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GCSE (9–1)
Transition Guide

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

J257
For first teaching in 2016

KS3–KS4 focus
Respiration

Version 1

Can also be used for teaching:
GCSE (9–1) TWENTY FIRST CENTURY COMBINED SCIENCE B

www.ocr.org.uk/biology

Introduction

GCSE (9–1)

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

Key Stage 3 to 4 Transition guides focus on how a particular topic is covered at the different key stages and provide information on:

- Differences in the demand and approach at the different levels;
- Useful ways to think about the content at Key Stage 3 which will help prepare students for progression to Key Stage 4;
- Common student misconceptions in this topic.

Transition guides also contain links to a range of teaching activities that can be used to deliver the content at Key Stage 3 and 4 and are designed to be of use to teachers of both key stages. Central to the transition guide is a Checkpoint task which is specifically designed to help teachers determine whether students have developed deep conceptual understanding of the topic at Key Stage 3 and assess their 'readiness for progression' to Key Stage 4 content on this topic. This checkpoint task can be used as a summative assessment at the end of Key Stage 3 teaching of the topic or by Key Stage 4 teachers to establish their students' conceptual starting point.

Key Stage 3 to 4 Transition Guides are written by experts with experience of teaching at both key stages.

Key Stage 3 Content

Cellular respiration

- aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life
- a word summary for aerobic respiration
- the process of anaerobic respiration in humans and microorganisms, including fermentation, and a word summary for anaerobic respiration
- the differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism

Key Stage 4 Content

B4.1 What happens during cellular respiration?

B4.1.1 compare the processes of aerobic and anaerobic respiration, including conditions under which they occur, the inputs and outputs, and comparative yields of ATP

B4.1.2 explain why cellular respiration occurs continuously in all living cells

B4.1.3 explain how mitochondria in eukaryotic cells (plants and animals) are related to cellular respiration

B4.1.4 describe cellular respiration as an exothermic process

B4.1.5 a) describe practical investigations into the effect of different substrates on the rate of respiration in yeast

b) carry out rate calculations for chemical reactions in the context of cellular respiration

Comment

Learners are presented with a number of differences between the Key Stage 3 and Key Stage 4 content. At Key Stage 3, learners learn about aerobic and anaerobic respiration in living organisms. This includes the breakdown of organic molecules in these processes to enable all the other chemical processes necessary for life.

Learners should be able to use a word summary to describe aerobic respiration and anaerobic respiration. This is a concept they are expected to retain for Key Stage 4 and build upon to include ATP formation. They should also know the process of anaerobic respiration in humans and microorganisms, including fermentation.

From Key Stage 3 learners should be able to describe the differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism. Learners will learn a simplified formula for both aerobic and anaerobic respiration.

At Key Stage 4 this is expanded on and learners will be able to give specific details on differences between aerobic and anaerobic respiration in humans and microorganisms. Learners will learn about aerobic and anaerobic in detail and be able to state the formulae for these processes.

Challenges learners face when tackling this topic at GCSE:

There are a large amount of key words that learners will encounter in this topic. They will come across words that are unfamiliar and others that learners have heard of but they will need to learn how to explain what the words mean and be able to use them effectively. There are words that learners sometimes incorrectly use e.g. respiration is mistakenly used to describe breathing.

One way of supporting learners in this is to have cards for each topic each with a single key word on, or all the key words for a particular topic on one sheet that learners can pick from to help them formulate their answers (these could be offered by learners). This can be followed up with peer work where learners can be posed questions that one of them answers using the cards or sheet before the second learner gives them feedback on their answer. This allows learners to really consider which words relate to the topic of study and receive instant feedback on their answers. It can enable learners to understand the processes individually and see similarities between them.

Learners often mix up the processes of aerobic and anaerobic respiration and sometimes assign one of them to a particular organism for example 'humans aerobically respire whilst fish always anaerobically respire as they live under water'. Learns often do not realise that plants respire as they will state that 'animals respire and plants photosynthesise'.

It is important that learners are aware that all living cells must respire to meet their energy needs. They should also be aware that almost all cells do this by aerobic respiration and would only undergo anaerobic respiration when the environment changes and the oxygen levels decrease. It may be worth highlighting specific cells such as red blood cells that have no mitochondria and as a result can only anaerobically respire.

Learners must be aware that although humans and microorganisms aerobically respire they have different methods of anaerobically respiring which need to be learned as separate processes. Learners need to be able to recall the events that occur in the different processes and be able to apply them to different scenarios.

Learners could be assessed on this in the exam via an extended answer. Asking learners to methodically work through the processes will result in answers that are well structured and of much higher quality.

Learners will be required to make links back to earlier topics involving cells and enzymes. Future links will include areas such as interdependence and decomposition.

Learners often find using chemical formulae such as $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + ENERGY difficult. It is advisable to introduce equations as words before introducing the formulae later.

Activities

Word searching respiration

NT Science

Resources: http://www.ntscience.co.uk/word-search/

Words research can be a great way to introduce new terminology or revisit key words used previously. Here a variety of word searches are available linked to QCA units including one on respiration 8B.

Build a cell

BBSRC

Resources: http://www.bbsrc.ac.uk/engagement/schools/keystage1-2/build-cell/

Learners are able to use this resource that includes teacher notes to build their own cell. This may be useful as a revision excerise before the details about mitochondria and respiration are introduced.

Respiration revision

BBC

Resources: http://www.bbc.co.uk/education/guides/zq349j6/revision

This Bitesize link provides a summary of aerobic and anaerobic respiration and includes some engaging video clips.

Enriching respiration with STEM

STEM.org

Resources: https://www.stem.org.uk/elibrary/list/12701/aerobic-and-anaerobic-respiration

STEM provide a resources that has a range of ideas allowing respiration to be incorporated into both biology and chemistry lessons. The resource has lesson activities and video clips of practical demonstrations that the learners could use to plan their own experiments.

Checkpoint task

Task 1

The idea of checkpoint task 1 is to identify what learners remember about aerobic and anaerobic respiration. The work at GCSE will develop the learners' understanding of these concepts.

The style of examination questions at GCSE may require learners to recall these equations and be able to describe the process in both humans and microorganisms. Some questions may be simple recall to complete tasks such as a gap fill activity but other questions may require learners to give more extended answers and apply their knowledge to practical situations. The more straightforward questions that assess the basic concepts of respiration such as those studied in Key Stage 3 need to be covered in detail before moving onto the GCSE content and the application for this knowledge.

Task 2

The second checkpoint task allows learners to carefully think about the types of respiration and the terminology associated with it. The learners should complete the true/false questions first before moving on to select the keyword that is most appropriate. All of the key words link to either the Key stage 3 or Key stage 4 course content. This task is designed to highlight those learners that may know the key words without fully understanding how they apply to respiration. This can be a good guide to decide when and at what level to introduce the GCSE content to the lessons.

Further information:

Strengthening Teaching and Learning of Cells
https://www.stem.org.uk/elibrary/resource/29863/strengthening-teaching-and-learning-of-cells-key-stage-three-national

This link provides a study guide for how to teach cells including respiration. There are also lots of great teaching resources that can be used.

Checkpoint Task:

http://www.ocr.org.uk/Images/305593-respiration-checkpoint-task.doc

Activities

Respiration in biotechnology

BBC

Resources: http://www.bbc.co.uk/bitesize/standard/biology/biotechnology/living_factories/revision/1/

Learners are provided with simple, clear notes on aerobic and anaerobic respiration. This can be used at the start of lesson to put the topic into a real life context. Activities such as bread making could be done at the start of the lesson to show respiration in action.

Practically investigating respiration

Pearson

Resources: http://www.phschool.com/science/biology_place/labbench/lab5/concepts.html

Pearson provide a resource that allows learners to understand respiration and assess themselves along the way. There are also opportunities to learn about practical investigations that can be carried out into respiration.

Exothermic food

Nuffield foundation

Resources: http://www.nuffieldfoundation.org/practical-biology/how-much-energy-there-food

Learners are able to investigate the amount of energy release from food samples. There are comprehensive notes available for teachers and learners along with web links that help to put the topic into a real life context.

Winter olympics

Science made simple

Resources: http://www.sciencemadesimple.co.uk/curriculum-blogs/biology-blogs/winter-olympics-energy

Learners have notes and videos to allow them to work independently and develop their understanding of both aerobic and anaerobic respiration. This would work well as an independent study lesson; allowing learners to produce their own notes or posters on the topic.

Activities

Respiration vs photosynthesis

SAPS

Resources: http://www.saps.org.uk/secondary/teaching-resources/113-secondary/collections/1281-animation-respiration-and-photosynthesis-gcse-a-level

SAPS have produced a resource that allows learners to visualise the processes of respiration and photosynthesis both in light and dark environments. There are teacher support notes and learner revision guides for up to key stage 5.

Turning food into energy

McGraw Hill

Resources: http://www.mhhe.com/biosci/bio_animations/MH01_CellularRespiration_Web/index.html

This animation by McGraw Hill gives a great overview of how food is digested before being used in aerobic respiration. It includes processes such as Kreb's cycle in a simplified way that makes it great as a summary for key stage 4 or as a starter at key stage 5.

Measuring rate of metabolism

Nuffield foundation

Resources: http://www.nuffieldfoundation.org/practical-biology/measuring-rate-metabolism

Learners are able to quantitatively investigate metabolism by measuring the rate of uptake of oxygen to give a clear indication of the activity of respiratory metabolism using a respirameter. Due to its complexity this is better conducted as a demonstration which allows an excellent opportunity for learners to comment on the variables, limitations and improvements of the investigation.

Energy in plant cells

McGraw Hill

Resources: http://www.mhhe.com/biosci/genbio/virtual_labs/BL_25/BL_25.html

Learners have notes and videos to allow them to work independently and develop their understanding of both aerobic and anaerobic respiration. This would work well as an independent study lesson; allowing learners to produce their own notes or posters on the topic.

Resources, links and support

Science Spotlight – Our termly update Science Spotlight provides useful information and helps to support our Science teaching community. Science Spotlight is designed to keep you up-to-date with Science here at OCR, as well as to share information, news and resources. Each issue is packed full with a series of exciting articles across the whole range of our Science qualifications: www.ocr.org.uk/qualifications/by-subject/science/science-spotlight/

Find resources and qualification information through our science page: http://www.ocr.org.uk/qualifications/by-subject/science/

Contact the team: science@ocr.org.uk

Continue the discussion on the science community forum: http://social.ocr.org.uk/

and follow us on Twitter, @ocr_science

To find out more about GCSE and A Level reform please visit: http://www.ocr.org.uk/qualifications/gcse-and-a-level-reform

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