A.v. plants are made of cells. this

A. V. Leeuwanhook (l 623-1723) was the first person to carefully study magnified cells. Cell Theory: The French scientist H.

J. Dutrochet (l 824), boiled the tissues in acid and separated the cells. On this basis he thought that all animals and plants are made of cells.

This was the foundation of the cell theory. The German botanist M. J. Schleiden (l838) and the German zoologist Theodor Schwann (l839) found the essential similarity in the structure of plant and animal tissues. On this basis they gave an abstract generalization which is now known as cell theory. The cell theory states that— 1.

All plants and animals are made of cells. The cell is a unit of structure and function. 2. Each cell behaves independently but also functions as an integral part of the complete organism. 3.

The new cells are formed by a process similar to crystal formation. Virchow (1858), a German scientist stated that the new cells orginate from the pre-existing cells only (Omnis cellula e cellula). The main features . of the cell theory as known today may be briefly summed up as follows: l.

All living organisms are composed of cells. Thus cell is the basic structural and functional unit of all living organisms. It is the smallest unit of an organism that is classified as living and is often called the building block of life. 2. All cells arise from the pre-existing cells of the similar kind.

Thus continuity of life from one generation to another is through living cells. 3. The chemical composition and metabolism of all cells is basically alike. 4. The function of an organism as a whole is the outcome of the activities and interactions of the constituent cells. Genetic material in all cells consist of nucleic acid Types of Cells: On the basis of presence or absence of organised nucleus, two types of cells have been recognised. 1.

Prokaryotic and 2. Eukaryotic cells. Table I: Differences between Prokaryotic and Eukaryotic cells: ProkaryotesEukaryotes1.

ProtoplasmRelatively rigid, usually non-vacuolate, relatively resistant to desiccation, osmotic shock and thermal denaturation. Typical more fluid, generally vacuolated, more sensitive to desiccation, osmotic shock and thermal denaturation. 2. NucleusTrue nucleus absent; nuclear membrane and nucleolus not present, nucleoplasm undifferentiated from cytoplasm.-True nucleus present, nuclear membrane, nucleolus and nucleoplasm distinct. 3.

DNAScattered in the protoplasm, without histone proteins. Organised with histone proteins to form distinct chromosomes. 4.

OrganellesMembrane bound organelles, like golgi bodies, plastids mitochondria, ER, etc., are absent. Organelles like golgi bodies, plastids, mitochondria, ER, etc., are present. 5. Ribosomes70 S type. 80 S type.

(70S in Mit. Chi.)6. Mitotic apparatusAbsent.

Present. 7. Cell divisionMostly amitotic. Typically mitotic. 8. Sexual processTypical sexual process lacking, but genetic material is exchanged by parasexual processesTypical sexual process (with alternating nuclear fusion and reduction division) often present. 9.

ExamplesCells of mycoplasma. bacteria, blue-green algae. Cells of all the higher organisms, except the three group mentioned as prokaryotes. Cell Structure: The cell can be divided into three major structural parts: (1) Cell wall, (2) Vacuoles and (3) Protoplasm. (1) Cell wall is in characteristic of plant cells only, being absent animal cells. It forms the outermost limiting layer of the plant cell and is freely permeable.

Cell wall is composed of cellulose which lies away from plasma memberane. (2) Vacuoles Are spaces filled with cell sap or vacuolar sap. Vacuole is bound by vacuolar membrane or tonoplast. In unicelluclar organisms such as ameoba there is a food vucuole in which all food items are filled which is consumed by it. (3) Protoplasm: The living matter of cells is called protoplasm and consists of cytoplasm and the nucleus. Cytoplasm includes all the structures outside the nucleus.

It is the fluid portion of protoplasm surrounding the nucleus. Table 2: Differences between Plant and Animal Cells Plant Cell Animal Cell 1 Cell wall A cell wall made of cellulose which is present outside the cell membrane. Cell wall is absent.

The outermost is the cell membrane or plasma membrane. 2. Chloroplasts The photosynthetic cells are green due to the presence of chloroplasts. Chloroplasts are absent3. Centrosome Except a few plant cells, Centrosome (centriole) is absent. 4. Vacuoles In most of the animal cells Centrosome (centriole) is generally present. Plant cells generally have a large, centrally located vacuole.

The protoplasm and the nucleus are present near the cell wall. Animal cells mostly lack vacuoles. If present, these are small and remain scattered throughout the cell. 5. Cytokinesis This occurs due to the formation of cell plate. Golgi apparatus is single and large coiled.

This is the result of formation of a furrow in the centre of the cell. Golgi apparatus is more than one is small sizes.

Cell Wall:

The plant cells are bounded externally by a non-living, more or less firm covering called cell wall. Animal cells do not have a cell wall and thus their outermost covering is cell membrane. The cell wall does not act as a physiological boundary.

Its main function is mechanical, i. e., to provide protection and shape to the cell. (I) Layers of the Cell Wall Cell wall is derived from the living protoplast. It consists of middle lamella, primary cell wall, secondary cell wall and tertiary cell wall. 1. Middle lamella: It is the first formed layer, present between the two adjacent cells. Middle lamella is situated outside the primary cell wall.

It is made of calcium and magnesium pectate. Middle lamella acts as a cement which holds the adjacent cells together. 2. Primary cell wall: This layer occurs inner to the middle lamella. The major components of this layer include cellulose, hemicellulose, pectic substances, lipids, proteins, mineral elements and water. This thin and elastic cell wall becomes thick and rigid after the completion of cell enlargement. During the development of primary cell wall and the middle lamella, certain openings are left at places between the adjacent cells.

These maintain cytoplasmic continuity between the neighbouring cells and are known as plasmodesmata. This term was used by Strasburger (1901) for the first time. 3. Secondary cell wall: It is situated inside the primary cell wall. It is thick being made of several layers of cellulose, hemicelluloses and polysaccharides. Secondary cell wall is deposited after the primary wall is fully formed, i. e.

, after the cell has undergone elongation. It is thick and non-elastic, being mostly made of lignin. 4. Tertiary cell wall: Sometimes tertiary cell wall is deposited in a few cells. It is considered to be a dried residue of the protoplasm. (II) Cell Wall Depositions: Some other substances found in the cell wall are as follows: 1.

Lignin: It is a complex chemical substance, found in woody and hard tissues. The cells become woody as a result of lignification. Woody tissues are, hence, generally dead. Most of the vegetable fibres are lignified.

Lignin deposition is generally not uniform and may result in annular, spiral, scalariform, reticulate or pitted patterns. These thickenings provide mechanical support to the cell. 2. Cutin: This waxy layers forms a thin or a thick cuticle on the stem and leaf. If is impervious to water. 3. Suberin: This fatty substance is present in the walls of the cork and is totally impermeable to water and gases. 4.

Mucilage: This slimy substance absorbs water and stores it. Mucilage becomes hard when dry and viscous when moist. 5. Mineral substances: Silica, calcium oxalate, calcium carbonate, etc., are present in the cell wall in the form of crystals.

Vacuoles:

A major part of the plant cell is occupied by a vacuole. Animal cells, on the other hand, have either very small vacuoles or these may be absent. A young dividing cell is completely filled with cell sap and has no vacuoles.

But as the cell grows, many small vacuoles appear which ultimately coalesce to form a large central vacuole. Thus in a mature plant cell, cytoplasm occurs as a thin layer near the periphery of the cell surrounding the large central vacuole. Vacuole is delimited by a membrane, known as vacuolar membrane or tonoplast. The vacuole is filled with cell sap or vacuolar sap. Physiologically, vacuole is a very important part of the cell. It serves as a storage place and a place for depositing the cellular wastes.

Vacuole may contain a variety of dissolved substances like sugars, salts, acids, alkaloids and pigment anthocyanin. Anthocyanins give purple or red colour to different organs. The tonoplast is a differentially permeable membrane of lipo-proteins. It maintains the cell structure and also the osmotic gradient. It also checks the outward flow of some ions, thus allowing their higher concentration in the vacuole than in the cytoplasm.

Plasmolysis: It is the process by which the cell memberane of cell will shrink along with the cell under the influence of hypertonic solution

Protoplasm:

Physical Characters: Protoplasm is the only substance that shows the properties of life. It is a complex, jelly-like, gelatinous, granular, viscous, elastic and colourless substance. The protoplasm responds to various stimuli like temperature, light, chemicals, etc. It also acts as a semi-permeable membrane.

Composition of the Protoplasm: 1. Water: Water forms most of the protoplasm. In aquatic plants the amount of water may be as high as 95% while in dry seeds it may be as low as 10%. 2. Proteins: Proteins form about 60-65% of the total dry weight. These are made of carbon, hydrogen, oxygen and nitrogen. In some proteins, sulphur and phosphorus are also found. The fundamental units of proteins are amino acids.

There are some 20 essential amino acids contributing to the protein structure. Each amino acid has an amino group – NH2 and one or more acidic carboxyl group – COOH. During the formation of proteins, amino group of one amino acid joins the carboxyl group of another amino acid.

This is called peptide bond. A simple protein consists of about 100 amino acid molecules. Proteins are basic building blocks of protoplasm. Most of the enzymes found in plants and animals are proteins or they occur in conjugation with proteins.

3. Lipids or fats: Fats consist of carbon, hydrogen, oxygen, nitrogen and phosphorus. These are mostly insoluble in water. Lipids are of three types — true fats, waxes and phospholipids. (a) True fats. These are made of glycerol and fatty acids. (b) Waxes.

These are lipids which are composed of fatty acids combined with long chain alcohols with 24 to 36 carbon atoms. These are found in combination with other substances as components of cell wall, e. g., suberin and cutin. (c) Phospholipids. They contain glycerol, fatty acids and atoms of phosphorus and nitrogen.

In plants, these occur in least amounts among the three classes of lipids. These provide structural framework for various cell membranes and cellular organelles. 4. Carbohydrates: These are made of carbon, hydrogen and oxygen. Typically, the hydrogen and oxygen atoms are present in 2: 1 ratio. The emperical formula of carbohydrates is CH2O.

On the basis of carbon atoms present, carbohydrates are divided into (i) monosaccharides, (ii) disaccharides and (iii) polysaccharides. (a) Monosaccharides or simple sugars. They contain 3 to 7 carbon atoms and are accordingly named as triose (3 carbon), tetrose (4 carbon), pentose (S carbon), hexose (6 carbon) and heptose (7 carbon) sugars.

Common monosaccharides are sweet tasting, colourless solids and are soluble in water (e. g., glucose). (b) Disaccharides. Two monosaccharides join together to form disaccharides (double sugars). Sucrose, maltose and lactose are the common disaccharides occurring in protoplasm. (c) Polysaccharides. They are composed of several monosaccharide units.

The constituent monosaccharide units may be similar (homopolysaccharides; e. g., starch, cellulose) or different (heteropolysaccharides; e.

g., pectin and chitins). Polysaccharides are tasteless and colourless amorphous powder which are little soluble in water, although some may form colloidal solution. Carbohydrates constitute about 1% of the protoplasm. On oxidation they give energy. Cellulose, pectin, chitin, etc., are important parts of the cell structure.

5. Inorganic substances: The essential inorganic substances found in the protoplasm are in the form of solution. These occur in ionic form. Calcium, magnesium, potassium and iron are the main cations while nitrate (NO3–), sulphate (SO4), phosphate (P04), chloride (Ñl–) and bicarbonate (HCO3) are the major anions.

Inorganic substances control pH of the cell and also influence numerous chemical reactions in the cell. 6. Nucleic acids: These are highly complex organic compounds, consisting of hydrogen, oxygen, carbon, nitrogen and phosphorus. These are of two types — Ribose Nucleic Acid (RNA) and Deoxyribose Nucleic Acid (DNA). Nucleic acid is made of many nucleotide units. Each nucleotide has three components — nitrogenous bases (purine or pyrimidine), pentose sugar (ribose or deoxyribose) and phosphoric acid. 7. Other substances: Besides the above major constituents, pigments, hormones, enzymes, alkaloides, latex, etc.

, are also found in the protoplasm. Cell Membrane:

Structure:

It is typical bilayer of lipids in which protein molecules are embedded. It may also contain sterol of various kinds. Cell membrane is not clearly visible under the light microscope but can be observed with electron microscope.

Two types of cell membranes are recognised — cytoplasmic membrane which surrounds the whole protoplasm and internal membrane which surrounds various cellular organelles. Following structures of cell membranes have been proposed by different workers.

1. Trilamellar structure: It was given by Danielli and Davson (1935). They suggested that cell membrane consists of a middle bimolecular layer of phospholipids, which is bounded on both sides by a protein layer (Fig. 1 A). The lipid molecule of each monomolecular layer has its hydrophilic and close to the protein layer while its hydrophobic end is away from it. 2.

Unit membrane concept: It was proposed by J. David Robertson (1959). He found that not only the cell membrane is trilamellar but most of the membranes of cellular organelles are also trilamellar (Fig. IB). Thus all the membranes in the cell are now called unit membranes. According to this concept, unit membrane is made of three layers.

3. Fluid mosaic model: It was given by Singer and Nicolson (1972). This is one of the most accepted views. It differs from Robertson’s model in the arrangement of proteins. According to this model, the proteins do not always cover the entire hydrophilic surface of the lipid bi layers but are of two types. These are: (i) Peripheral or extrinsic proteins.

The peripheral proteins are present superficially on the surface and can be easily removed, (ii) Integral or intrinsic proteins of the integral proteins, some are completely embedded in the lipid layer while other are partly embedded in the lipid layer and partly projected on the surface. These are tightly held and can not be easily removed. Lipids and integral proteins form a mosaic. The unit membrane is, hence, quasi-fluid (semifluid) in which lipids and integral proteins move within the bilamellar structure.

Chemical Composition:

Cell membrane is mainly made of lipids and proteins. About 60-80% of the substances are proteins, some of which act as enzymes. Lipids constitute about 20-40% of the total substances.

Besides, small amount of cellulose is also present. It is associated with proteins to give stability to the structure of cell membrane.

Functions:

The primary function of the cell membrane is the regulation of passage of various substances in and out of the cell. Some of the important functions of the cell membrane are given below: 1. Permeability: Cell membrane allows the movement of small ions and molecules in and out of the cell.

This membrane is selectively premeable. 2. Passive transport: Ions of different types move from their region of higher concentration to their region of lower concentration through cell membrane.

It is called passive transport because it does not require chemical energy. 3. Active transport: During this process molecules move against the normal diffusion gradient. The process is called active because it requires chemical energy. 4. Exocytosis and Endocytosis: Macromolecules are known out of the cell through exocytosis and ingested through endocytosis.

When the foreign substances ingested are fluids, the process is called pinacocytosis orpinocytosis, and if the substances ingested are solids, the process is known as phagocytosis. 5. Cellular recognition and adhesion: Two components of the cell membrane, glycoproteins and glycolipids, play an important role in selective adhesion of cells. It is due to this property of cell membrane that cells from different tissues like heart and liver do not adhere. Rejection or acceptance of transplanted tissues is determined by above mentioned components of the cell membrane.

This occurs in animals only because the cell membranes of adjacent cell come in contact.