Photosynthesis vs Respiration

Photosynthesis and **respiration** are reactions that complement 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, 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 give out oxygen which all living organisms need for respiration.

Comparison chart

	Photosynthesis	Respiration
Production of ATP	Yes	Yes; theoretical yield is 38 ATP molecules per glucose but actual yield is only about 30-32.
Reactants	6CO2 and 12H2O and light energy	C6H12O6 and 6O2
Requirement of sunlight	Can occur only in presence of sunlight	Sunlight not required; cellular respiration occurs at all times.
Equation	6CO2 + 12H2O + light --> C6H12O6 + 6O2 + 6H20	6O2 + C6H12O6 --> 6CO2 +6H2O + ATP (energy)
Process	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	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.
Fate of oxygen and carbon dioxide	Carbon dioxide is absorbed and oxygen is released.	Oxygen is absorbed and carbon dioxide is released.
Energy required or released?	Requires energy	Releases energy in a step wise manner as ATP molecules
Main function	Production of food. Energy Capture.	Breakdown of food. Energy release.
Chemical reaction	Carbon dioxide and water combine in presence of sunlight to produce glucose and oxygen.	Glucose is broken down into water and carbon dioxide (and energy).

	Photosynthesis	Respiration
Stages	2 stages: The light dependent reaction, light independent reaction. (AKA light cycle & calvin cycle)	4 stages: Glycolysis, Linking Reaction (pyruvate oxidation), Krebs cycle, Electron Transport Chain (oxidative phosphorylation).
What powers ATP synthase	H+ gradient across thylakoid membrane into stroma. High H+ concentration in the thylakoid lumen	H+ proton gradient across the inner mitochondria membrane into matrix. High H+ concentration in the intermembrane space.
Products	C6 H12 O6 (or G3P) and 6O2 and 6H20	6CO2 and 6H2O and energy(ATP)
What pumps protons across the membrane	Electron transport chain	Electron transport chain. Electrochemical gradient creates energy that the protons use to flow passively synthesizing ATP.
Occurs in which organelle?	Chloroplasts	Mitochondria Glycolysis (cytoplasm)
Final electron receptor	NADP+ (forms NADPH)	O2 (Oxygen gas)
Occurs in which organisms?	Occurs in plants, protista (algae), and some bacteria.	Occurs in all living organisms (plants and animals).
Electron source	Oxidation H2O at PSII	Glucose, NADH + , FADH2
Catalyst - A substance that increases the rate of a chemical reaction	Reaction takes places in presence of chlorophyll.	No catalyst is required for respiration reaction.
High electron potential energy	From light photons.	From breaking bonds

Definitions of photosynthesis and respiration

Photosynthesis is a process that converts carbon dioxide into organic compounds in presence of sunlight. **Respiration** is the set of metabolic reactions that take in cells of living organisms that convert nutrients like sugar into ATP (adenosine tri phosphate) and waste products.

Processes involved

Processes in **photosynthesis** are divided on basis of requirement of sunlight while respiration processes are divided on basis of requirement of oxygen. Hence in photosynthesis you have the light dependent reactions and the dark reactions while in **respiration** there is aerobic respiration and anaerobic respiration.

In photosynthesis light dependent reactions, ultra violet light strikes chlorophyll pigments which excites electrons leading to separation of oxygen molecules from carbon dioxide. In the dark reactions, carbon molecules now independent of oxygen are converted into carbohydrates and stored in plant cells as energy and food source. In aerobic cellular respiration oxygen is utilized to convert organic compounds into energy and in anaerobic respiration converts organic compounds into energy without using oxygen.

Site of Reactions

Photosynthesis takes place in the chloroplasts and organelles of a plant cell. **Respiration** takes place in the cytoplasm and mitochondria in the cell of a living organism.

Reaction kinetics

The electron acceptor in photosynthesis is NAD+ while in respiration the electron acceptor is NADH. In cellular respiration reaction 36 molecules of ATP are produced in complete oxidation of one molecule of glucose.