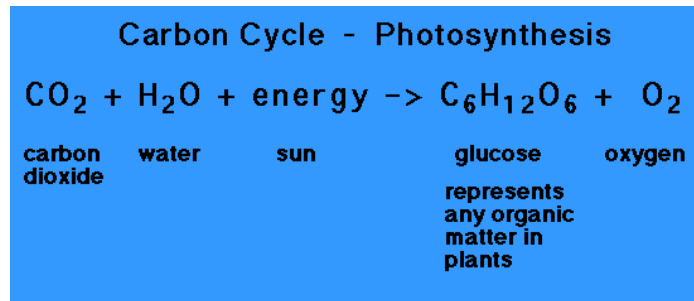


PHOTOSYNTHESIS → The Sun's energy shines down on a plant leaf. In the plant leaf, there are photosynthetic cells that contain chloroplasts which have evolved from photosynthetic bacteria. The chloroplasts have pigments that capture the electromagnetic energy of the photons of visible light. This energy drives a series of complex chemical reactions called photosynthesis in the chloroplast that combine carbon dioxide in the air and water from the ground to form sugar molecules called glucose. The photosynthetic reactions release oxygen molecules that escape through pores in the leaves into the air.



In this reaction, the carbon and oxygen from carbon dioxide are incorporated into the glucose, the hydrogen from the water is also incorporated into the glucose. It is important to remember that the oxygen that is released into the air from plants is derived from the water molecules.

This was discovered by the use of radioactive isotopes. Radioactive isotopes of elements were first made available to scientists in the mid-twentieth century by Oakridge National Laboratory. They act much like tracking devices that we see in spy movies where someone has an electronic device that allows others to track everywhere they travel. This revolutionized science because, for the first time, elements in chemical reaction could be traced and followed as they were moving through organisms or through the environment. In a few decades scientists would use these tracers many of the chemical reactions of life on Earth including the structure and function of DNA, the reactions of photosynthesis, how foods are metabolized into energy in cells, how and where molecules like hemoglobin are used. There is no other single scientific technique more important than radioactive tracing.

The glucose sugar molecules (C₆H₁₂O₆) are transported to the mitochondria where another set of complex chemical reactions convert the chemical energy from the sugar into an easily usable form of energy called adenosine triphosphate (ATP). During this conversion, carbon dioxide is released from the mitochondria. ATP is the most common form of easily accessed energy in any animal or plant cell and is the quick energy source to drive most chemical reactions that need energy in a cell. The ATP is transported to the nucleus and is used to copy DNA into a recipe for a protein called messenger RNA (mRNA). The mRNA is transported out of the nucleus through nuclear pores in the nuclear membrane and joins with ribosomes on the rough endoplasmic reticulum (RER). The ribosomes use the mRNA as a recipe to join (polymerize) amino acids into a chain. This chain of amino acids is a protein. As the protein is made, it is transported into the RER. A small vesicle of RER with protein inside will break away and be transported to a stack of membranes called the golgi. The vesicle will join with the golgi. The protein that is now in the golgi will often have sugars added to it (this sugar-protein is called a glycoprotein ...glycol is the prefix for sugar) and be packed into another vesicle which is transported to the cell membrane. The vesicle will fuse with cell membrane and the glycoprotein will either become part of the cell membrane or be released from the cell to be used somewhere else in the organism.

Carbohydrate Functions:

- -Store energy in the form of starch (**photosynthesis in plants**) or glycogen (in animals and humans).
- -Provide energy (ATP)
- -Provide carbon for synthesis of other compounds (all organic molecules contain carbon)
- -Form structural components in cells and tissues
 - Cellulose is a “structural” molecule that provides support to plants
 - Chitin is a polymer of sugars that for the exoskeleton of arthropods