

TITLE: 8B Cellular Respiration

Unit Overview (Linked to the KS3 Programme of Study)

Students will be taught:

- The process of aerobic respiration and the word equation for respiration
- How glucose and oxygen are transported to cells and used in respiration
- How respiration releases energy needed for movement, growth, repair and other life processes
- The relationship between the digestive, respiratory and circulatory systems in supplying cells with the substances needed for respiration
- The process of anaerobic respiration in humans when insufficient oxygen is available
- The differences between aerobic and anaerobic respiration
- The effects of exercise on the body and how energy demands influence the type of respiration used
- The process of fermentation in yeast as a form of anaerobic respiration
- How environmental factors such as temperature affect the rate of respiration
- The applications of fermentation in food and drink production
- How scientists use observations, measurements and evidence to investigate respiration and factors affecting its rate

Prior Learning (KS2)

Students have learnt previously about cells, body systems and the processes needed to keep organisms alive. This has involved:

- Identifying cells as the fundamental units of living organisms and describing the functions of key cell structures
- Explaining that multicellular organisms are organised into cells, tissues, organs and organ systems
- Describing the structure and function of the human digestive system and how it provides nutrients needed by the body
- Describing the structure and function of the human respiratory system, including gas exchange in the lungs
- Explaining how substances move into and out of cells by diffusion
- Understanding that living organisms require food, water and oxygen to survive and carry out life processes
- Investigating the effects of exercise on the body, including changes in breathing rate and heart rate
- Using scientific models and diagrams to explain biological processes that cannot be observed directly

Future Learning (KS4)

At GCSE students will build on their knowledge of aerobic and anaerobic respiration by studying how respiration transfers energy needed for all life processes. They will learn how respiration is linked to the movement of substances into and out of cells and how cells use glucose and oxygen to release energy.

Students will develop their understanding of aerobic respiration by exploring the role of the circulatory and respiratory systems in supplying oxygen and glucose to cells. They will also investigate how exercise affects the body, including changes in breathing rate, heart rate and oxygen demand before, during and after exercise.

Students will build on their understanding of anaerobic respiration by comparing its efficiency with aerobic respiration and explaining the causes and effects of lactic acid production in muscles. They will learn how the body responds to oxygen debt and recovery after exercise.

Students will further develop their knowledge of fermentation by studying the role of microorganisms in biotechnology and food production. They will investigate factors that

affect the rate of biological processes and use scientific evidence, data and experimental results to explain and evaluate respiration in living organisms.

Misconceptions

1. Respiration

- Respiration and breathing are the same process
- Respiration only happens during exercise
- Respiration only occurs in humans and animals

2. Aerobic Respiration

- Oxygen is a product rather than a reactant
- Energy is created during respiration rather than released
- Cells only respire when they need large amounts of energy

3. Body Systems and Respiration

- The respiratory system provides energy directly to cells
- Glucose is made in the lungs
- Oxygen and glucose reach cells without the need for transport systems

4. Anaerobic Respiration

- Anaerobic respiration releases more energy than aerobic respiration
- Anaerobic respiration is a completely different process from aerobic respiration
- Muscles only use anaerobic respiration during exercise

5. Exercise and Respiration

- Breathing rate increases only to remove carbon dioxide
- Fatigue is caused solely by tired muscles
- Athletes use only one type of respiration during sporting activities

6. Fermentation

- Fermentation requires oxygen
- Yeast is not a living organism
- Carbon dioxide is the only product of fermentation

7. Factors Affecting Respiration

- Increasing temperature will always increase the rate of respiration
- Respiration occurs at the same rate under all conditions
- The amount of carbon dioxide produced does not indicate respiration rate

8. Applications of Fermentation

- Fermentation is only used to produce alcoholic drinks
- Bread rises because of heat rather than carbon dioxide produced by yeast
- Respiration has no applications outside living organisms

Practical Requisitions

[8B Cellular Respiration Technician Summary.docx](#)

Mastery (HPA)

Students explain and justify biological ideas using evidence from investigations, observations and respiration equations. They apply their knowledge of aerobic respiration, anaerobic respiration and fermentation to unfamiliar situations, linking the movement of substances through body systems to the release of energy in cells. Students analyse patterns in data, make predictions about factors affecting respiration, and evaluate the advantages, limitations and applications of different forms of respiration in living organisms and industry.

8B.01 Aerobic Respiration		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Recall and interpret the word equation for aerobic respiration - Describe how glucose and oxygen are transported to cells for respiration - Explain why respiration is essential for life processes using the respiration equation	Apply the respiration equation to explain how energy is released in a range of everyday situations.	Working Scientifically WS 1.2 (Models) Use word equations as models of biological processes	EEF 4 (Memory): Retrieve prior knowledge of cells, gas exchange and digestion before introducing respiration.
Do Now (5 mins)	Purpose: Retrieval of prior knowledge from cells, diffusion and organ systems. Suggested structure (teacher adapts): - What is a cell? - Which organ system brings oxygen into the body? - What substance is released from digested food and transported in the blood? Diamond (Challenge): - Why do all cells need a supply of oxygen and nutrients? Teacher uses responses to assess understanding of prerequisite knowledge and identify misconceptions.	Analyse how the digestive and respiratory systems work together to supply cells with the reactants needed for respiration.	WS 1.1 (Development of ideas) Understand that scientific models help explain unseen cellular processes	EEF 3 (Modelling): Model how to interpret and apply the respiration equation to biological and everyday contexts.
Hook / Intro (5 mins)	Introduce key idea: “Every movement, thought and heartbeat requires energy.” Suggested strategy: - Pupils complete 20 seconds of exercise. - Ask: - Why are you breathing more quickly? - Why is your heart beating faster? - Where is the energy coming from?	Evaluate why respiration is essential for survival.	WS 3.6 (Explain using evidence) Use the respiration equation to explain biological processes	EEF 5 (Practical work): Use exercise-based demonstrations to make abstract cellular processes more concrete.
			WS 4.1 (Scientific vocabulary) Use terms such as respiration, glucose, oxygen, carbon dioxide and mitochondria accurately	EEF 6 (Language): Explicit teaching of key vocabulary including respiration, glucose, oxygen, mitochondria and reactant.
			Maths Skills 1c (Comparisons) Compare inputs and outputs in the respiration equation	EEF 7 (Feedback): Provide feedback on explanations that link body systems to respiration.
			2c (Patterns and relationships) Identify links between activity levels and	

	Link responses to energy release inside cells.		respiration demand	
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Aerobic Respiration Introduce the word equation: Glucose + Oxygen → Carbon Dioxide + Water (+ Energy) Introduce key concepts: • Glucose comes from digested food. • Oxygen enters the body through the lungs. • The circulatory system transports both substances to cells. • Respiration occurs in cell structures called mitochondria. Key Idea Respiration is not the same as breathing. Breathing provides oxygen, but respiration is the chemical process that releases energy inside cells. Teacher Modelling (EEF 3) Model interpretation of the equation: • Identify reactants. • Identify products. • Explain energy release. Model explanation: “Cells need glucose and oxygen because respiration releases energy for movement, growth and repair.” Check for Understanding (Hinge Point) • What are the reactants in aerobic respiration? • Where does glucose come from? • What is the difference between breathing and respiration? Mini whiteboards / cold calling		4a (Data interpretation) Interpret simple exercise and respiration data	
Guided Practice (10 mins)	Task type: Supported interpretation and explanation. Pupils: • Label a respiration equation. • Match body systems to their role in respiration. • Complete scaffolded explanation questions. Teacher models first examples and reinforces scientific			

	vocabulary.			
Main Task (20 mins)	Core Task Pupils: - Annotate the aerobic respiration equation. - Explain how oxygen and glucose reach cells. - Explain why respiration is essential for life. Teacher Flexibility Teachers select format based on class need: - Structured explanation - Flow diagram - Sequencing task - Annotated equation Success Criteria - Correct respiration equation. - Correct identification of reactants and products. - Clear explanation of how substances reach cells. - Accurate scientific vocabulary. Adaptation Prompts - If pupils struggle → provide labelled diagrams and sentence starters. - If secure → explain why more active people need more respiration.			
Support / Diamond (challenge)	Support - Word bank - Labelled equation - Body systems diagram - Sentence starters Diamond (Challenge) - Explain why a sleeping person still respire. - Apply the respiration equation to everyday activities. - Evaluate why respiration is essential for all living organisms.			
Common misconceptions	- Respiration and breathing are the same process. - Respiration only happens during exercise. - Energy is created rather than released. - Only humans respire.			
Assessment (5 mins)	Formative and summary Quick check options: Complete the respiration equation.			

	- Identify the reactants and products. - Explain why cells need respiration.			
Exit ticket (5 mins)	Purpose: Inform next lesson (and Do Now) Example questions: - State the aerobic respiration equation. - Why is respiration important for cells? Teacher uses this to plan next lesson's Do Now (adaptive link).			
Adaptive teaching	- Retrieval identifies gaps in prior learning. - Hinge questions guide lesson pacing and intervention. - Vocabulary is explicitly taught and revisited. - Tasks are scaffolded according to confidence and literacy needs. - Challenge extends application and evaluation. - Exit ticket informs planning for anaerobic respiration.			
British Values	Individual Liberty - Students develop independent scientific thinking by applying the respiration equation to explain how energy is released in cells and why respiration is essential for life. Democracy - Students share and justify explanations about how body systems work together to supply cells with glucose and oxygen, using scientific evidence to support their ideas. Mutual Respect - Students listen to and build upon the explanations of others when discussing the role of respiration in living organisms.			
Teacher Notes for MTP adaptations				
8B.02 Anaerobic Respiration		HPA Challenge	Skills	EEF Recommendations
Leaning Objectives	- Recall the word equations for aerobic and anaerobic respiration in humans - Describe why anaerobic respiration occurs when insufficient oxygen is available - Explain the advantages and limitations of aerobic and anaerobic respiration during different types	Evaluate which sports and activities rely more heavily on aerobic or anaerobic respiration and justify your reasoning using scientific evidence.	Working Scientifically WS 1.2 (Models) Use word equations as models of biological processes	EEF 4 (Memory): Retrieve prior knowledge of aerobic respiration and body systems before introducing anaerobic respiration.

	of exercise			
Do Now (5 mins)	Purpose: Retrieval from aerobic respiration. Suggested structure (teacher adapts): - State the aerobic respiration equation. - What are the reactants? - Why is oxygen needed? Diamond (Challenge): - What might happen if muscles cannot get enough oxygen during exercise? Teacher uses responses to identify misconceptions before introducing anaerobic respiration.	Compare the advantages and limitations of aerobic and anaerobic respiration during different types of exercise. Apply knowledge of respiration to explain fatigue and recovery in unfamiliar sporting scenarios.	WS 3.5 (Interpret data) Analyse exercise and respiration data to identify patterns and trends WS 3.6 (Explain using evidence) Use scientific evidence to explain why different types of respiration occur WS 4.1 (Scientific vocabulary) Use key terms such as aerobic, anaerobic, lactic acid, fatigue and respiration accurately Maths Skills 1c (Comparisons) Compare aerobic and anaerobic respiration 2c (Patterns and trends) Identify relationships between exercise intensity and respiration type 4a (Data interpretation) Interpret tables, graphs and data related to exercise and respiration	EEF 3 (Modelling): Model comparisons between aerobic and anaerobic respiration and demonstrate how to construct scientific explanations using evidence. EEF 5 (Practical work): Use exercise-based activities and observations to support conceptual understanding of oxygen demand and respiration. EEF 6 (Language): Explicit teaching of key vocabulary including anaerobic, aerobic, fatigue, lactic acid and recovery. EEF 7 (Feedback): Provide feedback on explanations and comparisons to improve scientific reasoning and use of evidence.
Hook / Intro (5 mins)	Introduce key idea: “Why do athletes sometimes feel muscle burn during intense exercise?” Suggested strategy: Compare: - A marathon runner - A 100 m sprinter Ask: - Do they release energy in the same way? - Why might their bodies need different strategies?			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Anaerobic Respiration Recall: Aerobic respiration Glucose + Oxygen → Carbon Dioxide + Water (+ Energy) Introduce: Anaerobic respiration in humans Glucose → Lactic Acid (+ Energy) Explain: - Occurs when oxygen supply cannot meet demand. - Often happens during vigorous exercise. - Releases less energy than aerobic respiration. Key Idea The body switches partially to anaerobic respiration when oxygen supply is limited.			

	Lactic acid accumulates and can contribute to muscle fatigue. Teacher Modelling (EEF 3) Model comparison: <table><tr><th>Aerobic</th><th>Anaerobic</th></tr><tr><td>Requires oxygen</td><td>Does not require oxygen</td></tr><tr><td>Releases more energy</td><td>Releases less energy</td></tr><tr><td>Suitable for long duration activity</td><td>Suitable for short bursts</td></tr></table> Use sporting examples to model explanations. Check for Understanding (Hinge Point) • Why does anaerobic respiration occur? • Which type releases more energy? • Why do sprinters rely more on anaerobic respiration? Mini whiteboards / cold calling	Aerobic	Anaerobic	Requires oxygen	Does not require oxygen	Releases more energy	Releases less energy	Suitable for long duration activity	Suitable for short bursts			
Aerobic	Anaerobic											
Requires oxygen	Does not require oxygen											
Releases more energy	Releases less energy											
Suitable for long duration activity	Suitable for short bursts											
Guided Practice (10 mins)	Task type: Supported comparison and application. Pupils: • Complete comparison tables. • Match activities to respiration type. • Explain exercise scenarios. Teacher models first examples.											
Main Task (20 mins)	Core Task Pupils: • Compare aerobic and anaerobic respiration. • Explain why athletes use different respiration pathways. • Apply respiration knowledge to sporting scenarios. Teacher Flexibility Teachers select format based on class need: • Venn diagram • Structured explanation • Sports scenario cards • Comparison table											

	Success Criteria • Correct recall of both equations. • Accurate comparison. • Explanation of oxygen demand. • Application to exercise. Adaptation Prompts • If pupils struggle → scaffolded comparison tables and sentence starters. • If secure → evaluate sporting events using scientific evidence.			
Support / Diamond (challenge)	Support • Word bank • Comparison scaffold • Sentence starters Diamond (Challenge) • Evaluate which sports depend on anaerobic respiration. • Explain fatigue using respiration. • Compare strengths and weaknesses of each respiration type.			
Common misconceptions	• Anaerobic respiration releases more energy. • Aerobic respiration only occurs during exercise. • Lactic acid is always present in muscles. • Athletes use only one type of respiration.			
Assessment (5 mins)	Formative and summary Quick check options: • Compare aerobic and anaerobic respiration. • Explain why anaerobic respiration occurs. • Apply knowledge to a sporting example.			
Exit ticket (5 mins)	Purpose: Inform next lesson (and Do Now) Example questions: • Why does anaerobic respiration occur? • Which type of respiration releases more energy? Teacher uses this to plan next lesson's Do Now (adaptive link).			
Adaptive teaching	• Retrieval secures aerobic respiration understanding. • Hinge questions identify misconceptions. • Comparisons reduce cognitive load. • Challenge develops evaluation skills. • Exit ticket informs fermentation lesson.			

British Values	• Individual Liberty - Students independently apply their understanding of respiration to explain sporting performance, fatigue and recovery in different scenarios. • Democracy - Students discuss and justify which types of exercise rely more heavily on aerobic or anaerobic respiration using evidence from scientific knowledge. • Tolerance - Students evaluate different explanations and viewpoints about exercise and energy release, refining their understanding through scientific discussion and evidence.
Teacher Notes for MTP adaptations	

8B.03 Fermentation		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	- Recall the word equation for anaerobic respiration in yeast - Investigate how temperature affects the rate of anaerobic respiration in yeast - Explain how the process of fermentation is used in food and drink production	Analyse results from a fermentation investigation to determine how temperature affects respiration in yeast. [secondary data available on mark scheme]	Working Scientifically WS 2.3 (Experimental skills) Use apparatus safely and effectively WS 3.1 (Recording data) Record observations systematically WS 3.5 (Interpret data) Identify patterns and trends WS 3.6 (Explain using evidence) Draw conclusions from experimental evidence WS 3.7 (Evaluation) Suggest improvements to investigations WS 4.1 (Scientific vocabulary) Use fermentation, yeast, ethanol, carbon dioxide and microorganism accurately Maths Skills 1c (Comparisons) Compare rates of fermentation 2c (Patterns and trends) Identify relationships between temperature and rate	EEF 5 (Practical work): Practical work used to develop conceptual understanding. EEF 3 (Modelling): Model graph interpretation and scientific conclusions. EEF 4 (Memory): Retrieve understanding of aerobic and anaerobic respiration. EEF 6 (Language): Explicit teaching of fermentation vocabulary. EEF 7 (Feedback): Improve conclusions and evaluation through feedback.
Do Now (5 mins)	Purpose: Retrieval from anaerobic respiration. Suggested structure (teacher adapts): - What is anaerobic respiration? - What is produced in human anaerobic respiration? - Why does anaerobic respiration occur? Diamond (Challenge): - Do all organisms respire anaerobically in the same way? Teacher uses responses to assess readiness for fermentation.	Evaluate factors that influence the rate of fermentation and identify optimum conditions for yeast respiration. [secondary data available on mark scheme] Explain how evidence from fermentation investigations supports its use in food and drink production		
Hook / Intro (5 mins)	Introduce key idea: “How does bread rise and where does alcohol come from?” Suggested strategy: Show bread dough or yeast. Ask: - Why does dough increase in size? - What might yeast be doing?			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Fermentation Introduce yeast: - A living microorganism. - Respires anaerobically under appropriate conditions. Word equation: Glucose → Ethanol + Carbon Dioxide (+ Energy) Applications - Bread making			

	• Brewing • Food production Temperature Explain: • Temperature affects respiration rate. • Higher temperatures increase rate up to an optimum. • Excessive temperatures can stop yeast functioning effectively. Teacher Modelling (EEF 3) Model: • Practical setup. • Data interpretation. • How to draw valid conclusions. Check for Understanding (Hinge Point) • What are the products of fermentation? • Why is carbon dioxide useful in bread making? • How does temperature affect fermentation? Mini whiteboards / cold calling		4a (Data interpretation) Interpret tables and graphs	
Guided Practice (10 mins)	Task type: Practical preparation and interpretation. Pupils: • Complete scaffolded data activities. • Interpret simple results. • Match products to industrial uses. Teacher models first examples.			
Main Task (20 mins)	Core Task Pupils: • Conduct or analyse a fermentation investigation. • Record observations. • Interpret data. • Explain industrial applications. Teacher Flexibility Teachers select format based on class need: • Practical investigation • Demonstration and analysis • Data interpretation task • Graph interpretation task			

	Success Criteria • Correct recall of fermentation equation. • Accurate observations and data interpretation. • Scientifically valid conclusions. • Clear application to food and drink production. Adaptation Prompts • If pupils struggle → scaffolded tables and sentence starters. • If secure → evaluate reliability and suggest improvements.			
Support / Diamond (challenge)	Support • Word bank • Practical scaffold • Sentence stems Diamond (Challenge) • Identify optimum conditions for fermentation. • Evaluate reliability of the investigation. • Explain industrial applications using evidence from results.			
Common misconceptions	• Fermentation requires oxygen. • Yeast is not a living organism. • Higher temperature always increases respiration rate. • Carbon dioxide is the only product.			
Assessment (5 mins)	Formative and summary Quick check options: • Recall the fermentation equation. • Explain the effect of temperature. • Interpret practical results.			
Exit ticket (5 mins)	Purpose: Inform future retrieval and assessment. Example questions: • State the fermentation equation. • How does temperature affect fermentation? Teacher uses this to plan future retrieval opportunities.			
Adaptive teaching	• Retrieval links aerobic, anaerobic and fermentation concepts. • Practical work develops conceptual understanding. • Hinge questions identify misconceptions.			

	• Tasks scaffolded according to confidence and scientific literacy. • Challenge develops analysis and evaluation. • Exit ticket informs future retrieval planning.			
British Values	• Rule of Law - Students follow scientific procedures and safety expectations when carrying out or analysing investigations into fermentation and the effect of temperature on yeast respiration. • Democracy - Students share observations, interpret data and justify conclusions using evidence gathered from practical work. • Individual Liberty - Students use evidence independently to identify patterns, draw conclusions and evaluate factors affecting the rate of fermentation.			
Teacher Notes for MTP adaptations				