5. **Osmosis:**
   a. the diffusion of water through a membrane is called osmosis
   b. occurs from a region of higher concentration of water (few dissolved particles) to a region of lower concentration of water (more dissolved particles)

6. **Active transport:**
   a. the use of cellular energy to move particles through a cell membrane.
   b. it may occur in the direction of diffusion or against the direction of diffusion.
   c. transport through the cell membrane is assisted by **carrier proteins** in the cell membrane.

7. **Phagocytosis:**
   a. the process by which a cell engulfs large, undissolved particles by surrounding them (pseudopods) and enclosing them in a vacuole.
   b. chemical digestion and absorption occurs in the vacuole
8. **Pinocytosis:**
   a. the process by which large, dissolved molecules become enclosed in a vacuole.
   b. the cell membrane forms a pocket around the molecule by pinching inward.
   c. both pinocytosis and phagocytosis requires cellular energy.

![Diagram of Pinocytosis](image)

C. **CIRCULATION:**

1. **Intracellular circulation**
   a. the movement of materials throughout the cell
   b. by diffusion, cyclosis (cytoplasmic streaming) and possibly through the endoplasmic reticulum.

2. **Circulation within the organism**
   a. materials moved from one part of an organism to another by active or passive transport between cells or by fluids flowing through tubes (vessels).
   b. tissues whose function is to transport fluids are called - **vascular tissues**.

   1. present in both plants and animals
D. ADAPTATIONS FOR CIRCULATION IN PLANTS AND ALGAE

within cells - circulation occurs as described in intracellular circulation above

Bryophytes (simple multicellular plants w/o vascular tissue)
- circulation occurs by diffusion and active transport

Tracheophytes (more complex plants)
- have specialized vascular tissues.

1. Transport in roots

   a. roots are specialized structures that anchor a plant, absorb water, nitrates, and other dissolved mineral salts from the soil and conduct these materials to the stem.
   b. growth of the root into the soil occurs by cell division at the root tip.
   c. Root hairs
      1. located just behind the growing root tip
      2. epidermal cells produce extensions of their cell membranes called root hairs
      3. penetrate the soil and increase the surface area for absorption
      4. water and dissolved materials in the soil enter the root hairs by diffusion, osmosis, and active transport.
   d. Xylem
      1. specialized transport tissue extending from the roots through the stems to the edges of the leaves.
      2. the xylem cells are dead and hollow, forming continuous tubes.
      3. water and minerals pass upward in the plant through the xylem
   e. Phloem tissue
      1. consists of living cells specialized for the transport of organic materials synthesized by the plant.
      2. transport materials both upward and downward to tissues of the plant for use or storage.
2. **Transport in stems**
   a. **Structure of stems**
      1. more complex in structure than roots
      2. contain vascular tissue (xylem and phloem) that are a continuation of those in the roots.
   b. **Function of stems**
      1. for support of leaves for light exposure
      2. provide transport of materials b/w the roots and the leaves
      3. stems of large diameter also contain horizontal rays - specialized tissues that transport materials across the stem.

3. **Transport in leaves**
   a. the veins of leaves contain extensions of the vascular tissues of the stem
   b. transport materials to and from the tissues of the leaf.

4. **Mechanisms of transport in xylem**
   Involves 3 physical processes in the upward movement of materials
   a. **Transpiration pull**
      1. as water evaporates out of the air spaces in the leaves (Transpiration), this creates an upward pull on the columns of water in the xylem from the veins in the leaves through the stems and into the roots.
      2. the columns of water are held together by cohesive forces and drawn upward by these forces.
   b. **capillary action**
      1. the ability of water to rise in tubes of narrow diameter
      2. accounts for the small part of upward movement of materials in the xylem.
   c. **root pressure**
      1. osmosis and active transport into the roots produces a pressure inside these cells. > xylem
5. **Mechanisms of movement in phloem**
   a. no completely satisfactory explanation of movement has been proposed up to this time.

E. **ADAPTATIONS FOR TRANSPORT IN ANIMALS AND PROTOZOA**

1. **Protozoans** (ameba and paramecium)
   a. the water in their environment acts as a transport medium
   b. absorption occurs directly through the cell membrane
   c. circulation w/in is by **diffusion** and **cyclosis** (cytoplasmic streaming)

2. **Hydra**
   a. most of the cells of the hydra are in direct contact with its environment
   b. absorption occurs directly into each cell (like protozoans)
   c. absorption from cell to cell is by diffusion through the membranes
   d. has no special transport system
   e. cells lining the GV cavity have flagella that aid in the circulation of materials

3. **Earthworm**
   a. many of the cells are not in direct contact with the environment
   b. Nutrients, oxygen and wastes are transported by fluid called **blood**.
      1. contains **hemoglobin** - aids in the carrying of oxygen and CO₂
   c. blood vessels carry blood to all the parts of the animal
   d. **Aortic arches** - act to pump the blood
   e. contains a **closed circulatory system**
      1. the blood stays enclosed in vessels and organs at all times
   f. oxygen is absorbed into the blood through the **moist skin**
      1. this is direct contact with its environment
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3. Earthworm (continued)
   g. the end products of digestion are absorbed from the digestive organs.
   h. the digestive tube contains many folds (typhlosole)
      1. increases the surface area for absorption of nutrient into the blood

4. Grasshopper
   a. has an open circulatory system
   b. the vessels that carry the blood empty into large body cavities called sinuses
   c. the blood bathes the body tissues and is then reabsorbed into the circulatory system.
   d. blood is pumped by a pulsating blood vessel
      1. a single vessel that pumps the blood towards the head
   e. blood does not contain hemoglobin, therefore it is not sufficient in the transport of respiratory gases.
   f. like the E.W., the GH digestive tube has folds to inc. surface area for the passage of materials to the blood.

5. Humans
   a. like the EW - has a closed circulatory system with hemoglobin aiding in the transport of respiratory gases.
   b. Heart - the pumping structure
The change in appearance of the cell resulted from more (1) salt flowing out of the cell than into the cell (2) salt flowing into the cell than out of the cell (3) water flowing into the cell than out of the cell (4) water flowing out of the cell than into the cell.

6. The natural streaming of the cytoplasm that occurs within all cells is called (1) pinocytosis (2) phagocytosis (3) osmosis (4) cyclosis

7. When a cell uses energy to move materials across a cell membrane, the process is known as (1) osmosis (2) active transport (3) diffusion (4) passive transport.

8. The diffusion of water molecules into and out of cells is called (1) cyclosis (2) pinocytosis (3) osmosis (4) homeostasis.

9. The net movement of molecules into cells is most dependent upon the (1) selectivity of the plasma membrane (2) selectivity of the cell wall (3) number of molecules (4) number of chromosomes.

10. A red blood cell placed in distilled water will swell and burst due to the diffusion of (1) salt from the red blood cell into the water (2) water into the red blood cell (3) water from the blood cell to its environment (4) salts from the water into the red blood cell.

Base your answers to questions 11 and 12 on your knowledge of biology and on the diagram below, which illustrates a process by which protein molecules may enters a cell.

11. Which process is illustrated in this diagram? (1) pinocytosis (2) osmosis (3) diffusion (4) passive transport.

12. Structure A is most likely a (1) ribosome (2) mitochondrion (3) nucleus (4) vacuole.

13. Carbohydrate molecules A and B come in contact with the cell membrane of the same cell. Molecule A passes through the membrane readily, but molecule B does not. It is most likely that molecule A is (1) a protein, and B is a lipid (2) a polysaccharide, and B is a monosaccharide (3) an amino acid, and B is a monosaccharide (4) a monosaccharide, and B is a polysaccharide.

14. The process by which amebas ingest food particles is called (1) pinocytosis (2) osmosis (3) phagocytosis (4) cyclosis.

Transport in Plants. The transport of materials in plants involves cyclosis, osmosis, diffusion, and active transport. Some plants contain specialized transport, or vascular, tissues, while others do not.
Figure 2-8. Structure of a growing root tip.