# Planning Support Booklet

**J247, J250**

**For first teaching in 2016**

This support material booklet is designed to accompany the OCR GCSE (9-1) specification in Biology A and Combined Science A (Gateway Science).

***DISCLAIMER***

This resource was designed using the most up to date information from the specification at the time it was published. Specifications are updated over time, which means there may be contradictions between the resource and the specification, therefore please use the information on the latest specification at all times.If you do notice a discrepancy please contact us on the following email address: resources.feedback@ocr.org.uk

# Introduction

This support material is designed to accompany the OCR GCSE (9-1) specification for first teaching from September 2016 for:

* [Biology A (Gateway Science – J247)](http://www.ocr.org.uk/Images/234594-specification-accredited-gcse-gateway-science-suite-biology-a-j247.pdf)
* [Combined Science A (Gateway Science – J250)](http://www.ocr.org.uk/Images/234596-specification-accredited-gcse-gateway-science-suite-combined-science-a-j250.pdf)

The Planning Guidance table on the following pages sets out *suggested* teaching times for the topics within the specification. Note that we always recommend that individual centres plan their schemes of work according to their individual needs. Actual teaching times for topics will depend on the amount of practical work done within each topic and the emphasis placed on development of practical skills in various areas, as well as use of contexts, case studies and other work to support depth of understanding and application of knowledge and understanding. It will also depend on the level of prior knowledge and understanding that learners bring to the course.

The table follows the order of the topics in the specification. It is not implied that centres teach the specification topics in the order shown, centres are free to teach the specification in the order that suites them.

## Delivery guides

The column ‘Delivery guides’ refers to individual teacher guides available from the [GCSE (9–1) Biology A](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-biology-a-j247-from-2016/) and [Combined Science A](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-combined-science-a-j250-from-2016/) qualification pages.

These Delivery guides provide further guidance and suggestions for teaching of individual topics, including links to a range of activities that may be used and guidance on resolving common misconceptions.

## Practical work

Specification topic p7 (Practical skills) is not included explicitly in the Planning Guidance table. The expectation is that the practical skills are developed throughout the course and in support of conceptual understanding.

Suggestions for where the PAG techniques can be are included throughout the table. This is by no means and exhaustive list of potential practical activities.

| Topic | Teaching hoursSeparate / Combined | Delivery guides | PAG opportunities |
| --- | --- | --- | --- |
| **Topic 1: Cell level systems** |
| B1.1 Cell structures | 3.0 / 3.0 | Cell level systems – delivery guide | PAG B1: Microscopy – investigation of a range of cellsPAG B6: Physiology, responses respiration – Investigation of cytoplasmic streaming in Elodea spp. PAG B7: Microbiological techniques – Preparation of cheek cell slides |
| B1.2 What happens in cells (and what do cells need)? | 6.5 / 4.0 | Cell level systems – delivery guide | PAG B1: Microscopy – observation of mitosis in root tip cellsPAG B2: Testing for biological molecules – Investigation of DNA extraction from a living organismPAG B2: Testing for biological molecules – Investigations of enzyme activityPAG B2: Testing for biological molecules – Investigation into the effect of amylase on a baby rice pastePAG B4: Rates of enzyme controlled reactions – Investigation into the effect of amylaseon a baby rice pastePAG B4: Rates of enzyme controlled reactions including numerical analysis of data and graphical representation of results |
| B1.3 Respiration | 5.5 / 5.0 | Cell level systems – delivery guide | PAG B2: Testing for biological molecules – Investigation into respirationPAG B6: Physiology, responses respiration – research into whether plants respirePAG B6: Physiology, responses respiration – investigation into aerobic and anaerobic respiration using fungi |
| B1.4 Photosynthesis | 6.0 / 5.0 | Cell level systems – delivery guide | PAG B2: Testing for biological molecules – Investigation into photosynthesisPAG B5: Photosynthesis – Investigation of photosynthesis in algae using alginate beadsPAG B5: Photosynthesis – Investigation of photosynthesis e.g. the Priestley experiment using Cabomba to collect oxygen or the Ingenhousz experiment to show mass gainPAG B5: Photosynthesis – Experiments to show the consequences of light exclusion on photosynthesising plantsPAG B5: Photosynthesis – Investigation of photosynthesis in algae using alginate beads to immobilize the algae |
| **Total for topic 1 = 21.0 / 17 hours** |
| **Topic B2: Scaling up** |
| B2.1 Supplying the cell | 6.0 / 5.0 | Scaling up – delivery guide | PAG B6: Physiology, responses respiration – Investigation of ‘creaming yeast’ to show osmosisPAG B6: Physiology, responses respiration – Investigation into changes in mass of vegetable chips when placed in sucrose/salt concentrations of varying concentrations PAG B8: Transport in and out of cells – Investigation into changes in mass of vegetable chips when placed in sucrose/salt concentrations of varying concentrations |
| B2.2 The challenges of size | 9.0 / 9.0 | Scaling up – delivery guide | PAG B1: Microscopy – investigation of a blood smear/blood vesselsPAG B1: Microscopy – Examination of root hair cellsPAG B1: Microscopy – Measurement of plant stomatal densityPAG B1: Microscopy – Investigation of the position of the xylem/phloem in root, stem and leaf tissuesPAG B6: Physiology, responses respiration – Measurement of plant stomatal density and openingPAG B6: Physiology, responses respiration – investigations into environmental factors that affect water uptake in plants |
| **Total for topic 2 = 15.0 / 14.0 hours** |
| **Topic B3: Organism level systems** |
| B3.1 Coordination and control – the nervous system | 7.0 / 3.0 | Organism level – delivery guide systems | PAG B6: Physiology, responses respiration – Research into reflexes/reaction times |
| B3.2 Coordination and control – the endocrine system | 8.0 / 5.0 | Organism level systems – delivery guide | PAG B6: Physiology, responses respiration – Investigation of the effects of phototropism using seedlings |
| B3.3 Maintaining internal environments | 9.0 / 4.0 | Organism level systems – delivery guide | PAG B8: Transport in and out of cells – Demonstration of the different water potentials on different cells |
| **Total for topic 3 = 24.0 / 12.0 hours** |
| **Topic B4: Community level systems** |
| B4.1 Ecosystems | 9.0 / 5.0 | Community level systems – delivery guide | PAG B1: – Examination of the roots of a leguminous plant PAG B3: Sampling techniques – Investigation of the holly leaf miner or the horse-chestnut leaf miner (Cameraria ohridella)PAG B3: Sampling techniques – Identification of the biotic factors in an ecosystem using sampling techniquesPAG B4: Rates of enzyme controlled reactions – Investigation of the most favourable conditions for compostingPAG B7: Microbiological techniques – Investigation of the most favourable conditions for composting |
| **Total for topic 4 = 9.0 / 5.0 hours** |
| **Topic B5: Genes, inheritance and selection** |
| B5.1 Inheritance | 12.0 / 9.0 | Genes, inheritance and selection – delivery guide |  |
| B5.2 Natural selection and evolution | 6.0 / 4.0 | Genes, inheritance and selection – delivery guide |  |
| **Total for topic 5 = 18.0 / 13.0 hours** |
| **Topic 6 Global challenges** |
| B6.1 Monitoring and maintaining the environment | 5.0 / 4.0 | Monitoring and maintaining the environment – topic exploration pack | PAG B3: Sampling techniques – Investigation into the effects of lichen distribution against pollutionPAG B3: Sampling techniques – Investigation into the effectiveness of germination in different strengths of acid rainPAG B3: Sampling techniques – Investigation of ecological sampling methods |
| B6.2 Feeding the human race | 6.0 / 3.0 | Feeding the human race – topic exploration pack |  |
| B6.3 Monitoring and maintaining health | 22.0 / 16.0 | Monitoring and maintaining health – topic exploration pack | PAG B7: Microbiological techniques – Investigation into growth bacterial cultures using aseptic techniques |
| **Total for topic 6 = 33.0 / 23.0 hours** |

**Total teaching hours = 120 hours / 84 hours**

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# Outline Scheme of Work: B1: Cell Level Systems

## Suggested teaching time for chapter: 21 hours biology / 17 hours combined science

### B1.1 Cell Structures

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 | B1.1b explain how the main sub-cellular structures of eukaryotic cells (plants and animals) and prokaryotic cells are related to their functions | The lesson and its objectives could be introduced by asking learners to watch this [parts of a cell song](https://www.youtube.com/watch?v=NkC9AiJf7gI) – highlight to students that some structures, such as lysosomes, they will only need to remember at A-Level.and then hand out blank pieces of paper / mini whiteboards. Ask learners to, from memory, draw a typical animal cell and label it. Use an animation such as the ones from [here](http://www.cellsalive.com/cells/cell_model.htm) to point out the nucleus in both plant and animal cells. Can also use an animation such as the one [here](http://www.cellsalive.com/cells/bactcell.htm) to show a plasmid in a bacterial cell. Activity 6 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) can be used as an introduction to an animal cell and its sub-cellular structures and help learners to visualise cells in 3D.Activity 10 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) will also help with the concept of a cell as a 3D structure.Activities 8 and 9 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) will give learners the chance to consider animal and plant cells and the functions of their sub-cellular structures.Activity 7 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) could be used as a plenary to consolidate the learning in this lesson.A Transition Guide has been written to provide support for the transition between KS3 and KS4 with some of the content of this topic. It can be found [here](http://www.ocr.org.uk/Images/266404-cell-level-systems-transition-guide.pdf). It contains a variety of activities to do with animal and plants cells and some ideas on moving learners on from the KS3 content to the more challenging KS4 ideas.One of the checkpoint tasks in the transition guide provides an activity for looking at the differences between animal and plant cells. The teacher instructions are here and the learner activity can be found by scrolling down to the bottom of [this](http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-biology-a-j247-from-2016/) page and clicking on ‘Transition guides – Checkpoint tasks’. The learner activity is the Word document. | From the Key Stage 3 Programme of Study:* Cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope.
* Functions of cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondrion and chloroplast.
* Similarities and differences between animal and plant cells.

Limit the function of a plasmid to it being a small loop of genetic material which can move between bacterial cells allowing it to be useful in genetic engineering. |
| 2 & 3 | B1.1a describe how light microscopes and staining can be used to view cells**BM1.1i demonstrate an understanding of number, size and scale and the quantitative relationship between units**BM1.1ii use estimations and explain when they should be usedBM1.1iii calculate with numbers written in standard formB1.1c explain how electron microscopy has increased our understanding of sub-cellular structures | Learners should be familiar with cells as the fundamental unit of living organisms and with the use of light microscopes to view cells.Activity 3 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) can be used as an introduction to scale and microscopy.Activity 1 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) can then be used to build learner confidence before trying their skills on microscopes.This can be further built on using Activity 2 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) as it allows learners to start to take measurements and determine the size of objects.Calculating magnification, often a challenging concept for learners, can be explored using Activities 4 and 5 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf). These allow a range of experiences to help learners to grasp the basic idea.A complete lesson titled “Comparing Light and Electron Microscope” can be found [here](https://www.ocr.org.uk/qualifications/gcse/gateway-science-suite-biology-a-j247-from-2016/planning-and-teaching/) (scroll down the page and click on ‘Lesson elements’ – there is a PowerPoint and Word document). This is a great way to present all sorts of ideas about microscopy, measuring and calculations. | From the Key Stage 3 Programme of Study:* Cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope.

Looking at animal and plant cells using a light microscope and doing scientific drawings from them allows skills from *PAG1* to be covered (see p. 48 of the specification). |

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| Additional remote learning opportunities***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** |
| **Lesson** | **Statement** | **Teaching activities** |
| 1 | B1.1a & B1.1b | This [video](https://www.youtube.com/watch?v=v2lHztS4sMU) can be used as a nice introduction to cell level systems, or be given to students as home learning to watch ready for the lesson. An alternative is this [video from the Amoeba sisters](https://www.youtube.com/watch?v=Pxujitlv8wc) which compares eukaryotic cells with prokaryotic cells.Here is a [virtual practical](https://ocr.org.uk/rpgbiol1) using onion cells and cheek cells, which can be used to demonstrate the skills for PAG 7. It is also accompanied by quiz questions students can work through.  |
| 2 & 3 | B1.1a & B1.1c | Here is a [video](https://www.bbc.co.uk/teach/class-clips-video/biology-ks3-gcse-microscopy/znykmfr) comparing light and electron microscopes, with examples such as red blood cells and plant cells shown. This [second video](https://www.youtube.com/watch?v=VBdVARYWq1c) fully compares light and electron microscopes, and goes through magnification calculations with practice questions. This [Oak National Academy resource](https://teachers.thenational.academy/lessons/microscopes-magnification-and-resolution-6mr38d) has lesson slides, and questions to check students understanding of the differences between the microscopes, as well as practising converting between units. |

### B1.2 What happens in cells (and what do cells need)?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 & 2 | B1.2a describe DNA as a polymer B1.2b describe DNA as being made up of two strands forming a double helixB1.2c describe that DNA is made from four different nucleotides; each nucleotide consisting of a common sugar and phosphate group with one of four different bases attached to the sugar | Activity 1 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) can be used to see what learners remember about DNA structure from previous learning.Introduce more about the structure of DNA by describing the role of modelling used by Watson and Crick in their determination of the structure. Show video from here about [base pairing](https://www.dnalc.org/resources/3d/25-basepairing.html).The video [here](https://www.youtube.com/watch?v=gpKjp51miwA) can be used to illustrate that the genome is the entire genetic material of an organism and then learners can link this idea to the very visual practical activity.Alternative methods to use to extract DNA from living material can be found in Activity 2 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf).Learners could make a model of DNA. There are many options, some have a different focus and use various raw materials. One example is found in the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) in Activity 4. There is also a complete lesson titled “DNA Modelling” to be found [here](http://www.ocr.org.uk/Images/221136-dna-modelling-teacher-instructions-lesson-element.pdf). A second Word document needs to be downloaded from [here](https://www.ocr.org.uk/qualifications/gcse/gateway-science-suite-biology-a-j247-from-2016/planning-and-teaching/) (scroll down the page and click on ‘Lesson elements’ and the Word document is called ‘DNA modelling – Lesson element – Learner activity.’)Other examples include the ones [here](http://www.yourgenome.org/activities/origami-dna), [here](https://www.tes.com/teaching-resource/dna-structure-sweet-model-6113201) and [here](http://learn.genetics.utah.edu/content/molecules/builddna/).Activity 3 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) can be used to consolidate learning. | From the Key Stage 3 Programme of Study:* A simple model of chromosomes, genes and DNA in heredity, including the part played by Crick, Watson, Wilkins and Franklin in the development of the DNA model.

The extraction of DNA from living material is an example of a practical that could be carried out to cover the skills required for *PAG2*. |
| 3 | **B1.2d recall a simple description of protein synthesis****B1.2e explain simply how the structure of DNA affects the proteins made in protein synthesis** | Learners need to have a good idea of what the code on the DNA is used for. There are many activities available to assist in the delivery of this concept.Activity 5 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) can be used to introduce the key terminology and concepts.There are many simple animations and videos that can be shown such as the examples [here](https://www.youtube.com/watch?v=2zAGAmTkZNY) and [here](https://www.youtube.com/watch?v=NJxobgkPEAo). |  |
| 4, 5 & 6 | B1.2g explain the mechanism of enzyme actionB1.2f describe experiments that can be used to investigate enzymatic reactionsBM1.2i carry out rate calculations for chemical reactionsBM1.2ii understand and use simple compound measures such as the rate of a reaction | A summary video clip about the action of enzymes such as the one [here](https://www.youtube.com/watch?v=smtCH5HX44o) could be shown as an introduction to the topic. It introduces quite a lot of the key terminology so an activity could be linked to this.Activity 6 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) could also be used as a starter activity. One example of a practical activity to investigate the action of enzymes is detailed in Activity 7 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf)examples can be found [here](http://www.nuffieldfoundation.org/practical-biology/factors-affecting-enzyme-activity), [here](http://www.biology-resources.com/biology-experiments2.html) and [here](https://www.stem.org.uk/elibrary/list/21565/enzymes). The GCSE Bitesize page found [here](http://www.bbc.co.uk/education/guides/z8wsgk7/revision/5) contains useful information about enzymes.The activity found [here](https://www.tes.com/teaching-resource/ks4-enzymes-revision-6012142) is a good revision / consolidation of the learning on enzymes. | From the Key Stage 3 Programme of Study:* Enzyme simply as biological catalysts.

There are lots of different procedures that could be carried out to demonstrate the way that enzymes work and these will cover the skills required for *PAG4*. |

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| Additional remote learning opportunities***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** |
| **Lesson** | **Statement** | **Teaching activities** |
| 1 & 2 | B1.2a – B1.2c | This BBC Bitesize [daily interactive remote lesson](https://www.bbc.co.uk/bitesize/topics/zpffr82) contains two videos and two practice activities to reinforce leaning from the videos. Here is a [virtual practical](https://ocr.org.uk/rpgbiol2) about extracting DNA from split peas. It has an interactive experiment, as well as a video and quiz questions. It can be used to demonstrate the skills for PAG2. |
| 2 & 3 | **B1.2d & B1.2e** | This [video from Amoeba sisters](https://www.youtube.com/watch?v=oefAI2x2CQM) could be used with students to demonstrate protein synthesis. They could be given questions after watching the video to check understanding. This [cut and stick activity](https://www.tes.com/teaching-resource/sb3d-protein-synthesis-11815617) could be shared with students who can virtually cut and stick the images. |
| 4, 5 & 6 | **B1.2g** | This [video](https://www.youtube.com/watch?v=VNX9UQ08fZ4) introduces how enzymes work, and can be followed up with the [next video](https://www.youtube.com/watch?v=qq1foXnvJao) about factors that affect enzymes.This [revision mat](https://www.tes.com/teaching-resource/synoptic-enzymes-revision-mat-11046017) can be completed virtually by students, or in the classroom. It may need to be adapted slightly to suit new specification content, or left as it is to extend students and reinforce their understanding of the role of enzymes. |

### B1.3 Respiration

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 | B1.3a describe cellular respiration as a universal chemical process, continuously occurring that supplies ATP in all living cellsB1.3b describe cellular respiration as an exothermic reaction | There is an introductory activity that could be used [here](http://www.bbc.co.uk/education/guides/zm6rd2p/activity). There is some information presented as video clips for learners to watch and then some multiple choice questions. It could be done as a whole class activity or individually, depending on IT capacity.[This](http://www.bbc.co.uk/education/guides/zm6rd2p/video) – move to home learning is a short video emphasising the importance of respiration and it being the release of energy from food. [This](https://www.tes.com/teaching-resource/respiration-lesson-with-circus-activity-6330251) set of activities presents an interactive way to look at the concepts in this topic.Showing that respiration is an exothermic reaction can be done using Activity 1 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf).[This](http://www.bbc.co.uk/education/guides/zm6rd2p/revision/1) is a set of revision information about respiration, followed up with a multiple choice [test](http://www.bbc.co.uk/education/guides/zm6rd2p/test) which can be used for consolidation. | From the Key Stage 3 Programme of Study:* A word summary for aerobic respiration.
 |
| 2 & 3 | B1.3c compare the processes of aerobic respiration and anaerobic respiration | This is a concept that is ideally presented using practical work and there are a range of ideas offered [here](http://www.biology-resources.com/biology-experiments2.html). Learners could use the practical work to consider the advantages and disadvantages of each type of respiration as well as the basics of a comparison. | From the Key Stage 3 Programme of Study:* 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 micro-organisms, 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.

The practical activities associated with these concepts are an opportunity for learners to cover the skills that arise in *PAG6.* |
| 4 | B1.3d explain the importance of sugars in the synthesis and breakdown of carbohydratesB1.3e explain the importance of amino acids in the synthesis and breakdown of proteinsB1.3f explain the importance of fatty acids and glycerol in the synthesis and breakdown of lipids | This lesson on metabolism could also be presented using a demonstration involving building blocks such as Lego.It is important that learners are familiar with the term “monomer” to describe molecules such as glucose and amino acids and then “polymer” to describe a molecule such as starch or a polypeptide. |  |

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| Additional remote learning opportunities***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** |
| **Lesson** | **Statement** | **Teaching activities** |
| 1, 2 & 3 | B1.3a – B1.3c | This [BBC class clip](https://www.bbc.co.uk/teach/class-clips-video/biology-ks3-gcse-aerobic-respiration/zmncqp3) could be given to students as a KS3 recap prior to starting this section. It could then be followed by this [Oak National Academy remote lesson](https://classroom.thenational.academy/lessons/respiration-71jpce) to reinforce learning. |
| 4 | B1.3d - B1.3f | This [video](https://www.youtube.com/watch?v=DvAIZ-WIUps) can be used to show the synthesis and breakdown of biological molecules, as well as showing the skills required for PAG B2.This [video practical](https://ocr.org.uk/rpgbiol7) of food tests includes a full video, interactive experiment and quiz questions to consolidate knowledge. |

### B1.4 Photosynthesis

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 & 2 | B1.4a describe photosynthetic organisms as the main producers of food and therefore biomass for life on EarthB1.4b describe the process of photosynthesisB1.4c describe photosynthesis as an endothermic reaction | Learners should be provided with an opportunity to recap their KS3 knowledge and move on to more complex KS4 ideas and Activity 1 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) provides a wealth of activities in order to do this. Quite a few of them are practical focused and all consider the many misconceptions that learners have about the ideas within the topic of photosynthesis.An appropriate amount of time can be spent depending on the prior learning of the class and the rate of progress in terms of the grasp of the concepts at a KS4 level.Activity 2 from the Cell Level Systems Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf) can be used to show that photosynthesis is an endothermic reaction.  | From the Key Stage 3 Programme of Study:* The reactants in, and products of, photosynthesis, and a word summary for photosynthesis.
* The dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy source and to maintain levels of oxygen and carbon dioxide in the atmosphere.
* The adaptations of leaves for photosynthesis.

There are lots of different procedures that could be carried out to demonstrate the process of photosynthesis and these will cover the skills required for *PAG5*. |
| 3 & 4 | B1.4d describe experiments to investigate photosynthesisBM1.4i understand and use simple compound measures such as the rate of a reactionBM1.4ii translate information between graphical and numerical form BM1.4iii plot and draw appropriate graphs, selecting appropriate scales and axes BM1.4iv extract and interpret information from graphs, charts and tables B1.4e explain the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis | A starting point for considering experiments to investigate photosynthesis can be found in Activities 3 and 4 in the Cell Level System Delivery Guide [here](http://www.ocr.org.uk/Images/204394-cell-level-systems-delivery-guide.pdf).The mathematical statements can also be considered in light of the experimental work.Information about various aspects to do with photosynthesis, including investigating it and a multiple choice test, can be found [here](http://www.bbc.co.uk/education/guides/zq239j6/revision/1).Other options for experiments to investigate photosynthesis can be found [here](http://www.nuffieldfoundation.org/practical-biology/investigating-factors-affecting-rate-photosynthesis) and [here](http://www.biology-resources.com/biology-experiments2.html).A basic simulation can be found [here](http://www.kscience.co.uk/animations/photolab.swf) that allows learners to manipulate different factors that affect the rate of photosynthesis. This could be used to provide a link to the next lesson based on limiting factors. | There are lots of different approaches that could be used to investigate the process of photosynthesis and consider the variables that affect the rate at which the reactions proceed and these will cover the skills required for *PAG5*. |
| 5 | **B1.4f explain the interaction of these factors in limiting the rate of photosynthesis****BM1.4v understand and use inverse proportion – the inverse square law and light intensity in the context of factors affecting photosynthesis** | [This](https://www.youtube.com/watch?v=xEhvsXG8cNs) video clip summarises the main points about photosynthesis and starts to talk about the limiting factors at the end so can be used as a starter to this lesson.Learners need to grasp the ideas about the limiting factors and they also need to be able to interpret graphs and consider data about them.[This](http://www.rsc.org/learn-chemistry/content/filerepository/CMP/00/001/068/Rate%20of%20photosynthesis%20limiting%20factors.pdf) is a good information sheet about limiting factors and is a useful starting point.The activity found [here](https://www.tes.com/teaching-resource/limiting-factors-6049709) can be used to help learners develop graph drawing skills and to give them the opportunity to use their graph to explain about the concept of limiting factors.As a consolidation or revision activity at the end of the whole B1 topic, a whole class loop activity can be found as part of the Transition Guide Checkpoint Task [here](http://www.ocr.org.uk/Images/261248-cell-level-systems-checkpoint-task-instructions.pdf). It needs to cut up prior to the lesson but is an excellent way to summarise key ideas from throughout the topic. |  |

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| Additional remote learning opportunities***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** |
| **Lesson** | **Statement** | **Teaching activities** |
| 1 & 2 | B1.4a – B1.4c | This Oak National academy [interactive remote lesson](https://classroom.thenational.academy/lessons/photosynthesis-64t3cc) can be used to introduce Photosynthesis. It has a quiz to recap students’ prior knowledge, as well as videos and lesson activities for students to work through.  |
| 3 & 4, 5 | B1.4d – e, **B1.4f** | This [second](https://classroom.thenational.academy/lessons/limiting-factors-of-photosynthesis-crw68d) Oak National academy interactive remote lesson can be used for the limiting factors of photosynthesis. A [third interactive remote lesson](https://classroom.thenational.academy/lessons/photosynthesis-required-practical-cmrk4t) can also be used for the rate of photosynthesis practical, which will demonstrate some of the skills required for PAG B4, PAG B5 and PAG B6. This [fourth remote lesson](https://classroom.thenational.academy/lessons/photosynthesis-required-practical-results-c4tp4t) can be used to go through plotting the results of the photosynthesis practical.This investigating photosynthesis [video practical](https://ocr.org.uk/rpgbiol8) could be used. It includes a full video, interactive version and quiz to consolidate learning.This [video](https://www.youtube.com/watch?v=kx7AeCx_6xQ) discusses the limiting factors of photosynthesis, and how to determine these from graphs. |



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