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Chapter 1 : Cell Structures and Functions by Katherine Rasche on Prezi

Large organic molecules made up of carbon, hydrogen, nitrogen, and in some cases, sulfur. Transport proteins also carry molecules out of cells in a similar way.

Bring fact-checked results to the top of your browser search. The process of differentiation Differentiation from visibly undifferentiated precursor cells occurs during embryonic development , during metamorphosis of larval forms, and following the separation of parts in asexual reproduction. It also takes place in adult organisms during the renewal of tissues and the regeneration of missing parts. Thus, cell differentiation is an essential and ongoing process at all stages of life. The visible differentiation of cells is only the last of a progressive sequence of states. In each state, the cell becomes increasingly committed toward one type of cell into which it can develop. Although states of specification and determination both represent differential gene activity, the properties of embryonic cells are not necessarily the same as those of fully differentiated cells. In particular, cells in specification states are usually not stable over prolonged periods of time. Two mechanisms bring about altered commitments in the different regions of the early embryo: Cytoplasmic localization is evident in the earliest stages of development of the embryo. During this time, the embryo divides without growth , undergoing cleavage divisions that produce separate cells called blastomeres. Each blastomere inherits a certain region of the original egg cytoplasm , which may contain one or more regulatory substances called cytoplasmic determinants. When the embryo has become a solid mass of blastomeres called a morula , it generally consists of two or more differently committed cell populationsâ€”a result of the blastomeres having incorporated different cytoplasmic determinants. Cytoplasmic determinants may consist of mRNA or protein in a particular state of activation. An example of the influence of a cytoplasmic determinant is a receptor called Toll, located in the membranes of Drosophila fruit fly eggs. Activation of Toll ensures that the blastomeres will develop into ventral underside structures, while blastomeres containing inactive Toll will produce cells that will develop into dorsal back structures. In induction, the second mechanism of commitment, a substance secreted by one group of cells alters the development of another group. In early development, induction is usually instructive; that is, the tissue assumes a different state of commitment in the presence of the signal than it would in the absence of the signal. Inductive signals often take the form of concentration gradients of substances that evoke a number of different responses at different concentrations. This leads to the formation of a sequence of groups of cells, each in a different state of specification. For example, in Xenopus clawed frog the early embryo contains a signaling centre called the organizer that secretes inhibitors of bone morphogenetic proteins BMPs , leading to a ventral-to-dorsal belly-to-back gradient of BMP activity. The activity of BMP in the ventral region of the embryo suppresses the expression of transcription factors involved in the formation of the central nervous system and segmented muscles. Suppression ensures that these structures are formed only on the dorsal side, where there is decreased activity of BMP. The final stage of differentiation often involves the formation of several types of differentiated cells from one precursor or stem cell population. Terminal differentiation occurs not only in embryonic development but also in many tissues in postnatal life. Control of this process depends on a system of lateral inhibition in which cells that are differentiating along a particular pathway send out signals that repress similar differentiation by their neighbours. For example, in the developing central nervous system of vertebrates, neurons arise from a simple tube of neuroepithelium, the cells of which possess a surface receptor called Notch. These cells also possess another cell surface molecule called Delta that can bind to and activate Notch on adjacent cells. Activation of Notch initiates a cascade of intracellular events that results in suppression of Delta production and suppression of neuronal differentiation. This means that the neuroepithelium generates only a few cells with high expression of Delta surrounded by a larger number of cells with low expression of Delta. High Delta production and low Notch activation makes the cells develop into neurons. Low Delta production and high Notch activation makes the cells remain as precursor cells or become glial supporting

cells. A similar mechanism is known to produce the endocrine cells of the pancreas and the goblet cells of the intestinal epithelium. Such lateral inhibition systems work because cells in a population are never quite identical to begin with. There are always small differences, such as in the number of Delta molecules displayed on the cell surface. The mechanism of lateral inhibition amplifies these small differences, using them to bring about differential gene expression that leads to stable and persistent states of cell differentiation. Errors in differentiation Three classes of abnormal cell differentiation are dysplasia , metaplasia , and anaplasia. Dysplasia indicates an abnormal arrangement of cells, usually arising from a disturbance in their normal growth behaviour. Some dysplasias are precursor lesions to cancer , whereas others are harmless and regress spontaneously. For example, dysplasia of the uterine cervix , called cervical intraepithelial neoplasia CIN , may progress to cervical cancer. It can be detected by cervical smear cytology tests Pap smears. Metaplasia is the conversion of one cell type into another. In fact, it is not usually the differentiated cells themselves that change but rather the stem cell population from which they are derived. Metaplasia commonly occurs where chronic tissue damage is followed by extensive regeneration. For example, squamous metaplasia of the bronchi occurs when the ciliated respiratory epithelial cells of people who smoke develop into squamous, or flattened, cells. In intestinal metaplasia of the stomach , patches resembling intestinal tissue arise in the gastric mucosa , often in association with gastric ulcers. Both of these types of metaplasia may progress to cancer. Anaplasia is a loss of visible differentiation that can occur in advanced cancer. In general, early cancers resemble their tissue of origin and are described and classified by their pattern of differentiation. However, as they develop, they produce variants of more abnormal appearance and increased malignancy. Finally, a highly anaplastic growth can occur, in which the cancerous cells bear no visible relation to the parent tissue. The evolution of cells The development of genetic information Life on Earth could not exist until a collection of catalysts appeared that could promote the synthesis of more catalysts of the same kind. Early stages in the evolutionary pathway of cells presumably centred on RNA molecules, which not only present specific catalytic surfaces but also contain the potential for their own duplication through the formation of a complementary RNA molecule. It is assumed that a small RNA molecule eventually appeared that was able to catalyze its own duplication. Molecules of RNA that acquired variations that increased the speed or the fidelity of self-replication would have outmultiplied other, less-competent RNA molecules. In addition, other small RNA molecules that existed in symbiosis with autocatalytic RNA molecules underwent natural selection for their ability to catalyze useful secondary reactions such as the production of better precursor molecules. In this way, sophisticated families of RNA catalysts could have evolved together, since cooperation between different molecules produced a system that was much more effective at self-replication than a collection of individual RNA catalysts. Another major step in the evolution of the cell would have been the development, in one family of self-replicating RNA, of a primitive mechanism of protein synthesis. Protein molecules cannot provide the information for the synthesis of other protein molecules like themselves. This information must ultimately be derived from a nucleic acid sequence. Protein synthesis is much more complex than RNA synthesis, and it could not have arisen before a group of powerful RNA catalysts evolved. Each of these catalysts presumably has its counterpart among the RNA molecules that function in the current cell: At some point in the evolution of biological catalysts, the first cell was formed. This would have required the partitioning of the primitive biological catalysts into individual units, each surrounded by a membrane. Membrane formation might have occurred quite simply, since many amphiphilic moleculesâ€”half hydrophobic water-repelling and half hydrophilic water-loving â€”aggregate to form bilayer sheets in which the hydrophobic portions of the molecules line up in rows to form the interior of the sheet and leave the hydrophilic portions to face the water. Such bilayer sheets can spontaneously close up to form the walls of small, spherical vesicles, as can the phospholipid bilayer membranes of present-day cells. Lipid molecules of this composition spontaneously form aggregate structures such as micelles and lipid bilayers, with their hydrophilic ends oriented toward the watery medium and their hydrophobic ends shielded from the water. As soon as the biological catalysts became compartmentalized into small individual units, or cells, the units

would have begun to compete with one another for the same resources. The active competition that ensued must have greatly accelerated evolutionary change, serving as a powerful force for the development of more efficient cells. In this way, cells eventually arose that contained new catalysts, enabling them to use simpler, more abundant precursor molecules for their growth. Because these cells were no longer dependent on preformed ingredients for their survival, they were able to spread far beyond the limited environments where the first primitive cells arose. It is often assumed that the first cells appeared only after the development of a primitive form of protein synthesis. However, it is by no means certain that cells cannot exist without proteins, and it has been suggested that the first cells contained only RNA catalysts. In either case, protein molecules, with their chemically varied side chains, are more powerful catalysts than RNA molecules; therefore, as time passed, cells arose in which RNA served primarily as genetic material, being directly replicated in each generation and inherited by all progeny cells in order to specify proteins. As cells became more complex, a need would have arisen for a stabler form of genetic information storage than that provided by RNA. DNA , related to RNA yet chemically stabler, probably appeared rather late in the evolutionary history of cells. It was only at this point that the central process of biologyâ€"the synthesis, one after the other, of DNA, RNA, and proteinâ€"appeared. The development of metabolism The first cells presumably resembled prokaryotic cells in lacking nuclei and functional internal compartments, or organelles. These early cells were also anaerobic not requiring oxygen , deriving their energy from the fermentation of organic molecules that had previously accumulated on the Earth over long periods of time. Eventually, more sophisticated cells evolved that could carry out primitive forms of photosynthesis , in which light energy was harnessed by membrane-bound proteins to form organic molecules with energy-rich chemical bonds. A major turning point in the evolution of life was the development of photosynthesizing prokaryotes requiring only water as an electron donor and capable of producing molecular oxygen. The descendants of these prokaryotes, the blue-green algae cyanobacteria , still exist as viable life-forms. Their ancestors prospered to such an extent that the atmosphere became rich in the oxygen they produced. The free availability of this oxygen in turn enabled other prokaryotes to evolve aerobic forms of metabolism that were much more efficient in the use of organic molecules as a source of food. The switch to predominantly aerobic metabolism is thought to have occurred in bacteria approximately 2 billion years ago, about 1. Aerobic eukaryotic cells cells containing nuclei and all the other organelles probably appeared about 1. Eukaryotic cells almost certainly became aerobic by engulfing aerobic prokaryotes, with which they lived in a symbiotic relationship. The mitochondria found in both animals and plants are the descendants of such prokaryotes. Later, in branches of the eukaryotic lineage leading to plants and algae , a blue-green algaelike organism was engulfed to perform photosynthesis. It is likely that over a long period of time these organisms became the chloroplasts. The eukaryotic cell thus apparently arose as an amalgam of different cells, in the process becoming an efficient aerobic cell whose plasma membrane was freed from energy metabolismâ€"one of the major functions of the cell membrane of prokaryotes. The eukaryotic cell membrane was therefore able to become specialized for cell-to-cell communication and cell signaling. It may be partly for this reason that eukaryotic cells were eventually more successful at forming complex multicellular organisms than their simpler prokaryotic relatives. The history of cell theory Formulation of the theory Early observations The history of cell theory is a history of the actual observation of cells, because early prediction and speculation about the nature of the cell were generally unsuccessful. English physicist Robert Hooke , who described cork and other plant tissues in , introduced the term cell because the cellulose walls of dead cork cells reminded him of the blocks of cells occupied by monks. Even after the publication in of excellent pictures of plant tissues, no significance was attached to the contents within the cell walls. The magnifying powers of the microscope and the inadequacy of techniques for preparing cells for observation precluded a study of the intimate details of the cell contents. Such discoveries extended the known variety of living things but did not bring insight into their basic uniformity. Moreover, when Leeuwenhoek observed the swarming of his animalcules but failed to observe their division, he could only reinforce the idea that they arose spontaneously.

Chapter 2 : Cell - The process of differentiation | calendrierdelascience.com

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What Is an Organelle in a Cell? Much like an organ serves a specific function in an organism, such as an eye helps a fish see or a stamen helps a flower reproduce, organelles each have specific functions within cells. Cells are self-contained systems within their respective organisms, and the organelles inside of them work together like components of an automated machine to keep things operating smoothly. Many things float around in a cell, and not all of them are organelles. Some are called inclusions, which is a category for items such as stored cell products or foreign bodies that made their way into the cell, like viruses or debris. Most, but not all organelles are surrounded by a membrane to protect them from the cytoplasm they are floating in, but this is usually not true of cellular inclusions. They are self-contained systems within their respective organisms, and the organelles inside of them work together like components of an automated machine to keep things operating smoothly. Most are bound in one or two membranes to separate it from the cytoplasm that fills the cell. Some of the most vital organelles are the nucleus, the endoplasmic reticulum, the Golgi apparatus, the lysosomes and the mitochondria, although there are many more. He was astonished to find marked similarities between such different materials, which all reminded him of a honeycomb. He coined them cellulae, which translated from the Latin, means little rooms; in modern English, these pores are familiar to students and scientists as cells. He named this part of the cell the nucleus, the Latin word for kernel. He stated that the cytoblast was the most important part of the cell, since he believed it formed the rest of the parts of the cell. He theorized that the nucleus â€" as it is again referred to today â€" was responsible for the varying appearances of cells in different species of plant and in different parts of an individual plant. As a botanist, Schleiden studied plants exclusively, but when he collaborated with the German physiologist Theodor Schwann, his ideas about the nucleus would be shown to hold true about animal and other species cells as well. He had been laboring to come up with a unifying theory that explained the variations in all the cells of living things; like so many other scientists of the time, he sought a theory that encompassed the differences in all of the many types of cells he was viewing under the microscope, but one that still allowed them all to be counted as cells. Animal cells come in a great many structures. Together, they proposed a cell theory with the following tenets: Cells are the building blocks of all living organisms. The vital phenomena of one are repeated, entirely or in part, in all the rest. For the next few decades, their cell theory was debated, and other theories were put forth. To this day, however, much of what the two German scientists posited in the s is considered accurate in the biological fields. In the following years, microscopy allowed the discovery of more details of the insides of cells. He called this substance protoplasm. He and other scientists noted that protoplasm contained small, suspended items within it. A period of great interest in the protoplasm, which came to be called cytoplasm, began. In time, using improving methods of microscopy, scientists would enumerate the organelles of the cell and their functions. The Largest Organelle The largest organelle in a cell is the nucleus. As Matthias Schleiden discovered in the early 19th century, the nucleus serves as the center of cell operations. Deoxyribose nucleic acid, better known as deoxyribonucleic acid or DNA, holds the genetic information for the organism and is transcribed and stored in the nucleus. The nucleus is also the locus of cell division, which is how new cells are formed. The nucleus is separated from the surrounding cytoplasm that fills the cell by a nuclear envelope. This is a double membrane that is periodically interrupted by pores through which genes that have been transcribed into strands of ribonucleic acid, or RNA â€" that becomes messenger RNA, or mRNA â€" pass to other organelles called endoplasmic reticulum outside the nucleus. The outer membrane of the nuclear membrane is connected to the membrane that surrounds the endoplasmic membrane, which facilitates the transfer of the genes. This is the endomembrane system, and it also includes the Golgi apparatus, lysosomes, vacuoles, vesicles and the cell membrane. The inner membrane of the nuclear

envelope does the primary work of protecting the nucleus. Protein Synthesis Network The endoplasmic reticulum is a network of channels extending from the nucleus, and which is enclosed in a membrane. The channels are called cisternae. There are two types of endoplasmic reticulum: They are connected and are part of the same network, but the two types of endoplasmic reticulum have different functions. The smooth endoplasmic reticulum synthesizes lipids, especially steroids. It helps in the breakdown of steroids and carbohydrates as well, and it detoxifies alcohol and other drugs that enter the cell. It also contains proteins that move calcium ions into the cisternae, allowing the smooth endoplasmic reticulum to serve as a storage location for calcium ions and as a regulator of their concentrations. The rough endoplasmic reticulum is connected to the outer membrane of the nuclear membrane. Ribosomes are not enclosed in membranes. The rough endoplasmic reticulum synthesizes proteins that get sent outside of the cell, or packaged inside other organelles inside the cell. The ribosomes that sit on the rough endoplasmic reticulum read the genetic information encoded in the mRNA. The ribosomes then use that information to build proteins out of amino acids. Protein Distribution Center The Golgi complex, which is also known as the Golgi body or Golgi apparatus, is another network of cisternae, and like the nucleus and the endoplasmic reticulum, it is enclosed in a membrane. It also helps in the transport of lipids around the cell. When it processes materials to be transported, it packages them in something called a Golgi vesicle. Some of the Golgi vesicles leave the cell, and some store a protein to release later. Others become lysosomes, which is another type of organelle. Recycle, Detoxify and Self-Destruct Lysosomes are a round, membrane-bound vesicle created by the Golgi apparatus. They are filled with enzymes that break down a number of molecules, such as complex carbohydrates, amino acids and phospholipids. Lysosomes are part of the endomembrane system like the Golgi apparatus and the endoplasmic reticulum. When a cell no longer needs a certain organelle, a lysosome digests it in a process called autophagy. When a cell is malfunctioning or is no longer needed for any other reason, it engages in programmed cell death, a phenomenon also known as apoptosis. The cell digests itself by means of its own lysosome, in a process called autolysis. A similar organelle to the lysosome is the proteasome, which is also used to break down unneeded cell materials. When the cell needs a rapid reduction in the concentration of a certain protein, it can tag the protein molecules with a signal by attaching ubiquitin to them, which will send them to the proteasome to be digested. Another organelle in this group is called a peroxisome. Peroxisomes are not manufactured in the Golgi apparatus like lysosomes are, but in the endoplasmic reticulum. Their main function is to detoxify harmful drugs such as alcohol and toxins that travel in the blood. An Ancient Bacterial Descendent as a Fuel Source Mitochondria, the singular of which is mitochondrion, are organelles responsible for using organic molecules to synthesize adenosine triphosphate, or ATP, which is the source of energy for the cell. Mitochondria are continually shifting between a threadlike shape and a spheroidal shape. They are surrounded by a double membrane. The inner membrane has many folds in it, so that it looks like a maze. The folds are called cristae, the singular of which is crista, and the space between them is called the matrix. The matrix contains enzymes that mitochondria use to synthesize ATP, as well as ribosomes, like those studding the surface of rough endoplasmic reticulum. In the s, an evolutionary scientist named Lynn Margulis proposed a theory of endosymbiosis, which is still today commonly thought to explain mtDNA. She believed that mitochondria evolved from bacteria that lived in a symbiotic relationship inside the cells of a host species about 2 billion years ago. Eventually, the result was the mitochondrion, not as its own species, but as an organelle with its own DNA.

Chapter 3 : Introduction to botany The Plant Cell

Discoveries by German scientists Schleiden, Schwann, and Virchow led to the development of the cell theory, which states: â€¢ All living things are made of cells.

The central and rightmost cell are in interphase , so the entire nuclei are labeled. The cell on the left is going through mitosis and its DNA has condensed. Cells are the basic unit of structure in all organisms and also the basic unit of reproduction. With continual improvements made to microscopes over time, magnification technology advanced enough to discover cells in the 17th century. This discovery is largely attributed to Robert Hooke , and began the scientific study of cells, also known as cell biology. Over a century later, many debates about cells began amongst scientists. Most of these debates involved the nature of cellular regeneration, and the idea of cells as a fundamental unit of life. Cell theory was eventually formulated in This is usually credited to Matthias Schleiden and Theodor Schwann. However, many other scientists like Rudolf Virchow contributed to the theory. It was an important step in the movement away from spontaneous generation. The three tenets to the cell theory are as described below: All living organisms are composed of one or more cells. The cell is the basic unit of structure and organization in organisms. Cells arise from pre-existing cells. The first of these tenets is disputed, as non-cellular entities such as viruses are sometimes considered life-forms. 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 metabolism and biochemistry occurs within cells. 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. Types of cells Eukaryote cell.

Chapter 4 : Introduction to Biology - Molecules and Cells - Cells

The cell is the basic unit of life because_____. it is midway between the biosphere and an organic molecule in size it is the smallest unit capable of exhibiting the fundamental characteristics of life.

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 5 : Cell theory | Revolvy

Schleiden emphasized that structures and morphological features, not processes, give organic life its character. Schleiden also proved that a nucleated cell is the first element of the plant embryo. His botanical studies essentially stopped after , when he began to pursue philosophical and historical studies.

Chapter 6 : Biological Atomism and Cell Theory | Daniel J Nicholson - calendrierdelascience.com

by Matthias Jakob Schleiden and Theodor Schwann, states that all organisms are composed of one or more cells, that all cells come from preexisting cells, that vital functions of an organism occur within cells, and that all cells contain the hereditary information.

Chapter 7 : Cell theory - Wikipedia

Building upon Schleiden and Schwann's cell theory, a great many scientists contributed discoveries - many made through the microscope - and theories about what went on inside of cells. For the next few decades, their cell theory was debated, and other theories were put forth.

Chapter 8 : What Is an Organelle in a Cell? | Sciencing

Chapter one Biology review 1. Schleiden, Schwann, and Virchow is the "powerhouse" of the cell where organic molecules are broken down.