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The Habitat and Characteristics of Amoeba Proteus ===== Amoeba proteus, a single-celled organism, is widely distributed in freshwater environments such as ponds, lakes, and slow-moving streams. It thrives in clean waters with high oxygen levels and can be found in large aquatic ecosystems teeming with algae and plants. Culture and Regeneration The cultivation of Amoeba proteus involves collecting decaying vegetation from the bottom of a pond or lake. The sediment is then transferred to a wide-mouth container, where different species of amoebas may be sorted using a fine pipette under a binocular microscope. A temporary culture can be created by infusing hay or other organic matter in freshwater and allowing it to cool. Structure and Pseudopodia Amoeba proteus is a unicellular organism with a diameter ranging from 250 to 600 micrometers. Its shape is irregular, and the outline changes due to the formation of pseudopodia – small, finger-like extensions used for movement and feeding. The plasmalemma, a thin external membrane, provides structural support and allows water and soluble molecules to pass through. Conclusion The unique characteristics of Amoeba proteus make it an fascinating subject for study. Its ability to adapt and regenerate in different environments has allowed it to thrive in various freshwater ecosystems. The plasmalemma, a critical component of the Amoeba proteus cell structure, boasts numerous fine, ridge-like projections on its outer surface that act as adhesive and binding agents to its substrate. ===== The cytoplasm is a dense mass located within the plasmalemma, comprising two distinct sections: the ectoplasm and endoplasm. Ectoplasm serves as an outer layer, offering protection to organelles while maintaining the cell's shape and aiding in pseudopodia production. ===== a) Ectoplasm Ectoplasm is a clean, thin, and transparent layer situated beneath the plasmalemma. This layer is somewhat rigid and contractile, playing a vital role in supporting the cell's structure. The advancing end of pseudopodia displays a hyaline cap. ===== b) Endoplasm Endoplasm forms the bulk of the Amoeba and is characterized by being fluid-like, granular, and semi-transparent. This gel state consists of various components, including peripheral viscid or gel state, plasma gel, and central flowing or sol state plasmasol. ===== The endoplasmic organelles include several structures suspended within it, such as the nucleus, contractile vacuole, food vacuoles, and water globules. These organelles play a crucial role in maintaining cellular function. ===== Amoeba proteus is a unicellular organism that belongs to the phylum Amoebozoa, previously classified as Rhizopoda. It is widely studied and can be found in various environments, including soil, mud, and freshwater pools. This amoeboid species has been extensively researched and is considered one of the most well-known species within its genus. The habitat of Amoeba proteus primarily consists of aquatic vegetation-covered areas, muddy bottoms of freshwater pools, lakes, and slow-moving streams. The organism feeds on bacteria, small protists, and other unicellular organisms, with only a few parasitic species found among its relatives. In terms of structure, the amoeba has an irregular shape, is colorless, and appears translucent when viewed without staining. Its cytoplasm contains various granules, a nucleus, and a large vacuole. Notably, Amoeba proteus lacks a multilocalized nucleus characteristic of some other genera within its class. This species exhibits unique characteristics through the extension and retraction of pseudopodia for movement and prey capture. The organism's name is derived from Greek words: 'amoi  ', meaning change, and 'Proteus,' referencing the mythological sea-god who could transform into various forms. Its classification has undergone changes over time, but it remains a prominent subject in scientific research. The amoeba's movement is a complex phenomenon that can be understood by likening it to our own physical movements. Just as we take a step forward and then retract, the amoeba projects one end of its pseudopod forward and then retracts the other end to anchor itself to the surface. For this reason, the process of forming a pseudopod is crucial in understanding how an amoeba moves. The actin molecule, which forms part of the cytoskeletal structure, plays a key role in this process. When the cytoplasm changes from a liquid to a gel-like state, it allows for the formation of a flexible skeleton that can push the cell forward. The mechanism behind this is not fully understood, but research has shown that actin molecules form bundles and move along them, creating a contractile force that propels the cell forward. The movement is also influenced by other proteins that interact with actin to create crossed links between filaments, generating a three-dimensional grid that hardens the cytoplasm. A useful analogy for understanding this process can be drawn from a jelly-like substance, such as meat broth. When cooled, it forms a gel-like structure due to the aggregation of protein molecules. Similarly, in the case of the amoeba's pseudopod, actin proteins aggregate to form filaments that create a three-dimensional grid. This mechanism highlights the importance of proteins and molecular motors in creating movement within cells. The cytoskeleton plays a vital role not only in cell movement but also in muscle function, where it is essential for contracting and relaxing muscles. ===== In order for an amoeba's filaments of action to form, what triggers their creation? What does it mean for an amoeba to be "anterior" or "posterior"? We know that amoebae respond to environmental signals, like positive or negative tropisms, which can attract them to food sources. For example, when the amoeba binds receptor proteins on its membrane with molecules released by these food sources, it triggers a response that causes the globular actin to aggregate and form filaments. Interestingly, the same molecules used in this process in amoebae are also found in human white blood cells or other mobile cells. This chemical signal stimulates the protrusion of the pseudopods and determines which end of the cell will be the "anterior" pole. Once the signal is gone, the pseudopods stop elongating, and the filaments disassemble. The next step involves moving the cell body in the direction of the pseudopod, where motor proteins like myosins come into play. These proteins "walk" along the actin filaments, driving the movement of the cytoskeletal scaffoldings in that direction. This process is similar to muscle contraction. However, the elongation of these filaments requires energy provided by ATP, a molecule produced by cellular metabolism. Even isolated fragments of cytoplasm move when treated with ATP. Furthermore, experiments where amoebae are administered a drug called cytochalasin show that the absence of actin filaments prevents pseudopod formation and movement. The fact that similar molecular mechanisms govern the movements of amoebae, white blood cells, and muscles is remarkable. This similarity can be attributed to the common ancestor of these organisms, which lived over a billion years ago. Although the actin molecules in modern amoebae and humans have evolved through millions of years of mutations, they retain their basic functional characteristics. The amoeba is an opportunistic predator that obtains its nutrients by engulfing other protists or bacteria through phagocytosis. This process relies on the amoeba's ability to perceive chemical signals or make contact with prey. The pseudopods play a crucial role in this process, forming a "mouth" around the prey and inserting it into a membrane vesicle called a phagosome. Each day, an amoeba can carry out hundreds of endocytoses, which significantly reduces its surface area by removing about 10% of its own membrane. This is made possible by concurrent exocytosis events that return membrane material to the cell surface. The continuous recycling of membranes and the transfer of materials between different parts of a cell are essential processes. ===== The vesicles in a cell can be compared to oil drops in a dish of water, where they may merge or split apart. Similarly, from the cell membrane, vesicles can detach and remerge, transferring their contents and membranes in a continuous process. In the same way, the phagocytosed material is sent to digestion by fusing with other membranous vesicles containing digestive enzymes. The resulting acidic vesicle takes the name of lysosome, which carries out the function of cell digestion. In the amoeba, the membrane with phagocytosis produces a vesicle that merges with the lysosome after digestion. After digestion, waste products are expelled through exocytosis, and the membrane is subtracted with phagocytosis. The transporter proteins in the lysosome membrane transfer useful substances into the cytoplasm, while the lysosome gets close to the cell membrane and fuses with it, pouring out waste products. The comparison with our digestive system is easy: food is digested by stomach enzymes, useful substances are absorbed by the intestinal wall, and waste products are expelled with feces. The breaking of the intestine or stomach wall has serious consequences. The amoeba can incorporate voluminous structures through phagocytosis and get nutrients through pinocytosis, a process based on similar principles to phagocytoses. The cell membrane holds mechanisms of selective permeability that allow the passage of single molecules from outside to the cytoplasm without forming vesicles. Living in freshwater environments, the amoeba must regulate its water content to survive. The contractile vacuole, which stores excess water and expels it out of the cell, is crucial for this regulation. Hydrogen ions (protons) play a key role in this process. As protons are actively pumped into the vacuole, its interior accumulates a high concentration of ions. This creates an osmotic gradient that draws water from the cytoplasm. The water, initially entering the cell via osmosis from the external environment, now moves into the vacuole due to the concentration difference. The gradient is minimal outside, moderate in the cytoplasm, and highest in the vacuole, driving water flow from the exterior to the cytoplasm and then into the vacuole. When the vacuole expands, it contacts the cell membrane and releases its contents outward. The vacuole's membrane contains not only proton pumps but also transporters that accumulate metabolic waste like carbon dioxide, urea, or uric acid. These substances are expelled when the vacuole fuses with the cell membrane, causing its disappearance and the formation of a new vacuole through vesicle production. Energy for these processes is supplied by ATP. The term "contractile vacuole" hints at active contraction, though microscopists observed periodic volume changes, likely due to water accumulation rather than active movement. In marine amoebae, where external salinity is higher than cytoplasm, vacuoles are absent due to dehydration risks. Genetics and reproduction involve Amoeba proteus's nucleus containing 250 chromosome pairs and 290 billion DNA bases, a result of polyploidy. These values fluctuate during its life cycle, though their functional significance remains unclear. Reproduction occurs via binary fission when the cell reaches 0.2-0.3 mm, involving nuclear division, cytoplasmic cleavage, and pseudopod activity. Multiple fission occurs under stress, forming a cyst with many nuclei that later divide into new cells. Symbiosis and parasitism notes Amoeba proteus's ability to phagocytize bacteria, though some observations suggest possible conjugation, though its meaning is uncertain. To survive inside phagosomes and avoid digestion, certain bacteria have formed symbiotic relations with amoebas. These relationships alter both species, rendering them mutually dependent. Some amoebae are infected by viruses characterized by exceptionally large dimensions, such as Mimivirus or Pandoravirus, which have diameters between 400-1000 nm and DNA of one to two million bases. Most viruses have smaller dimensions and shorter DNA. Various organisms, including nematodes, small fishes, crustaceans, and mollusks, prey on amoebae by secreting toxic or repellent substances. However, the pathogenicity of amoebae is not fully understood, as only a few strains are permanently pathogenic to humans, and most cases result in the loss of infectivity. The genera Naegleria and Balamuthia can cause serious encephalitis, while Acanthamoeba causes meningoencephalitis and keratitis. Hartmannella is also associated with keratitis. Additionally, some amoebae can be infected by pathogenic bacteria, acting as disease vectors. Entamoeba histolytica is the most important pathogenic species, causing intestinal amoebiasis, which can lead to severe complications, including death. It is estimated that 50 million people worldwide are infected with E. histolytica, particularly in tropical countries, resulting in 50,000-100,000 deaths per year. In most cases, the infection is asymptomatic, but it can cause dysentery in approximately 10% of cases. The amoeba invades the intestinal mucosa, destroying cells and causing ulcerations that can lead to severe anemia and perforations. The mature cysts produced by E. histolytica are resistant and can survive for long periods in water or soil. The infection occurs through ingestion of contaminated food or water, allowing the cysts to transform into active amoebae that can multiply and infect new hosts. This illustrates the concept of "F Cycle" fecal contagion infection, where parasites in feces spread through hands, flies, and food. Looking at myself, I see two of me, both very handsome. Here we go slithering around, here we go squelching on the floor ..." Volvox proteus Pallas, 1766; Proteus diffluens O.F. M  ller, 1786; Chaos diffluens (O.F. M  ller, 1786) Schaeffer, 1926. A type of Amoeba proteus was last modified: May 18th, 2018 by Giuseppe Mazza You can use, share or remix this work non-commercially for any purpose including commercial use, but please attribute the creator and provide a link to this license Creative Commons Attribution License The comprehensive guide to Class 11 preparation provides students with a well-rounded approach to exam success. To enhance their understanding, Amoeba Proteus Notes on EduRev offer valuable study materials, including recommended books and practice papers. 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