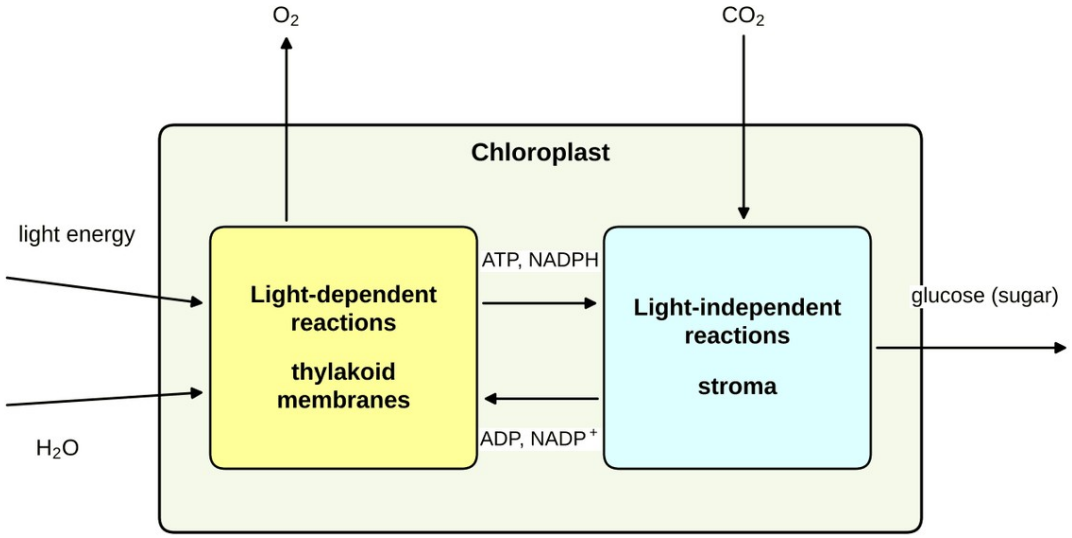
Essential Question

What do the light-dependent and light-independent reactions each do?

Stages of Photosynthesis

Two Stages, Two Places

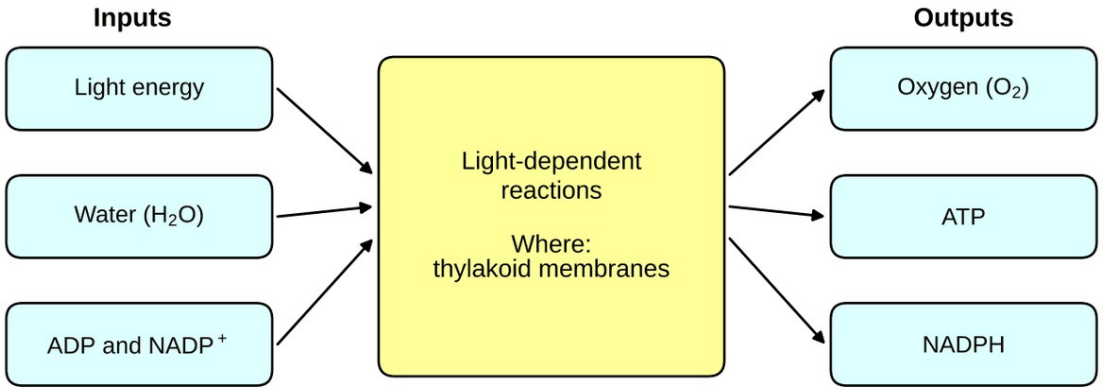
- Light-dependent reactions: thylakoid membranes
- Light-independent reactions: stroma
- ATP and NADPH link the two stages
- Together they make glucose from CO_2



Stages of Photosynthesis

Light-Dependent Reactions

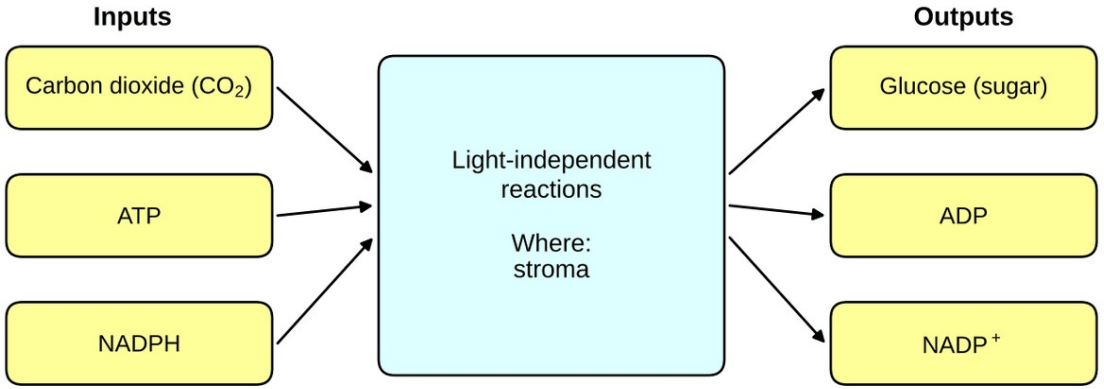
- Inputs: light energy, H_2O, ADP, $NADP^+$
- Outputs: O_2, ATP, NADPH
- Light energy is converted to chemical energy
- Oxygen comes from splitting water



Light energy is converted to chemical energy in ATP and NADPH

Light-Independent Reactions

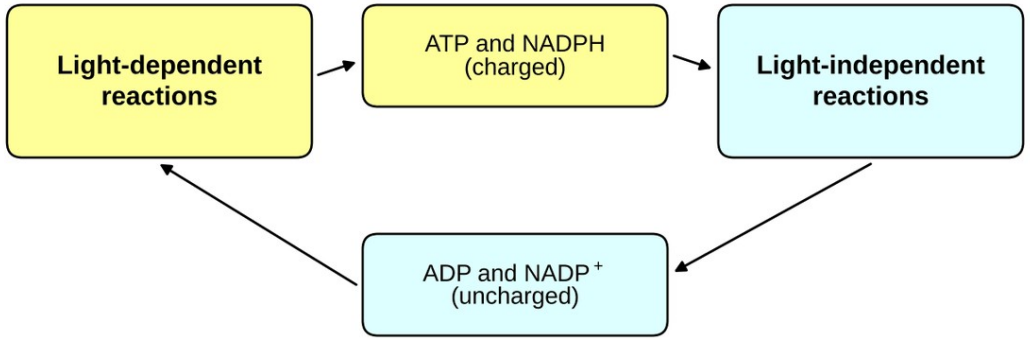
- Inputs: CO_2, ATP, NADPH
- Outputs: glucose, ADP, $NADP^+$
- Energy from ATP and NADPH is stored in glucose
- Carbon from CO_2 is built into sugar



Energy from ATP and NADPH is stored in the bonds of glucose

Energy Carriers Are Recycled

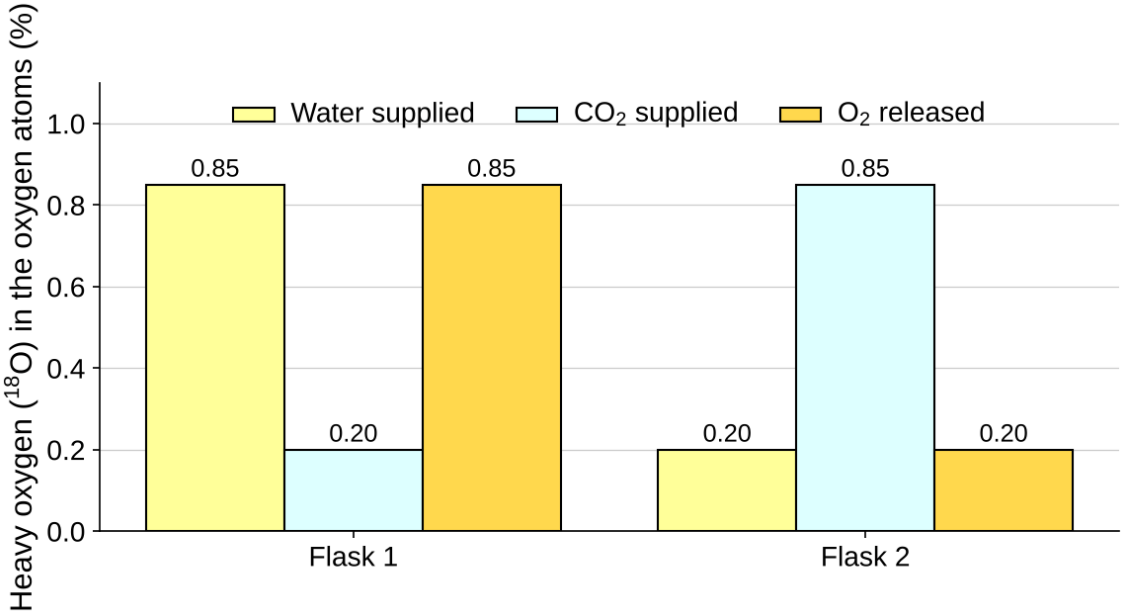
- ADP and $NADP^+$: empty carriers
- Light-dependent reactions charge them
- Light-independent reactions empty them
- No light or no CO_2 slows the whole cycle



The carriers are used over and over: charged in the light, emptied in the stroma

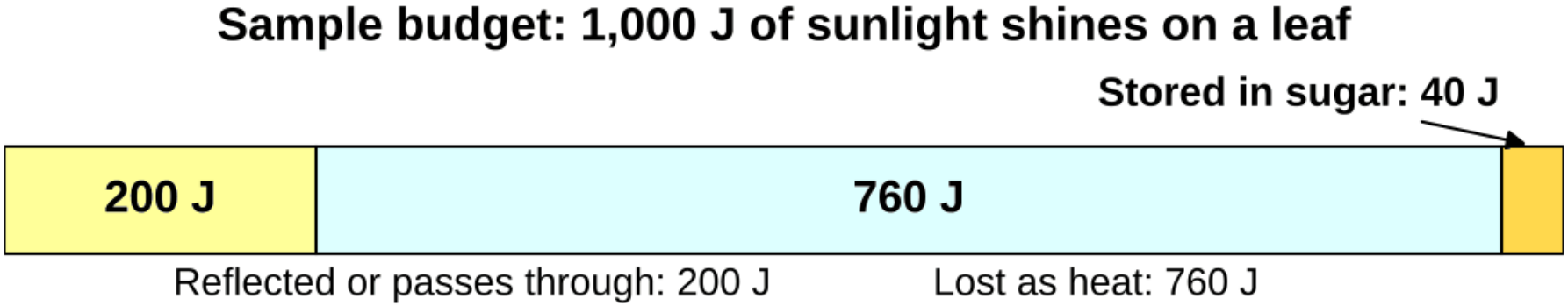
Where Does the Oxygen Come From?

- Scientists used heavy oxygen (^{18}O) as a tracer
- Flask 1: ^{18}O in the water
- Flask 2: ^{18}O in the CO_2
- The O_2 matched the water, not the CO_2



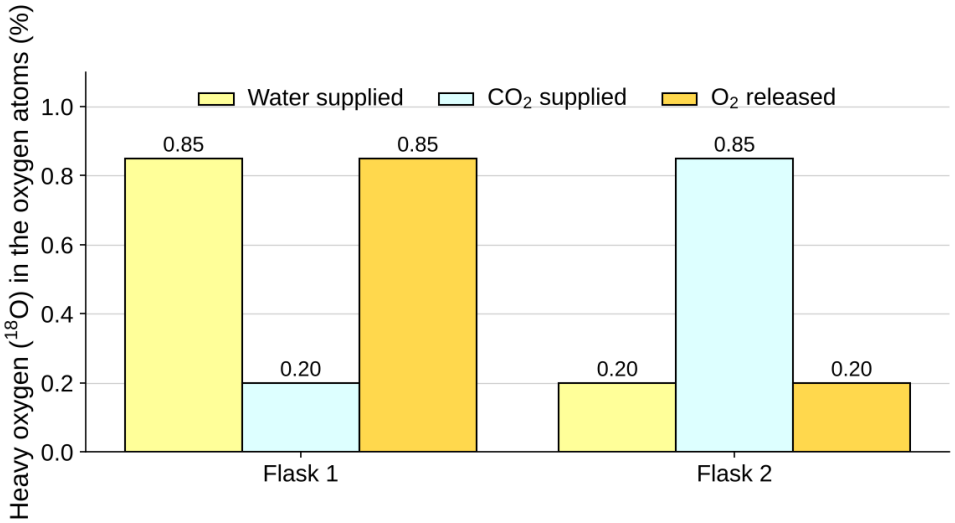
Example: Where Does the Sunlight Go?

In this model, 1,000 J of sunlight shines on a leaf. Of that, 200 J is reflected or passes through, 760 J is lost as heat, and 40 J is stored in sugar. (a) What percent is stored in sugar? (b) How much energy would be stored from 25,000 J of sunlight? (c) What does the stored energy do for the plant?



Example: Where Does the Oxygen Come From?

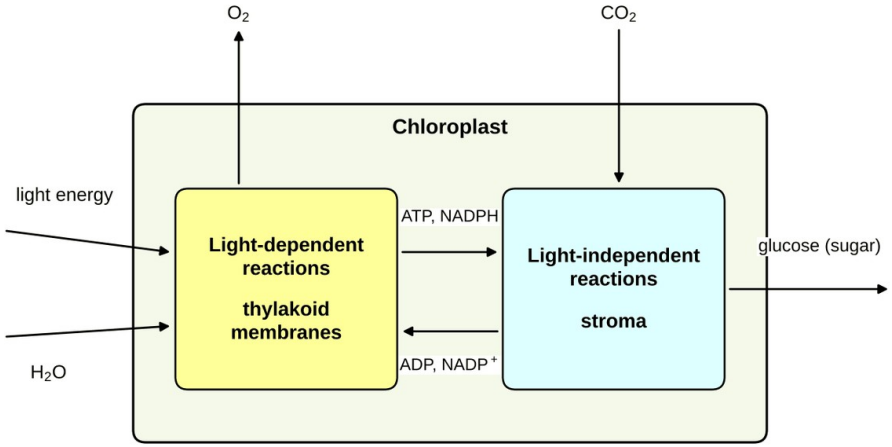
Use the tracer data. (a) Which flask's oxygen came from water? (b) State a claim about the source of the O_2, give your evidence, and explain your reasoning.



Example: No Carbon Dioxide

Use the model of the two stages. A plant in bright light is placed in air that has no CO_2.

(a) Which stage stops first? (b) Predict what happens to the ADP and $NADP^+$ supply. (c) Predict what happens to O_2 production over time, and explain.



Stages of Photosynthesis

Big Ideas

- Light-dependent reactions: thylakoid membranes, make O_2, ATP, NADPH
- Light-independent reactions: stroma, use CO_2, ATP, NADPH to make glucose
- ADP and $NADP^+$ are recycled between the stages
- The O_2 comes from water, not from CO_2