



TaimurKhani
LEARNING HUB

Learn • Grow • Succeed



BIOLOGY SHORT COURSE

RESPIRATION

HOW CELLS RELEASE ENERGY

The amazing process that provides energy
for every living thing!



GLUCOSE

+



OXYGEN



CARBON
DIOXIDE

+



WATER

+



ENERGY
(ATP)



RELEASES
ENERGY



HAPPENS IN
MITOCHONDRIA



POWERS EVERY
CELL ACTIVITY



OXYGEN IN,
ENERGY OUT



KEEPS US ALIVE
AND ACTIVE

*Energy
for Life!*



ATP
ENERGY



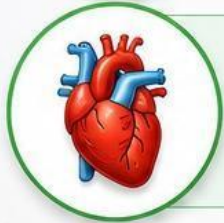
*Understand the science
that powers
your life every day!*

2 LEARNING OBJECTIVES

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



1 Define respiration.



2 Explain why respiration is important.



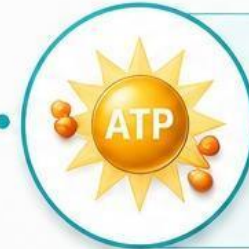
3 Write the word equation for respiration.



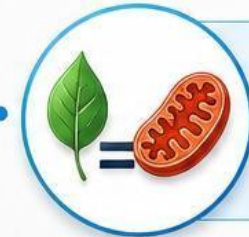
4 Identify where respiration occurs.



5 Differentiate between aerobic and anaerobic respiration.



6 Understand ATP (energy) and its role in cells.



7 Compare respiration with photosynthesis.

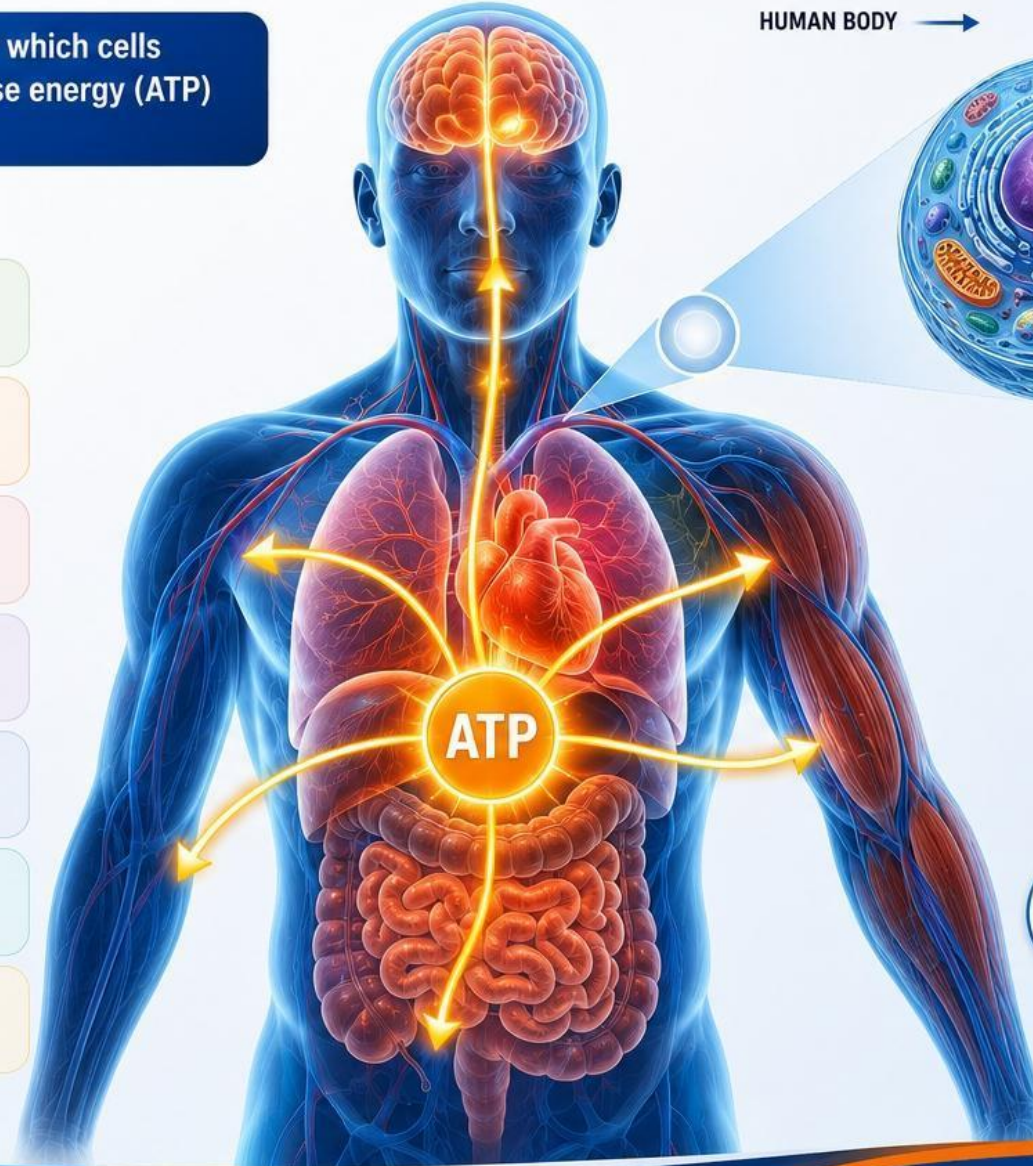
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WHAT IS RESPIRATION?

Respiration is the process by which cells **break down glucose** to release energy (ATP) needed for life.

CELLS NEED ENERGY FOR:

- Movement**
For walking, running, and playing.
- Thinking**
For brain activity and concentration.
- Heartbeat**
For the heart to pump blood.
- Growth**
For growth and development.
- Repair**
For repairing worn-out cells and tissues.
- Breathing**
For muscles used in breathing.
- Keeping Warm**
To maintain body temperature.

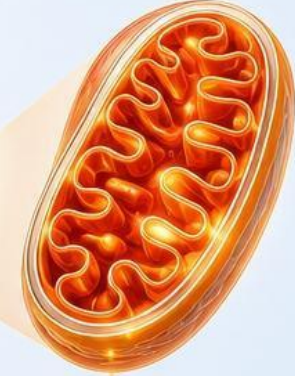


ZOOM IN:

HUMAN BODY

CELL

MITOCHONDRION



Respiration mainly happens inside the **mitochondria**.



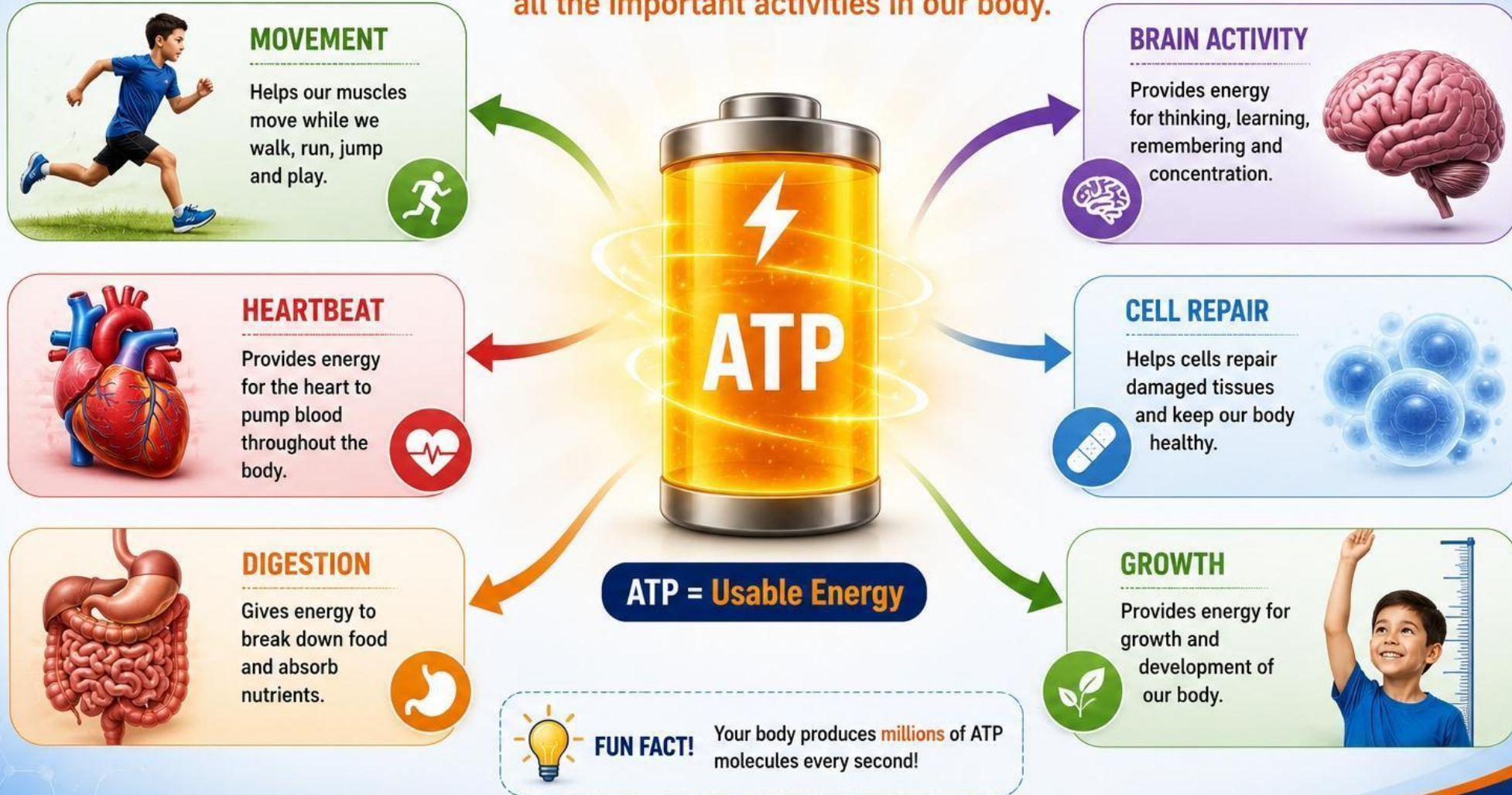
KEY FACT

Respiration happens in all living organisms, including plants and animals, **24/7!**

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WHY IS RESPIRATION IMPORTANT?

Respiration releases energy (ATP) that powers
all the important activities in our body.



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THE RESPIRATION EQUATION

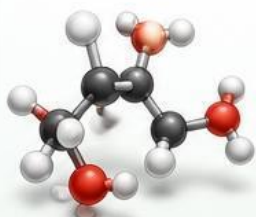
Cells break down glucose using oxygen to release energy (ATP).

WORD EQUATION

Glucose + Oxygen → Carbon Dioxide + Water + Energy (ATP)

INPUTS

GLUCOSE



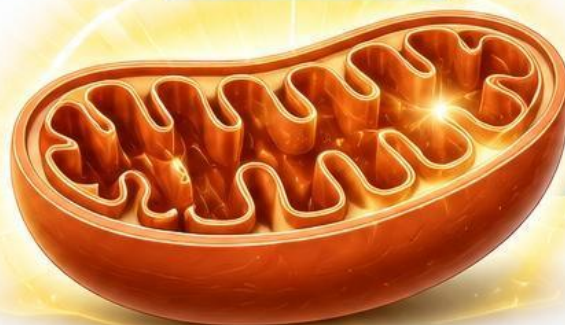
$C_6H_{12}O_6$

OXYGEN



$6O_2$

MITOCHONDRION



The powerhouse of the cell where respiration happens.

OUTPUTS

CARBON DIOXIDE



$6CO_2$

WATER



$6H_2O$

ENERGY (ATP)



CHEMICAL EQUATION (FOR OLDER STUDENTS)

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy (ATP)}$



Glucose is the main **fuel**.



Oxygen helps break down glucose.



Carbon dioxide is a waste gas released.



Water is also produced during respiration.



ATP is the usable energy for cells.



FUN FACT!

Your body produces about **30–32 ATP** molecules from each glucose molecule.



KEY TAKEAWAY

Glucose + Oxygen → Carbon dioxide + Water + Energy (ATP)
This equation shows how cells release energy to power life!

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WHERE DOES RESPIRATION OCCUR?

Respiration happens in every living cell, mainly inside the **mitochondria**.

STEP 1

HUMAN BODY

All your organs and tissues are made of billions of cells.



STEP 2

A CELL

Respiration takes place in the cells of all living things.



STEP 3

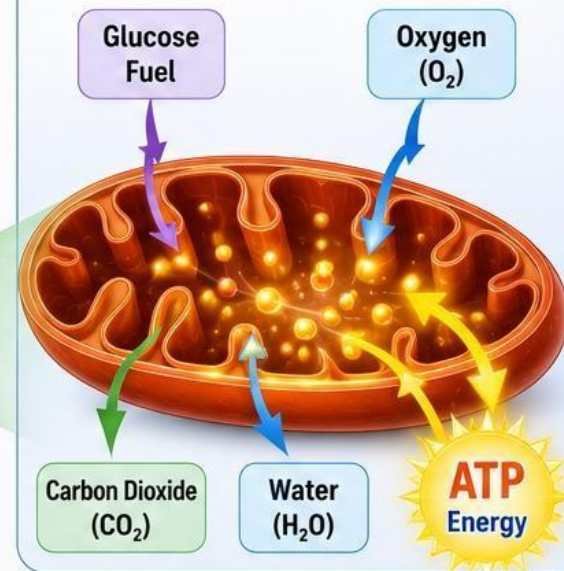
MITOCHONDRION

Most of the respiration happens inside the mitochondria.



INSIDE THE MITOCHONDRION

Glucose and oxygen are broken down to release energy (**ATP**).



KEY POINTS



Respiration occurs in **EVERY** living cell (plants and animals).



It happens all the time, day and night, **24/7**.



Mitochondria are called the "powerhouse of the cell."



ATP produced in mitochondria powers all life activities.



DID YOU KNOW?

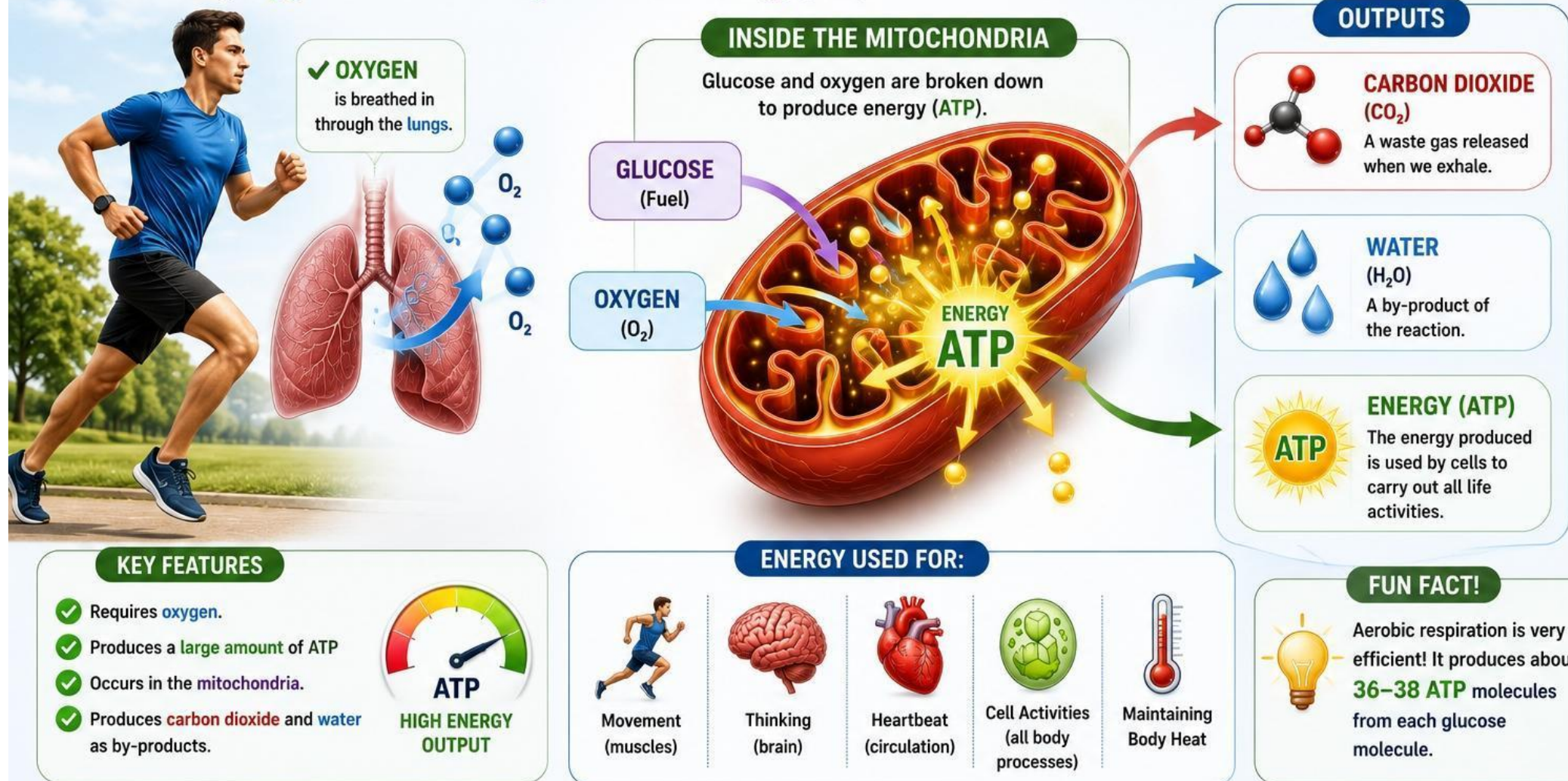
A single cell can contain **hundreds to thousands** of mitochondria!

★ **MITOCHONDRIA = POWERHOUSE OF THE CELL** ★

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AEROBIC RESPIRATION

Aerobic respiration is the process of breaking down glucose using **oxygen** to release a **large amount of energy (ATP)**.



★ Aerobic respiration = **Oxygen** + **Glucose** → **Lots of ATP (Energy)** + **CO₂** + **H₂O**

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ANAEROBIC RESPIRATION

Anaerobic respiration is the breakdown of glucose **without oxygen** to release a **small amount** of energy.



NO OXYGEN AVAILABLE!



When our muscles need energy quickly and there is not enough oxygen, cells switch to anaerobic respiration.

LACTIC ACID BUILDS UP

Lactic acid is produced in muscles, causing:

- Muscle fatigue
- Cramps
- Soreness

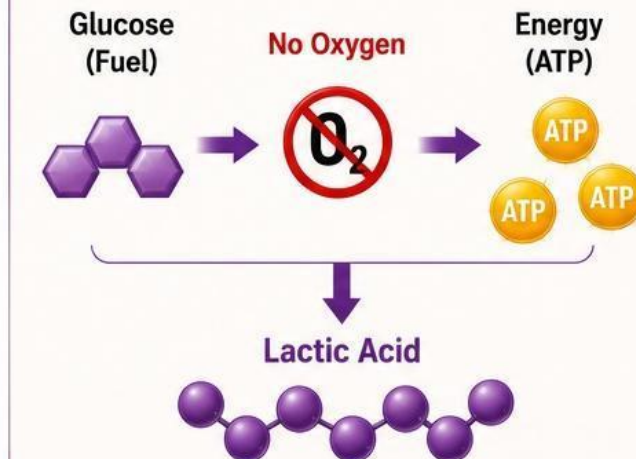


KEY FEATURES

- ✓ Does **NOT** require oxygen.
- ✓ Produces a **small** amount of **ATP**.
- ✓ Occurs in the **cytoplasm** of cells.
- ✗ Produces **lactic acid** as a by-product.



HOW IT WORKS



RESULTS



LESS ENERGY

Produces only **2 ATP** molecules per glucose (very little energy).



LACTIC ACID PRODUCED

Lactic acid is produced as a by-product.



MUSCLE FATIGUE

Lactic acid causes muscles to get tired and sore.



OXYGEN DEBT

After intense exercise, extra oxygen is needed to remove lactic acid and recover.

WHEN DOES IT OCCUR?



Short bursts of intense activity



Heavy lifting or power activities



High-intensity sports (sprinting, etc.)



When oxygen supply is not enough

FUN FACT!



Anaerobic respiration helps you perform at your best in short, powerful movements—but your muscles need oxygen later to **recover**!

★ Anaerobic respiration = Glucose → (No Oxygen) → Lactic Acid + Small Amount of ATP (Energy)

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AEROBIC vs ANAEROBIC RESPIRATION

Two Ways Cells Release Energy

- ✓ Efficient
- ✓ Sustained energy
- ✓ Less fatigue



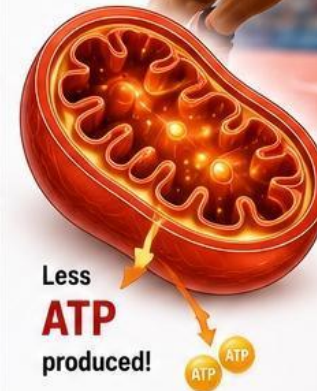
AEROBIC RESPIRATION

Uses oxygen to produce a **large amount** of energy.

AEROBIC	FEATURE	ANAEROBIC
✓ Requires oxygen	OXYGEN	✗ Does NOT require oxygen
✓ Occurs in mitochondria	LOCATION	Occurs in cytoplasm
✓ Lots of ATP (about 36–38 per glucose)	ATP PRODUCED	Very little ATP (only 2 per glucose)
✓ Carbon dioxide and water	BY-PRODUCTS	Lactic acid
✓ Slower but sustained	ENERGY RELEASE	Very fast but short-lived
✓ Walking, jogging, swimming, cycling	EXAMPLES	Sprinting, heavy lifting, intense exercise
✓ Less fatigue	FATIGUE	More fatigue



NO OXYGEN used



- ✗ Quick energy only
- ✗ Muscle fatigue
- ✗ Oxygen debt

ANAEROBIC RESPIRATION

Does not use oxygen and produces a **small amount** of energy.

IN SHORT



Aerobic respiration =
 Oxygen + Glucose → **Lots of ATP** + CO₂ + H₂O
 Great for long activities!



Anaerobic respiration =
 Glucose (**No Oxygen**) → Lactic Acid + **Small ATP**
 Useful for short, intense activities!



Both types of respiration help our bodies get the **energy** they need!

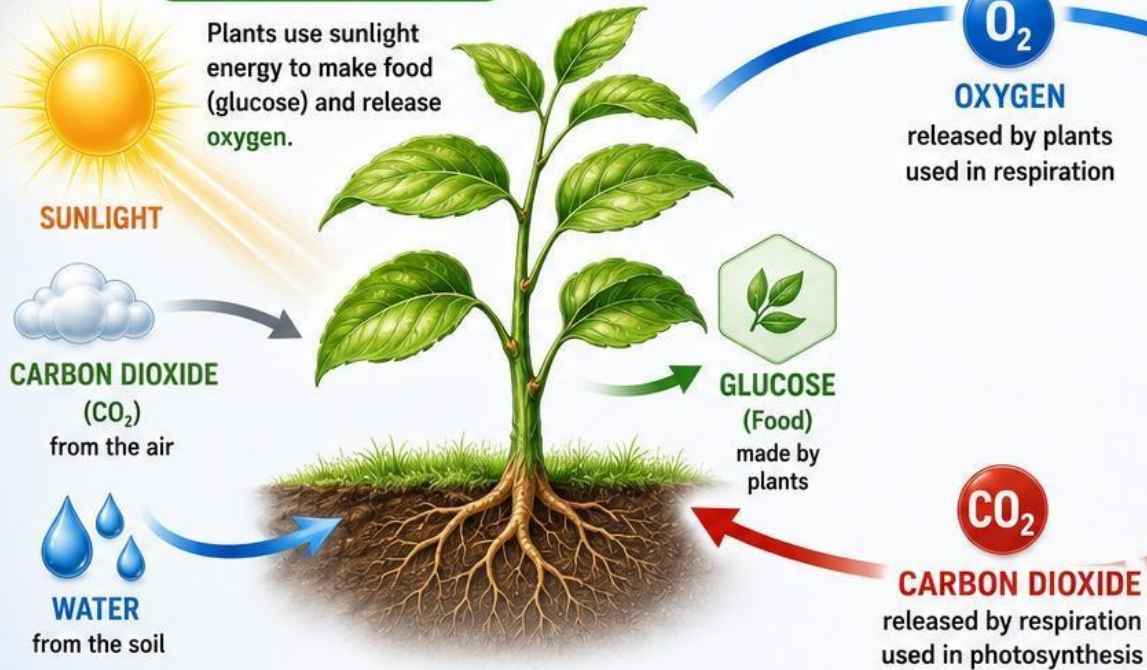
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RESPIRATION vs PHOTOSYNTHESIS

Two amazing processes that keep life on Earth in perfect balance!

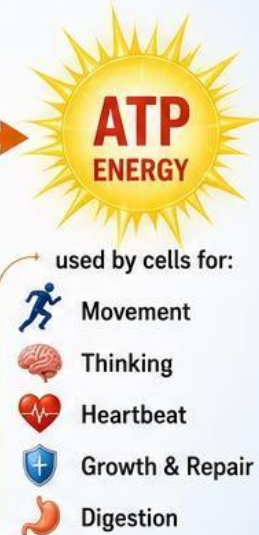
PHOTOSYNTHESIS

Plants use sunlight energy to make food (glucose) and release oxygen.



RESPIRATION

Cells break down glucose with oxygen to release energy (ATP) for all life activities.



PHOTOSYNTHESIS	COMPARISON	RESPIRATION
Stores energy in the form of glucose	ENERGY	Releases energy in the form of ATP
Makes glucose (food)	GLUCOSE	Uses glucose (food)
Needs sunlight to occur	CONDITIONS	Does not need sunlight, occurs day and night
Occurs in green plants (chloroplasts)	WHERE IT HAPPENS	Occurs in all living cells (mitochondria)



TOGETHER, THEY KEEP LIFE GOING!

Photosynthesis provides food and oxygen.
Respiration releases energy and carbon dioxide.

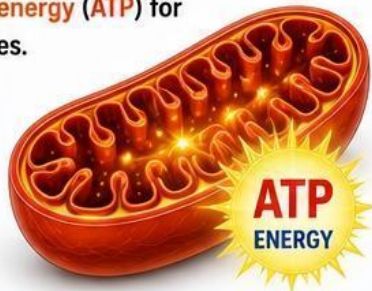


KEY POINTS – RESPIRATION

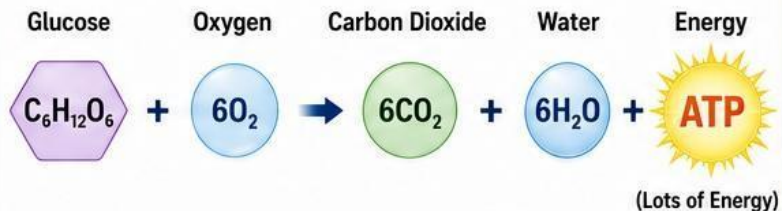
Let's quickly review the most important takeaways from this lesson!

WHAT IS RESPIRATION?

Respiration is the process by which cells break down glucose to release **energy (ATP)** for life activities.



OVERALL EQUATION (AEROBIC)



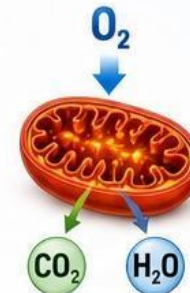
In words:

Glucose + Oxygen → Carbon Dioxide + Water + Lots of Energy (ATP)

TYPES OF RESPIRATION

AEROBIC RESPIRATION

- ✓ Uses oxygen.
- ✓ Occurs in mitochondria.
- ✓ Produces lots of ATP (about 36–38 per glucose).
- ✓ By-products: carbon dioxide and water.



ANAEROBIC RESPIRATION

- ✓ Does not use oxygen.
- ✓ Occurs in cytoplasm.
- ✓ Produces very little ATP (only 2 per glucose).
- ✓ By-product: lactic acid.



WHERE DOES IT HAPPEN?



In every living organism



Inside cells



Mainly in mitochondria

WHY IS IT IMPORTANT?



Provides energy for movement



Supports thinking



Aids in digestion and other processes



Keeps heart beating



Helps growth and repair

FUN FACT!



Mitochondria are called “powerhouses of the cell” because they produce most of the energy we need!



SUMMARY



Respiration breaks down glucose to release energy (ATP).



Aerobic uses **oxygen** and produces lots of ATP.



Anaerobic does not use **oxygen** and produces very little **ATP**.



It mainly occurs in **mitochondria** inside cells.



The **energy** released is essential for all life activities.

★ REMEMBER: **ENERGY = LIFE!** TAKE CARE OF YOUR BODY AND IT WILL TAKE CARE OF YOU. ★

QUIZ TIME!



Let's test what you've learned!

★ Choose the **correct** answer.

1 What is respiration?



- A) Breathing in oxygen
- B) Breaking down glucose to release energy
- C) Making food in plants
- D) Pumping blood in the body

2 Where does aerobic respiration mainly occur?



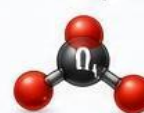
- A) Nucleus
- B) Cytoplasm
- C) Mitochondria
- D) Chloroplast

3 Which gas do we need for aerobic respiration?



- A) Carbon dioxide
- B) Nitrogen
- C) Oxygen
- D) Hydrogen

4 What are the main by-products of aerobic respiration?



- A) Carbon dioxide and water
- B) Lactic acid and oxygen
- C) Water and glucose
- D) Lactic acid and water

5 How much ATP is produced in aerobic respiration per glucose molecule?



- A) 2 ATP
- B) 4 ATP
- C) 36–38 ATP
- D) 10 ATP

6 Which type of respiration does NOT require oxygen?



- A) Aerobic respiration
- B) Anaerobic respiration
- C) Photosynthesis
- D) Cellular division

7 Where does anaerobic respiration occur in the cell?



- A) Mitochondria
- B) Cytoplasm
- C) Nucleus
- D) Ribosome

8 What is the by-product of anaerobic respiration in human muscles?



- A) Carbon dioxide
- B) Water
- C) Lactic acid
- D) Glucose

9 What happens in our muscles when lactic acid builds up?



- A) Muscles get stronger
- B) Muscles become tired and sore
- C) Muscles grow bigger
- D) Muscles relax

10 Which process uses the products of photosynthesis?



- A) Respiration
- B) Transpiration
- C) Digestion
- D) Excretion



Great job!
You're now a
Respiration Expert!



Keep learning, stay curious,
and keep exploring the
amazing world of **Biology!**

Answer Key

- | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| B | C | C | A | C | B | B | C | B | A |