

**GCSE (9–1)**

*Delivery Guide*

# ***TWENTY FIRST CENTURY SCIENCE BIOLOGY B***

J257

For first teaching in 2016

## **Using food and controlling growth**

Version 1



## GCSE (9 –1)

**TWENTY FIRST CENTURY SCIENCE BIOLOGY B**

Delivery guides are designed to represent a body of knowledge about teaching a particular topic and contain:

- Content: A clear outline of the content covered by the delivery guide;
- Thinking Conceptually: Expert guidance on the key concepts involved, common difficulties students may have, approaches to teaching that can help students understand these concepts and how this topic links conceptually to other areas of the subject;
- Thinking Contextually: A range of suggested teaching activities using a variety of themes so that different activities can be selected which best suit particular classes, learning styles or teaching approaches.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email [resources.feedback@ocr.org.uk](mailto:resources.feedback@ocr.org.uk)



*'These draft qualifications have not yet been accredited by Ofqual. They are published (along with specimen assessment materials, summary brochures and sample resources) to enable teachers to have early sight of our proposed approach.'*

*Further changes may be required and no assurance can be given at this time that the proposed qualifications will be made available in their current form, or that they will be accredited in time for first teaching in 2016 and first award in 2018.*

**Subtopic 1 – B4.1 What happens during cellular respiration?**

Curriculum Content	Page 4	
Thinking Conceptually	Page 5	
Thinking Contextually	Page 6	
Activities	Page 7	

**Subtopic 2 – B4.2 How do we know about mitochondria and other cell structures?**

Curriculum Content	Page 8	
Thinking Conceptually	Page 9	
Thinking Contextually	Page 10	
Activities	Page 11	

**Subtopic 3 – B4.3 How do organisms grow and develop?**

Curriculum Content	Page 12
Thinking Conceptually	Page 13
Thinking Contextually	Page 14
Activities	Page 15

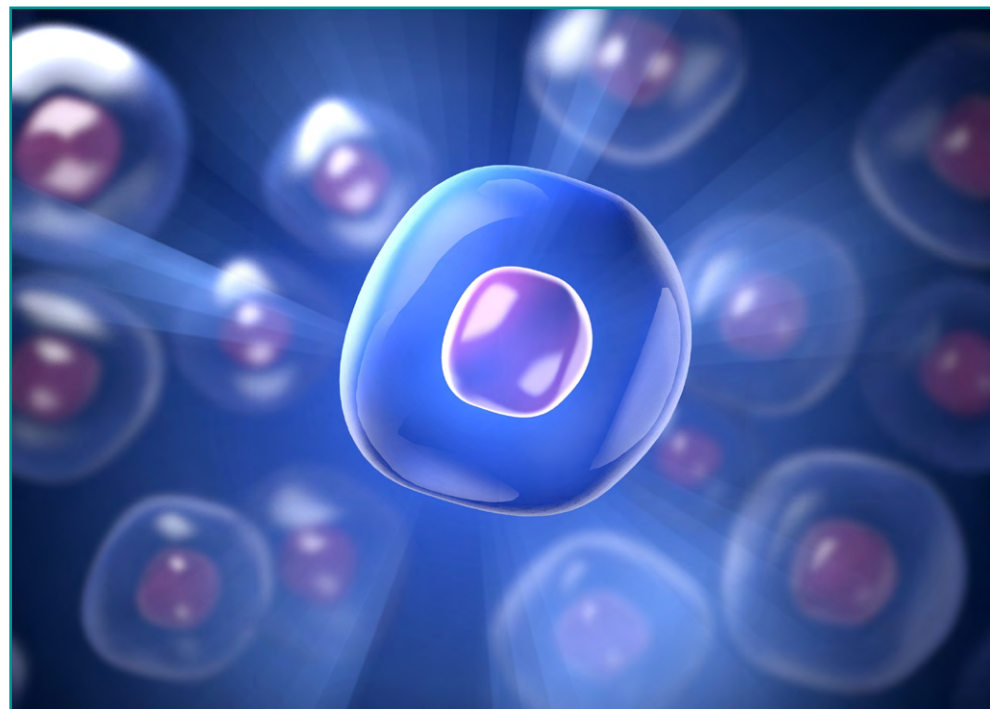
**Subtopic 4 – B4.4 How is plant growth controlled? (separate science only)**

Curriculum Content	Page 17
Thinking Conceptually	Page 18
Thinking Contextually	Page 19
Activities	Page 20

**Subtopic 4 – B4.5 Should we use stem cells to treat damage and disease?**

Curriculum Content	Page 21
Thinking Conceptually	Page 22
Thinking Contextually	Page 23
Activities	Page 24

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	<ul style="list-style-type: none"><li>a) Describe practical investigations into the effect of different substrates on the rate of respiration in yeast PAG5</li><li>b) Carry out rate calculations for chemical reactions in the context of cellular respiration M1a, M1c</li></ul>



*All living cells continuously respire*



## General approaches:

This chapter can prove difficult and sometimes demotivating as learners often have a basic understanding of cellular respiration but with a number of misconceptions.

Learners can develop their understanding and enjoyment of the content through a number of fun activities.

Images and video clips, model making and online gaming can be used to show cellular respiration and allow the learners to visualise these processes and therefore lead to a better understanding.

Practical tasks such as 'mitochondria model making' is a good way of developing understanding and an appreciation of respiration; making a link between the different mitochondrial structures and then to the use of respiration in biological processes.

This section has a large number of key terms that learners will have incorrectly learned in the past (e.g. respiration means breathing) or will find difficult to remember so it is important to build in numerous short, fun activities into lessons and to revisit these terms throughout the unit. This will not only help learners to remember and understand these terms, but will also highlight any misconceptions the learners may have had.

## Common misconceptions or difficulties learners may have:

The majority of learners believe that respiration is breathing and we breathe in only oxygen not realising that air contains mainly nitrogen with some oxygen, carbon dioxide and other gases. These two common misconceptions should be addressed early on by highlighting that 'ventilation' is breathing and oxygen is not all that is breathed in/not only carbon dioxide is breathed out.

Learners often believe that plants photosynthesise in the day and only respire at night whilst others believe that leaves photosynthesise and roots respire. It could be valuable to start the topic by looking at respiration and why organisms undergo the process to make learners aware of the consequences of not respiring.

A common misconception is that plants photosynthesise and animals respire. Once the role of respiration is established this misconception could be addressed, making links between the activity of animals and plants.

One of the biggest misconceptions is that anaerobic respiration in humans releases carbon dioxide. Whilst this is true for yeast in alcohol fermentation the only product of anaerobic respiration is lactate. After this explanation it may be useful to ask the learners 'Where does the carbon dioxide come from that is breathed out in anaerobic respiration?' and see if they can make the link to aerobic respiration that occurred earlier.

## Conceptual links to other areas of the specification – useful ways to approach this topic to set learners up for topics later in the course:

Learners will be identifying the functions of sub cellular organelles in B4.2 so the basic understanding of the mitochondrion can be developed later on in the course.

*Haemoglobin in the blood carries oxygen from the respiratory organs*



## Approaches to teaching the content:

The topic lends itself to a range of laboratory practical activities. Learners should have the opportunity to gain lab based skills in investigating the effect of different substrates on the rate of respiration.

Learners can be allowed to plan their own investigations, write their own methods, results tables, graphs, and evaluations. This can only serve to increase their confidence and understanding in their own practical skills along with increased awareness of the mechanisms involved in respiration. This activity can also be used to address a number of the maths learning objectives, particularly M1a and M1c.

As practical skills are an important aspect of this section and must be carried out safely, teachers and learners should be made aware of the Cleapss learner safety sheet 1 (<http://www.cleapss.org.uk/secondary/secondary-science/secondary-science-student-safety-sheets>).



*Working safely in a lab, safety goggles on hand*

## Activity 1

### Aerobic vs Anaerobic respiration

Biology made simple

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

A clear overview of aerobic and anaerobic respiration along with a short video clip by BBC Bitesize will allow learners to develop a basic understanding of the processes. This could be an ideal homework activity.

## Activity 2

### Photosynthesis and respiration game

Bioman games

<http://www.biomanbio.com/GamesandLabs/PhotoRespgames/phorespgame.html>

This game by Bioman games allows learners to develop an understanding of the relationship between respiration and photosynthesis. This activity may be useful as a homework or plenary activity to support the learning of less able learners.

## Activity 3

### Build a better mitochondrion

Learner Resource 1

[www.ocr.org.uk/Images/281304-using-food-and-controlling-growth-learner-resource.doc](http://www.ocr.org.uk/Images/281304-using-food-and-controlling-growth-learner-resource.doc)

This resource is a nice way to introduce the topic of respiration. Learners produce a model mitochondrion either in class or as homework that they then use to teach others in the class.



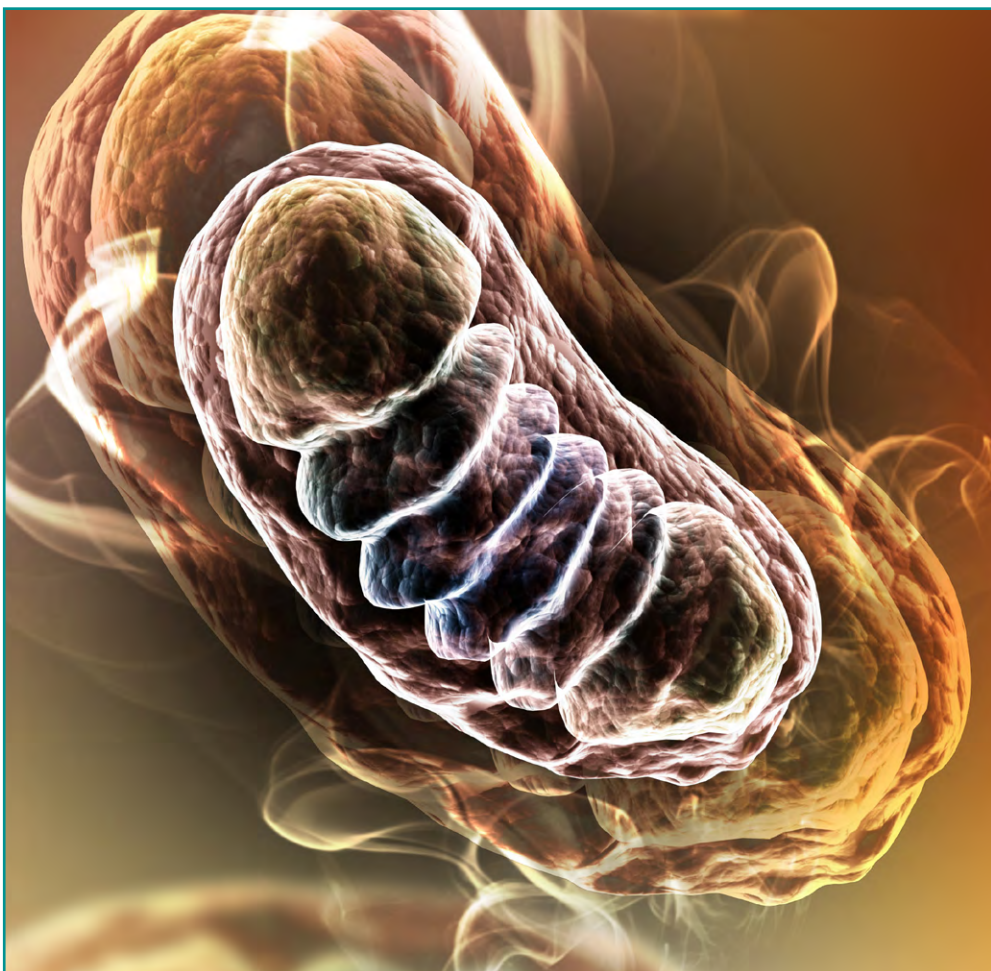
*A long distance runner will require a lot of oxygen*



B4.2.1 Explain how electron microscopy has increased our understanding of sub cellular structures

B4.2.2 In the context of cells and sub cellular structures:

- a) demonstrate an understanding of number, size and scale and the quantitative relationship between units M2a, M2h
- b) use estimations and explain when they should be used M1d
- c) **calculate with numbers written in standard form M1b**



*A rendered image of mitochondria*



### General approaches:

Learners can develop their understanding of the content through a number of fun activities.

Virtual cells and virtual microscopes can be used to show cellular structure and allow the learners to learn about electronmicroscopy, including how it is used to gain a better understanding of sub cellular structures.

The use of microscope drawings and associated units can be used to address a number of the mathematical learning objectives, particularly M1d, M2a and M2h.

### Common misconceptions or difficulties learners may have:

Learners may have difficulty understanding the scale of sub cellular structures. It therefore may be of benefit to start with scales that they understand such as kilometres (km), meters (m) and millimetres (mm) and the order of magnitude between each before progressing on to micrometers ( $\mu\text{m}$ ).

Using simple analogies may help the learners e.g. if the length of a football field (100m) represents 1mm then the centre spot (10cm) would represent  $1\mu\text{m}$ .

### Conceptual links to other areas of the specification – useful ways to approach this topic to set learners up for topics later in the course:

Learners will have prepared slides to cover PAG 1 Microscopy so will have a basic understanding of the sub cellular organelles present in a cell. They will also have gained an understanding of the double helix model of DNA when studying B1.1 which will aid their learning later in B4.3. when the learners will need this knowledge to look at meiosis and mitosis.



*A molecule of Deoxyribonucleic acid (DNA)*

## Approaches to teaching the content:

The activity on the 'virtual cell' can be differentiated depending upon ability of the learners. They can be asked to present their work in different formats such as posters for lower ability learners or reports for more able groups.



*Plant cell cutaway illustration*

### Activity 1

#### Virtual cell

Learn Genetics

<http://learn.genetics.utah.edu/content/cells/insideacell/>

Learn genetics provide an excellent resource that allows learners to investigate a virtual cell. Learners can then use the resource to independently produce their own cell information poster as they investigate the functions of cells organelles.

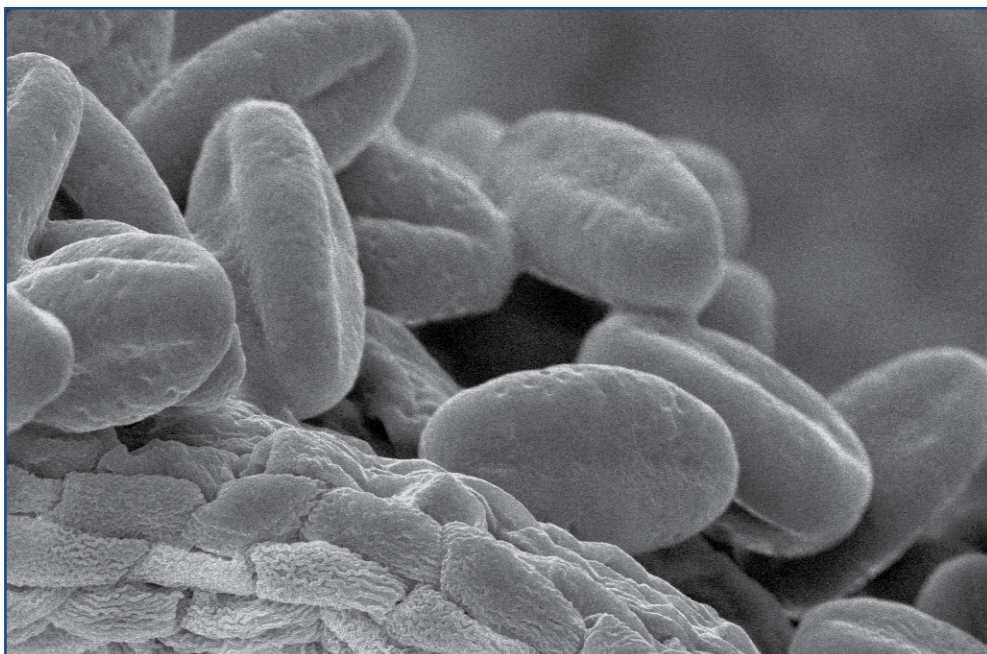
### Activity 2

#### Using and electron microscope

Australian Microscopy and Microanalysis Research Facility

<http://www.ammrf.org.au/myscope/sem/practice/virtalsem/bone.php>

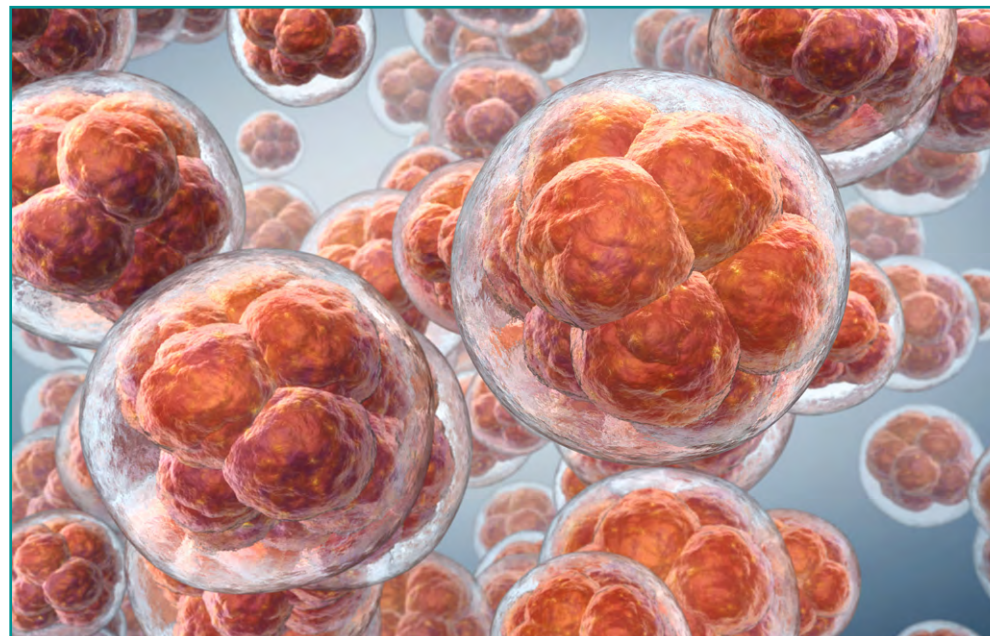
For the most able of learners the Australian Microscopy and Microanalysis Research Facility provide a resource to allow learners to gain an understanding of how to use an electron microscope.



*A photograph of apple tree pollen grains obtained from an electron microscope*



B4.3.1	a) Describe the role of the cell cycle in growth, including interphase and mitosis b) Describe how to use a light microscope to observe stages of mitosis PAG1
B4.3.2	Describe cancer as the result of changes in cells that lead to uncontrolled growth and division
B4.3.3	Explain the role of meiotic cell division in halving the chromosome number to form gametes, including the stages of interphase and two meiotic divisions
B4.3.4	Describe the function of stem cells in embryonic and adult animals and meristems in plants
B4.3.5	Explain the importance of cell differentiation, in which cells become specialised by switching genes off and on to form tissues with particular functions



*A rendered image of stem cells*



## General approaches:

This section can prove to be quite difficult for some learners to understand so using models, videos, animations and diagrams will be useful.

There are a number of learning objectives that are a series of sequential steps such as those found in mitosis and the formation of cancers. Activities involving card sorts will benefit the learners before they progress to make the link to visual animations such as those found in the 'Stages of mitosis' activity.

There are a number of key terms that learners will find difficult to remember or understand so flash cards may be useful.

The introduction of learning objectives B4.3.2 and B4.3.4 should be approached with sensitivity as these areas of science may have impacted on the lives of some of the learners. However these provide a great opportunity for discussion into the advances in the treatment of cancers and the use of stem cells in the treatments of certain diseases.

## Common misconceptions or difficulties learners may have:

The majority of learners have difficulty when studying mitosis and meiosis due to a lack of understanding about when the chromosomes replicate. An effort should be made to highlight that the quantity of DNA has doubled even before mitosis begins.

Learners are likely to have little understanding of stem cells beyond what they have experienced in the news. It may be useful to question the learners as part of a starter activity to ascertain their level of understanding.

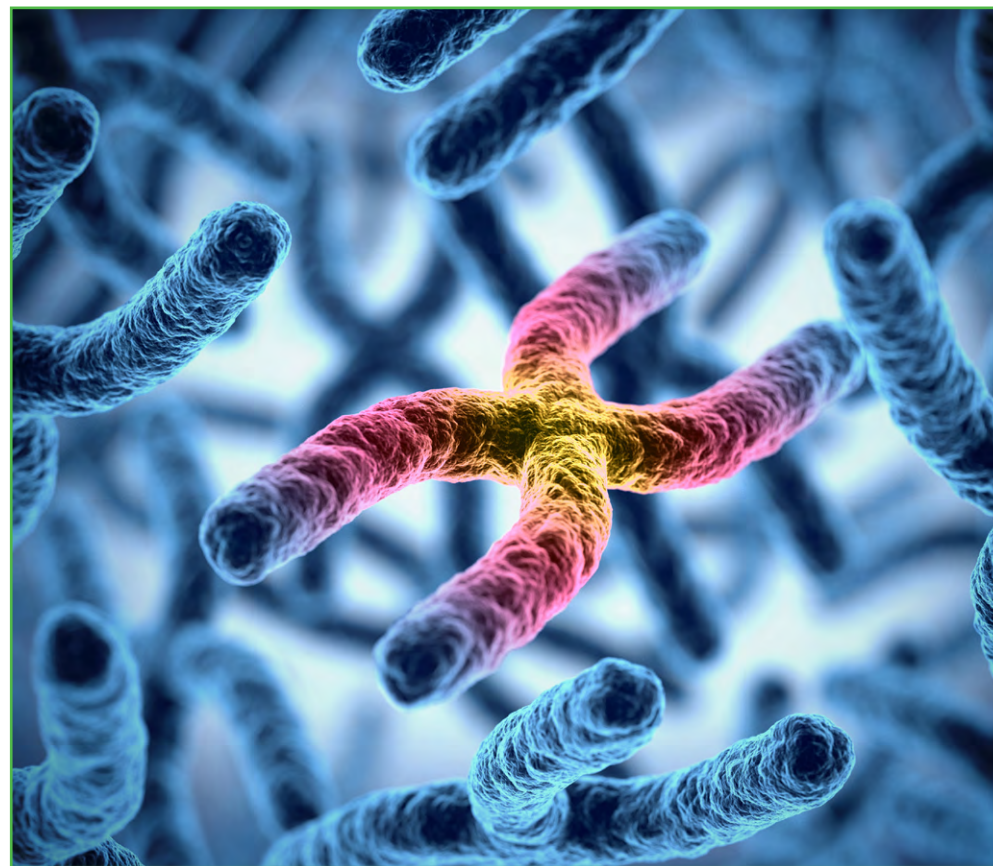
## Conceptual links to other areas of the specification – useful ways to approach this topic to set learners up for topics later in the course:

### B1.2 How do organisms inherit characteristics?

They should have a simple understanding of the double helix model of DNA from B1.1, 'What is the genome and what does it do?' and the implications this can have as a factor that can increase the risk of developing cancer from B2.5.

The learning from B1.1 and B1.2 will help to support the learners' understanding of the way in which DNA is made and the way it behaves as this will be required through the learning of meiosis and mitosis that is covered in B4.3.

The knowledge gained in B4.3 will be of benefit to the learners when studying B6.3 'How does our understanding of biology help us classify the diversity of organisms on Earth?'

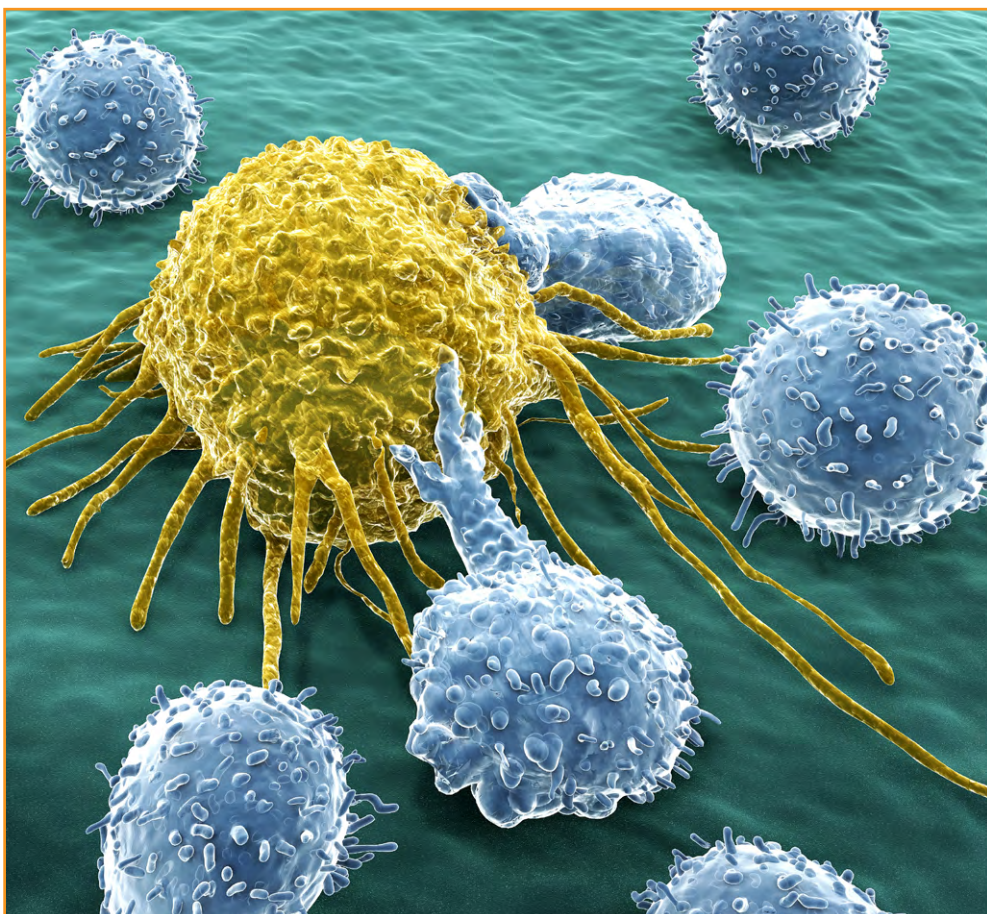


*A rendered image of a chromosome*

## Approaches to teaching the content:

The growth of cancers and the use of stem cells are two areas that can be used to enhance the learners' debating skills. Learners can discuss arguments for or against the use of stem cells and using the websites highlighted in 'using stem cells' and pros and cons arguments from activity 2 learn how to evaluate and put together a justified argument for their group, regardless of their own opinion.

This section lends itself well to learning new skills from group activities involving learners using resources to sequence events such as 'stage of mitosis', 'Tumour development' and the 'Formation of cancer'.



*A cancer cell and lymphocytes*

### Activity 1

#### Cell cycle

BBC

[http://www.bbc.co.uk/schools/gcsebitesize/science/add\\_ocr\\_pre\\_2011/growth\\_development/cellreproductionrev2.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_pre_2011/growth_development/cellreproductionrev2.shtml)

This visual representation of the cell cycle and DNA replication can be used by the learners to allow them to independently study the process and produce their own revision resource. Learners could produce their own model of a DNA molecule that they can then use to help teach a fellow classmate.

### Activity 2

#### Stages of mitosis

Pearson

[http://www.phschool.com/science/biology\\_place/biocoach/mitosisig/process.html](http://www.phschool.com/science/biology_place/biocoach/mitosisig/process.html)

A simple animation of the stages of mitosis is provided by Pearson that the learners can use to develop a basic understanding of the process.

Cells alive

[http://www.cellsalive.com/mitosis\\_js.htm](http://www.cellsalive.com/mitosis_js.htm)

A more in depth animation is provided by Cells alive for the more able learners or as part of a stretch and challenge activity.

Learners can use the resources to produce their own revision activity or the class can work together to collaborate and produce a mitosis wall display.

### Activity 3

#### Tumour development

DNA Learning centre

<https://www.dnalc.org/view/15536-Cell-division-tumor-growth-and-metastasis-3D-animation-with-basic-narration.html>

This short video clip shows how tumours develop, how they become vascularised and how metastasis occurs.

This could be used as a starter activity to generate discussion on the problems facing the treatment of cancers.

### Activity 4

#### Formation of cancer

Cancer quest

<http://www.cancerquest.org/images/FLV/fullDocumentary/English/fullDocInterfaceEng.swf>

The video clip by cancer quest which is 11 minutes long provides detailed documentary on the formation of cancer. This provides a great opportunity for stretch and challenge of learners. The video clip makes links to a number of different areas of the specification incorporating organelles, membranes and DNA structure.

### Activity 5

#### Virtual microscope

University of Delaware

<https://www.udel.edu/biology/ketcham/microscope/scope.html>

This virtual resource allows learners to practice using a light microscope to view a number of different samples. This resource could be a great homework to allow learners to practice and write their own step-by-step guide on how to focus a light prior to using them in the lab.

### Activity 7

#### Stem cells or Meristem?

BBC

[http://www.physics-chemistry-interactive-flash-animation.com/electricity\\_electromagnetism\\_interactive/oscilloscope\\_description\\_tutorial\\_sounds\\_frequency.htm](http://www.physics-chemistry-interactive-flash-animation.com/electricity_electromagnetism_interactive/oscilloscope_description_tutorial_sounds_frequency.htm)

YouTube

<https://www.youtube.com/watch?v=h9kCPO7oMf8>

Stem cells and their uses are clearly described by the BBC resource whilst the YouTube clip on the function of meristems video provides an overview of meristematic tissue.

SAPs

<http://www.saps.org.uk/secondary/teaching-resources/706-cauliflower-cloning-tissue-culture-and-micropropagation>

A practical experiment is detailed by SAPs that allows learners to clone their own cauliflower plants and bring together their knowledge of mitosis with totipotent cells.

### Activity 8

#### Actions of embryonic stem cells

Sumanas Inc

<http://www.sumanasinc.com/scienceinfocus/stemcells/stemcells.html>

The 'Actions of embryonic stem cells' animation provides learners with a clear yet high level description of how embryonic stem cells may be used in the lab to produce a particular specialised cell type. It goes on to describe how somatic cell nuclear transfer can be used to improve the success rate in tissue transplants.

### Activity 9

#### Cell differentiation

BBC

[http://www.bbc.co.uk/schools/gcsebitesize/science/add\\_ocr\\_gateway/living\\_growing/growthdevrev5.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/living_growing/growthdevrev5.shtml)

Cell differentiation is summarised in this concise description before links are made to stem cells and stem cell treatments.



- B4.4.1 a) Explain how plant hormones are important in the control and coordination of plant growth and development, with reference to the role of auxins in phototropisms and gravitropisms  
b) Describe practical investigations into the role of auxin in phototropism PAG6

**B4.4.2 Describe some of the variety of effects of plant hormones, relating to gibberellins and ethene**

**B4.4.3 Describe some of the different ways in which people use plant hormones to control plant growth**



*Phototropism – go to the light*

## General approaches:

The learning involved in plant hormones and their importance in the control and coordination can be firmly developed using theoretical and practical investigations.

Learners can develop theoretical and practical skills in implementation, analysis and evaluation. This can be done effectively by allowing learners opportunities to research and plan their own investigations into plant tropisms. Learners are required to have a clear understanding of the role of auxin in plants which the resource 'Tropisms and the role of Auxin' will help with before learners move on to the practical investigation.

## Common misconceptions or difficulties learners may have:

Learners are likely to have little prior knowledge of plant hormones so are unlikely to have misconceptions on the topic. However the learners' prejudice towards a topic on 'plant hormones' is likely to evoke resilience from the learners. This could be addressed by starting the topic with some of the practical investigations and then building on these with the theory on plant hormones.



*An example of geotropism on a hilly countryside*

## Approaches to teaching the content:

Learning new skills from experimental activities can be developed by the learners as they analyse and evaluate theoretical investigations or by planning, implementing, analysing and evaluating their own practical investigations.

The resource 'Interpreting practical investigations in plant hormones' has five investigations for the learners to interpret which they can then explain to the class. A class discussion after the explanations could focus on the industrial use of plant hormones and this will give learners a direct link to how plant hormones influence the food production.



*Genetically modified crops are now very prevalent*

## Activity 1

### Tropisms and the role of Auxin

Sumanas Inc

<http://www.sumanasinc.com/webcontent/animations/content/plantgrowth.html>

SAPs

<http://www.saps.org.uk/secondary/teaching-resources/185-student-sheet-8-the-response-of-seedlings-to-light-phototropism-experiment>

Sumanas provide a clear animation showing the action of auxin within the plant. Learners can use the resource to produce labelled diagrams before they put their learning into practice by carrying out an investigation into phototropism as provided by SAPs.

## Activity 2

### Auxin

Kscience

<http://www.kscience.co.uk/animations/auxin.htm>

Kscience provides a short self study activity on auxin that could be used as part of a homework or plenary before learners attempt the 'test yourself' section of the resource.

## Activity 3

### Interpreting practical investigations in plant hormones

Nuffield foundation

<http://www.nuffieldfoundation.org/practical-biology/interpreting-investigation-plant-hormones>

Learners are able to interpret practical investigations into phototropism as set out by Nuffield foundation. The class could be split into five groups with each one being given one of the investigations to read, understand and explain to the rest of the class.

## Activity 4

### Using plant hormones

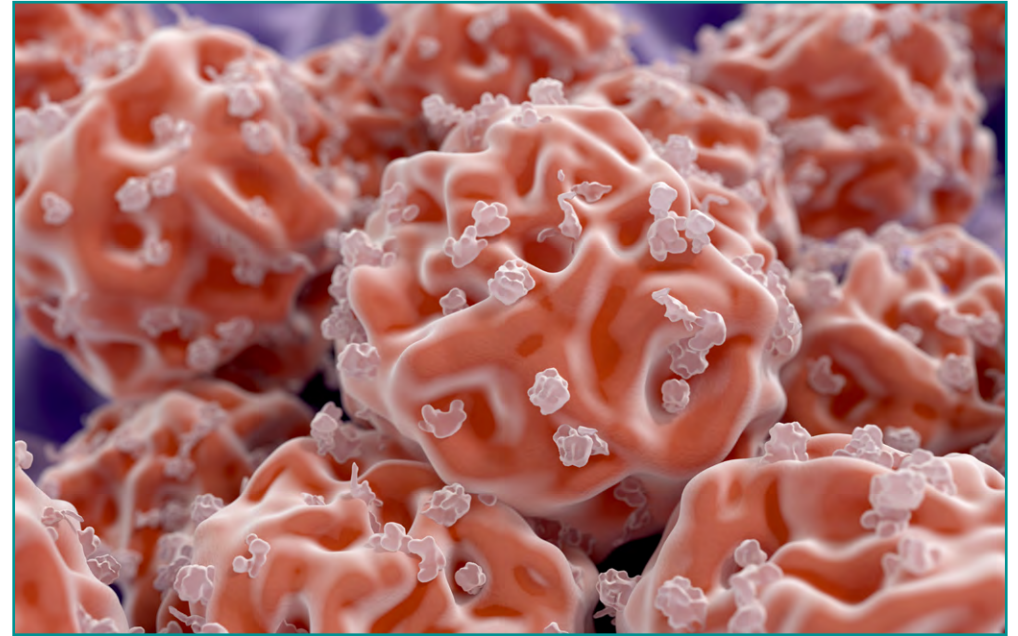
BBC

[http://www.bbc.co.uk/schools/gcsebitesize/science/ocr\\_gateway/understanding\\_organisms/control\\_plant\\_growthrev2.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/ocr_gateway/understanding_organisms/control_plant_growthrev2.shtml)

Learners can independently discover some of the other uses of plant hormones before testing themselves with the 'test bite'.



B4.5.1 Discuss potential benefits, risks and ethical issues associated with the use of stem cells in medicine



*An electron microscopic image of stem cells*

## General approaches:

The learning involved in using stem cells focuses around an understanding of the potential benefits and disadvantages of stem cell technology along with a consideration of the impact that such a technology may have on the individual and the future generations. This subtopic requires learners to analysis and critically evaluate the evidence surrounding stem cell research and to consider then debate the moral and ethical issues that this subtopic generates. This learning is supported in the resource 'Ethics of stem cells'. For the most able learners 'Stem cell research' can help to develop further skills including research and planning skills.

## Common misconceptions or difficulties learners may have:

Many learners may have difficulty when studying the ethics of stem cells due to a lack of understanding about the techniques. Learners should be able to highlight their understandings so that the facts about the techniques can be established.

A common misconception is that stem cells are commonly from embryos. Although stems cells from embryos are used in stem cell research there has never been a successful treatment of a disease using embryonic stem cells. There are over 25,000 patients treated with adult bone marrow stem cells in Europe each year.

Learners may believe that the use of stem cells in medicine requires modifying the individual which will then go on to affect their offspring for future generations. Obviously this would only apply to germ-line therapy which is relatively rare compared to somatic stem cell therapy.

Stem cells will be used to cure all diseases is a common misconception the learners may have. Although stem cells can be used to treat a number of diseases they are unable to treat conditions such as coronary heart.

## Conceptual links to other areas of the specification – useful ways to approach this topic to set learners up for topics later in the course:

Learners will learn about the potential benefits, risks and ethical issues associated with the use of stem cells in medicine which can be developed further when studying stem cell therapy for neuron damage in B5.6.



*Many have questioned the use of genetic modification*

## Approaches to teaching the content:

The resource 'Ethics of stem cells' allows the learners to not only understand the role of stem cells but also the processes that scientists go through to develop them. Learners can also consider and discuss how they are used in medicine and the implications that this branch of science may have for humans.



*Stem cells frozen in liquid nitrogen*

**Activity 1****Ethics of stem cells**

Euro stem cell

<http://www.eurostemcell.org/factsheet/embyronic-stem-cell-research-ethical-dilemma>

Learners can read about stem cell research and watch a short video clip on the ethical arguments. The class can then be divided into two groups to debate the pros and cons of the technique. Alternatively for less able learners the arguments 'for' and 'against' the use of stems cells could be added to a card sort activity to allow the learners to organise them and debate their decisions along the way.

**Activity 2****Stem cell research**

Wellcome trust

<http://www.wellcome.ac.uk/About-us/Policy/Spotlight-issues/Human-Fertilisation-and-Embryology-Act/index.htm>

Learners are able to stretch and challenge themselves by reading about stem cell research along with watching animations about the process and interviews on its potential uses. Learners can use this to undertake their own research project and potentially produce arguments for and against the procedure that the can debate within the class.





We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

If you do not currently offer this OCR qualification but would like to do so, please complete the Expression of Interest Form which can be found here: [www.ocr.org.uk/expression-of-interest](http://www.ocr.org.uk/expression-of-interest)

#### OCR Resources: the small print

OCR's resources are provided to support the teaching of OCR specifications, but in no way constitute an endorsed teaching method that is required by the Board and the decision to use them lies with the individual teacher. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources. We update our resources on a regular basis, so please check the OCR website to ensure you have the most up to date version.

© OCR 2016 – This resource may be freely copied and distributed, as long as the OCR logo and this message remain intact and OCR is acknowledged as the originator of this work.

OCR acknowledges the use of the following content: Page 4: Living cells – BillionPhotos/Shutterstock.com, Page 5: Red blood cells – RomanenkoAlexey/Shutterstock.com, Page 6: Lab worker – bikeriderlondon/Shutterstock.com, Page 7: Runner – Dudarev Mikhail/Shutterstock.com, Page 8: Mitochondria – Raj Creationzs/Shutterstock.com, Page 9: DNA helix – Sergey Nivens/Shutterstock.com, Page 10: Plant cell illustration – Mopic/Shutterstock.com, Page 11: Electron Microscopic image – Larry Bruce/Shutterstock.com, Page 12: Stem cells – Tatiana Shepeleva/Shutterstock.com, Page 13: Chromosome – koya979/Shutterstock.com, Page 14: Cancer cell – Juan Gaertner/Shutterstock.com, Page 17: Phototropism – Triff/Shutterstock.com, Page 18: Geotropism – Filip Fuxa/Shutterstock.com, Page 19: Harvesting – prudkov/Shutterstock.com, Page 21: Stem cells – Juan Gaertner/Shutterstock.com, Page 22: Genetic engineering – Lightspring/Shutterstock.com, Page 23: Stem cells in liquid nitrogen – Elena Pavlovich/Shutterstock.com, Page 25: Square down and Square up: – alexwhite/Shutterstock.com

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: [resources.feedback@ocr.org.uk](mailto:resources.feedback@ocr.org.uk)

We will inform centres about any changes to the specification. We will also publish changes on our website. The latest version of our specification will always be the one on our website ([www.ocr.org.uk](http://www.ocr.org.uk)) and this may differ from printed versions.

Copyright © OCR 2016. All rights reserved.

#### Copyright

OCR retains the copyright on all its publications, including the specifications. However, registered centres for OCR are permitted to copy material from this specification booklet for their own internal use.

## ocr.org.uk/gcsereform

### OCR customer contact centre

#### General qualifications

Telephone 01223 553998

Facsimile 01223 552627

Email [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

OCR is part of Cambridge Assessment, a department of the University of Cambridge. For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored. © OCR 2016 Oxford Cambridge and RSA Examinations is a Company Limited by Guarantee. Registered in England. Registered office 1 Hills Road, Cambridge CB1 2EU. Registered company number 3484466. OCR is an exempt charity.

