



Photosynthesis and Cellular Respiration

Explain how photosynthesis and cellular respiration are complementary metabolic processes that transform energy and matter in living organisms

BIOLOGY · YEAR 11 · 60 MIN



TODAY

What we will do

Explain how photosynthesis and cellular respiration are complementary metabolic processes that transform energy and matter in living organisms

- 1 I can write a balanced word equation for photosynthesis and cellular respiration.
- 2 I can describe where each process occurs within the cell and what conditions are required.
- 3 I can explain how the reactants of one process are the products of the other.
- 4 I can justify why both processes are essential for sustaining life in organisms.
- 5 I can analyse a scenario and identify which process is dominant, using evidence from the data.

LOOK CLOSELY

Which jar turns yellow, and why?

Two sealed jars: one holds a healthy plant, one holds germinating seeds. The CO₂ indicator solution turns yellow in one.



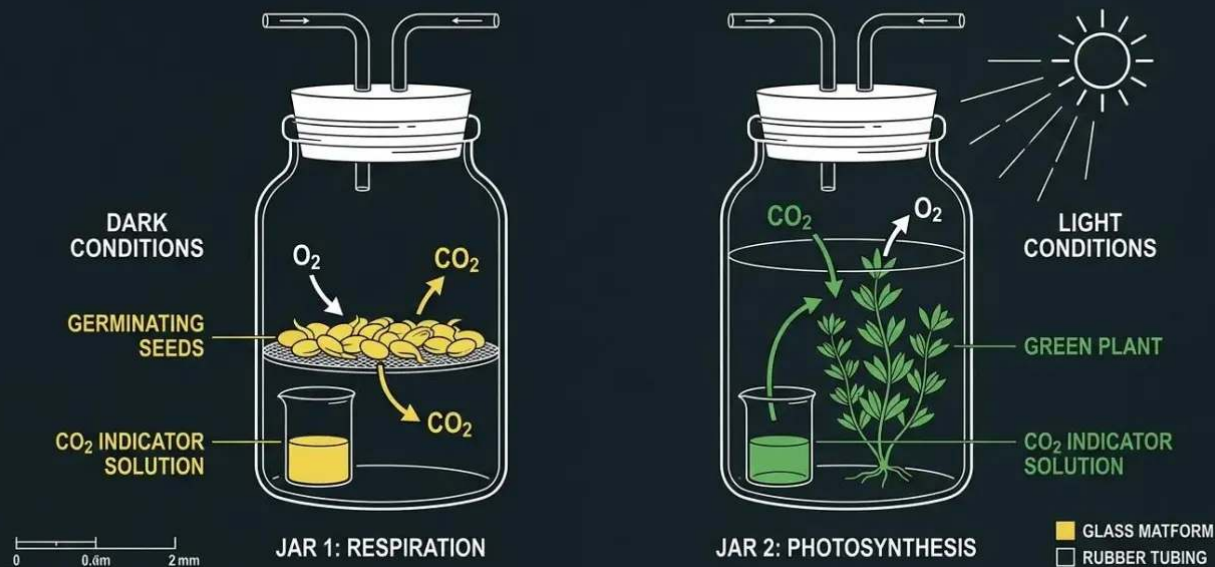
TALK *Predict which jar. Tell your partner why.*

ANSWER

The seeds jar turns yellow

Germinating seeds respire rapidly, releasing CO₂. The plant also respire, but photosynthesis absorbs CO₂ faster in light.

COMPARATIVE DIAGRAM: PHOTOSYNTHESIS AND RESPIRATION IN SEALED SYSTEMS



WHY Both jars show life processes at work. The question is which process dominates.

KEY TERMS

Four words to know

These terms describe how living cells transform energy and matter.

Photosynthesis

A process using light energy to make glucose from CO_2 and water.

Cellular respiration

Breaking down glucose to release ATP energy for the cell.

ATP

Adenosine triphosphate: the usable energy currency of the cell.

Metabolic process

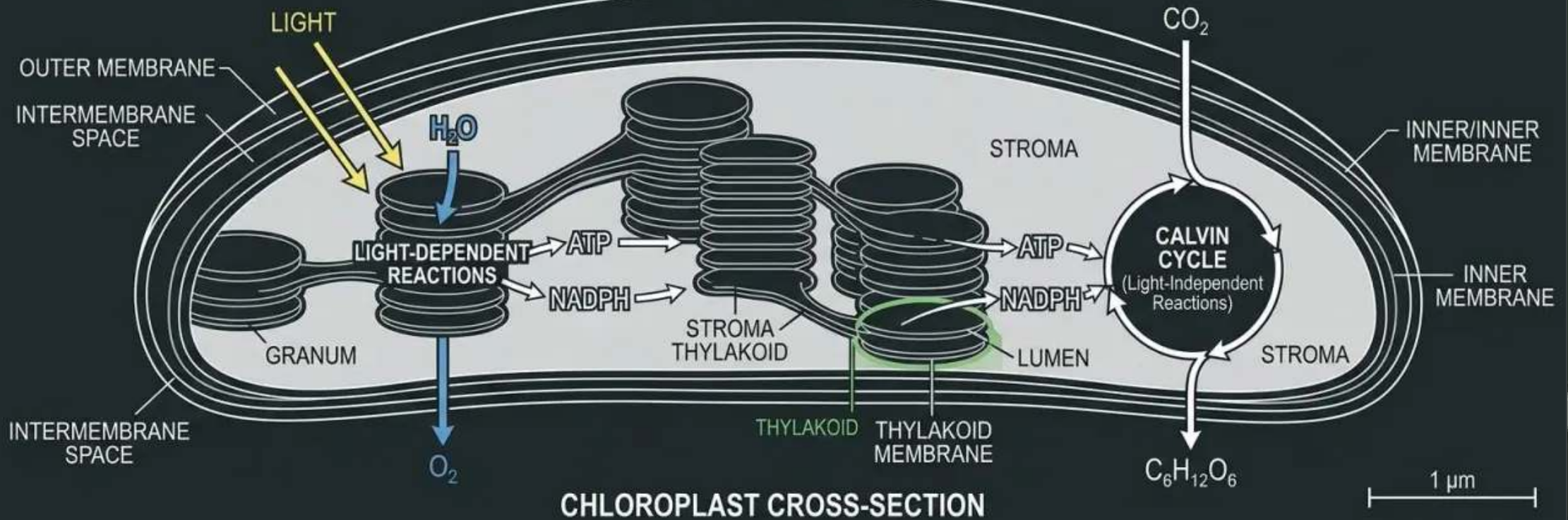
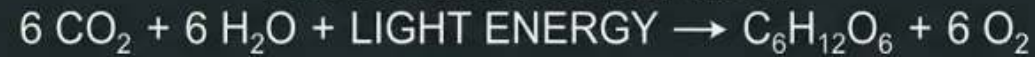
A chemical reaction that transforms energy or matter inside a living cell.

PHOTOSYNTHESIS

Capturing light energy in the chloroplast

Carbon dioxide and water enter the chloroplast. Light energy converts them into glucose and oxygen.

PHOTOSYNTHESIS EQUATION:



CELLULAR RESPIRATION

Releasing ATP energy in the mitochondria

Glucose and oxygen enter the mitochondria. They are broken down to release CO₂, water, and ATP energy.



WORD EQUATION

Glucose + oxygen → carbon dioxide + water + ATP

WATCH OUT

Respiration is not breathing. It happens in every living cell, all the time, even in plants.

THE LINK

Products of one are reactants of the other

The output of photosynthesis feeds directly into respiration, and vice versa. This is not coincidence.

PHOTOSYNTHESIS



$\text{CO}_2 + \text{H}_2\text{O}$ → Glucose + O_2 (chloroplasts, light required)

CELLULAR RESPIRATION



Glucose + O_2 → $\text{CO}_2 + \text{H}_2\text{O} + \text{ATP}$ (mitochondria, continuous)

The equations are inverses. Together they cycle matter and transform energy continuously.

HOW THEY CONNECT

One cycle, two complementary processes

Matter is recycled continuously. Energy flows in one direction.

PHOTOSYNTHESIS CELLULAR RESPIRATION

Shared molecules

CO_2 , H_2O , glucose, and O_2 move between both processes as reactants and products.

Energy direction

Photosynthesis stores light energy as chemical energy. Respiration releases it as ATP.

Location in cell

Photosynthesis occurs in chloroplasts. Respiration occurs in mitochondria.

Timing

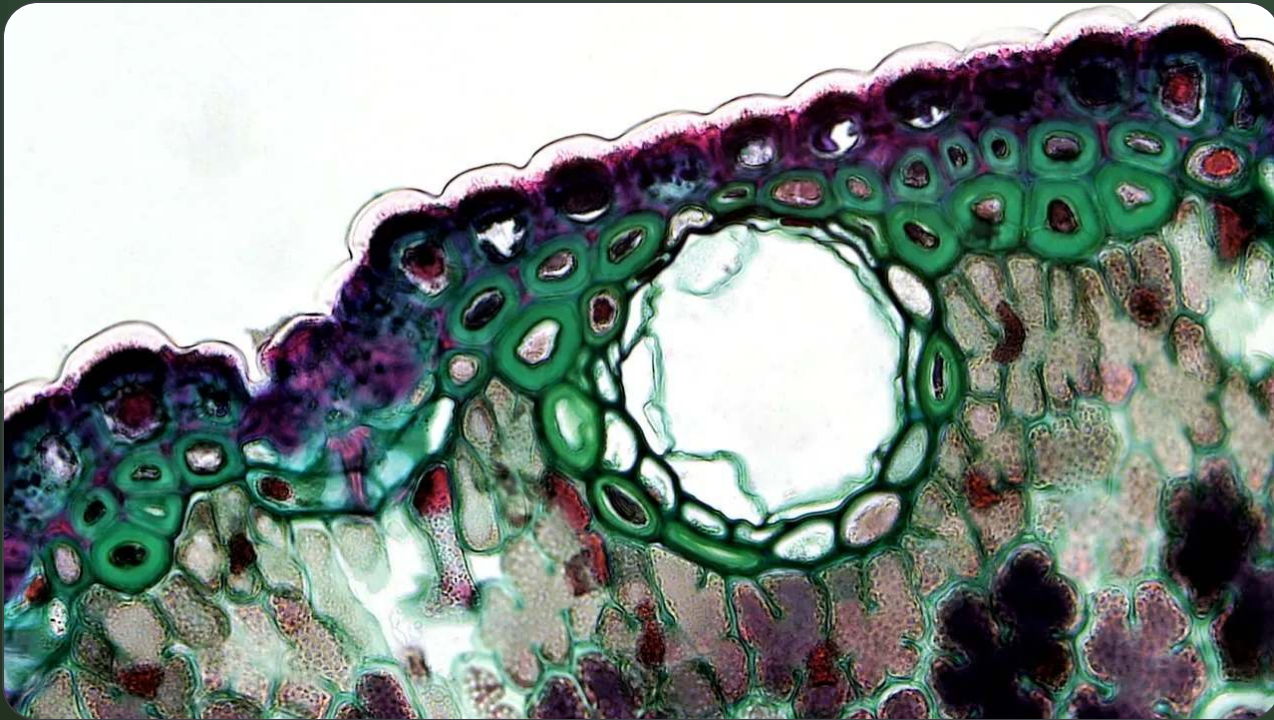
Photosynthesis needs light and stops at night. Respiration is continuous in all living cells.

Neither process cancels the other. They are complementary, not opposite.

THINK ABOUT IT

Do photosynthesis and respiration cancel each other out?

The equations are mathematical inverses. A student claims the two processes balance perfectly and no net change occurs.



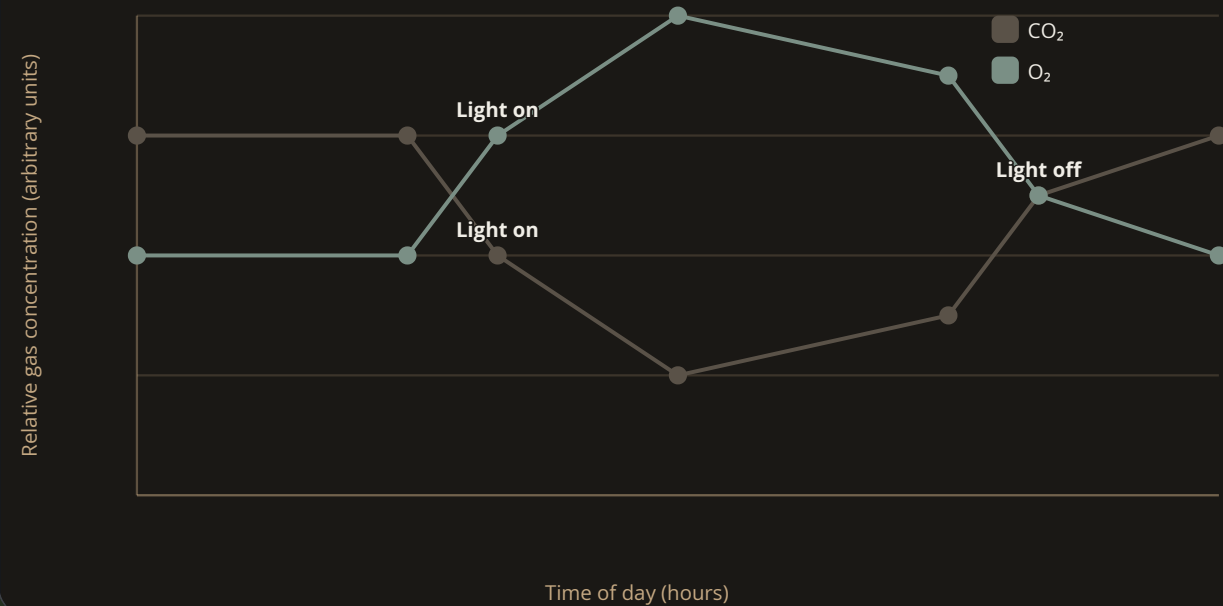
Is the student correct? What evidence would you use?

ANSWER

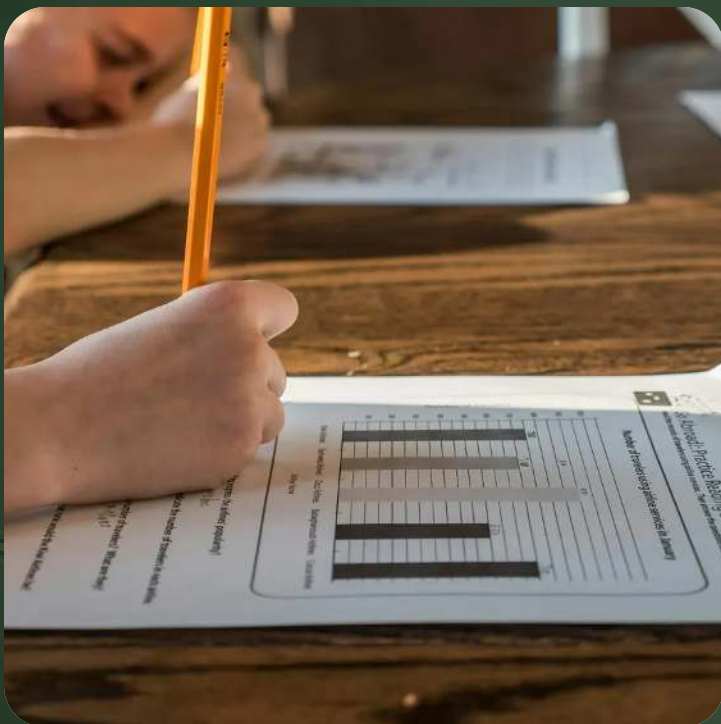
No. Rates differ, and purposes differ.

In bright light, photosynthesis exceeds respiration: net glucose is stored. At night, only respiration runs. They are not in permanent balance.

CO₂ and O₂ Levels Over 24 Hours



WHY Same molecules, opposite energy directions. They sustain each other but do not cancel.



YOUR TURN

Annotate the 24-hour graph

- 1 Write balanced word equations for photosynthesis and cellular respiration on your graph.
- 2 Mark each time point on the graph: label which process dominates and state why.
- 3 Write one sentence linking both processes causally: use the words 'reactant' and 'product'.

LOOK FOR *Where CO₂ falls and O₂ rises, photosynthesis dominates. Where CO₂ rises and O₂ falls, respiration dominates.*



EXIT TICKET

Three questions to close

Which process produces ATP, and where does it occur?

Name one molecule that is both a product and a reactant across the two processes.

Write one sentence linking photosynthesis and respiration causally.

Why would life on Earth be impossible if only one process existed?

WRITE IT DOWN *Answer all four in your workbook before the end of the lesson.*



TODAY WE LEARNED

Three things to remember

I can write balanced word equations for photosynthesis and cellular respiration.

I can explain that the products of each process are the reactants of the other.

I can justify why both processes together are essential to sustain life.