

PHOTOSYNTHESIS

HOW PLANTS MAKE THEIR OWN FOOD

A SHORT COURSE ON THE AMAZING PROCESS THAT KEEPS LIFE ON EARTH GOING!

TaimurKhani LEARNING HUB
• BIOLOGY SHORT COURSE •

EASY TO UNDERSTAND | REAL LIFE EXAMPLES | ENGAGING VISUALS

Learn the science behind life — in a simple and exciting way!

LEARN TODAY, GROW TOMORROW!

LEARNING OBJECTIVES

By the end of this lesson, you will be able to:

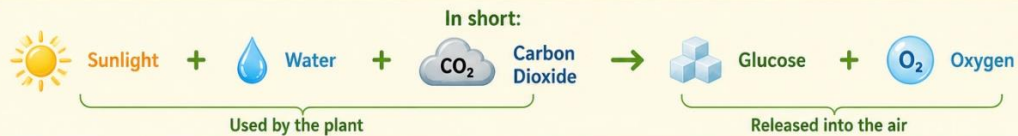
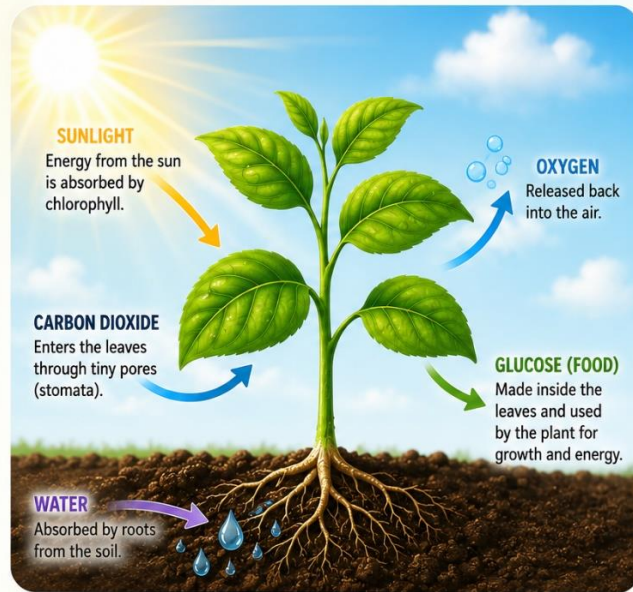
- 1 Define** photosynthesis.
- 2 Explain** why photosynthesis is important.
- 3 Identify** the raw materials and products.
- 4 Write** the word equation.
- 5 Explain** where photosynthesis occurs.
- 6 Describe** the factors affecting the rate of photosynthesis.
- 7 Understand** limiting factors.
- 8 Apply** knowledge to simple questions.

INTRODUCTION

What is Photosynthesis?

Photosynthesis is the process by which green plants make their own food using sunlight.

In simple words:
Plants use sunlight, water and carbon dioxide to make food (glucose) and release oxygen.



WHY IS PHOTOSYNTHESIS IMPORTANT?

Photosynthesis is essential for life on Earth.

1 Produces food for plants

Plants make glucose (their food) which provides energy for growth and survival.



2 Releases oxygen for living organisms

Oxygen released during photosynthesis is needed for animals and humans to breathe.



3 Removes carbon dioxide from the atmosphere

Plants absorb CO₂, helping to keep the air clean and fresh.



4 Provides food for almost every living thing

All food chains begin with plants.



5 Maintains the balance of nature

It supports ecosystems, climate balance, and sustains life on Earth.



**No photosynthesis, no food. No food, no life.
That's how important it is!**

WHERE DOES PHOTOSYNTHESIS OCCUR?

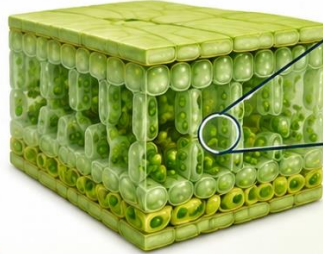
Photosynthesis takes place mainly in the **leaves** of green plants.

LEAF

Leaves are the main part of the plant where photosynthesis happens.

INSIDE THE LEAF

Photosynthesis occurs inside tiny structures called **chloroplasts**.



CHLOROPLAST

Contains chlorophyll, the green pigment that absorbs sunlight.

KEY POINTS



Main site:
Leaves



Place inside leaf:
Chloroplasts



Special pigment:
Chlorophyll



Leaves have many **chloroplasts**, which capture **sunlight** and start the amazing process of photosynthesis!

REQUIREMENTS FOR PHOTOSYNTHESIS

Plants need these **four main things** to make their own food.

1 SUNLIGHT

Sunlight provides energy that is absorbed by chlorophyll in the leaves.



2 CARBON DIOXIDE

Carbon dioxide from the air enters the leaves through tiny openings called stomata.



3 WATER

Water is absorbed by the roots from the soil and transported to the leaves.



4 CHLOROPHYLL

Chlorophyll is the green pigment in leaves that captures sunlight to make food.



REMEMBER:

Sunlight + Water + Carbon Dioxide + Chlorophyll → Glucose (food) + Oxygen

THE PHOTOSYNTHESIS EQUATION

• This equation shows the overall process of photosynthesis. •

WORD EQUATION

Carbon dioxide + Water $\xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$ Glucose (food) + Oxygen (released)

IN SIMPLE WORDS

Plants take in carbon dioxide and **water** using **sunlight** and **chlorophyll** to make **glucose** (their food) and release **oxygen**.

BALANCED CHEMICAL EQUATION

$$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$

- Carbon dioxide
- Water
- Glucose (food)
- Oxygen

Remember:

The number of atoms on both sides is the same. That's why the equation is balanced!

KEY IDEA

With the help of **sunlight** and **chlorophyll**, plants turn simple raw materials (CO_2 and H_2O) into food (**glucose**) and release **oxygen** for us to breathe.

PHOTOSYNTHESIS STEP-BY-STEP PROCESS

Plants use **sunlight**, **water** and carbon dioxide to make **food** and release **oxygen**.

1 ROOTS ABSORB WATER

Roots take in water from the soil. The water travels up the stem to the leaves.

2 LEAVES TAKE IN CARBON DIOXIDE

Leaves take in carbon dioxide from the air through tiny openings called stomata.

3 CHLOROPHYLL ABSORBS SUNLIGHT

Chlorophyll in the chloroplasts absorbs sunlight energy.

4 GLUCOSE IS PRODUCED

The energy from sunlight helps combine water and carbon dioxide to make glucose (food) in the leaves.

5 OXYGEN IS RELEASED

Oxygen, a useful by-product, is released back into the air.

IN SHORT:

Water (from soil) + Carbon dioxide (from air) $\xrightarrow{\text{Sunlight (energy)}}$ Glucose (food) + Oxygen (released)

WHAT HAPPENS INSIDE A LEAF?

A closer look at how photosynthesis happens in a leaf.

Tiny pores called stomata let gases in and out of the leaf.

Cut Section of Leaf

- 1 Upper Epidermis**
Protects the leaf.
- 2 Palisade Mesophyll**
Contains many chloroplasts. Main site of photosynthesis.
- 3 Spongy Mesophyll**
Has air spaces that help in gas exchange.
- 4 Lower Epidermis**
Has stomata for gas exchange.

1 Sunlight is absorbed
Chlorophyll in the palisade cells absorbs sunlight energy.

2 Carbon dioxide enters
CO₂ from the air enters the leaf through stomata.

3 Food (glucose) is made
Inside chloroplasts, sunlight energy is used to turn CO₂ and water into glucose (food) for the plant.

4 Oxygen is released
O₂, a useful by-product, is released back into the air through stomata.

KEY TAKEAWAY
Leaves are like tiny factories. With the help of sunlight, they take in carbon dioxide and water, make food for the plant, and release oxygen for us to breathe!

ADAPTATIONS OF LEAVES FOR PHOTOSYNTHESIS

Leaves have special features that help them carry out photosynthesis efficiently.

- 1 Broad and flat**
A large surface area catches more sunlight for photosynthesis.
- 2 Thin**
It allows sunlight to reach the cells easily inside the leaf.
- 3 Chloroplasts in cells**
Cells in the leaf contain many chloroplasts with chlorophyll to absorb sunlight.
- 4 Moist cells**
Moisture helps in the chemical reactions that make food.
- 5 Veins (vascular bundles)**
Veins transport water to the leaf and carry food away to other parts of the plant.
- 6 Stomata**
Tiny pores on the underside of the leaf allow carbon dioxide to enter and oxygen to leave.

Think About it!
Without these amazing adaptations, would plants be able to make their own food? Think about it!

KEY IDEA
Each part of a leaf has a special job that helps the plant make food and survive.

FACTORS AFFECTING PHOTOSYNTHESIS

The rate of photosynthesis can change depending on different factors.

MAIN FACTORS



1. LIGHT INTENSITY

More light usually increases the rate of photosynthesis up to a point.



2. CARBON DIOXIDE CONCENTRATION

More carbon dioxide usually increases the rate up to a point.



3. TEMPERATURE

The rate increases with temperature up to an optimum, then decreases.



4. WATER AVAILABILITY

Plants need enough water. Too little water decreases the rate.

EXAMPLE: EFFECT OF LIGHT INTENSITY

The pondweed experiment shows how increasing light affects the rate of photosynthesis.

LOW LIGHT



HIGH LIGHT



Light Intensity (lux)	50	100	200	400	800	1600
Number of bubbles per minute	5	12	24	38	48	50



Conclusion: As light intensity increases, the rate of photosynthesis increases up to a point, then levels off.

RESULTS SUMMARY



Increasing light intensity increases the rate up to a certain level.



Increasing carbon dioxide increases the rate up to a certain level.



Temperature has an optimum range for the highest rate.



Lack of water causes stomata to close and reduces the rate.



REMEMBER!

These factors do not act alone. They all work together in real plants.



KEY TAKEAWAY

Photosynthesis works best when light, carbon dioxide, temperature, and water are all in the right amounts. Too little or too much of any factor can slow it down.



These reactions need light energy. They happen first and provide energy for making food.

THE LIGHT REACTIONS OF PHOTOSYNTHESIS

Light energy is converted into chemical energy (ATP and NADPH), and oxygen is released.



HOW IT WORKS - STEP BY STEP

1 Light is absorbed

Chlorophyll in Photosystem II (PSII) absorbs sunlight.

2 Water is split (photolysis)

Water molecules are split into electrons (e^-), protons (H^+), and oxygen (O_2).

3 Electrons move

Electrons travel through an electron transport chain.

4 ATP is produced

The energy from electrons is used to make ATP.

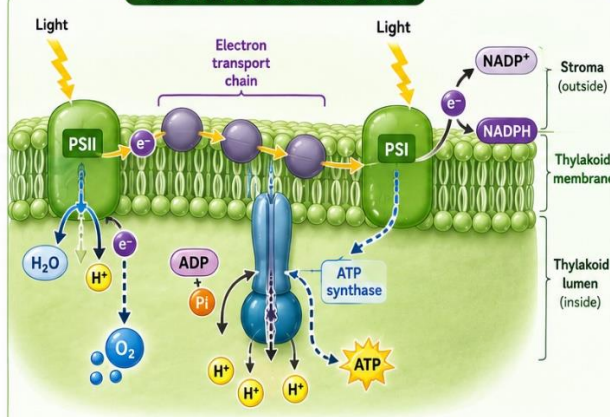
5 NADPH is formed

Electrons are used to convert $NADP^+$ into NADPH.

6 Oxygen is released

Oxygen gas (O_2) leaves the chloroplast through stomata.

INSIDE THE THYLAKOID MEMBRANE



Products of light reactions: **ATP** + **NADPH** + **O_2**

WHAT WE GET

ATP

Energy for the next stage

NADPH

Carries high-energy electrons

O_2 (OXYGEN)

Released into the air

WHERE IT HAPPENS



The light reactions occur on the thylakoid membranes inside the chloroplast.



KEY TAKEAWAY

The light reactions capture sunlight and convert it into chemical energy (ATP and NADPH), and release oxygen. These products are used in the next stage to make glucose.



PHOTOSYNTHESIS IN REAL LIFE

Photosynthesis isn't just a science concept – it happens all around us every day!

1 Plants grow
Photosynthesis helps plants make their own food and grow strong and healthy.




2 Food for us
Many foods we eat come from plants that make food using photosynthesis.



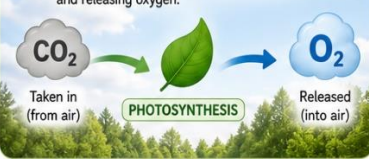

3 Oxygen for breathing
Photosynthesis releases oxygen, which we and other animals breathe to stay alive.




4 Habitat for living things
Plants provide food and shelter for many animals and insects through photosynthesis.




5 Keeps the environment balanced
Photosynthesis helps maintain the balance of gases in the air by using carbon dioxide and releasing oxygen.

6 Useful products
Many things we use come from plants that make food by photosynthesis, like wood, cotton, oils and medicines.






THE BIG PICTURE

Without photosynthesis, there would be no food, no oxygen, and no life as we know it.
It is the foundation of life on Earth!



Sunlight

+



Photosynthesis

→



Life on Earth



Remember:
Every green leaf
is a little life-maker!

PHOTOSYNTHESIS – SUMMARY

Plants use sunlight to make food, grow, and keep life on Earth possible! 🌍

WHAT IS PHOTOSYNTHESIS?

Photosynthesis is the process used by green plants (and some algae) to make their own food using sunlight.



THE OVERALL EQUATION

$$6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$

Carbon dioxide Water Glucose (Food) Oxygen

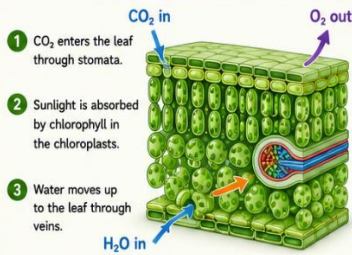
FACTORS AFFECTING THE RATE

FACTOR	EFFECT
Light intensity	Increases rate up to a point.
Carbon dioxide concentration	Increases rate up to a point.
Temperature	Increases rate up to an optimum, then decreases.
Water availability	Too little water causes stomata to close and reduces the rate.

WHAT DO PLANTS NEED?

- Sunlight**
Provides energy for the reactions.
- Water**
Taken in by the roots from the soil.
- Carbon Dioxide**
Taken in from the air through stomata.
- Chlorophyll**
Green pigment in chloroplasts that absorbs sunlight.

WHAT HAPPENS IN A LEAF?



- CO₂ enters the leaf through stomata.
- Sunlight is absorbed by chlorophyll in the chloroplasts.
- Water moves up to the leaf through veins.
- Glucose (food) is made inside the chloroplasts.
- O₂ is released out of the leaf through stomata.

Food (glucose) is used by the plant for growth and stored for energy.

REAL-LIFE IMPORTANCE

- ✓ Provides food for plants and animals (including us).
- ✓ Releases oxygen that we breathe.
- ✓ Maintains the balance of gases in the atmosphere.
- ✓ Supports growth, habitats, and many useful products from plants.

Remember this!



Sunlight (energy)

+



CO₂ (from air)

+



H₂O (from soil)

+



Chlorophyll (in leaves)

→



Glucose (Food)

+



O₂ (Oxygen)

=



Growth, life, and a healthy planet!

★ KEY TAKEAWAY

Photosynthesis turns light energy into chemical energy (food) and releases oxygen.

It is the foundation of LIFE on Earth! 🌍



QUICK QUIZ

Test your understanding!

Think, write your answer and check at the end!

1 Which of the following is the main product (food) made by photosynthesis?

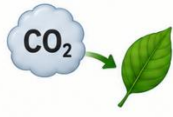
A. Oxygen
B. Glucose
C. Carbon dioxide
D. Water



Food is stored in plants as glucose.

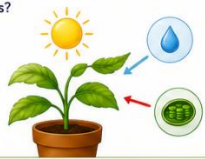
2 What gas do plants take in from the air for photosynthesis?

A. Oxygen (O₂)
B. Nitrogen (N₂)
C. Carbon dioxide (CO₂)
D. Water vapor



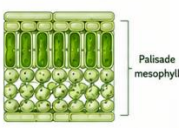
3 Which of the following is NOT a requirement for photosynthesis?

A. Sunlight
B. Water
C. Chlorophyll
D. Soil



4 Where in the leaf does photosynthesis mainly occur?

A. Upper epidermis
B. Spongy mesophyll
C. Palisade mesophyll
D. Lower epidermis



Palisade mesophyll

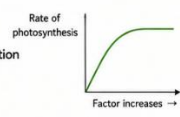
5 What is the overall equation for photosynthesis?

$6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

A. $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
B. $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow 6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6$
C. $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
D. $6\text{H}_2\text{O} + 6\text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{CO}_2$

6 Which factor, when increased, will generally increase the rate of photosynthesis up to a point?

A. Darkness
B. Carbon dioxide concentration
C. Lack of water
D. Too high temperature



7 What gas is released as a by-product during photosynthesis?

A. Carbon dioxide
B. Nitrogen
C. Oxygen
D. Hydrogen



8 Which of the following best describes the role of chlorophyll in photosynthesis?

A. It absorbs sunlight energy.
B. It stores glucose in the leaf.
C. It transports water to the leaf.
D. It releases oxygen to the air.



9 Put the following steps of photosynthesis in the correct order.

- Sunlight is absorbed by chlorophyll.
- Water is absorbed by roots.
- Carbon dioxide enters the leaf.
- Glucose is made and stored.
- Oxygen is released.

10 CHALLENGE QUESTION

If a plant is kept in complete darkness, what will most likely happen?



How did you do?

★ 9 – 10 Excellent! You are a photosynthesis champion! 🌱

✔ 7 – 8 Great job! Keep practicing!

🔵 0 – 6 Keep learning! Review the lesson and try again.

REMEMBER

Photosynthesis turns light energy into chemical energy (food) and keeps life on Earth going!





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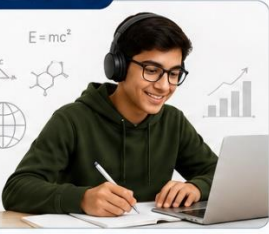
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