**Photosynthesis** and **respiration** are reactions that [complement](https://www.diffen.com/difference/Complement_vs_Compliment) each other in the environment. They are in reality the same reactions but occurring in reverse. While in photosynthesis carbon dioxide and water yield glucose and [oxygen](https://www.diffen.com/difference/Oxygen_vs_Ozone), through the respiration process glucose and oxygen yield carbon dioxide and water.

They work well since living organisms supply plants with carbon dioxide which undergoes photosynthesis and produces glucose and these plants and [bacteria](https://www.diffen.com/difference/Bacteria_vs_Virus) give out oxygen which all living organisms need for respiration.

**Comparison chart**

|  |  |  |
| --- | --- | --- |
|  | **Cellular Respiration** | **Photosynthesis** |
| **Production of ATP** | Yes; theoretical yield is 38 ATP molecules per glucose but actual yield is only about 30-32. | Yes |
| **Reactants** | C6H12O6 and 6O2 | 6CO2 and 12H2O and light energy |
| **Requirement of sunlight** | Sunlight not required; cellular respiration occurs at all times. | Can occur only in presence of sunlight |
| **Chemical Equation (formula)** | 6O2 + C6H12O6 --> 6CO2 +6H2O + ATP (energy) | 6CO2 + 12H2O + light --> C6H12O6 + 6O2 + 6H20 |
| **Process** | Production of ATP via oxidation of organic sugar compounds. [1] glycolosis: breaking down of sugars; occurs in cytoplasm [2] Krebs Cycle: occurs in mitochondria; requires energy [3] Electron Transport Chain-- in mitochondria; converts O2 to water. | The production of organic carbon (glucose and starch) from inorganic carbon (carbon dioxide) with the use of ATP and NADPH produced in the light dependent reaction |
| **Fate of oxygen and carbon dioxide** | Oxygen is absorbed and carbon dioxide is released. | Carbon dioxide is absorbed and oxygen is released. |
| **Energy required or released?** | Releases energy in a step wise manner as ATP molecules | Requires energy |
| **Main function** | Breakdown of food. Energy release. | Production of food. Energy Capture. |
| **Chemical reaction** | Glucose is broken down into water and carbon dioxide (and energy) | Carbon dioxide and water combine in presence of sunlight to produce glucose and oxygen |
| **Stages** | 4 stages: Glycolysis, Linking Reaction (pyruvate oxidation), Krebs cycle, Electron Transport Chain (oxidative phosphorylation). | 2 stages: The light dependent reaction, light independent reaction. (AKA light cycle & calvin cycle) |
| **What powers ATP synthase** | H+ proton gradient across the inner mitochondria membrane into matrix. High H+ concentration in the intermembrane space. | H+ gradient across thylakoid membrane into stroma. High H+ concentration in the thylakoid lumen |
| **Products** | 6CO2 and 6H2O and energy(ATP) | C6 H12 O6 (or G3P) and 6O2 and 6H20 |
| **What pumps protons across the membrane** | Electron transport chain. Electrochemical gradient creates energy that the protons use to flow passively synthesizing ATP. | Electron transport chain |
| **Occurs in which organelle?** | Mitochondria Glycolysis (cytoplasm) | Chloroplasts |
| **Final electron receptor** | O2 (Oxygen gas) | NADP+ (forms NADPH ) |
| **Occurs in which organisms?** | Occurs in all living organisms (plants and animals). | Occurs in plants, protista (algae), and some bacteria. |
| **Electron source** | Glucose, NADH + , FADH2 | Oxidation H2O at PSII |
| **Catalyst - A substance that increases the rate of a chemical reaction** | No catalyst is required for respiration reaction. | Reaction takes places in presence of chlorophyll. |
| **High electron potential energy** | From breaking bonds | From light photons |