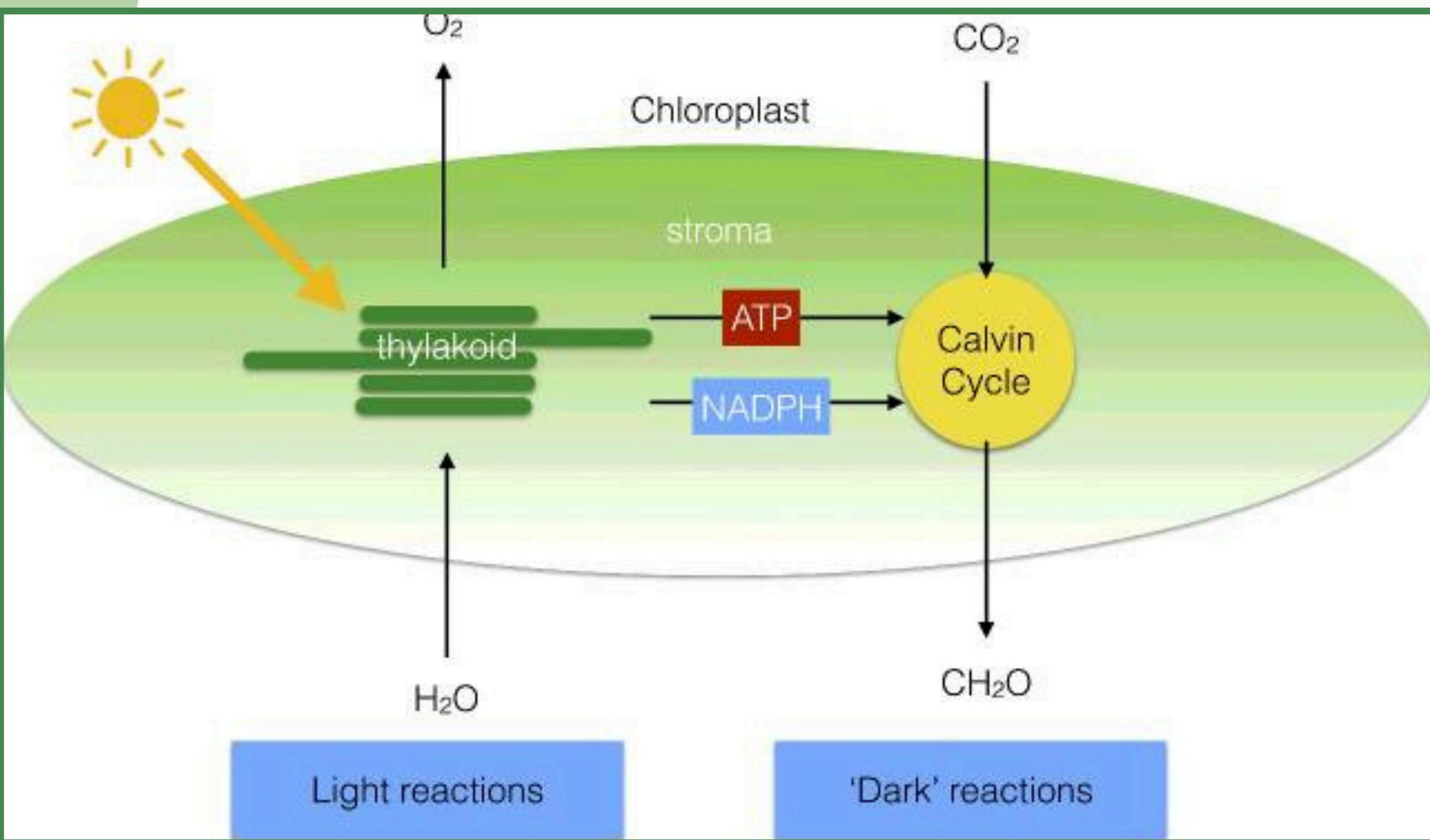


Using Models to Break Down the Complexity of Photosynthesis

Scientific Example

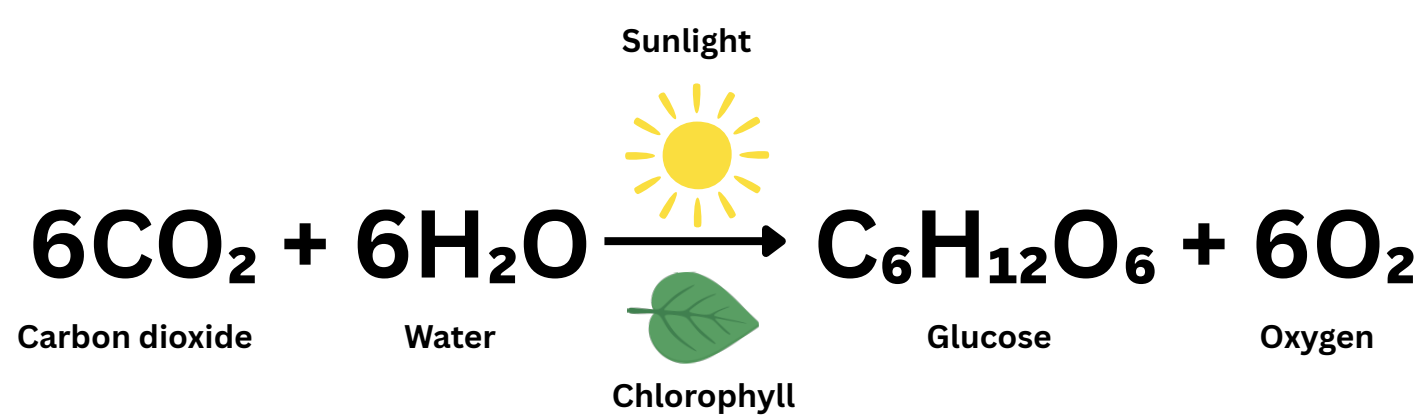
By Ava Zirnhelt

Photosynthesis is where plants use water, carbon dioxide, and sunlight to produce oxygen and sugar. However, the biochemical process is much more complex. Photosynthesis consists of two main phases and takes place entirely in the chloroplasts (Johnson M. P. 2016; Lambers, H., Bassham, J. A. 2026). Phase one, the light-dependent reactions, occur in the thylakoid membranes, where solar energy drives an electron transport chain to produce ATP and NADPH (Johnson M. P. 2016; Lambers, H., Bassham, J. A. 2026). These molecules are then used in the Calvin cycle, which occurs in the stroma (Johnson M. P. 2016). This is the second phase of photosynthesis and is also known as the light-independent reactions (Johnson M. P. 2016). During the Calvin cycle, ATP and NADPH provide the energy needed to convert carbon dioxide into the sugars plants need to grow (Johnson M. P. 2016; Lambers, H., Bassham, J. A. 2026).



Nature of Science Principle

In general, it's easy to understand the photosynthetic equation as shown on the lower left. However, the actual process is much more complex. Models are a useful tool to simplify photosynthesis because they can focus on basic knowledge or breaking down certain steps, but they can't be used to show every mechanism and interaction all in one picture. For example, you could have a diagram showing an overview of the process, as shown on the upper left, or you could have a diagram focusing on the structure of the chloroplast, the electron transport chain, or the Calvin cycle. Multiple diagrams are therefore required for representing different parts of the same process. Although they are great visual tools, it is important not to rely just on diagrams and models because they aren't able to show the complete process occurring during photosynthesis.



Why This Matters

Understanding that scientific models do not usually encompass the entire process helps students interpret them more accurately. Models are an important part of education because they can help students visualize complicated mechanisms that cannot be observed directly. Being able to recognize models that don't include the exact demonstrations of what is happening will help students evaluate the information more clearly. Knowing that information might be missing can encourage students to ask further questions and seek additional information.

Classroom Use

Teachers can use this case card as a discussion prompt on the use of diagrams and how they cannot solely be relied on to learn complex mechanisms. Teachers can ask questions like "Without reading the text, is there enough information in this diagram to understand the mechanisms of photosynthesis?" or "What additional information do you need to know about the process of photosynthesis that isn't included in this picture and would a separate diagram help?"

References

- Johnson, M. P. (2016). Division of labour within the chloroplast [Photograph]. *Essays In Biochemistry*. <https://doi.org/10.1042/EBC20160016>
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