DOWNLOAD PDF PLANT CELL PERSPECTIVE

Chapter 1 : Cell theory - Wikipedia

SH3P2 plays a crucial role at the step of membrane tubulation during cell plate formation in plants Technology Turbocharges Functional Genomics Secrets of the Forest: Volatiles First Discovered in Pine Trees Propagate Defense Signals Within and Between Plants.

Approximately a third of the genes in yeast code specifically for them, and this number is even higher in multicellular organisms. Integral proteins, peripheral proteins, and lipid-anchored proteins. Examples of integral proteins include ion channels, proton pumps, and g-protein coupled receptors. Ion channels allow inorganic ions such as sodium, potassium, calcium, or chlorine to diffuse down their electrochemical gradient across the lipid bilayer through hydrophilic pores across the membrane. The electrical behavior of cells i. Processes such as electron transport and generating ATP use proton pumps. G-protein coupled receptors are used in processes such as cell to cell signaling, the regulation of the production of cAMP, and the regulation of ion channels. As such, a large variety of protein receptors and identification proteins, such as antigens , are present on the surface of the membrane. Functions of membrane proteins can also include cellâ€"cell contact, surface recognition, cytoskeleton contact, signaling, enzymatic activity, or transporting substances across the membrane. Most membrane proteins must be inserted in some way into the membrane. Once inserted, the proteins are then transported to their final destination in vesicles, where the vesicle fuses with the target membrane. Function A detailed diagram of the cell membrane Illustration depicting cellular diffusion The cell membrane surrounds the cytoplasm of living cells, physically separating the intracellular components from the extracellular environment. The cell membrane also plays a role in anchoring the cytoskeleton to provide shape to the cell, and in attaching to the extracellular matrix and other cells to hold them together to form tissues. Fungi , bacteria , most archaea , and plants also have a cell wall , which provides a mechanical support to the cell and precludes the passage of larger molecules. The cell membrane is selectively permeable and able to regulate what enters and exits the cell, thus facilitating the transport of materials needed for survival. The movement of substances across the membrane can be either " passive ", occurring without the input of cellular energy, or " active ", requiring the cell to expend energy in transporting it. The membrane also maintains the cell potential. The cell membrane thus works as a selective filter that allows only certain things to come inside or go outside the cell. The cell employs a number of transport mechanisms that involve biological membranes: Passive osmosis and diffusion: Some substances small molecules, ions such as carbon dioxide CO_2 and oxygen O_2 , can move across the plasma membrane by diffusion, which is a passive transport process. Because the membrane acts as a barrier for certain molecules and ions, they can occur in different concentrations on the two sides of the membrane. Diffusion occurs when small molecules and ions move freely from high concentration to low concentration in order to equilibrate the membrane. It is considered a passive transport process because it does not require energy and is propelled by the concentration gradient created by each side of the membrane. Osmosis, in biological systems involves a solvent, moving through a semipermeable membrane similarly to passive diffusion as the solvent still moves with the concentration gradient and requires no energy. While water is the most common solvent in cell, it can also be other liquids as well as supercritical liquids and gases. Transmembrane protein channels and transporters: Transmembrane proteins extend through the lipid bilayer of the membranes; they function on both sides of the membrane to transport molecules across it. Such molecules can diffuse passively through protein channels such as aquaporins in facilitated diffusion or are pumped across the membrane by transmembrane transporters. Protein channel proteins, also called permeases, are usually quite specific, and they only recognize and transport a limited variety of chemical substances, often limited to a single substance. Another example of a transmembrane protein is a cell-surface receptor, which allow cell signaling molecules to communicate between cells. Endocytosis is the process in which cells absorb molecules by engulfing them. The plasma membrane creates a small deformation inward, called an invagination, in which the substance to be transported is captured. This invagination is caused by proteins on the outside on the cell membrane, acting as receptors and clustering into depressions that eventually promote accumulation of more proteins and lipids on the cytosolic side of the membrane. Endocytosis is a pathway for internalizing solid particles "cell eating" or phagocytosis , small molecules and ions "cell drinking" or pinocytosis , and macromolecules. Endocytosis requires energy and is thus a form of active transport. Just as material can be brought into the cell by invagination and formation of a vesicle, the membrane of a vesicle can be fused with the plasma membrane, extruding its contents to the surrounding medium. This is the process of exocytosis. Exocytosis occurs in various cells to remove undigested residues of substances brought in by endocytosis, to secrete substances such as hormones and enzymes, and to transport a substance completely across a cellular barrier. In the process of exocytosis, the undigested waste-containing food vacuole or the secretory vesicle budded from Golgi apparatus , is first moved by cytoskeleton from the interior of the cell to the surface. The vesicle membrane comes in contact with the plasma membrane. The lipid molecules of the two bilayers rearrange themselves and the two membranes are, thus, fused. A passage is formed in the fused membrane and the vesicles discharges its contents outside the cell Prokaryotes Prokaryotes are divided into two different groups, Archaea and Bacteria , with bacteria dividing further into gram-positive and gram-negative. Gram-negative bacteria have both a plasma membrane and an outer membrane separated by periplasm , however, other prokaryotes have only a plasma membrane. These two membranes differ in many aspects. The outer membrane of the gram-negative bacteria differ from other prokaryotes due to phospholipids forming the exterior of the bilayer, and lipoproteins and phospholipids forming the interior. The inner, plasma membrane is also generally symmetric whereas the outer membrane is asymmetric because of proteins such as the aforementioned. Also, for the prokaryotic membranes, there are multiple things that can affect the fluidity. One of the major factors that can affect the fluidity is fatty acid composition. This supports the concept that in higher temperatures, the membrane is more fluid than in colder temperatures. When the membrane is becoming more fluid and needs to become more stabilized, it will make longer fatty acid chains or saturated fatty acid chains in order to help stabilize the membrane. Some eukaryotic cells also have cell walls, but none that are made of peptidoglycan. For example, proteins on the surface of certain bacterial cells aid in their gliding motion. Nicolson , which replaced the earlier model of Davson and Danielli , biological membranes can be considered as a two-dimensional liquid in which lipid and protein molecules diffuse more or less easily. Examples of such structures are protein-protein complexes, pickets and fences formed by the actin-based cytoskeleton , and potentially lipid rafts. Lipid bilayer Diagram of the arrangement of amphipathic lipid molecules to form a lipid bilayer. The yellow polar head groups separate the grey hydrophobic tails from the aqueous cytosolic and extracellular environments. Lipid bilayers form through the process of self-assembly. The cell membrane consists primarily of a thin layer of amphipathic phospholipids that spontaneously arrange so that the hydrophobic "tail" regions are isolated from the surrounding water while the hydrophilic "head" regions interact with the intracellular cytosolic and extracellular faces of the resulting bilayer. This forms a continuous, spherical lipid bilayer. Hydrophobic interactions also known as the hydrophobic effect are the major driving forces in the formation of lipid bilayers. An increase in interactions between hydrophobic molecules causing clustering of hydrophobic regions allows water molecules to bond more freely with each other, increasing the entropy of the system. This complex interaction can include noncovalent interactions such as van der Waals , electrostatic and hydrogen bonds. Lipid bilayers are generally impermeable to ions and polar molecules. The arrangement of hydrophilic heads and hydrophobic tails of the lipid bilayer prevent polar solutes ex. This affords the cell the ability to control the movement of these substances via transmembrane protein complexes such as pores, channels and gates. Flippases and scramblases concentrate phosphatidyl serine , which carries a negative charge, on the inner membrane. Along with NANA , this creates an extra barrier to charged moieties moving through the membrane. Membranes serve diverse functions in eukaryotic and prokaryotic cells. One important role is to regulate the movement of materials into and out of cells. The phospholipid bilayer structure fluid mosaic model with specific membrane proteins accounts for the selective permeability of the membrane and passive and active transport mechanisms. In addition, membranes in prokaryotes and in the mitochondria and chloroplasts of eukaryotes facilitate the synthesis of ATP through chemiosmosis. Membrane polarity See also: Epithelial polarity Alpha intercalated cell The apical membrane of a polarized cell is the surface of the plasma membrane that faces inward to the lumen. This is particularly evident in epithelial and endothelial cells , but also describes other polarized cells, such as neurons. The basolateral membrane of a polarized cell is the surface of the plasma membrane that forms its basal and lateral surfaces. It faces outwards, towards the interstitium , and away from the lumen. Basolateral membrane is a compound phrase referring to the terms "basal base membrane" and "lateral side membrane", which, especially in epithelial cells, are identical in composition and activity. Proteins such as ion channels and pumps are free to move from the basal to the lateral surface of the cell or vice versa in accordance with the fluid mosaic model. Tight junctions join epithelial cells near their apical surface to prevent the migration of proteins from the basolateral membrane to the apical membrane. The basal and lateral surfaces thus remain roughly equivalent[clarification needed] to one another, yet distinct from the apical surface. Cell membrane can form different types of "supramembrane" structures such as caveola , postsynaptic density , podosome , invadopodium , focal adhesion , and different types of cell junctions. These structures are usually responsible for cell adhesion , communication, endocytosis and exocytosis. They can be visualized by electron microscopy or fluorescence microscopy. They are composed of specific proteins, such as integrins and cadherins. Cytoskeleton The cytoskeleton is found underlying the cell membrane in the cytoplasm and provides a scaffolding for membrane proteins to anchor to, as well as forming organelles that extend from the cell. Indeed, cytoskeletal elements interact extensively and intimately with the cell membrane. The cytoskeleton is able to form appendage-like organelles, such as cilia , which are microtubule -based extensions covered by the cell membrane, and filopodia , which are actin -based extensions. The apical surfaces of epithelial cells are dense with actin-based finger-like projections known as microvilli , which increase cell surface area and thereby increase the absorption rate of nutrients. Localized decoupling of the cytoskeleton and cell membrane results in formation of a bleb. Intracellular membranes The content of the cell, inside the cell membrane, is composed of numerous membrane-bound organelles, which contribute to the overall function of the cell. The origin, structure, and function of each organelle leads to a large variation in the cell composition due to the individual uniqueness associated with each organelle. Mitochondria and chloroplasts are considered to have evolved from bacteria, known as the endosymbiotic theory. This theory arose from the idea that Paracoccus and Rhodopseaudomonas, types of bacteria, share similar functions to mitochondria and blue-green algae, or cyanobacteria, share similar functions to chloroplasts. The endosymbiotic theory proposes that through the course of evolution, a eukaryotic cell engulfed these 2 types of bacteria, leading to the formation of mitochondria and chloroplasts inside eukaryotic cells. Considering that mitochondria and chloroplasts both contain their own DNA is further support that both of these organelles evolved from engulfed bacteria that thrived inside a eukaryotic cell. Materials move between the cytosol and the nucleus through nuclear pores in the nuclear membrane. The protein composition of the nucleus can vary greatly from the cytosol as many proteins are unable to cross through pores via diffusion. Within the nuclear membrane, the inner and outer membranes vary in protein composition, and only the outer membrane is continuous with the endoplasmic reticulum ER membrane.

Chapter 2 : History of Cell Biology - Bitesize Bio

The potential of plant cell culture for the production of commercially valuable secondary metabolites is reviewed. The techniques employed for large-scale plant cell suspension culture are largely.

Plant Cell Structure Plants are unique among the eukaryotes, organisms whose cells have membrane-enclosed nuclei and organelles, because they can manufacture their own food. Chlorophyll, which gives plants their green color, enables them to use sunlight to convert water and carbon dioxide into sugars and carbohydrates, chemicals the cell uses for fuel. Like the fungi, another kingdom of eukaryotes, plant cells have retained the protective cell wall structure of their prokaryotic ancestors. The basic plant cell shares a similar construction motif with the typical eukaryote cell, but does not have centrioles, lysosomes, intermediate filaments, cilia, or flagella, as does the animal cell. Plant cells do, however, have a number of other specialized structures, including a rigid cell wall, central vacuole, plasmodesmata, and chloroplasts. Although plants and their typical cells are non-motile, some species produce gametes that do exhibit flagella and are, therefore, able to move about. Plants can be broadly categorized into two basic types: Vascular plants are considered to be more advanced than nonvascular plants because they have evolved specialized tissues, namely xylem, which is involved in structural support and water conduction, and phloem, which functions in food conduction. Consequently, they also possess roots, stems, and leaves, representing a higher form of organization that is characteristically absent in plants lacking vascular tissues. The nonvascular plants, members of the division Bryophyta, are usually no more than an inch or two in height because they do not have adequate support, which is provided by vascular tissues to other plants, to grow bigger. They also are more dependent on the environment that surrounds them to maintain appropriate amounts of moisture and, therefore, tend to inhabit damp, shady areas. It is estimated that there are at least , species of plants in the world today. They range in size and complexity from small, nonvascular mosses to giant sequoia trees, the largest living organisms, growing as tall as feet meters. Only a tiny percentage of those species are directly used by people for food, shelter, fiber, and medicine. Indeed, all living organisms are dependent either directly or indirectly on the energy produced by photosynthesis, and the byproduct of this process, oxygen, is essential to animals. Plants also reduce the amount of carbon dioxide present in the atmosphere, hinder soil erosion, and influence water levels and quality. Plants exhibit life cycles that involve alternating generations of diploid forms, which contain paired chromosome sets in their cell nuclei, and haploid forms, which only possess a single set. Generally these two forms of a plant are very dissimilar in appearance. In higher plants, the diploid generation, the members of which are known as sporophytes due to their ability to produce spores, is usually dominant and more recognizable than the haploid gametophyte generation. In Bryophytes, however, the gametophyte form is dominant and physiologically necessary to the sporophyte form. Animals are required to consume protein in order to obtain nitrogen, but plants are able to utilize inorganic forms of the element and, therefore, do not need an outside source of protein. Plants do, however, usually require significant amounts of water, which is needed for the photosynthetic process, to maintain cell structure and facilitate growth, and as a means of bringing nutrients to plant cells. The amount of nutrients needed by plant species varies significantly, but nine elements are generally considered to be necessary in relatively large amounts. Termed macroelements, these nutrients include calcium, carbon, hydrogen, magnesium, nitrogen, oxygen, phosphorus, potassium, and sulfur. Seven microelements, which are required by plants in smaller quantities, have also been identified: Thought to have evolved from the green algae, plants have been around since the early Paleozoic era, more than million years ago. The earliest fossil evidence of land plants dates to the Ordovician Period to million years ago. By the Carboniferous Period, about million years ago, most of the Earth was covered by forests of primitive vascular plants, such as lycopods scale trees and gymnosperms pine trees, ginkgos. Cell Wall - Like their prokaryotic ancestors, plant cells have a rigid wall surrounding the plasma membrane. It is a far more complex structure, however, and serves a variety of functions, from protecting the cell to regulating the life cycle of the plant organism. Chloroplasts - The most important characteristic of plants is their ability to photosynthesize, in effect, to make their own food by converting light energy into chemical energy. This process is carried out in specialized organelles called chloroplasts. Endoplasmic Reticulum - The endoplasmic reticulum is a network of sacs that manufactures, processes, and transports chemical compounds for use inside and outside of the cell. It is connected to the double-layered nuclear envelope, providing a pipeline between the nucleus and the cytoplasm. In plants, the endoplasmic reticulum also connects between cells via the plasmodesmata. It modifies proteins and fats built in the endoplasmic reticulum and prepares them for export as outside of the cell. Microfilaments - Microfilaments are solid rods made of globular proteins called actin. These filaments are primarily structural in function and are an important component of the cytoskeleton. Mitochondria - Mitochondria are oblong shaped organelles found in the cytoplasm of all eukaryotic cells. Nucleus - The nucleus is a highly specialized organelle that serves as the information processing and administrative center of the cell. This organelle has two major functions: Peroxisomes - Microbodies are a diverse group of organelles that are found in the cytoplasm, roughly spherical and bound by a single membrane. There are several types of microbodies but peroxisomes are the most common. Plasmodesmata - Plasmodesmata are small tubes that connect plant cells to each other, providing living bridges between cells. Plasma Membrane - All living cells have a plasma membrane that encloses their contents. In prokaryotes and plants, the membrane is the inner layer of protection surrounded by a rigid cell wall. These membranes also regulate the passage of molecules in and out of the cells. Ribosomes - All living cells contain ribosomes, tiny organelles composed of approximately 60 percent RNA and 40 percent protein. In eukaryotes, ribosomes are made of four strands of RNA. In prokaryotes, they consist of three strands of RNA. Vacuole - Each plant cell has a large, single vacuole that stores compounds, helps in plant growth, and plays an important structural role for the plant. Leaf Tissue Organization - The plant body is divided into several organs: The leaves are the primary photosynthetic organs of plants, serving as key sites where energy from light is converted into chemical energy. Similar to the other organs of a plant, a leaf is comprised of three basic tissue systems, including the dermal, vascular, and ground tissue systems. These three motifs are continuous throughout an entire plant, but their properties vary significantly based upon the organ type in which they are located. All three tissue systems are discussed in this section. Send us an email. 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Chapter 3 : A chromatin perspective of plant cell cycle progression.

The potential of plant cell culture for the production of commercially valuable secondary metabolites is reviewed. The techniques employed for large-scale plant cell suspension culture are largely those developed for microbial culture, so the basic characteristics of the two types of culture are compared.

By Dan Rhoads The cell theory, or cell doctrine, states that all organisms are composed of similar units of organization, called cells. First Cells Seen in Cork While the invention of the telescope made the Cosmos accessible to human observation, the microsope opened up smaller worlds, showing what living forms were composed of. The cell was first discovered and named by Robert Hooke in He remarked that it looked strangely similar to cellula or small rooms which monks inhabited, thus deriving the name. However what Hooke actually saw was the dead cell walls of plant cells cork as it appeared under the microscope. The cell walls observed by Hooke gave no indication of the nucleus and other organelles found in most living cells. The first man to witness a live cell under a microscope was Anton van Leeuwenhoek , who in described the algae Spirogyra. Van Leeuwenhoek probably also saw bacteria. Formulation of the Cell Theory In , Theodor Schwann and Matthias Schleiden were enjoying after-dinner coffee and talking about their studies on cells. It has been suggested that when Schwann heard Schleiden describe plant cells with nuclei, he was struck by the similarity of these plant cells to cells he had observed in animal tissues. He summarized his observations into three conclusions about cells: The cell is the unit of structure, physiology, and organization in living things. The cell retains a dual existence as a distinct entity and a building block in the construction of organisms. Cells form by free-cell formation, similar to the formation of crystals spontaneous generation. We know today that the first two tenets are correct, but the third is clearly wrong. Modern Cell Theory All known living things are made up of cells. All cells come from pre-existing cells by division. Spontaneous Generation does not occur. Cells contains hereditary information which is passed from cell to cell during cell division. All cells are basically the same in chemical composition. It became possible to maintain, grow, and manipulate cells outside of living organisms. The first continuous cell line to be so cultured was in by George Otto Gey and coworkers, derived from cervical cancer cells taken from Henrietta Lacks, who died from her cancer in The cell line, which was eventually referred to as HeLa cells , have been the watershed in studying cell biology in the way that the structure of DNA was the significant breakthrough of molecular biology. In an avalanche of progress in the study of cells, the coming decade included the characterization of the minimal media requirements for cells and development of sterile cell culture techniques. It was also aided by the prior advances in electron microscopy, and later advances such as development of transfection methods, discovery of green fluorescent protein in jellyfish, and discovery of small interfering RNA siRNA , among others. He saw bacteria some 9 years later. Pringsheim observed how a sperm cell penetrated an egg cell. Cambridge Instruments produced the first commercial scanning electron microscope. Mouse embryonic stem cell line established. Landmark Papers in Cell Biology: Cold Spring Harbor Laboratory Press.

Chapter 4 : Structure of Animal Cell and Plant Cell Under Microscope + Diagrams

Type a term to search within all articles in this journal: e.g., stem cell.

Mitochondrion Rough Endoplasmic Reticulum That is a generalized plant cell structure, therefore not all 13 parts appear in every single plant cell. You already know the fact, the cell is the basic structural and functional unit of living beings. This means a cell does various tasks that it was designed to accomplish. Not every cell is the same copy of other. The cell structure must be adapted and changed according to the function it does in the body. This is known as Division of Labor which is presented in any living organism. This is the reason why your palm has a thicker skin unlike the skin of your face. Palm â€" Made from lots of cells â€" is designed to grip things and so it is thicker than other parts of the skin. And it is the same reason for your heart to distribute the blood throughout the body, lungs to transport Oxygen into the body while getting Carbon Dioxide out of the body and so on! A high efficiency is available for the cells to perform their functions when the structure is adapted according to its function. If you are into video gaming, you know that your ordinary laptop cannot play the best video games, because it is not designed to play games. If not, read the last 2 paragraphs again. Plant leaves are capable of doing something highly important to earth. As you guessed, it is Photosynthesis. The most required part for the Photosynthesis is Chlorophyll which is contained in the cells of plant leaves. In other words Chlorophyll is appearing only on plant leaf cells, it does not appear in the cells of roots. Perhaps, you may realize that there are many parts of the cells depending on the function. However for easy learning of the basic unit of structure of the cell, the scientists introduced the Generalized Cell structure which contains all the identified common parts of cells. If you were wondering what is an animal cell, below is your answer showing a picture of animal cell. Generalized Structure of an Animal Cell Diagram You know, Animal cell structure contains only 11 parts out of the 13 parts you saw in the plant cell diagram, because Chloroplast and Cell Wall are available only in a plant cell. Generalized Cell is used for structure of Animal Cell and Plant Cell to present the common parts, appearing in various parts of the bodies of animals and plants. There are various parts of the cell are known as Organelles â€" Subunits of the cell that performs its own sub functions to help the cell to do its job well. Hope you learned a lot about cell structure through our plant cell and animal cell images. More Lovely Science Pieces

Chapter 5 : Molecular Expressions Cell Biology: Plant Cell Structure

The first plant stem cell precursors are specified during embryogenesis, and Gerd JÃ¼rgens (TÃ¼bingen University) presented data on the involvement of the plant hormone auxin in specifying the precursors for the organizing quiescent cells in the plant embryo.

In the first century BC, Romans were able to make glass, discovering that objects appeared to be larger under the glass. The expanded use of lenses in eyeglasses in the 13th century probably led to wider spread use of simple microscopes magnifying glasses with limited magnification. Hooke also used a simpler microscope with a single lens for examining specimens with directly transmitted light, because this allowed for a clearer image. At some point in his life before , he was able to learn how to grind lenses. This eventually led to Leeuwenhoek making his own unique microscope. His were a single lens simple microscope, rather than a compound microscope. This was because he was able to use a single lens that was a small glass sphere but allowed for a magnification of x. This was a large progression since the magnification before was only a maximum of 50x. After Leeuwenhoek, there was not much progress for the microscopes until the s, two hundred years later. Carl Zeiss , a German engineer who manufactured microscopes, began to make changes to the lenses used. But the optical quality did not improve until the s when he hired Otto Schott and eventually Ernst Abbe. Later in the s, the electron microscope was developed, making it possible to view objects that are smaller than optical wavelengths, once again, changing the possibilities in science. The cell was first discovered by Robert Hooke in , which can be found to be described in his book Micrographia. Hooke discovered a multitude of tiny pores that he named "cells". However, Hooke did not know their real structure or function. With microscopes during this time having a low magnification, Hooke was unable to see that there were other internal components to the cells he was observing. Therefore, he did not think the "cellulae" were alive. In Micrographia, Hooke also observed mould, bluish in color, found on leather. This led to Hooke suggesting that spontaneous generation, from either natural or artificial heat, was the cause. Since this was an old Aristotelian theory still accepted at the time, others did not reject it and was not disproved until Leeuwenhoek later discovers generation is achieved otherwise. He made use of a microscope containing improved lenses that could magnify objects almost fold, or x. In a letter to The Royal Society on October 9, , he states that motility is a quality of life therefore these were living organisms. Over time, he wrote many more papers in which described many specific forms of microorganisms. He also found for the first time the sperm cells of animals and humans. Once discovering these types of cells, Leeuwenhoek saw that the fertilization process requires the sperm cell to enter the egg cell. This put an end to the previous theory of spontaneous generation. After reading letters by Leeuwenhoek, Hooke was the first to confirm his observations that were thought to be unlikely by other contemporaries. Biologists believed that there was a fundamental unit to life, but were unsure what this was. It would not be until over a hundred years later that this fundamental unit was connected to cellular structure and existence of cells in animals or plants. In , Karl Rudolphi and J. Cell theory Theodor Schwann â€" Credit for developing cell theory is usually given to two scientists: Theodor Schwann and Matthias Jakob Schleiden. In , Schleiden suggested that every structural part of a plant was made up of cells or the result of cells. He also suggested that cells were made by a crystallization process either within other cells or from the outside. He claimed this theory as his own, though Barthelemy Dumortier had stated it years before him. This crystallization process is no longer accepted with modern cell theory. In , Theodor Schwann states that along with plants, animals are composed of cells or the product of cells in their structures. From these conclusions about plants and animals, two of the three tenets of cell theory were postulated. All living organisms are composed of one or more cells 2. In Latin, this tenet states Omnis cellula e cellula. All cells arise only from pre-existing cells However, the idea that all cells come from pre-existing cells had in fact already been proposed by Robert Remak; it has been suggested that Virchow plagiarized Remak and did not give him credit. He instead said that binary fission , which was first introduced by Dumortier, was how reproduction of new animal cells were made. Once this tenet was added, the classical cell theory was complete. Modern interpretation The generally accepted parts of modern cell theory include: All known living things are made up of one or more cells [17] All living cells arise from pre-existing cells by division. The cell is the fundamental unit of structure and function in all living organisms. Energy flow occurs within cells. The first cell theory is credited to the work of Theodor Schwann and Matthias Jakob Schleiden in the s. In this theory the internal contents of cells were called protoplasm and described as a jelly-like substance, sometimes called living jelly. At about the same time, colloidal chemistry began its development, and the concepts of bound water emerged. A colloid being something between a solution and a suspension , where Brownian motion is sufficient to prevent sedimentation. The idea of a semipermeable membrane , a barrier that is permeable to solvent but impermeable to solute molecules was developed at about the same time. In this view, the cell was seen to be enclosed by a thin surface, the plasma membrane , and cell water and solutes such as a potassium ion existed in a physical state like that of a dilute solution. In Hamburger used hemolysis of erythrocytes to determine the permeability of various solutes. By measuring the time required for the cells to swell past their elastic limit, the rate at which solutes entered the cells could be estimated by the accompanying change in cell volume. Evolution of the membrane and bulk phase theories Two opposing concepts developed within the context of studies on osmosis , permeability, and electrical properties of cells. The membrane theory developed as a succession of ad-hoc additions and changes to the theory to overcome experimental hurdles. Overton a distant cousin of Charles Darwin first proposed the concept of a lipid oil plasma membrane in The major weakness of the lipid membrane was the lack of an explanation of the high permeability to water, so Nathansohn proposed the mosaic theory. In this view, the membrane is not a pure lipid layer, but a mosaic of areas with lipid and areas with semipermeable gel. Ruhland refined the mosaic theory to include pores to allow additional passage of small molecules. Since membranes are generally less permeable to anions , Leonor Michaelis concluded that ions are adsorbed to the walls of the pores, changing the permeability of the pores to ions by electrostatic repulsion. Michaelis demonstrated the membrane potential and proposed that it was related to the distribution of ions across the membrane. Loeb also studied gelatin extensively, with and without a membrane, showing that more of the properties attributed to the plasma membrane could be duplicated in gels without a membrane. Some criticisms of the membrane theory developed in the s, based on observations such as the ability of some cells to swell and increase their surface area by a factor of A lipid layer cannot stretch to that extent without becoming a patchwork thereby losing its barrier properties. Such criticisms stimulated continued studies on protoplasm as the principal agent determining cell permeability properties. In , Fischer and Suer proposed that water in the protoplasm is not free but in a chemically combined formâ€”the protoplasm represents a combination of protein, salt and waterâ€”and demonstrated the basic similarity between swelling in living tissues and the swelling of gelatin and fibrin gels. Dimitri Nasonov viewed proteins as the central components responsible for many properties of the cell, including electrical properties. By the s, the bulk phase theories were not as well developed as the membrane theories. This drove the concept that cells are in a state of dynamic equilibrium , constantly using energy to maintain ion gradients. In , Karl Lohmann discovered ATP and its role as a source of energy for cells, so the concept of a metabolically-driven sodium pump was proposed. The tremendous success of Hodgkin , Huxley , and Katz in the development of the membrane theory of cellular membrane potentials, with differential equations that modeled the phenomena correctly, provided even more support for the membrane pump hypothesis. The modern view of the plasma membrane is of a fluid lipid bilayer that has protein components embedded within it. The structure of the membrane is now known in great detail, including 3D models of many of the hundreds of different proteins that are bound to the membrane. These major developments in cell physiology placed the membrane theory in a position of dominance and stimulated the imagination of most physiologists, who now apparently accept the theory as factâ€”there are, however, a few dissenters. Troshin published a book, The Problems of Cell Permeability, in Russian in German, in Chinese, in English in which he found that permeability was of secondary importance in determination of the patterns of equilibrium between the cell and its environment. Troshin showed that cell water decreased in solutions of galactose or urea although these compounds did slowly permeate cells. Since the membrane theory requires an impermanent solute to sustain cell shrinkage, these experiments cast doubt on the theory. Such questions became even more urgent as dozens of new metabolic pumps were added as new chemical gradients were discovered. In , Gilbert Ling became the champion of the bulk phase theories and proposed his association-induction hypothesis of living cells.

Chapter 6 : Cell membrane - Wikipedia

The basic plant cell has a similar construction to the animal cell, but does not have centrioles, lysosomes, cilia, or flagella. It does have additional structures, a rigid cell wall, central vacuole, plasmodesmata, and chloroplasts.

Cell Theory and Cell Structure Photo by: These simple and powerful statements form the basis of the cell theory, first formulated by a group of European biologists in the mids. So fundamental are these ideas to biology that it is easy to forget they were not always thought to be true. Hooke first described cells in Early Observations The invention of the microscope allowed the first view of cells. English physicist and microscopist Robert Hooke â€” first described cells in He made thin slices of cork and likened the boxy partitions he observed to the cells small rooms in a monastery. The open spaces Hooke observed were empty, but he and others suggested these spaces might be used for fluid transport in living plants. He did not propose, and gave no indication that he believed, that these structures represented the basic unit of living organisms. Grew likened the cellular spaces to the gas bubbles in rising bread and suggested they may have formed through a similar process. The presence of cells in animal tissue was demonstrated later than in plants because the thin sections needed for viewing under the microscope are more difficult to prepare for animal tissues. At the time, virtually all biologists were convinced that organisms were composed of some type of fundamental unit, and it was these "atomistic" preconceptions that drove them to look for such units. While improvements in microscopy made their observations better, it was the underlying belief that there was some fundamental substructure that made the microscope the instrument of choice in the study of life. In the Dutch microscopist Antony van Leeuwenhoek â€” published his observations of single-cell organisms, or "little animalcules" as he called them. It is likely that Leeuwenhoek was the first person to observe a red blood cell and a sperm cell. Leeuwenhoek made numerous and detailed observations on his microorganisms, but more than one hundred years passed before a connection was made between the obviously cellular structure of these creatures and the existence of cells in animals or plants. The Development of the Cell Theory In Frenchman Henri Milne-Edwards suggested that the basic structure of all animal tissues was an array of "globules," though his insistence on uniform size for these globules puts into question the accuracy of his observations. Henri Dutrochet â€” made the connection between plant cells and animal cells explicit, and he proposed that the cell was not just a structural but also a physiological unit: Raspail was the first to state one of the two major tenets of cell theory: Omnis cellula e cellula, which means "Every cell is derived from another cell. Raspail was also the founder of cell biochemistry, making experiments on the chemical composition of the cell and their response to changing chemical environments. In Barthelemy Dumortier â€” of France described "binary fission" cell division in plants. He observed the formation of a mid-line partition between the original cell and the new cell, which, Dumortier noted, "seems to us to provide a perfectly clear explanation of the origin and development of cells, which has hitherto remained unexplained" Harris , p. The discovery of cell division is usually attributed to Hugo von Mohl â€” , but Dumortier proceeded him in this regard. Von Mohl did coin the word "protoplasm" for the material contained in the cell. The first unequivocal description of the cell nucleus was made by a Czech, Franz Bauer, in and was given its name in by Robert Brown â€” of Scotland, who is best remembered for discovering the random "Brownian" motion of molecules. The first accurate description of the nucleolus was made in Schleiden and Schwann, who are usually given credit for elucidating the cell theory, made their marks in and In Matthais Schleiden â€” proposed that every structural element of plants is composed of cells or the products of cells. However, Schleiden insisted on priority for several ideas that were not his and clung to the idea that cells arise by a crystallization-like process either within other cells or from outside, which Dumortier had dispensed with some years earlier. In a fellow German, Theodor Schwann â€” , proposed that in animals too every structural element is composed of cells or cell products. In addition, Schwann made the explicit claim that the fundamental laws governing cells were identical between plants and animals: Purkinje was the premiere cytologist of his day, and one of the most influential formulators of the cell theory. He gave his name to structures throughout the body, including the Purkinje cells of the cerebellum. Purkinje, in fact, deserves much of the credit that usually goes to Schwann, for in he proposed not only that animals were composed principally of cells and cell products though he left room for fibers but also that the "basic cellular tissue is again clearly analogous to that of plants" Harris , p. Unfortunately, Schwann did not credit Purkinje in his influential publication. Reproduction and Inheritance Despite the work of Dumortier, the origins of new cells remained controversial and confused. In a German, Robert Remak â€” , published his observations on cell division, stating categorically that the generation schemes proposed by Schleiden and Schwann were wrong. Based on his observations of embryos, Remak stated instead that binary fission was the means of reproduction of new animal cells. This view was widely publicized not by Remak but by Rudolf Virchow â€” , unfortunately without crediting Remak. Virchow is also usually given the credit for the phrase Omnis cellula e cellula, indicating the importance of cell division in the creation of new cells. The understanding of the central importance of chromosomes lagged well behind their discovery. In Walther Flemming â€” noted that the chromosomes split longitudinally during mitosis a term he introduced. Wilhelm Roux â€” proposed that each chromosome carried a different set of hereditable elements and suggested that the longitudinal splitting observed by Flemming ensured the equal division of these elements. This scheme was confirmed in by Theodor Boveri â€” The chemical nature of the gene was determined in a series of experiments over the next fifty years, culminating in the determination of the structure of deoxyribonucleic acid DNA in by James Watson and Francis Crick. Modern Advances The modern understanding of cellular substructure began with the use of the electron microscope. Keith Porter â€” was a pioneer in this field and was the first to identify the endoplasmic reticulum and many elements of the cytoskeleton. The explosion of knowledge brought about by improvements in microscopy, biochemistry, and genetics has led to a depth of understanding of cell structure and function undreamed of by the earliest cell biologists.

Chapter 7 : e-Book on plant virus infectionâ€”a cell biology perspective

Plants will have a primary cell wall and sometimes a secondary wall as well. These two major parts are what determines the function of each individual plant cell.).

Nelson Find articles by Richard S. Schoelz Find articles by James E. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in other forums, provided the original authors and source are credited and subject to any copyright notices concerning any third-party graphics etc. This article has been cited by other articles in PMC. Plant viruses cause extensive remodeling of infected cells. These structural alterations include reshaping of large organelles e. These alterations have a profound impact on plant physiology and development. However, it is only recently that studies have deeply investigated the biogenesis of virus-induced structures and their biological function s. Novel techniques that allow easy expression of viral proteins or modified viral genomes in plants combined with powerful visualization tools [e. Other morphological changes e. Finally, induction of autophagosomes and modification of large organelles have been observed in association with the innate immune response. This e-Book on Plant Virus Infectionâ€”a Cell Biology Perspective aims at providing the latest information on the molecular and cellular requirements that underlie the biogenesis of these virus-induced structures. First, we have a look at a non-virus pathogen: In contrast to a virus, the viroid genome is composed of a tiny circular RNA â€" nt that does not code for proteins. Nevertheless, viroid infections are accompanied by cellular and developmental disorders that sometimes have dramatic economic consequences, for instance the cadang-cadang disease of coconut palms. Di Serio et al. In their review, Patarroyo et al. They provide an overview of the plant secretory pathway and discuss recent advances in our understanding of how viruses utilize and alter this system in order to permit such processes as replication, intra- and inter-cellular movement. The membrane often targeted by these viral proteins is the endoplasmic reticulum. In reviewing the latest cell biological studies describing tobacco mosaic virus TMV replication and movement, Liu and Nelson highlight how a divergent function of two orthologous proteins may explain different infection requirements by two tobamoviruses. The authors review the many publications showing influences or interactions of proteins encoded by TMV as infections develop. The complexity of the interactions and their proposed functions for just this one virus are striking. The findings from multiple laboratories strongly suggest that the host membrane is a primary vehicle for tobamovirus intercellular movement and that the cytoskeleton has a role in modulating movement for only some members. The triple gene block TBG proteins are the focus of several contributions. First, Solovyev et al. The authors provide links between virus cell-to-cell trafficking and replication, silencing suppression, virus systemic spread over the plant, and the roles of the nucleus in plant virus movement. Indeed, TGB proteins may have multiple functions in the viral infection process. Specifically, they found that previously observed granular structures produced by TGB2 and TGB3 proteins are fine membrane doughnut-shaped loops of remodeled tubular ER containing the viral proteins. These loops form dense arrays wrapped around the TGB1 protein inclusions. These findings provide new insights into the structural organization of a PVX complex considered as a virus factory. Interestingly, a second research paper studying a different Potexvirus genus member, alternanthera mosaic virus AltMV , provides insight into how its TGB3 protein may function to modify its target, the chloroplast and its membranes. In this study, Jang et al. They also found that TGB3 interacts with a nuclear-encoded chloroplast protein that may result in a destabilization of the thylakoid membranes. While shedding light on an influence of a viral protein on another membrane system, this and the previous study on PVX indicate how conserved proteins may have diverged in function. In another research paper, Cowan et al. Protein-lipid interaction assays confirmed the association of TGB2 with lipids of chloroplasts. Consistently, EM data revealed abnormal chloroplasts with cytoplasmic inclusions and terminal projections. Viral cell-to-cell movement remains a hot topic for plant virologists. They also found that NSvc4 contains a chloroplast-targeting signal and localizes to chloroplasts in infected cells, suggesting NSvc4 may also be a multi-functional protein. In their hypothesis and theory article, Krenz et al. They provide evidence that abutilon mosaic virus AbMV infection induces a network of stromules that extend from the plastid to the cellular periphery. The stromules contain heat shock cognate 70 kDa protein, a plant chaperone that interacts with the AbMV movement protein. The authors discuss a model in which AbMV traffics along the stromule network to move into neighboring cells. Cellular remodeling is also the consequence of molecular pathways being overpowered by viruses. Verchot explores the recruitment of host proteins, such as cellular chaperones, to membrane bound sites required for virus replication and cell-to-cell movement. She discusses the possibilities that cellular chaperones are acting within their normal context to enable viral protein folding, trafficking, and functioning, or whether they are diverted from their normal activities to provide novel contributions to virus infection. Zhang and Wang summarize current knowledge about the unfolded protein response UPR in cells, which is a reaction to ER stress triggered by the accumulation of unfolded or misfolded proteins in the lumen of the endoplasmic reticulum. Both animal and plant viruses are capable of redirecting the cell to produce large amounts of viral proteins, which causes ER stress and sets in motion the UPR signaling pathways. Zhang and Wang discuss how viral infections activate the UPR and implications for host physiology. Bujarski gives an overview of genetic recombination in plant positive-sense RNA viruses. Genetic recombination in plant-infecting messenger-sense RNA viruses: The potato mop-top virus TGB2 protein and viral RNA associate with chloroplasts and viral infection induces inclusions in the plastids. Cytopathic effects incited by viroid RNAs and putative underlying mechanisms. Insights into Alternanthera mosaic virus TGB3 functions: The induction of stromule formation by a plant DNA-virus in epidermal leaf tissues suggests a novel intra- and intercellular macromolecular trafficking route. Unraveling the structure of viral replication complexes at super-resolution. The cell biology of Tobacco mosaic virus replication and movement. Hijack it, change it: Investigating the role of viral integral membrane proteins in promoting the assembly of nepovirus and comovirus replication factories. Recent advances in research of plant virus movement mediated by triple gene block. Cellular chaperones and folding enzymes are vital contributors to membrane bound replication and movement complexes during plant RNA virus infection. Role of rice stripe virus NSvc4 in cell-to-cell movement and symptom development in Nicotiana benthamiana. Virus-induced ER stress and the unfolded protein response.

Chapter 8 : Plant cell reactorsâ€”A perspective | Sant Bhojwani and Saroj Mishra - blog.quintoapp.com

The cell theory, or cell doctrine, states that all organisms are composed of similar units of organization, called cells. The concept was formally articulated in by Schleiden & Schwann and has remained as the foundation of modern biology. The idea predates other great paradigms of biology.