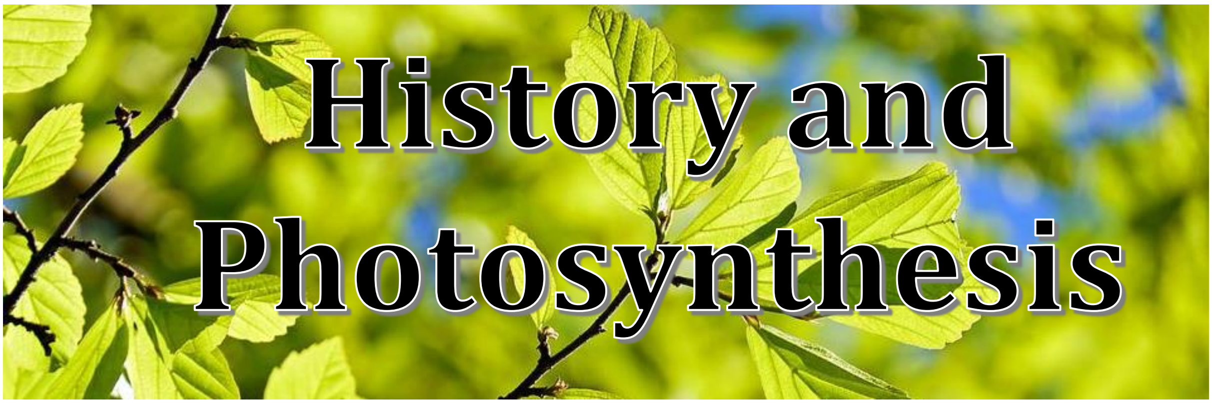


Adapted from Shmoop Editorial Team (2017) accessed via http://www.shmoop.com/photosynthesis/history.html#

Why do we study photosynthesis?

The process of photosynthesis underpins much of Biology and indeed life. The oxygen you breathe in only exists on Earth due to the photosynthesis performed by early life forms billions of years ago. The sugars you eat only exist because plants created them for you to consume – directly in plant-based foods or indirectly through eating animals that first ate plants.

Since photosynthesis is such an important series of chemical reactions, much scientific study has occurred to better our understanding of this amazing process. Indeed, we still do not know everything there is to know about this complex set of reactions and it continues to be studied further, even today.

The history of research on photosynthesis

Jan Van Helmont was one of the early contributors to our modern understanding of photosynthesis. His work in the 1600s helped us realise the importance of water for plants, and the contribution of water to their gain in mass.

Helmont observed (as had many others) that as trees grow, their mass increases. Yet unlike animals, trees did not eat. Helmont's line of inquiry was thus to work out from where trees gained nutrition to grow. Helmont went about growing a tree in soil, with both the tree and soil mass carefully measured. Over the years, Helmont watered the soil and the tree grew, and grew, and grew. After five years, Helmont measured the mass of the tree and soil once more. The tree's mass had increased significantly, while the soil mass remained relatively unchanged. Helmont concluded the water he added to the soil must have been the nutrition the plant used to gain mass.

Helmont was on the right track, but not entirely correct. Modern knowledge of photosynthesis allows us to see that water is indeed needed for photosynthesis. However, so too are carbon dioxide and light. Photosynthesis is a plants' main source of nutrition for growth. Yet soil nutrients are also required for specific processes within plants to enable growth and function.

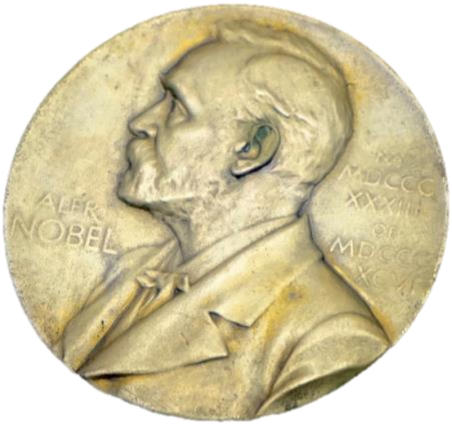
Jan Ingen-Housz is credited with demonstrating that plants could generate oxygen. His work was conducted about a century after Helmont, in the 1700s. Ingen-Housz showed that the green parts of plants could produce oxygen (O_2) and that they did so using light (but not heat) from the Sun. He also hypothesised that plants used carbon dioxide (CO_2) – an idea that was novel at the time.

Theodor Engelmann conducted work in the late 1800s on photosynthesis. Through his work, the location of photosynthetic reactions reaction was identified: the chloroplast. He also furthered Ingen-Housz's work – showing that plants used specific wavelengths (colours) of sunlight and that brightness of light was significant for plants.

For many years, it was assumed that the source of the oxygen atoms required for photosynthesis to make oxygen (O_2) came from carbon dioxide (CO_2). However, in the 1930s, L. B. Neil (of Stanford University) hypothesised that these atoms came instead from water (H_2O). Both carbon dioxide and water contain oxygen atoms after all, so either could theoretically be the source of the atoms to form oxygen gas. But how could this be tested? In 1941, Samuel Ruben and Martin Karmen used isotopes to solve the mystery. Isotopes are forms of chemical elements that react the same chemically, but differ in the mass (due to having different numbers of neutrons inside the atoms involved). And what did they find? Neil's hypothesis was supported by their experiment – the water was the source of the oxygen produced in photosynthesis.

Throughout the 1900s and continuing today, photosynthesis has been an area of active research. Many Nobel Prizes in Chemistry have been awarded for research focused on understanding more of the biochemical processes involved in photosynthesis. For example, Robert Huber received a Nobel Prize in 1988 for discovering the structure of the photosynthetic centre – the inner machinery of the chloroplast.

Nobel Prize awards for work on photosynthesis



The following list is compiled from the Nobel Prize website and provides an outline of recipients whose contributions have related to and/or aided our understanding of photosynthesis.

- **1915:** Richard Martin Wilstätter "for his researches on plant pigments, especially chlorophyll"
- **1930:** Hans Fischer "for his researches into the constitution of haemin and chlorophyll and especially for his synthesis of haemin"
- **1937:** Paul Karrer "for his investigations on carotenoids, mavins and vitamins A and B2" and Walter Haworth "for his investigations on carbohydrates and vitamin C"
- **1938:** Richard Kuhn "for his work on carotenoids and vitamins"
- **1961:** Melvin Calvin "for his research on the carbon dioxide assimilation in plants"
- **1965:** Robert Burns Woodward "for his outstanding achievements in the art of organic synthesis"
- **1978:** Peter Mitchell "for his contribution to the understanding of biological energy transfer through the formulation of the chemiosmotic theory"
- **1988:** Harmut Michel, Robert Huber, and Johann Deisenhofer "for the determination of the three-dimensional structure of a photosynthetic reaction centre"
- **1992:** Rudolph Marcus "for his contributions to the theory of electron transfer reactions in chemical systems"
- **1997:** Paul Boyer, John Walker, and Jens Skou "for their elucidation of the enzymatic mechanism underlying the synthesis of adenosine triphosphate (ATP)"