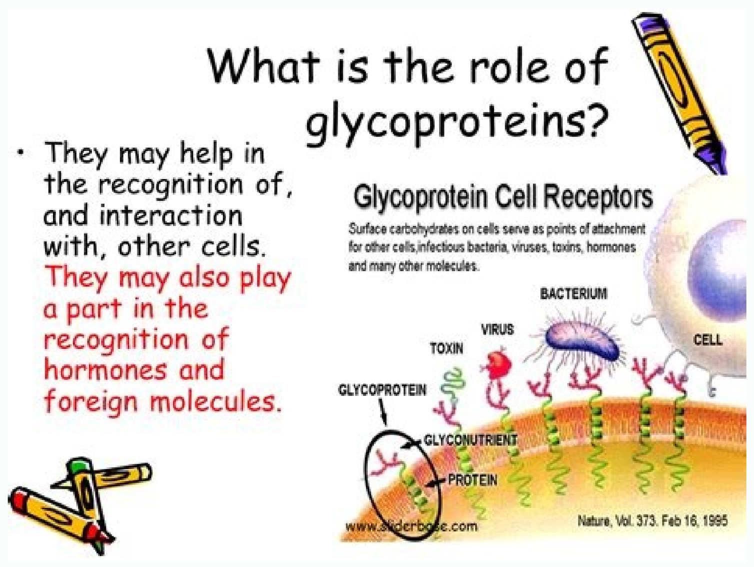
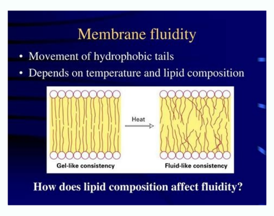
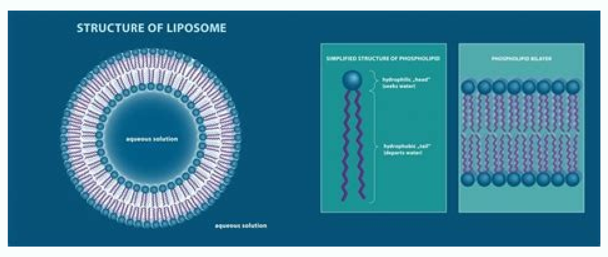
Why does the lipid bilayer form







Why is the lipid bilayer important. Why does a lipid bilayer form in the presence of water. Why do lipids form a bilayer. Why does the cell membrane have to form a lipid bilayer.

Different mixtures of lipids are found in the membranes of cells of different types, as well as in the various membranes of a single eucaryotic cell. The ganglioside GM1 (see Figure 10-16), for example, acts as a cell-surface receptor for the bacterial toxin that causes the debilitating diarrhea of cholera. The long fatty acid chains of a phospholipid are nonpolar and thus avoid water because of their insolubility. The anesthetic gets into the membrane structure and causes shifts in how ions move across the membrane. This remarkable behavior, fundamental to the creation of a living cell, follows directly from the shape and amphipathic nature of the phospholipid molecule. Phospholipase C, for example, cleaves an inositol phospholipid in the cytosolic monolayer of the plasma membrane to generate two fragments, one of which remains in the membrane and helps activate protein kinase C, while the other is released into the cytosol and stimulates the release of Ca2+ from the endoplasmic reticulum (see Figure 15-36).Animals exploit the phospholipid asymmetry of their plasma membranes to distinguish between live and dead cells. Although cholesterol tends to make lipid bilayers less fluid, at the high concentrations found in most eucaryotic plasma membranes, it also prevents the hydrocarbon chains from coming together and crystallizing. Many membrane proteins also contain attached carbohydrates on the outside of the lipid bilayer, allowing it to form hydrogen bonds with water. A synthetic bilayer made from a single type of phospholipid changes from a liquid state to a two-dimensional rigid crystalline (or gel) state at a characteristic freezing point. Many cytosolic proteins bind to specific lipid head groups found in the cytosolic monolayer of the lipid bilayer. Moreover, some cytosolic enzymes bind to specific lipid head groups exposed on the cytosolic face of a membrane and are thus recruited to and concentrated at Membrane sites. The types of lipid molecules in cell membranes are randomly mixed into the lipid monolayer in which they reside. In contrast, lipid molecules easily exchange places with their neighbors within a monolayer (~107 times per second). Figure \ (\ PAGININEX {1} \): A phospholipid consists of a head and a tail. These proteins form channels through which specific ions and molecules can move. One queue usually has one or more double CIS links (i.e., it is not saturated), while the other queue does not (i.e., it is saturated). Tails are usually fatty acids, and may differ in length (typically contain between 14 and 24 carbon atoms). Suggestions on which glycolipid functions may come from their location. However, this cost of free energy is minimized if the hydrophobic molecules (or the hydrophobic parts of the amphipathic molecules) are grouped together so that the smallest number of water molecules is affected. The attractive forces of Van der Waals between neighboring fatty acid tails are not selective enough to hold groups of such molecules together. Some membrane-bound enzymes require specific lipid head groups to function. However, the lipid bilayer of many cell membranes is not composed exclusively of phospholipids; It often also contains cholesterol and glycolipids. The main groups of some lipids form coupling sites for specific cytosolic proteins. A phospholipide consists of a hydrophilic head (water-loving) and a hydrophobic tail (water-conscious) (see figure below). The enzymatic protein kinase C (PKC), for example, is activated in response to several extracellular signals. Because the negatively charged phosphatidylserine is found in the inner monolayer, solle solle o ,ortneda aicah saloc sal noc ,sacir©Ãfse salecim ramrof nedeup :samrof sod ed areiuqlauc ne olrecah nedeup ,amrof us ed odneidnepeD .apacib al ed sedatim sod sal ertne ograc a avitacifingis aicnerefid anu form bimolecular mines, or bilayers, with the hydrophic tails ³ interspersed between groups of hydrophic heads (Figure 10-4). Various techniques have been used to measure the movement of individual lithographic molecules and their different parts. As in the synthetic bilayers, the individual phospholÃ© molecules are normally confined to their own monolayer. The lipúdic molecules with the most extreme asymmetric in their membrane distribution³ are the lipúdic molecules that contain the so-called glycolÃúpidos. Cholesterol molecules improve the properties of the permeability barrier of the lip layer. In Chapter 12 we discuss how ³ membrane-bound phospholÃpidos translocators generate and maintain the asymmetric lipÃdica. In this way, only the heads of moles are exposed to water, while the hydrophic tails interactÃ ³an sÃ ³ lo entre sÃ. As the temperature drops, for example, fatty acids are synthesized with more cis-double bonds, so the decrease ³ the bifÃ sic fluidity that otherwise result from the temperature cavity is avoided. They are also found in some intracellular membranes. This confinement creates a problem for your synthesis. The plasma membranes of the largest of the eucariÃ ³tic cells, on the other hand, are more varied, not only in terms of containing large amounts of cholesterol, but also in terms of containing a mixture of different phospholipids.Four main phospholipids predominate in the plasma membrane of many mammalian cells: phosphatidylcholine, phosphatidylethanolamine, phosphatidylserine and sphingomielin. Figure \(\PageIndex{3}\): The phospholipid bilayer of a cell membrane contains embedded protein moles that allow the selective passage of ions and moles through the membrane. Other phospholipids, such as phospholipids inositol, are present in smaller quantities but are very important. When you go to the dentist to take you out a tooth, you really do not want to feel any pain. In this energetically favorable favorable The hydrating heads ³ rows face the water on each surface of the bilayer, and the hydrating tails ³ phobes are protected from the water inside. A variety of lipÃdic kinases can add phosphate groups at different positions in the inositol ring. The glycolÃ pidos complex, the gangliÃ sidos³ contain oligosacÃ rios with one or more residues of the acid SIALIC, which provide gangliosides a net negative charge (Figure 10-16). Phosphatidylserine exposed on the cell surface serves as a mechanism for inducing neighboring cells, such as macrÃ ³ phagos, to phagocytize and digest the dead cell. Differences in the length and saturation ³ of fatty acid tails are important because they influence the ability of phospholipid molecules to pack between themselves, thus affecting the fluidity of the membrane (discussed ³ n). These studies have also shown that the individual lipstick molecules spin very quickly about their long axis and that their hydrocarbon chains are flexible (Figure 10-8). The learning results describe the structure of a phospholipid. In the plasma membrane of the epithelial cells, for example, the glycolUpids are limited to the exposed apical surface, where they can help protect the membrane against the harsh conditions that are frequently found there (such as low pH and degradative enzymes). The "tail" of the molecule consists of two fatty acids, which are hydrated ³ phobes and do not dissolve in water. The kinases of similar lipids phosphorylate inositol phospholipids in the intracellular membranes and, therefore, help recruit proteÃnas that guide membrane transport. The asymmetric distribution ³ glycolipids in the bilayer is due to the addition ³ groups of sugar to the moles of lipids in the lumen of the GOLGI apparatus, which is topolÃ ³ gically equivalent to the outside of the cÃ© lula (discussed in the Chapter) When animal cells are reduced to programmed cell death, apoptosis (discussed in Chapter 17), phosphatidylserine, which is usually limited to the cell. Monolane of the plasma membrane Lipid Bilayer, translocated quickly to extracellular monolayer. All lipid molts of cell membranes are amphipathic (or amphidicate) Ã ¢ â € â € "have a hydrophilic end (Ã ¢ â € œ water loving (â €) or polar and a hydrophobic end (Ã ¢ Ã ¢ â € The water-fearingÃ ¢) or non-polar. The most abundant membrane lipids are phospholipids. They are more abundant in the plasma membrane of nerve cells, where gangliósidos constitute 5 Ã € 10% "Total lipid mass, are also found in much lower amounts in other cell types. Figure \ (\ PageiNex {2} \): In a water solution, phospholipids form a bilayer in which The hydrophobic tails point to each other inside and only the hydrophyl heads are exposed to water. If the movement of the ions interrup, the nerve impulses will not be transmitted and will not feel pain - at least not until the anesthetic wear down. The toxin of the spine joins the cells that have GM1 on its surface, including the Intestinal epithelial cells, and enter them. Lipid compositions of several biological membranes are compared in Table 10-1. The "head" of the molecule contains the phosphate group and is hydrophlyte, which means that it will dissolve in water. In this way, it inhibits possible phase transitions. Being cylindrical, phospholipid molts spontaneously form bilayers in aqueous environments. When they are placed in water they are assembled spontaneously in bilayers, which form sealed compartments that are resected if they are torn. There are three main classes of phospholipid ", cholesterol and glycolipid membrane lipid molms. Bacteria, yeasts and other organisms whose fluctuated temperature with that of their environment adjust the fatty acid composition of their membrane lipids to maintain a relatively constant fluidity. It is easily visible by arap arap ,arutcarf-n³Äicalegnoc ed acin³Ártcele aÃpocsorcim al y X soyar ed n³Äiccarfid al omoc ,sadazilaicepse sacinc©Ãt natisecen es euqnua ,acin³Ártcele The details of your organization. In this way, it is thought that lipid rafts help to organize these proteins, â € well concentrate to transport them in small vesicles or to allow proteins to work together, as when they convert extracellular signals in intracellular (â " Treat in chapter 15). A theory on what the work of the anesthetics deals with the movement of the ions through the cell membrane. Such microdomi, or lipid rafts, can be thought as transient phase separations in the fluid lipid bilayer where the sphingypids are concentrated. It is believed that the plasma membrane of animal cells contains many of these small rafts of lipids (~ 70 nm of diameter), which are rich in sphingolipids and cholesterol. It joins the cytosolic face of the plasma membrane, where phosphatidylserine is concentrated, and requires this phospholipid negatively charged for its activity. In other cases, the lipid head group should be modified first so that items of union sites are created to proteins At one point and place determined. A lipid mill can be constructed, for example, whose polar head group carries a Ã ¢ â € œ â € œ Ã ¢ α-like nitroxyl group (> N-O); It contains an unpailed electron whose ESPI creates a paramagnic signal that can be detected by electronic spindle resonance spectroscopy (ESR). Thus, the two monolayers in a raft of lipids communicate through their lipid queues. The lipid compositions of the two monolayers of the lipid bilayer in many membranes are surprisingly different. Such studies show that phospholipid molts of synthetic bilayers very rarely migrate from monolayer (also call brochure) on one side to the other. Phosphorylated inositol phospholipids then act as union sites that recruit specific protein from cytosol the membrane. One may wonder why eucari membranes contain such a variety of phospholipids, with groups of heads that differ in size, shape and load. ³. Some membrane membranes may work in the presence of main groups of specific phospholipides, in the same way that many enzymes in aqueous solution require a particular ion for their activity. Following the "as it dissolves as" rule, the hydrophilic head of the phospholipid molecule is easily dissolved in water. Certain membrane transport processes and enzymatic activities, for example, cease when the two-layer viscosity is experimentally increased above a threshold.The fluidity of a lipid bilayer depends both on its composition and on its temperature, as is easily demonstrated in synthetic bilayer studies. The most numerous are phospholipids. As discussed in Chapter 2, hydrophilic molecules dissolve easily in water because they contain charged groups or uncharged polar groups that can form favorable electrostatic interactions or hydrogen bonds with water molecules. The results are generally the same as for synthetic biceams, and show that the lipid component of a biological membrane is a two-dimensional liquid in which the constituent molecules move sideways freely. A phospholipid is a lipid that contains a phosphate group and is an important component of cell membranes. As shown in Figure 10-2, each double bond creates a small wrinkle in the tail. An important example of a lipid kinase is phosphatidylinositol kinase (PI 3-kinase), which is activated in response to extracellular signals and helps recruit specific intracellular signaling proteins to the cytosol side of the plasma membrane (Figure 10-15A).). The dentist injects an anesthetic into your gum and eventually falls asleep. Lipid asymmetry is functionally important. Glycolipids tend to self-associate, partly by hydrogen bonds between their sugars and partly by van der Waals forces between their long, saturated chains. ne ne etreivnoc es anarbmem al ,riced se(ronem se ecudorp es euq al a arutarepmet al y ,esaf ed n³Äicisnart animoned es odatse ed oibmac etsE .sorubracordih difficult to freeze) if the hydrocarbon chains are short or have double bonds. The membrane lipid molecules are amphipathic. However, an important function of the cell membrane is to allow selective passage of certain substances into and out of cells. In this position, their rigid, platelike steroid rings interact with¢ÃÂÂand partly immobilize¢ÃÂÂthose regions of the hydrocarbon chains closest to the polar head groups (Figure 10-11). Surprisingly, however, mutant mice that are deficient in all of their complex gangliosides show no obvious abnormalities, although the males cannot transport testosterone normally in the testes and are consequently sterile.Whatever their normal function, some glycolipids provide entry points for certain bacterial toxins. Phospholipid molecules are made in only one monolayer of a membrane, mainly in the cytosolic monolayer of the endoplasmic reticulum (ER) membrane. In lipid rafts, however, the long hydrocarbon chains of the sphingolipids in one monolayer interact with those in the other monolayer. These intriguing molecules are found exclusively in the noncytosolic monolayer of the lipid bilayer, where they are thought to partition preferentially into lipid rafts. The same forces that drive phospholipids to form bilayers also provide a self-healing property. If dispersed in water, they force the adjacent water molecules to reorganize into icelike cages that surround the hydrophobic molecule (Figure 10-3). This process, known as ¢ÃÂÂflip-flop,¢ÃÂÂ occurs less than once a month for any individual molecule. For the most part, lipid molecules in one monolayer of the bilayer move about independently of those in the other monolayer. Because these cage structures are more ordered than the surrounding water, their formation increases the free energy. If none of these newly made molecules could migrate reasonably promptly to the noncytosolic monolayer, new lipid bilayer could not be made. For some however, molecules such as sphingolÃpidos (discussed below), which tend to have long and saturated fatty hydrocarbon chains, the attractive forces can be strong enough to hold adjacent molecules together transitorily in small microdomains. Translocation ³ phosphatidylserine in apoptÃ© lulas ³ occurs by two mechanisms: 1.The phospholipid translocator that normally transports this single layer from the non-cyte³ lica monolayer to the cyte monolayerÃ lica ³ is inactivated.2.A Ã¢ Â scrapedÃ¢ Â Â that transfers phospholipids inspecifically in both directions between the two monolayers is activated. Similar studies have been conducted with labeled lipÃ dic molecules in isolated biolÃ ³ gic membranes and in living cells. The structures of these molecules are shown in Figure 10-12. In the water, the phospholipids spontaneously form a double layer called the lipÃdic bilayer in which the hydrophic tails ³ the phospholipids are interspersed between two layers of hydrophic heads (see figure below³ n). A lipÃdic bilayer has other characteristics besides its self-sealing properties that make it an ideal structure for cell membranes. Phospholipids in the plasma membrane are also used in another way in the response to extracellular salts. The plasma membrane contains several phospholipases that are activated by extracellular molecules to cleave specific phospholipid molecules, generating fragments of these molecules that act as short-lived intracellular mediators (Figure 10-15B). ³ It is the shape and amphibious nature of the lip molecules that causes spontaneously forming bilayers in aqueous environments. One can begin to understand why if one thinks of membrane plains as constituting a two-dimensional solvent for membrane proteÃnas, anarbmem anarbmem al a nenu es euq sol ne ,ralulec otneimiconocer ed sosecorp ne nanoicnuf sodipÃlocilg sol euq eerc es n©ÃibmaT .asouca n³Äiculos anu ne sanÃetorp sal arap lanoisnemidirt etnevlos nu eyutitsnoc auga le omoc proteÃnas (lectins) are attached to the groups of acic both in the glycolÃ pidos and in the glycoproteÃ nas in the process of adhesiÃ ³ a cellular (discussed in chapter 19). This is achieved by incorporating ³ several notches of proteÃnas in and through the lacidos bicapa (see figure below³ n). Identify the polar (hydrophobic) and non-polar (hydrophobic³bic) regions of a phospholipid. By decreasing the mobility of the first CH2 groups of hydrocarbon chains of phospholipid molecules, cholesterol makes the lipÃdic bilayer less deformable in this regionÃ ³ n and therefore decreases the permeability of the bilayer to small molecules soluble in water. In the plasma membrane, sugary groups are exposed on the cell surface (see Figure 10-14), where they play an important role in the interactions of the cell with its environment. GlycolUpids are probably present in all the plasma membranes of animal cells, where they generally constitute about 5% of the lipUdic molecules in the outer monolayer. These have a polar head group and two hydrophic ³ hydrocarbon tails. Bacterial plasma membranes are often composed of a major type of phospholipid and do not contain cholesterol; its mecÃ'nica stability is reinforced by an overlapping cell wall (see Figure 11-17). By the ³ race, the lipÃ© molecules are spontaneously added to bury their hydrophic tails inside and expose their hydrophulic heads to water. Phospholipid bilayers are cratic components of cell membranes. Contributors and Attributions Allison Soult, Ph.D. (Department of Química, University of Kentucky) Inositol phospholipids, for example, have a crucial role in the ³ As discussed in chapter 15. The phospholipid is essentially a triglycride in which a fatty acid has been replaced by a phosphate group of alpha-type. Note that only phosphatidylserine carries a net negative charge, the importance of we discuss later; the other three are electrically neutral at physiological pH, carrying one positive and one negative charge. Two types of preparations have been very useful in such studies: (1) bilayers made in the form of spherical vesicles, called liposomes, which can vary in size from about 25 nm to 1 Ã¼Ãm in diameter depending on how they are produced (Figure 10-6); and (2) planar bilayers, called black membranes, formed across a hole in a partition between two aqueous compartments (Figure 10-7). A small tear in the bilayer creates a free edge with water; because this is energetically unfavorable, the lipids spontaneously rearrange to eliminate the free edge. Page content has been edited and updated to conform to the style and standards of the LibreTexts platform; a detailed versioning history of the edits to source content is available upon request. The lipid bilayer has been firmly established as the universal basis for cell-membrane structure. In the human red blood cell membrane, for example, almost all of the lipid molecules that have choline¢ÃÂÂ(CH3)3N+CH2CH2OH¢ÃÂÂin their head group (phosphatidylcholine and sphingomyelin) are in the outer monolayer, whereas almost all of the phospholipid molecules that contain a terminal primary amino group (phosphatidylethanolamine and phosphatidylserine) are in the inner monolayer (Figure 10-14). More than 40 different gangliosides have been identified. (In eucaryotic plasma membranes, larger tears are repaired by the fusion of intracellular vesicles.) The prohibition against free edges has a profound consequence: the only way for a bilayer to avoid having edges is by closing in on itself and forming a sealed compartment (Figure 10-5). The bilayer structure is attributable to the special properties of the lipid molecules, which cause them to assemble spontaneously into bilayers even under simple artificial conditions.Lipid¢ÃÂÂthat is, fatty¢ÃÂÂmolecules constitute about of the mass of most animal cell membranes, almost all the rest is protein. Because the hydrocarbon chains of the concentrated lipids are longer and straighter than the fatty acid chains of most membrane lipids, the rafts are thicker than other parts of the bilayer (see Figure 10-9) and can accommodate better. certain membrane proteins, which therefore tend to accumulate there (Figure 10-13). Charged glycolipids, such as gangliosides, may be important for their electrical effects: their presence alters the electric field through the membrane and the concentrations of ions, especially Ca2+, on the surface of the membrane. Together, these four phospholipids make up more than half of the mass of lipids in most membranes (see Table 10-1). They orient themselves in the biclayer with their hydroxyl groups near the polarhead groups of the phospholipid molecules. This lipid bilayer is fluid, with individual lipid molecules able to diffuse rapidly within its own monolayer. Explain how phospholipid molecules form the biclayer of the cell membrane. The lipid compositions of the internal and external monolayers are different, reflecting the different functions of the two sides of a cell membrane. The problem is solved with a special class of membrane-bound enzymes, called phospholipid translocators, which catalyze the rapid flip-flop of phospholipids from one monolayer to another, as discussed in Chapter 12. n. Some extracellular signals that act through membrane receptor proteins activate phospholipases that divide selected phospholipid molecules in the plasma membrane, generating fragments that act as intracellular signaling molecules. Hydrophobic molecules, on the other hand, are In water because all, or almost all, their atoms are not charged and are not polar and therefore can not form energy interactions favorable with water molt. (La .Lec. 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