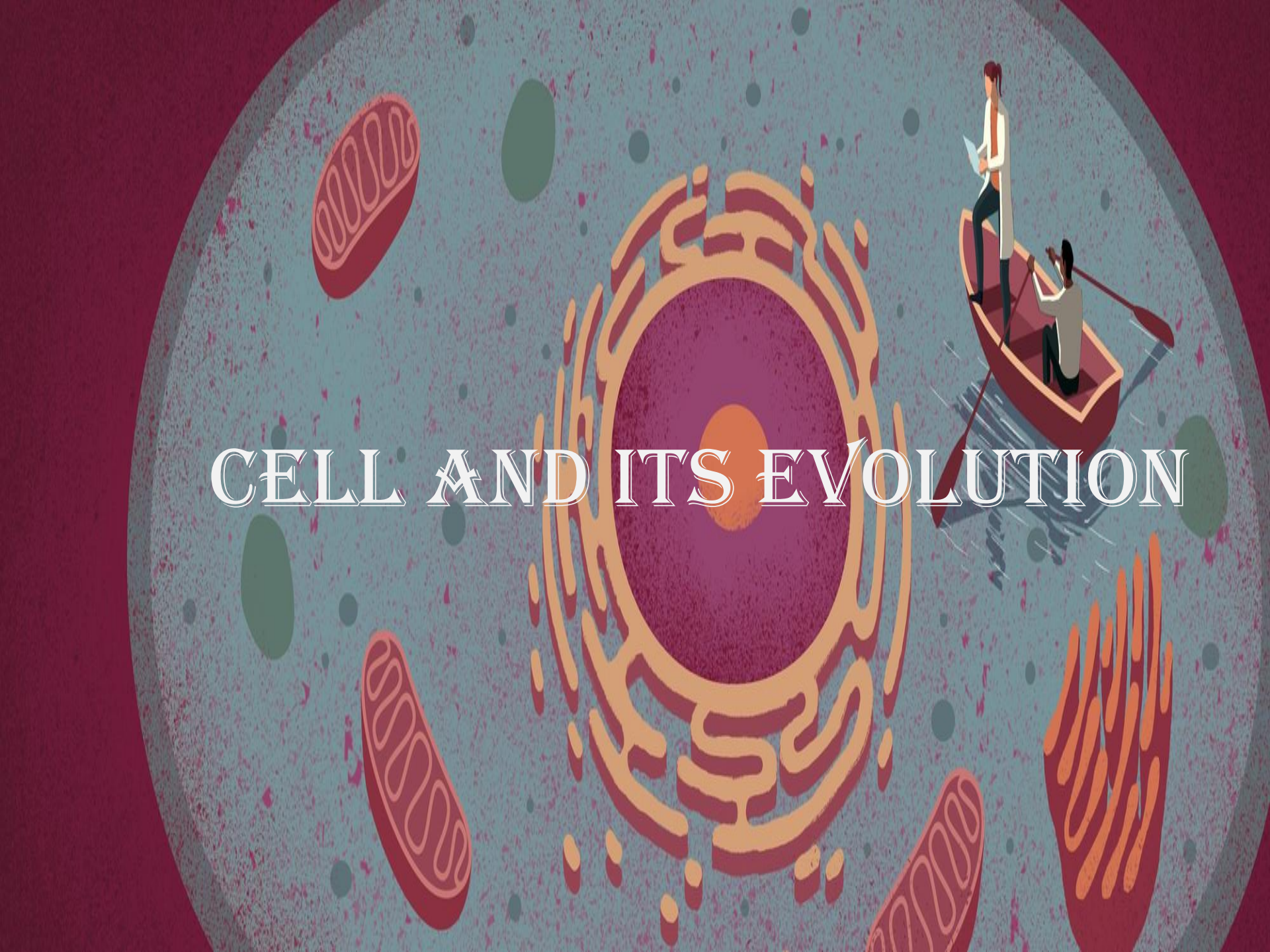
CELL AND ITS EVOLUTION

INTRODUCTORY BIOCHEMISTRY

Chapter: 3
Cell and Its Evolution
Lecture - 11

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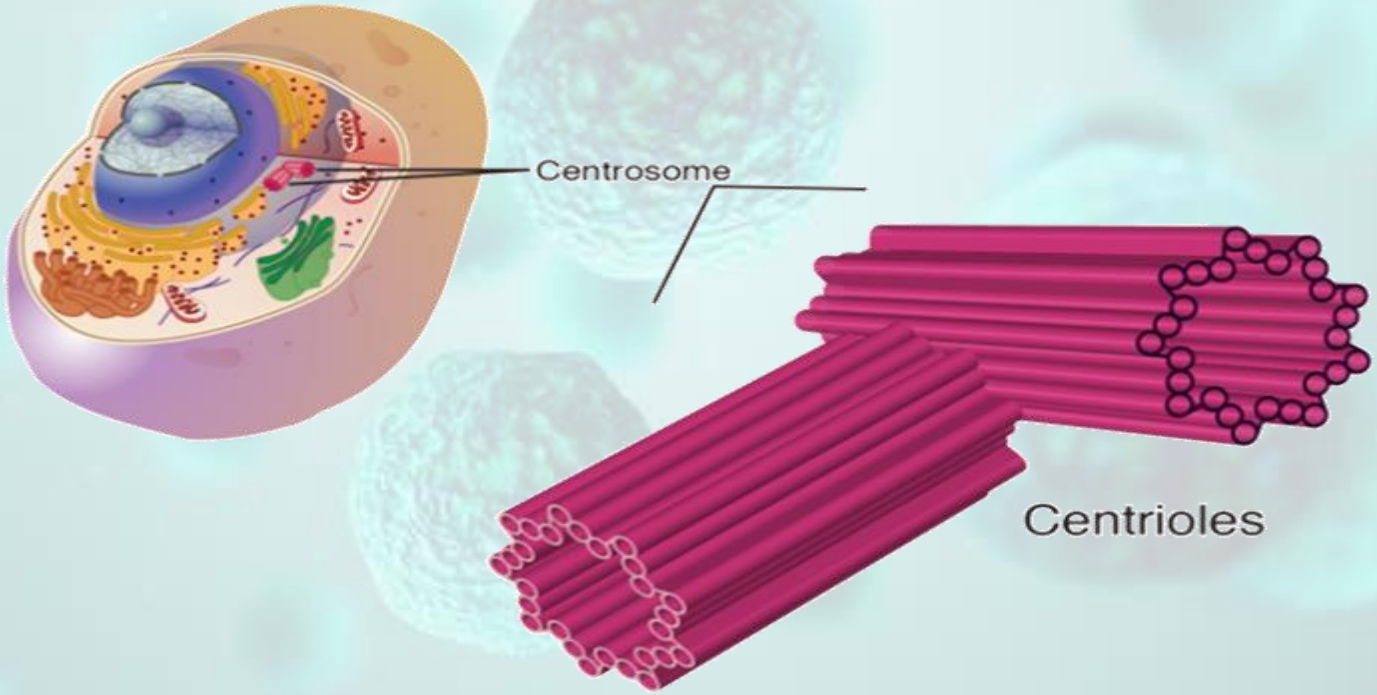
Centrosome

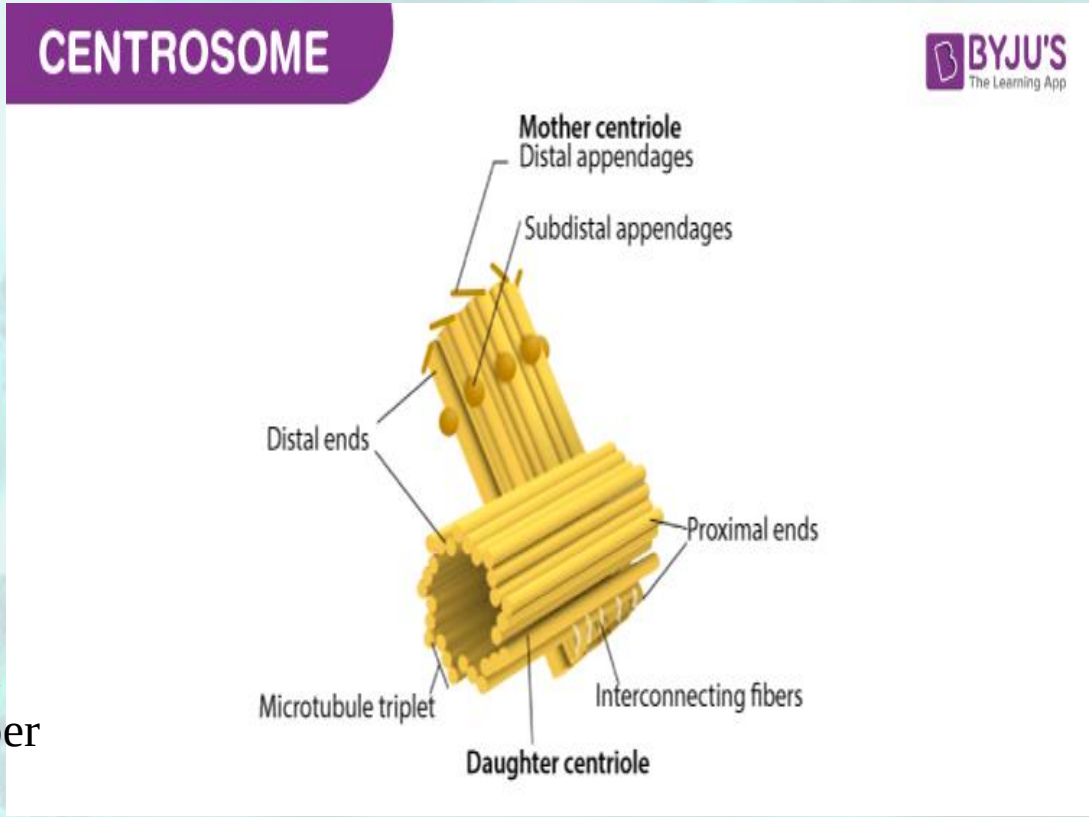
The centrosome (Latin centrum 'center' + Greek sōma 'body') (archaically cytocentre) is an organelle that serves as the main microtubule organizing center (MTOC) of the animal cell, as well as a regulator of cell-cycle progression.



The centrosome is made up of two perpendicular centrioles, a daughter centriole, and a mother centriole, linked together by interconnecting fibres.

Centrosome

It consists of a complex of proteins that helps in the formation of additional microtubules. An amorphous pericentriolar matrix surrounds the centrioles. It is involved in the nucleation and anchoring of cytoplasmic microtubules.



Centrosome Function

The centrosomes help in cell division. They maintain the chromosome number during cell division.

They also stimulate the changes in the shape of the cell membrane by phagocytosis. In mitosis, it helps in organizing the microtubules ensuring that the centrosomes are distributed to each daughter cell.
They regulate the movement of microtubules and cytoskeletal structures, thereby, facilitating changes in the shapes of the membranes of the animal cell.

Vacuoles

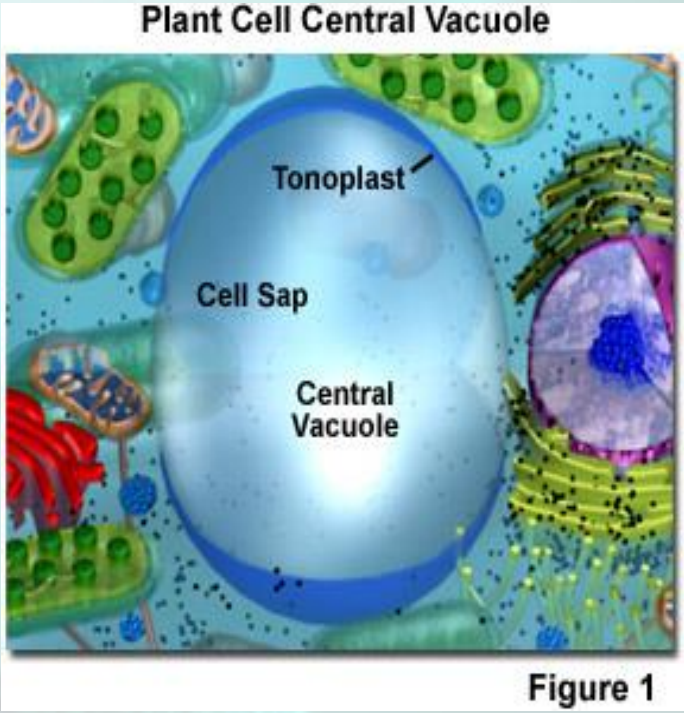
The term “vacuole” means “empty space”. Vacuoles are membrane-bound organelles that can be found in both animals and plants. The vacuoles may be one or more in number.

Structure of Vacuole

A vacuole is a membrane bound structure found in the cytoplasmic matrix of a cell. The membrane surrounding the vacuole is known as tonoplast.

The components of the vacuole, known as the cell sap, differ from that of the surrounding cytoplasm.

The membranes are composed of phospholipids. The membranes are embedded with proteins that help in transporting molecules across the membrane. Different combinations of these proteins help the vacuoles to hold different materials.



Vacuoles

In animal cells, vacuoles are generally small and help sequester waste products. In plant cells, vacuoles help maintain water balance. Sometimes a single vacuole can take up most of the interior space of the plant cell.

Functions of Vacuole

The important functions of vacuole include:

Storage

A vacuole stores salts, minerals, pigments and proteins within the cell. The vacuole is also filled with protons from the cytosol that helps in maintaining an acidic environment within the cell. A large number of lipids are also stored within the vacuoles.

Turgor Pressure

The vacuoles are completely filled with water and exert force on the cell wall. This is known as turgor pressure. It provides shape to the cell and helps it to withstand extreme conditions.

Endocytosis and Exocytosis

The substances are taken in by a vacuole through endocytosis and excreted through exocytosis.

Subcellular fractionation of tissue.

Eukaryotic Cells Have a Variety of Membranous Organelles, Which Can Be Isolated for Study

In a major advance in biochemistry, Albert Claude, Christian de Duve, and George Palade developed methods for separating organelles from the cytosol and from each other—an essential step in investigating their structures and functions.

In a typical cell fractionation, cells or tissues in solution are gently disrupted by physical shear. This treatment ruptures the plasma membrane but leaves most of the organelles intact

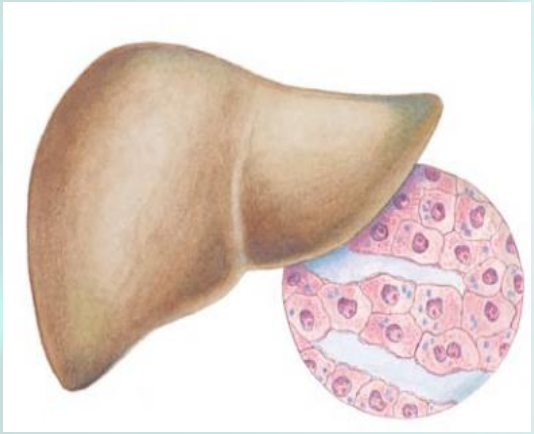
The homogenate is then centrifuged; organelles such as nuclei, mitochondria, and lysosomes differ in size and therefore sediment at different rates.

Differential centrifugation results in a rough fractionation of the cytoplasmic contents, which may be further purified by isopycnic (“same density”) centrifugation.

In this procedure, organelles of different buoyant densities are separated by centrifugation through a column of solvent with graded density

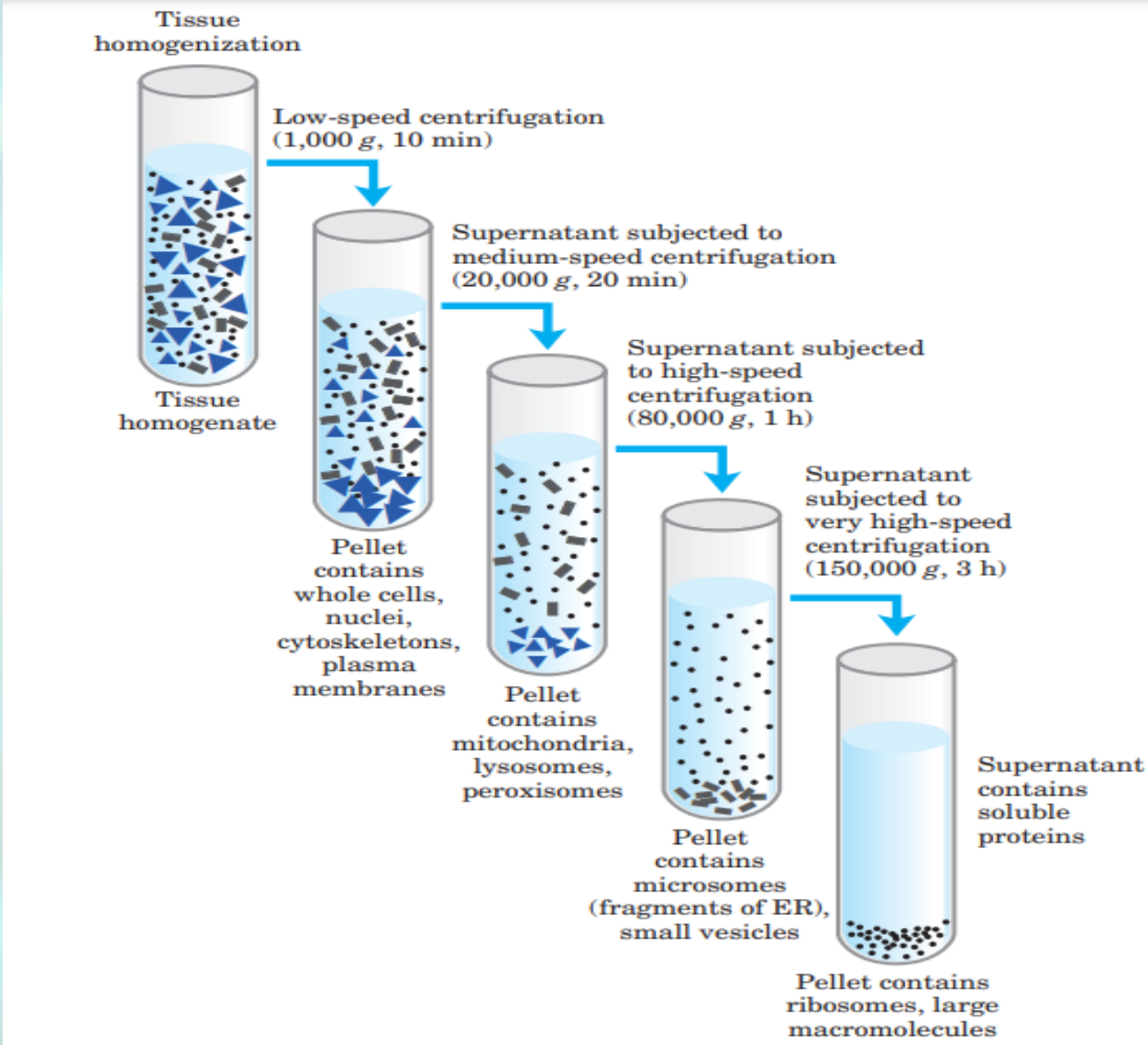
Subcellular fractionation of tissue.

A tissue such as liver is first mechanically homogenized to break cells and disperse their contents in an aqueous buffer.



The sucrose medium has an osmotic pressure similar to that in organelles, thus balancing diffusion of water into and out of the organelles,

a. Differential centrifugation



Subcellular fractionation of tissue.

A solute such as sucrose is dissolved at different concentrations to produce the density gradient

When a mixture of organelles is layered on top of the density gradient and the tube is centrifuged at high speed, individual organelles sediment until their buoyant density exactly matches that in the gradient.

Carefully remove material from each region of the gradient and observe it with a microscope