



Aerobic and Anaerobic Respiration

Charlene Jackson

Aerobic and Anaerobic Respiration

What is respiration?

Respiration is a chemical reaction that occurs in all living plant and animal cells. It involves the release of energy from glucose to help fuel natural life processes. Respiration should not be confused with breathing, which is scientifically known as ventilation. Respiration takes place in the mitochondria of a cell, found in the cell cytoplasm.

Internal and External Respiration

External Respiration

One method for obtaining oxygen from the atmosphere is through external respiration. This is done in different ways by different animals and organisms, with many animals having specialised organs to allow for external respiration. Humans and other mammals have a respiratory system, using the lungs to take in oxygen and expel carbon dioxide. External respiration in humans and mammals also encompasses the processes involved in breathing, such as the contraction and relaxation of the diaphragm.

Internal Respiration

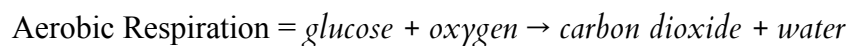
External respiration gets oxygen into the body, but internal respiration involves the transportation of gases between the blood and body tissues and organs.

The lungs help with this process, diffusing oxygen from the lung into the bloodstream while simultaneously expelling carbon dioxide.

Aerobic Respiration

In aerobic respiration, glucose and oxygen react together to produce carbon dioxide (CO₂) and water and release energy.

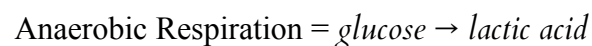
It is called aerobic respiration because oxygen is required for the process to occur.



This process leads to the release of energy from the cell.

Anaerobic Respiration

The body cannot always receive enough oxygen for aerobic respiration, in cases where we are doing vigorous exercise. In these cases, it is replaced with anaerobic respiration. Anaerobic respiration does not need oxygen and produces the waste product lactic acid. Anaerobic respiration produces much less energy than aerobic respiration.



In anaerobic respiration, the excess lactic acid builds up in the muscles and causes pain, cramp, and tiredness. This continues until aerobic respiration takes over again. Anaerobic respiration happens in microorganisms such as bacteria as well as in humans. Fermentation, used to create alcohol, is a form of anaerobic respiration.

Fermentation = *glucose* → *ethanol* + *carbon dioxide*

ACTIVITY 1

Directions: Find and circle the words given below in the puzzle.

Digestive system lungs body cell heart pump haemoglobin

fitness Breathing rate exercise debt cramp Blood

glucose anaerobic oxygen Lactic acid energy respiration

aerobic plasma pulse Carbon dioxide

Y Y S J K C R G Y Y P I M S T G D C V Z E U D I
Y L N X Y K F P H J M P N M C R N Z V B R E B R
E O D V V F H C Z X E X E R C I S E M Y J U R H
C A R B O N D I O X I D E L I H L C X L H H E A
S A H E A R T I V Q Z C M Z I X P I F B X N A E
X O D O B Q F N I Y N P V G M B X H O E T O T M
T T I B M E M L M P T R U V X R Y D B L U U H O
P H C P P L F T E K B A J L X K Y X C Y R G I G
F T A M U S P U T J E U K Z S C M I D E C O N L
D S C K F V X K S D D S T Z E E B Z O M M G G O
L A I F P D X R Y G Z P S L U O Q X C F J P R B
W M T X O M X R S L Q E L E R H Y K P S S S A I
R N C C I H U A E U T E N E N G X B V M B N T N
C Y A L T I J P V C H S A E E T F M D T A S E O
H U L G H I R D I O C N J N R I I A J O R R O V
H D S S L F S H T S A X I N K G J F X A O P C V
Z R V F N H E X S E L W Q Y P P Y N X G P L Y Q
Z Q L K F P O J E A C N S P O H X J X E I J B X
C L Z R R H F V G E C W B W Z L M A Z D V P N T
E U Q E Y C Z E I B U U V L U N G S Y I G K O Y
A W H L X R C B D L B E Q Y Y I O A W I R G A B
C S O F O Z F Q C I B O R E A G H Q P L A S M A
Q W G F F W R W R E S P I R A T I O N S S Q N U
X K I L X D V J V Y O C J L M B K N T T U Z O S

ACTIVITY 2

1. Complete the following statements using the words “with” or “without.”

Anaerobic means _____ oxygen.

- a) with
- b) without

Aerobic means _____ oxygen.

- a) without
- b) with

2. What reactant is required for aerobic respiration to take place but is not required for anaerobic respiration?
 - a) Water
 - b) Carbon dioxide
 - c) Lactic acid
 - d) Glucose
 - e) Oxygen
3. For the following situations, decide whether the muscle cells in the body are likely to be relying mainly on aerobic or anaerobic respiration to supply their energy requirements.

A person is running a marathon distance of 26 miles over 4 hours.

- a) Aerobically
- b) Anaerobically

A child sprints 50 meters down a hallway in 8 seconds.

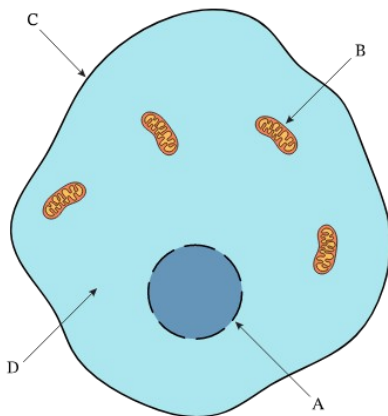
- a) Anaerobically
- b) Aerobically

A rabbit in a garden spots a fox and immediately jumps away.

- a) Aerobically
- b) Anaerobically

4. What product of anaerobic respiration in animal cells is **not** a product of aerobic respiration?
 - a) Water

- b) Lactic acid
 - c) Carbon dioxide
 - d) Glucose
 - e) Oxygen
5. Which of the following is a disadvantage of having lactic acid in the body?
- a) If it is not broken down, lactic acid can cause pain in the bones.
 - b) If it is not broken down, lactic acid can change the shape of red blood cells.
 - c) If it is not broken down, lactic acid can cause the muscles to become more alkaline.
 - d) There are no disadvantages of having lactic acid in the body.
 - e) If it is not broken down, lactic acid can cause pain in muscles and muscle cramps.
6. When would the ability of cells to respire anaerobically be an advantage to a human?
- a) During short bursts of activity when oxygen intake is limited
 - b) During long periods of moderate activity when oxygen intake is not limited
7. Which of the following is the scientific term given to the process of anaerobic respiration in yeast?
- a) Decomposition
 - b) Fermentation
 - c) Contraction
 - d) Conversion
 - e) Deoxygenation
8. Which of the following is the correct word equation for anaerobic respiration in animal cells?
- a) Glucose \rightarrow carbon dioxide
 - b) Glucose + oxygen \rightarrow lactic acid
 - c) Glucose \rightarrow lactic acid
 - d) Glucose + oxygen \rightarrow carbon dioxide + water
 - e) Lactic acid \rightarrow glucose
9. The diagram shows a basic outline of an animal cell.



Which letter indicates where anaerobic respiration occurs in the cell?

- a) C
- b) B
- c) A
- d) D

10. What key term in anaerobic respiration is described as the heavy breathing that occurs after intense exercise to break down lactic acid?

- a) Oxygen debt
- b) Carbon dioxide debt
- c) Respiration debt
- d) Lactic acid debt

ACTIVITY 3

1. Respiration makes _____ available to all _____ to keep them alive.
2. Aerobic respiration uses the gas _____.
3. Aerobic respiration is also called _____ respiration and the process is sped up using _____.
4. CELLS use the energy from respiration for the following activities _____, _____, _____ and _____.
5. The entire organism itself uses energy from its respiring cells to _____, _____, _____ and _____.
6. How do the oxygen and glucose get to the cells for respiration to occur?

GLUCOSE _____ SYSTEM

OXYGEN _____ SYSTEM and
_____ SYSTEM

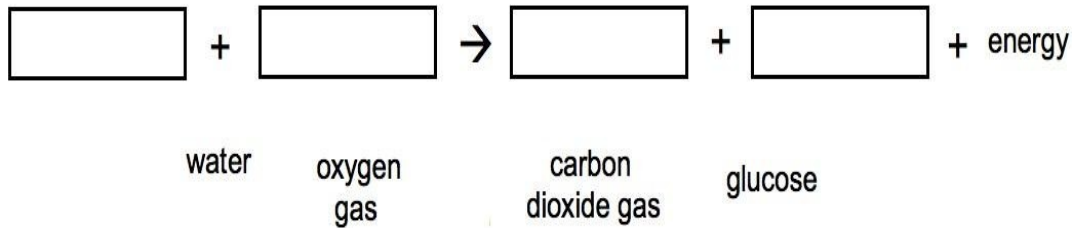
7. What is the word equation for aerobic respiration (oxidation of glucose)?



	C₆H₁₂O₆	6 H₂O	6 CO₂	6 O₂	
stores energy permanently	stores energy temporarily	stores food and water	energy easy to travel from place to place		
energy disappears	energy easily	lots of energy is	stores energy in exact		

without creating a problem	dissolves	wasted	amount needed
-----------------------------------	------------------	---------------	----------------------

8. What is the balanced chemical equation for the aerobic respiration?



9. What does ATP and ADP stand for? ATP _____
 ADP _____

10. Which of the following are advantages of storing energy from respiration in Adenosine triphosphate (ATP) molecules.

11. In which organelle does (aerobic) respiration occur?

12. Complete the table below to compare anaerobic respiration in yeast and fatigued animal muscle cells.

	YEAST CELLS	FATIGUED ANIMAL MUSCLE CELLS
STARTING MATERIAL		
PRODUCTS		

13. What is the result of a build-up of lactic acid in animal muscle cells?
 _____ and _____

14. How can the lactic acid in animal cells be reduced after exercising?

15. Define the term oxygen debt. _____

16. Name the waste product from anaerobic respiration in yeast and state their uses in human industries.

PRODUCT	USES

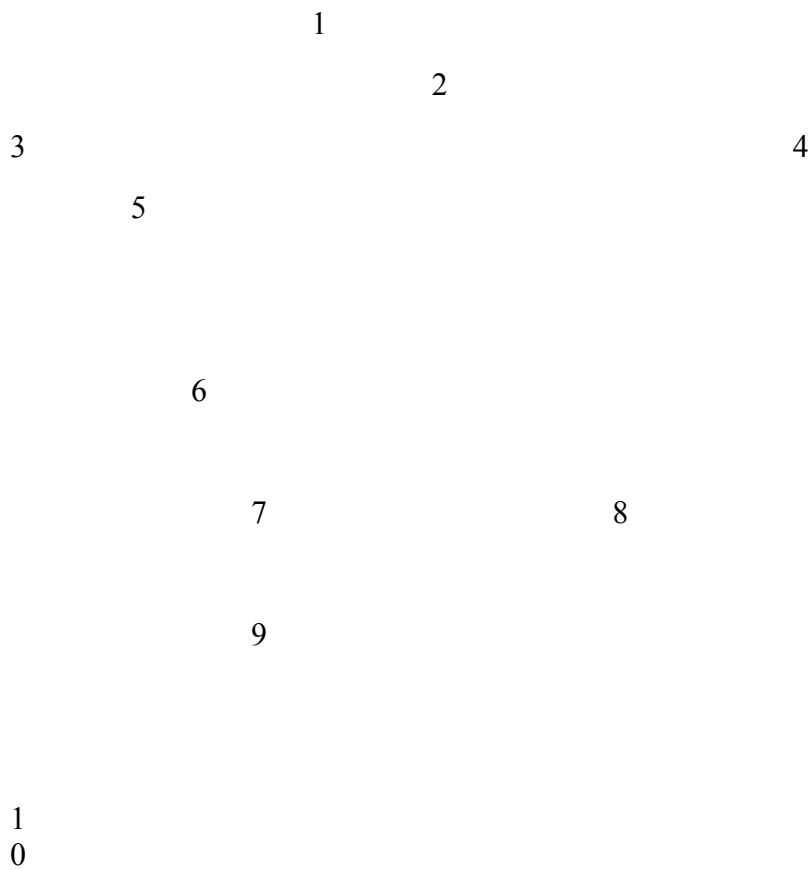
17. Differentiate the difference between aerobic and anaerobic respiration. Place the correct content in the space.

Carbon dioxide and water are waste.	Glucose completely oxidized and broken down.
Small amounts of energy released (2ATP)	Occurs in the cytoplasm.
Glucose combines with no oxygen.	

AEROBIC RESPIRATION	ANAEROBIC RESPIRATION
Glucose combines with oxygen.	
	In animal cells, lactic acid is the waste. In plants and yeast, carbon dioxide and ethanol are the waste.
Large amounts of energy produced (38 ATP molecules) per glucose molecule.	
	Glucose not completely broken down (ethanol and lactic acid can still be broken down further to release energy if oxygen is added).
Occurs in the mitochondria of cells.	

ACTIVITY 4

Directions: Use the clue below to complete the crossword puzzle.



Across

- 5. A simple sugar which is an important energy source in living organisms and is a component of many carbohydrates.
- 6. The production of energy WITHOUT

Down

- 1. What is another name for Windpipe?
- 2. The process that takes place in living cells which releases energy from food molecules.

oxygen.

7. The waste product produced during anaerobic respiration.
9. returning to a normal state of health, mind, or strength.
10. The waste gas that is produced when carbon is combined with oxygen as part of the body's energy-making processes.

3. The act of inhaling and exhaling.
4. A temporary oxygen shortage in the body tissues arising from exercise.
8. The production of energy WITH oxygen.

ACTIVITY 5

Respiration Worksheet

Respiration is the controlled release of energy from food

- The food involved in respiration is usually _____
- Internal respiration is controlled by _____ which allow energy to be released in _____
- The energy is trapped in molecules called _____

Types of Respiration

- **Aerobic Respiration** - the release of energy from food in the _____ of oxygen
- **Anaerobic Respiration** The release of energy from food _____ the presence of oxygen

Aerobic Respiration

- Most living things get energy from aerobic respiration and are called _____
- The energy stored in _____ in glucose is released and used to make _____
- When ATP breaks down it _____ for all the reactions in a cell such as movement of muscles, growth of new cells, etc.

Equation for Aerobic Respiration

_____ + _____ \rightarrow _____ + _____ + _____

_____ + _____ \rightarrow _____ + _____ + _____

- Aerobic respiration is relatively _____, 40% of the energy in glucose is used to make ATP
- Any energy not used to produce ATP is _____

Aerobic Respiration occurs in 2 stages

} Stage 1 _____

↓ _____



Stage 1 Glycolysis

- Takes place in the _____ (the cytoplasm without the organelles) as enzymes are found here
- Does not require _____
- It only releases _____ of energy
- Is the same for both _____ and _____ respiration

Stage 1 Glycolysis

- A 6 carbon carbohydrate (Glucose) is converted to _____ with the release of a small amount of energy

- Most of the energy in the glucose molecule remains _____ in each 3-carbon molecule

Stage 2

- This stage requires and uses _____
- It releases a _____ of energy
- It occurs in the _____ as the necessary enzymes are found here
- The 3-carbon molecules are broken down to _____ and _____

Stage 2

- The _____ breakdown of the 3-carbon molecules releases a lot of _____
- There is _____ energy left in Carbon Dioxide and Water

Anaerobic Respiration

- Anaerobic respiration can occur in the presence of _____ but it _____

- In anaerobic respiration Glycolysis occurs - this means glucose is broken into two 3-carbon molecules
- A _____ of energy is released this way

Anaerobic Respiration

- There are _____ of anaerobic respiration where the 3-carbon molecules are converted to different substances but all _____
_____ of energy

- Anaerobic respiration is said to be _____ than aerobic respiration as less energy is released

Fermentation

Anaerobic Respiration is also known as _____

🔖 2 types of fermentation

1. _____ Fermentation
2. _____ Fermentation

Lactic Acid Fermentation

- This occurs in some _____ and _____ and in animal _____ when there is not enough oxygen
- In this fermentation _____ is produced
- Glucose \rightarrow 2 _____ + small amount of energy

Examples of Lactic Acid Fermentation

- Lactic acid forms when bacteria cause _____ to go _____
- When bacteria respire on cabbage to form _____
- In _____ production and
- In _____ production

Lactic Acid Fermentation in Muscles

- When we exercise and get out of breath not enough _____ can reach our muscles and _____ respiration takes place in the muscle
- This forms _____ which causes _____, when we rest the lactic acid is broken down by the _____

Alcohol Fermentation

- Takes place in _____ and some fungi such as _____ and in plants when they are deprived of _____
- Involves the _____ of glucose
- $\text{Glucose} \rightarrow 2 \text{ } + 2 \text{ } + \text{small amount energy}$

Alcohol Fermentation

- The ethanol itself is high energy
- Alcohol fermentation has been used for centuries
- In baking, yeast is used for alcohol fermentation, the _____ evaporates but the carbon dioxide causes the _____
- ~~Baking powder is used instead of yeast in _____~~

Industrial Fermentation

- **Biotechnology** refers to the use of _____ (such as micro-organisms and enzymes) to carry out _____
- In _____ fermentation the micro-organisms are placed in a container with a suitable _____ on which they can _____
- The vessel in which biological reactions can take place is called a _____