Alexa Talens
BIOL293
Professor Steel
Old Dominion University
March 17 2024

Scientific Literacy 1

Cellular metabolism is an essential process cells go through in order to remain healthy and functional. Cells absorb food and convert the energy stored within for its own use; catalyzed by proteins called enzymes. The chemical reactions allow for cells to possess the energy needed to even undergo these processes as well as to maintain their structure. The converted energy is also used to allow for the cells of the organism to further develop and reproduce in addition to adjusting to the environment the cell is within. Various nutrients and minerals absorbed by the body serve to aid cellular metabolism. One significant nutrient is inorganic phosphate (Pi), which are free phosphate anions from the element phosphorus. Anions are negatively charged atoms as they possess more electrons than usual for that element.

Inorganic phosphate (Pi) is a nutrient required for life to exist as they serve as a material for many metabolic pathways and are used in the creation of various cellular components. These components include proteins, nucleic acids, and phospholipids which are three of the four major biological macromolecules in biology. More importantly, they aid in the formation of ATP, adenosine triphosphate, via oxidative phosphorylation. This is important as ATP is the energy cells utilize to undergo chemical processes in the first place. Pi plays an active role in the activation of enzyme reliant reactions such as glycolysis and ammoniagenesis [12]. Glycolysis is a process where enzymes break down glucose obtained from food to energy (ATP) and pyruvate.

Pi also serves a function in both the overall body structure and cellular structure. It is used to aid mineralization of the bony matrix and teeth. Phosphate binds to calcium to regulate the amount of calcium within the body. At the cellular level, Pi is used in phospholipids to form the lipid bilayer which separates the inside of the cell from its environment. Phospholipids are a type of lipid that possess phosphate from a phosphate group substituting a fatty acid. Phospholipids in particular are processed and broken down which regulates the whole organism's energy metabolism. This process is called phospholipid metabolism and is important for other metabolic pathways as they rely on particular phospholipids to function.

Lipids are one of the four macromolecules in cells which are composed of various fatty compounds that serve to maintain cellular structure and to serve as a barrier for the cell. They also store energy for the body and participate in cell communication. Phospholipids possess all of these traits as they are simply a type of lipid. Lipids can be found in multilamellar organelles. Multilamellar organelles, also known as multilamellar bodies (MLBs), are membraned lysosomal organelles composed of multiple layers. They serve to store and secrete lipids which are important for membrane maintenance. MLBs are able to secrete lipids when low lipid levels are detected.

References

Adams, J.U. (2010). Cell Metabolism (Nature Publishing Group). https://www.nature.com/scitable/topicpage/cell-metabolism-14026182/

Dawson, J.L. (2010). Inorganic Phosphate. https://www.sciencedirect.com/topics/chemistry/inorganic-phosphate

(2024b). Metabolism (Wikimedia Foundation). https://en.wikipedia.org/wiki/Metabolism

Cell biology (Bio-Techne). https://www.tocris.com/cell-biology/cell-metabolism

Takeda, E., Yamamoto, H., Nashiki, K., Sato, T., Taketani, Y., and Arai, H. (2004). Inorganic phosphate homeostasis and the role of dietary phosphorus (U.S. National Library of Medicine). https://pubmed.ncbi.nlm.nih.gov/15256067/

Anion - definition, meaning & synonyms. https://www.vocabulary.com/dictionary/anion

Sapio, L., and Naviglio, S. (2010). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4675902/

Dick, C.F., Dos-Santos, A.L.A., and Meyer-Fernandes, J.R. (2011). Inorganic phosphate as an important regulator of phosphatases (U.S. National Library of Medicine). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3132463/

Dunn, J., and Grider, M.H. (2023). Physiology, adenosine triphosphate (U.S. National Library of Medicine). https://www.ncbi.nlm.nih.gov/books/NBK553175/#:~:text=Adenosine%20triphosphate%20(ATP)%20is%20the,three%20serially%20bonded%20phosphate%20groups.

Claude, A. (2008). Proteins, lipids, and nucleic acids in, cell structures and functions (Academic Press). https://www.sciencedirect.com/science/article/pii/S0065323308605902

Qadeer, H.A., and Bashir, K. (2023). Physiology, phosphate (U.S. National Library of Medicine). https://www.ncbi.nlm.nih.gov/books/NBK560925/

Chaudhry, R., and Varacallo, M. (2023). Biochemistry, glycolysis (U.S. National Library of Medicine). https://www.ncbi.nlm.nih.gov/books/NBK482303/

Sebaaly, C., Griege-Gerges, H., and Charcosset, Ca. (2019). Lipid Membrane Models for Biomembrane Properties' Investigation. https://www.sciencedirect.com/science/article/abs/pii/B9780128136065000117

Zheng, L. (2015). Phospholipid metabolism in cell membrane (NIH). https://grantome.com/grant/NIH/R01-GM098572-04

Lajoie, P., Guay, G., Dennis, J.W., and Nabi, I.R. (2005). The lipid composition of autophagic vacuoles regulates expression of multilamellar bodies (The Company of Biologists).

https://journals.biologists.com/jcs/article/118/9/1991/28895/The-lipid-composition-of-autophagic-vacuoles

(2024a). Lipid (Wikimedia Foundation). https://en.wikipedia.org/wiki/Lipid