EARLY EXPERIMENTS

The journey towards comprehending the intricacies of photosynthesis has been marked by a series of fundamental experiments that gradually unfolded the mystery surrounding this vital biological process.

- **Joseph Priestley (1733-1804):** In 1770, Priestley embarked on experiments that laid the foundation for understanding the role of air in the growth of green plants. Through meticulous observations, he discovered oxygen in 1774. One of his experiments involved placing a burning candle and a mouse in a closed space, leading to their respective extinction due to air consumption. Intriguingly, when a mint plant was introduced into the same space, the mouse thrived, and the candle continued to burn. This pivotal observation led Priestley to the profound conclusion that plants restore to the air what is consumed by breathing organisms and burning objects.

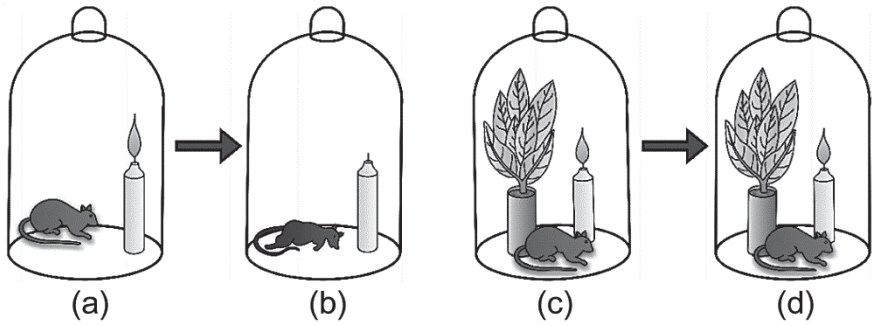

Fig. : Priestley's experiment

- **Jan Ingenhousz (1730-1799):** Ingenhousz furthered the exploration by demonstrating the necessity of sunlight for the plant processes responsible for purifying air. In experiments with aquatic plants like Hydrilla, he observed oxygen bubbles forming around green parts in bright sunlight. His findings underscored that only the green parts of plants, in the presence of sunlight, release oxygen.
- **Julius von Sachs (1854):** Sachs contributed significantly by identifying that glucose production primarily occurs in the green parts of plants, which is stored as starch. His work unveiled the presence of chlorophyll, now known to reside in chloroplasts within plant cells.
- **T.W. Engelmann (1843-1909):** Engelman's pioneering work on Cladophora involved using a prism to split light into spectral components. By illuminating the alga with different colors, he discovered that oxygen evolution was prominent in the regions of blue and red light. This groundbreaking experiment resulted in the first action spectrum of photosynthesis.
- **Cornelius van Niel (1897-1985):** A microbiologist, van Niel delved into the source of oxygen in photosynthesis. Through studies on purple and green sulphur bacteria, he proposed that oxygen released by green plants originates from water, not carbon dioxide. This hypothesis was later substantiated through radioisotopic techniques.

  The culmination of these experiments paved the way for an empirical equation representing photosynthesis in oxygen-evolving organisms:

$$CO_2 + H_2O \xrightarrow{\text{Light}} [CH_2O] + O_2$$

  Where $[CH_2O]$ signifies a carbohydrate.

  The accurate representation of the entire photosynthesis process, validated by later experiments, emerged as:

$$6CO_2 + 12H^2O \xrightarrow{\text{Light}} C_6H_{12}O_6 + 6H_2O + 6O_2 \uparrow$$

Where $C_6H_{12}O_6$ glucose, and O_2 is released from water.
Researchers such as Ruben, Kamen, and others utilized non-radioactive isotopes, like oxygen-18, to confirm that the evolved O_2 during the light reaction indeed comes from water, not carbon dioxide.

- **Light in Photosynthesis:** Sunlight, akin to a cascade of photons, constitutes an essential component for photosynthesis. The visible light spectrum, crucial for this process, ranges between 400-700 nm and is termed Photo synthetically Active Radiation (PAR).