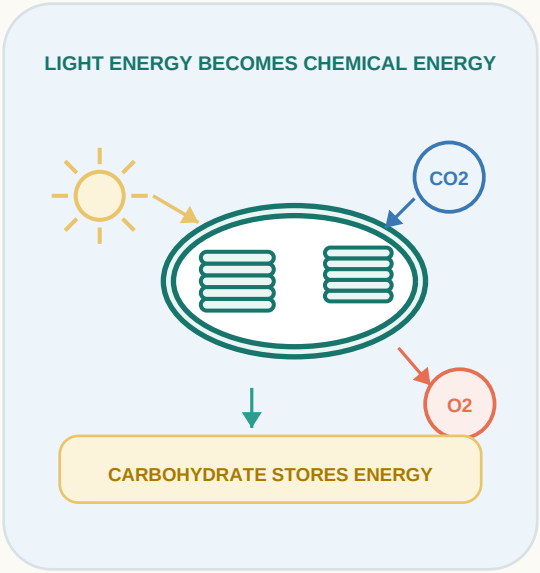
AP BIOLOGY | UNIT 3

TOPIC 3.4

Photosynthesis

Chloroplasts capture light energy, build ATP and NADPH, and use those molecules to reduce carbon dioxide into carbohydrates.



THE CORE CAUSAL CHAIN

LIGHT
excites electrons

→

ETC
builds H+ gradient

→

ATP + NADPH
carry energy

→

CALVIN CYCLE
builds carbohydrate

BY THE END, YOU SHOULD BE ABLE TO...

1. Link chloroplast structure to photosynthetic processes.
2. Trace energy and electrons through the light reactions.
3. Explain how the Calvin cycle builds carbohydrate from CO2.

OVERALL TRANSFORMATION

Carbon dioxide + water + light energy -> carbohydrate + oxygen. The equation summarizes two linked stages, not one reaction.

1 Chloroplast structure and light reactions

Thylakoid membranes organize photosystems, electron carriers, and ATP synthase so light-driven electron flow can build ATP and NADPH.

STRUCTURE DIVIDES THE WORK

THYLAKOID MEMBRANE

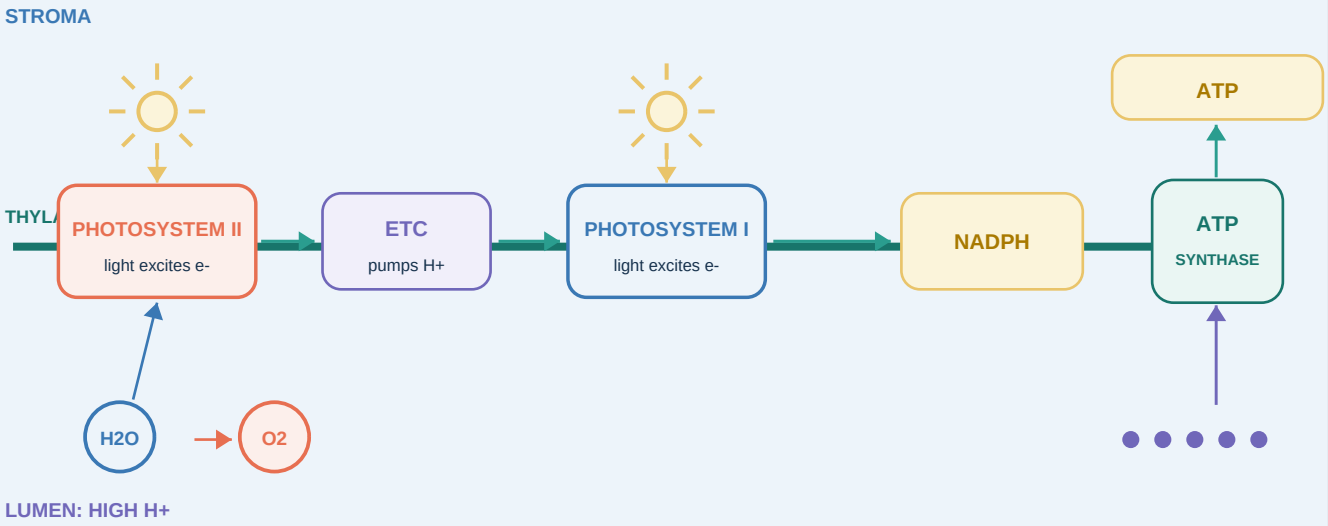
Light reactions: electron transport, proton pumping, and ATP synthesis.

STROMA

fluid

Calvin cycle: enzymes use ATP and NADPH to reduce carbon dioxide.

LIGHT REACTIONS ACROSS THE THYLAKOID



INPUTS AND OUTPUTS

PROCESS	INPUT	OUTPUT	PURPOSE
WATER SPLITTING	H2O	O2 + H+ + e-	replace PSII electrons
CHEMIOSMOSIS	H+ gradient	ATP	capture usable energy
NADP+ REDUCTION	NADP+ + H+ + e-	NADPH	carry reducing power

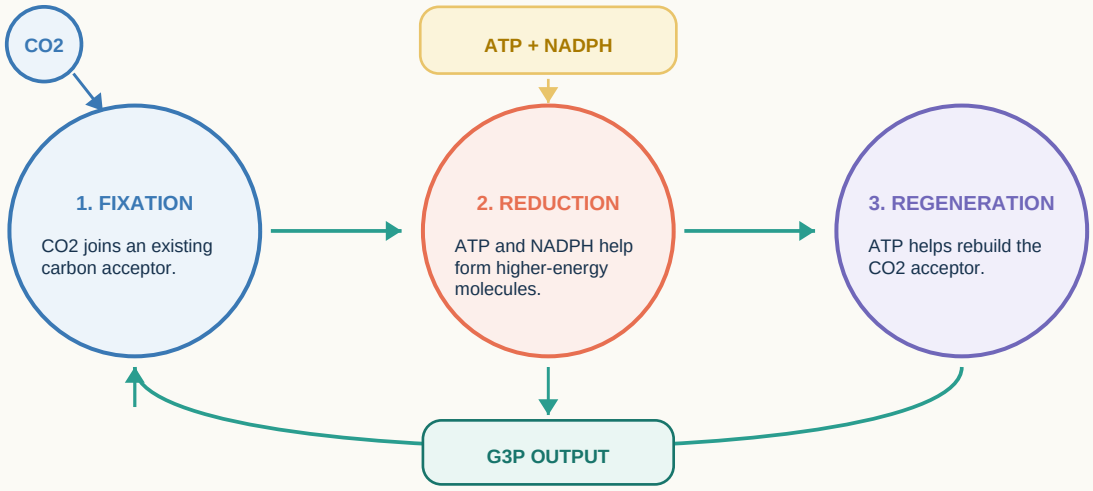
COMMON ERROR

The oxygen released by photosynthesis comes from water splitting, not from carbon dioxide.

2 The Calvin cycle stores carbon and energy

Stromal enzymes use ATP and NADPH from the light reactions to reduce carbon dioxide and produce carbohydrate-building molecules.

THREE PHASES IN THE STROMA



THE TWO STAGES EXCHANGE ENERGY CARRIERS



Energy carriers link the stages; carbon atoms do not cycle back to the light reactions.

SIDE-BY-SIDE

	LIGHT REACTIONS	CALVIN CYCLE
LOCATION	thylakoid membrane	stroma
ENERGY ROLE	captures light in ATP and NADPH	uses ATP and NADPH to reduce CO2
KEY OUTPUT	O2, ATP, NADPH	G3P for carbohydrate

COMMON ERROR

The Calvin cycle does not directly require light, but it normally depends on ATP and NADPH supplied by the light reactions.