

# Learn the photosynthesis formula

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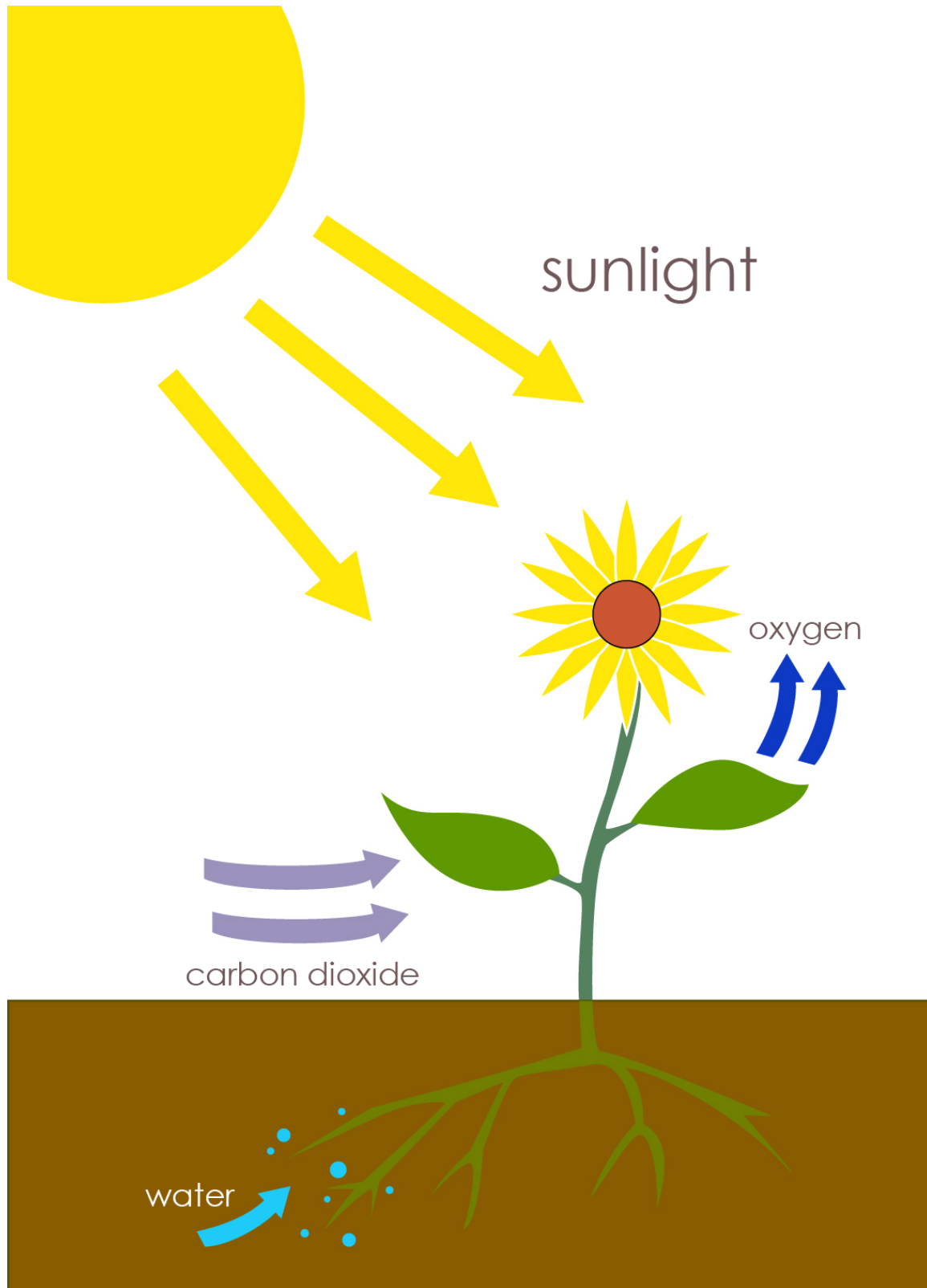
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Image 1. In plants, photosynthesis occurs mainly within the leaves. Photo from the public domain

Living things need energy to survive. Some organisms can take in energy from sunlight and use it to make sugar and other chemicals. The sugars are then used to provide fuel for the organism. This process, called photosynthesis, is used by organisms such as plants, algae and some types of bacteria.



## **Photosynthesis Equation**

Photosynthesis turns energy from the sun (solar energy) into chemical energy, providing the fuel for plants to grow. Chemical energy is stored in molecules like glucose, which is a sugar.

For photosynthesis to take place, three ingredients are needed: carbon dioxide, water and sunlight.

These three ingredients combine and create three chemicals: glucose, oxygen and water.

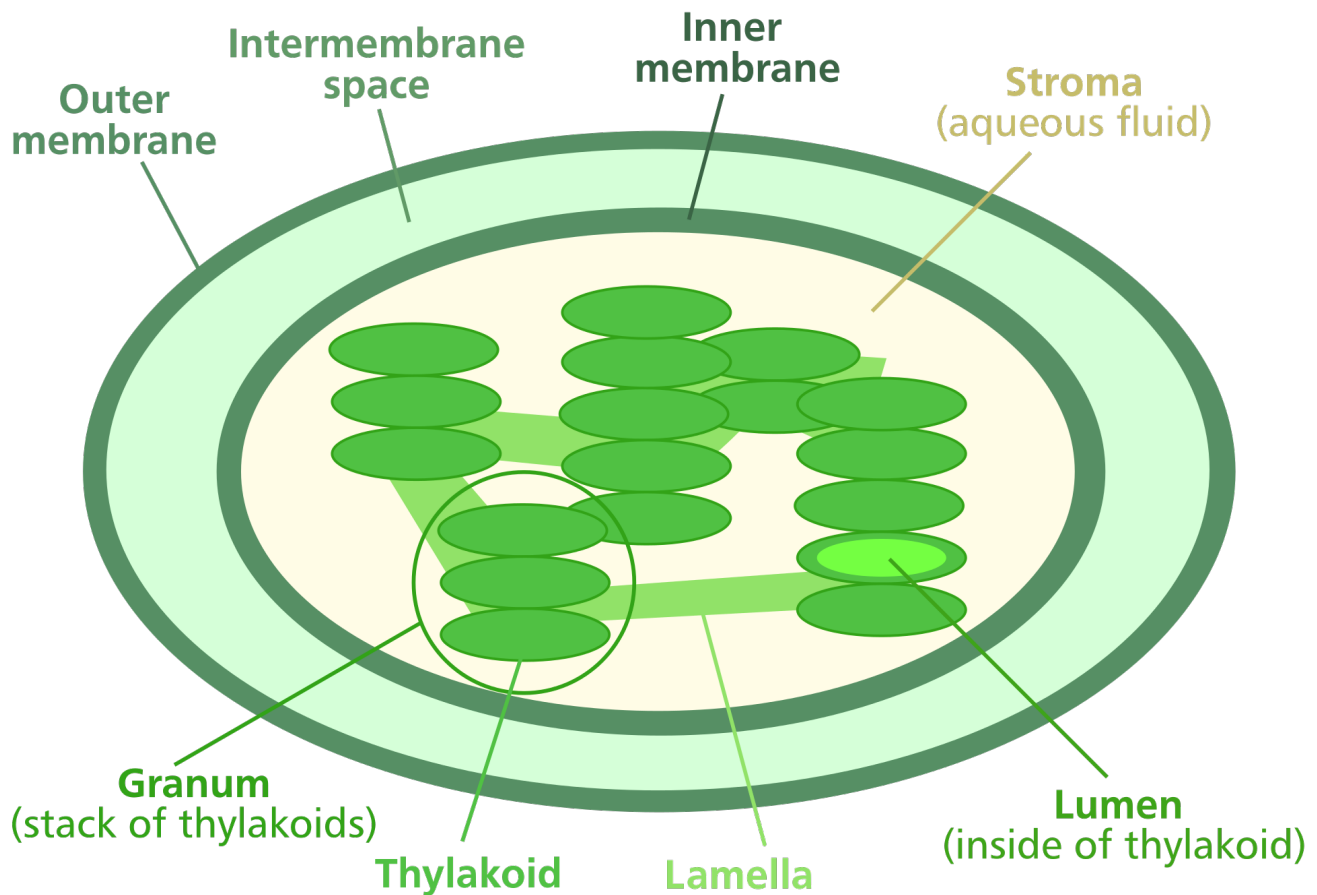
The chemical equation for the process is:



Six molecules of carbon dioxide ( $6\text{CO}_2$ ) and six molecules of water ( $6\text{H}_2\text{O}$ ) are used up in the process. Glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) and six molecules of oxygen ( $6\text{O}_2$ ) are produced.

## **Photosynthesis In Plants**

In plants, photosynthesis happens mainly within the leaves, which are designed to bring together carbon dioxide, water and sunlight.



Leaves can take in carbon dioxide from the air. They do it through tiny holes called stomata. It is also through stomata that plants give off oxygen.

Water is taken up by the plant through its roots and delivered to the leaves through a system of veins, similar to those that carry blood throughout our bodies.

Sunlight is taken in by chlorophyll, a green chemical located in plant cell structures called chloroplasts. Chloroplasts are where photosynthesis happens. There are several smaller structures within a chloroplast, each serving a different purpose:

- The outer and inner membranes are coverings that keep chloroplast structures enclosed.
- Stroma is a dense fluid within the chloroplast where carbon dioxide gets turned into sugar.
- Thylakoids look like flattened sacks and are where light energy is turned into chemical energy.
- Grana are composed of thick stacks of thylakoids.
- Chlorophyll is a chemical within the chloroplast that takes in light energy and gives plants their green color.

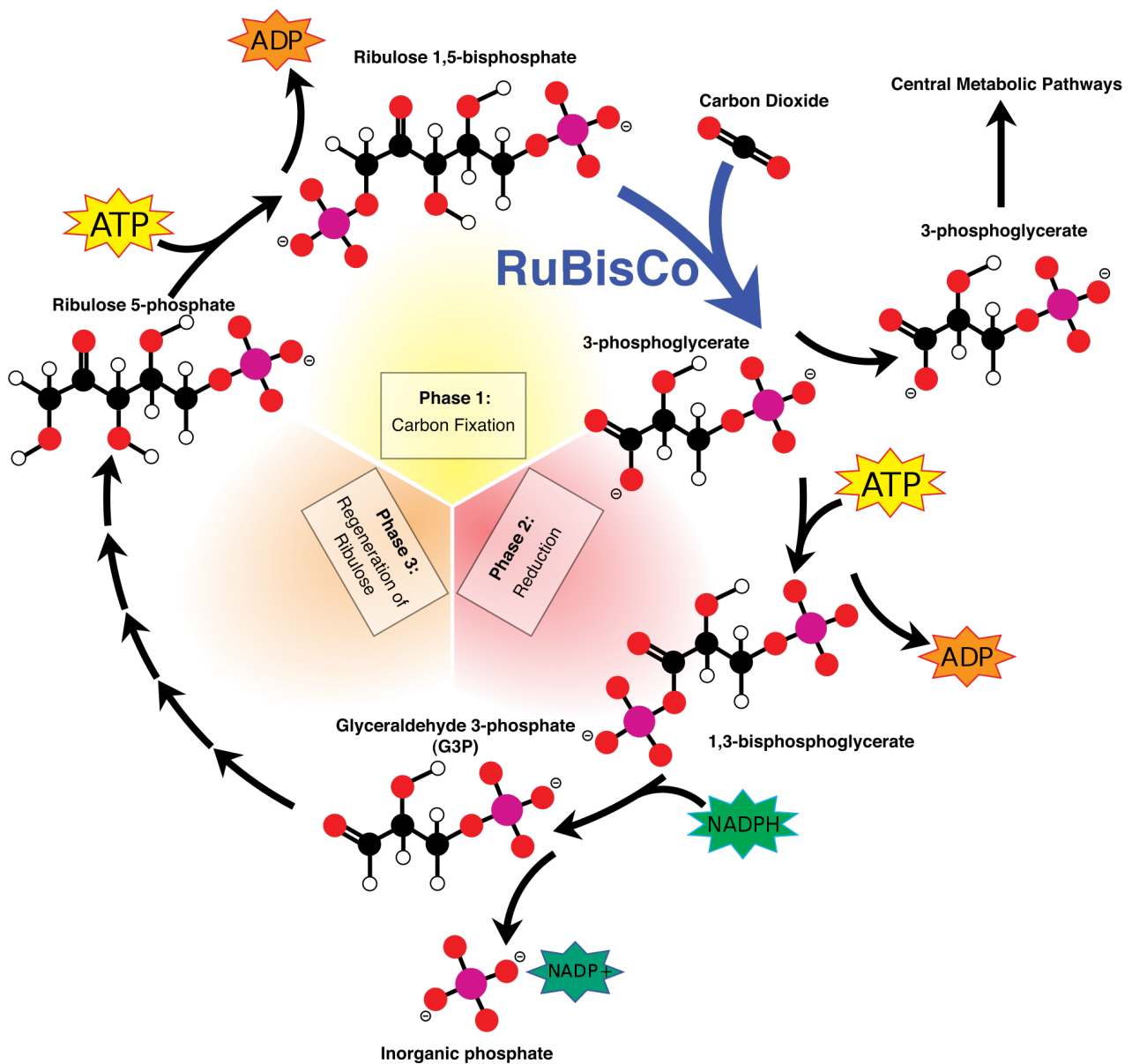
## **Stages Of Photosynthesis**

Photosynthesis happens in two stages, which are the light reactions and the dark reactions. The light reactions take place in the presence of light, whereas dark reactions do not require direct light.

Light reactions happen mostly in the thylakoid stacks of the grana, which is the place where sunlight is turned into chemical energy in the form of ATP and NADPH. ATP stands for adenosine triphosphate and is an important molecule that transfers energy between cells. NADPH stands for nicotinamide adenine dinucleotide phosphate, and is an important molecule for the storage of energy.

During photosynthesis, chlorophyll takes in energy from the sunlight, and this starts a chain of steps that result in the production of ATP and NADPH. In photosynthesis, water molecules ( $H_2O$ ) have to split. When the water molecules split, they release oxygen through the stomata.

Both ATP and NADPH are used in the dark reactions to produce sugar. These reactions happen in the stroma.



This process is known as carbon fixation, or the Calvin cycle. It has three main stages: carbon fixation, reduction and regeneration.

There are many different kinds of sugars, and sugar molecules can have a different number of carbon molecules. During the process of carbon fixation, carbon dioxide is combined with a 5-carbon sugar [ribulose1,5-biphosphate (RuBP)], making a 6-carbon sugar.

ATP and NADPH produced in the light reaction stage are used to turn the 6-carbon sugar into two 3-carbon molecules called glyceraldehyde 3-phosphate. Glyceraldehyde 3-phosphate is used to make glucose and fructose, and these two molecules then come together to make sucrose, a common sugar.

In the regeneration stage, some molecules of glyceraldehyde 3-phosphate are combined with ATP. They are then turned back into the 5-carbon sugar RuBP, completing the cycle.

Next, RuBP can combine with carbon dioxide, starting the cycle over again.

## **Photosynthesis Summary**

In summary, photosynthesis is a process in which light energy is turned into chemical energy, which is then used by plants and other organisms to turn the power of the sun into fuel.

In plants, photosynthesis happens in the chloroplasts, which are found on the leaves. There are two main stages to the process, which are the light reactions and the dark reactions. The light reactions turn light into energy (ATP and NADHP) and the dark reactions use the energy and carbon dioxide to produce sugar.