# *PLANNING SUPPORT BOOKLET*

**J257, J260**

**For first teaching in 2016**

This support material booklet is designed to accompany the OCR GCSE (9–1) in Biology B and Combined Science B (Twenty First Century).

***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 B (Twenty First Century Science – J257)](http://www.ocr.org.uk/Images/234595-specification-accredited-gcse-twenty-first-century-science-suite-biology-b-j257.pdf)
* [Combined Science B (Twenty First Century Science – J260)](http://www.ocr.org.uk/Images/234597-specification-accredited-gcse-twenty-first-century-science-suite-combined-science-b-j260.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 suits them.

## Delivery guides

Delivery guides are individual teacher guides available from the GCSE Biology B and Combined Science B q qualification pages.

* <http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-biology-b-j257-from-2016/>
* http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-combined-science-b-j260-from-2016/

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.

## Ideas about Science (B7) and Practical Work (B8)

Specification Chapter B7 (Ideas about Science) and Chapter B8 (Practical skills) are not included explicitly in the Planning Guidance table. The expectation is that these ideas and practical skills are developed throughout the course and in support of conceptual understanding.

Links to B7 learning outcomes and suggestions where the PAG techniques can be included are found throughout the table. This is by no means an exhaustive list of potential practical activities.

| Chapter | Estimated teaching hours**Separate / Combined** | Comments and PAG opportunities |
| --- | --- | --- |
| **Chapter 1: You and Your Genes** |
| 1.1 What is the genome and what does it do? | 7 / 4 | PAG1 Describe how to use a light microscope to observe a variety of plant and animal cells |
| 1.2 How is genetic information inherited? | 4 / 3 |  |
| 1.3 How can and should genetic information be used? | 5 / 5 |  |
|  | **Total 16 / 12** |  |
| **Chapter 2: Keeping Healthy** |
| 2.1 What are the causes of disease? | 5 / 5 |  |
| 2.2 How do organisms protect themselves against pathogens? | 6 / 5 |  |
| 2.3 How can we prevent the spread of infections? | 3 / 3 |  |
| 2.4 How can we identify the cause of an infection? | 5 / 0 | PAG1 Describe how to use a light microscope to observe microorganismsPAG7 Describe and explain the aseptic techniques used in culturing microorganisms |
| 2.5 How can lifestyle, genes and the environment affect health? | 4 / 3 | PAG6 Describe how to practically investigate the effect of exercise on pulse rate and recovery rate |
| 2.6 How can we treat disease? | 3 / 2 | PAG7 Calculate cross-sectional areas of bacterial cultures and of clear zones around antibiotic discs on agar jelly using πr2 |
|  | **Total 26 / 18** |  |
| **Chapter 3 Living Together – Food and Ecosystems** |
| 3.1 What happens during photosynthesis? |  10 / 9 | PAG5 Describe practical investigations into the requirements and products of photosynthesisPAG4 Describe practical investigations into the effect of substrate concentration, temperature and pH on the rate of enzyme controlled reactions |
| 3.2 How do producers get the substances they need? |  8 / 7 | PAG8 Describe practical investigations into the processes of diffusion and osmosisPAG1 Describe how to use a light microscope to observe the structure of the xylem and phloemPAG6 Describe how to use a simple potometer |
| 3.3 How are organisms in an ecosystem interdependent? | 7 / 4 | PAG2 Describe the use of qualitative tests for biological molecules |
| 3.4 How are populations affected by conditions in an ecosystem? | 3 / 3 | PAG3 Describe how to carry out a field investigation into the distribution and abundance of organisms in an ecosystem |
|  | **Total 28 / 23** |  |
| **Chapter 4 Using Food and Controlling Growth** |
| 4.1 What happens during cellular respiration? |  3 / 3 | PAG5 Describe practical investigations into the effect of different substrates on the rate of respiration in yeast |
| 4.2 How do we know about mitochondria and other cell structures? |  1 / 1 |  |
| 4.3 How do organisms grow and develop? | 5 / 5 | PAG1 Describe how to use a light microscope to observe stages of mitosis |
| 4.4 How is plant growth controlled? |  3 / 0 | PAG6 Describe practical investigations into the role of auxin in phototropism |
| 4.5 Should stem cells be used to treat damage and disease? | 1 / 1 |  |
|  | **Total 13 / 10** |  |
| **Chapter 5 The Human Body – Staying Alive** |
| 5.1 How do substances get into, out of and around our bodies? | 7 / 6 |  |
| 5.2 How does the nervous system help us respond to changes? | 5 / 2 | PAG6 Describe practical investigations into reflex actions |
| 5.3 How do hormones control responses in the human body? | 2 / 2 |  |
| 5.4 Why do we need to maintain a constant internal environment? | 5 / 1 | PAG6 Describe practical investigations into temperature control in the body |
| 5.5 What role do hormones play in human reproduction? | 5 / 5 |  |
| 5.6 What can happen when organs and control systems stop working? | 7 / 2 | PAG6 Describe practical investigations into the response of the pupil in different light conditions |
|  | **Total 31 / 18** |  |
| **Chapter 6 Life on Earth – Past and Present** |
| 6.1 How was the theory of evolution developed? | 8 / 5 |  |
| 6.2 How do sexual and asexual reproduction affect evolution? | 1 / 0 |  |
| 6.3 How does our understanding of biology help us classify the diversity of organisms on Earth? | 1 / 1 |  |
| 6.4 How is biodiversity threatened and how can we protect it? | 8 / 3 |  |
|  | **Total 18 / 9** |  |

**Total teaching hours = 132 / 90 hours**

# Outline Scheme of Work: B3 Living together – food and ecosystems

## Suggested teaching time for chapter: 28/23 hours

|  |
| --- |
| **Additional remote learning opportunities*****As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.***  |
| **Statement**  | **Teaching activities**  |
| B3.1.1a  | 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 [BBC Bitesize interactive remote lesson](https://www.bbc.co.uk/bitesize/articles/z4hx6v4), which contains three videos and three practice activities to reinforce learning.  |
| B3.1.3 | 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. Alternatively, this third video explains how enzymes catalyse reactions. It shows how the structure of an enzyme is vital to its function. 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.  |
| B3.1.1b, B3.1.4 & **B3.1.6**  | 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.  |
| B3.2.2a | This Oak National Academy [interactive remote lesson](https://classroom.thenational.academy/lessons/diffusion-226c0e) on diffusion contains a recap quiz, presentation slides and worksheets for students to work through. This [BBC class clip](https://www.bbc.co.uk/teach/class-clips-video/biology-ks3-gcse-osmosis-rap/zfv8xyc) could be used to introduce osmosis. Alternatively, this video from the Amoeba sisters about [osmosis and water potential](https://www.youtube.com/watch?v=L-osEc07vMs) can be used with students. This video shows an experiment that demonstrates osmosis. It also shows how osmosis affects plants cells and can be used to consolidate learning. This second video shows the effect of plasmolysis in cells from the petal of a tulip. This [video practical](https://ocr.org.uk/rpgbiol3) about osmosis on plant tissue demonstrates some of the skills required in PAG B8. It has a full video, interactive experiment and quiz questions. Further remote lessons from [BBC Bitesize](https://www.bbc.co.uk/bitesize/articles/zbvdwty) and [Oak National Academy](https://classroom.thenational.academy/lessons/active-transport) could be used to reinforce learning for Diffusion & Osmosis and Active Transport respectively. This [video](https://www.youtube.com/watch?v=eDeCgTRFCbA) about active transport could also be given to students to reinforce learning. |
| B3.2.1 | This [virtual experiment](https://ocr.org.uk/rpgbiol4) demonstrates a model lung, and how gas exchange happens in the lung. There is a full video, interactive experiment and a quiz to check learning. This BBC Bitesize clip can be used to reinforce learning about [photosynthesis](https://www.bbc.co.uk/teach/class-clips-video/biology-ks3-gcse-photosynthesis-rap/zm638xs).  |
| B3.2.4, B3.2.6a & B3.2.5a | This [clip](https://www.channel4.com/programmes/the-royal-institution-christmas-lectures/videos/series-3/fast-phloem/2844935139001) can be used by students to find out what substances are transported in the phloem. This [animation](https://www.saps.org.uk/secondary/teaching-resources/1299-biology-animations-plant-transport-photosynthesis-and-cell-growth) shows how substances can be transported in a plant.  |
| B3.2.7 & B3.6.6c |  This [virtual experiment](http://www.reading.ac.uk/virtualexperiments/ves/preloader-transpiration.html) demonstrates how transpiration can be affected by the presence and absence of light and wind. This second [virtual experiment](http://glencoe.mheducation.com/sites/dl/free/0078802849/383946/BL_10.html) allows students to carry out their own online transpiration experiment, and log the results from it.  |
| B3.3.1 | 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.  |
| B3.3.9, B3.3.10, B3.3.11 & B3.3.13 | There are a pair of videos about the carbon cycle. [Part 1](https://www.youtube.com/watch?v=zrD3tMNPjXU) is about the carbon cycle itself, and [part 2](https://www.youtube.com/watch?v=oe2kPpmhLuc) looks at how humans have had an influence on the carbon cycle (linking to content in B6.1 also). These [revision pages](https://www.bbc.co.uk/bitesize/guides/zydbqhv/revision/1) can be used by students to review their learning, along with the interactive test at the end of the revision.  |
| B3.3.6 – B3.3.8 | This Amoeba sisters [video](https://www.youtube.com/watch?v=-oVavgmveyY) can be used to review and reinforce learning about food webs and pyramids. This [video](https://www.youtube.com/watch?v=mOsHEkTixk8) can be used by students to review how to calculate the efficiency of biomass transfers, as well as understanding how biomass is lost at different trophic levels. These [virtual labs](http://glencoe.mheducation.com/sites/0078695104/student_view0/unit1/chapter2/virtual_labs.html) allow students to model interdependence in ecosystems and how energy flows through an ecosystem.  |

### B3.1 What happens during photosynthesis?

**Notes:**

* Statements in bold are for higher tier learners only.
* A reference to PAG indicates an opportunity to cover some skills from one of the Practical Activity Groups – see Chapter 8: Practical Skills of the Biology B specification for more information.
* A reference prefixed with “M” indicates an opportunity to cover some of the mathematical skills required for this qualification – see Appendix 5d of the Biology B specification for more information.

| Lessons | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1–3 | B3.1.1 a) describe the process of photosynthesis, including the inputs and outputs of the two mains stages and the requirement of light in the first stage, and describe photosynthesis as an endothermic processb) describe practical investigations into the requirements and products of photosynthesis*PAG5 (Separate Science) / PAG B4 (Combined Science)*B3.1.2 explain how chloroplasts in plant cells are related starch to photosynthesis | **Introduction to photosynthesis**This [video](http://www.bbc.co.uk/bitesize/standard/biology/revision_videos/photosynthesis/video/) from the BBC provides learners with a brief overview of photosynthesis and could be a great starter to generate discussion and interest in the topic. Activities from page 5 of the Photosynthesis Transition Guide [here](http://www.ocr.org.uk/Images/289244-photosynthesis-ks3-ks4-transition-guide.pdf) can be used to recap Key Stage 3 knowledge of this topic.The first checkpoint task linked to the Photosynthesis Transition Guide is intended to see if learners have grasped key terminology needed for this topic. The task can be found [here](http://www.ocr.org.uk/Images/289146-photosynthesis-checkpoint-task.doc). Activities from pages 7–8 of the Photosynthesis Transition Guide [here](http://www.ocr.org.uk/Images/289244-photosynthesis-ks3-ks4-transition-guide.pdf) can then be used to move learners on to other ideas that have more of a Key Stage 4 focus. There are many activities available that allow investigation into the requirements and products of photosynthesis. Science and Plants for Schools (SAPS) have a wide range including the ones [here](http://www.saps.org.uk/secondary/teaching-resources/1222-photosynthesis-testing-a-variegated-leaf-for-starch), [here](http://www.saps.org.uk/secondary/teaching-resources/285-student-sheet-20-starch-production-in-plants-during-photosynthesis) and [here](http://www.saps.org.uk/secondary/teaching-resources/284-investigating-photosynthesis-with-leaf-discs) and a video clip about the production of oxygen by plants [here](http://www.saps.org.uk/secondary/teaching-resources/798-video-clip-oxygen-production-in-photosynthesis). **Investigating *Cabomba***This [practical explanation](http://www.saps.org.uk/secondary/teaching-resources/190-using-cabomba-to-demonstrate-oxygen-evolution-in-the-process-of-photosynthesis-) will allow teachers to plan investigations using the release of oxygen bubbles from *Cabomba* to indicate the rate of photosynthesis.**What goes on inside plant cells?**This selection of [animations](http://www.saps.org.uk/secondary/teaching-resources/113-secondary/collections/1281-animation-respiration-and-photosynthesis-gcse-a-level) allows learners to work independently to find out how the activity of leaves and their cells differs in both light and dark environments. There are also a [range of resources](http://www.saps.org.uk/secondary/teaching-resources/1219-photosynthesis-what-are-chloroplasts) focusing specifically on chloroplasts. | 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 store 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* */ PAG B4.*As the variety of *Cabomba* commonly recommended in practical instructions is a non-native species, CLEAPSS have made information available [here](http://science.cleapss.org.uk/Resource/Bulletin-156-Summer-2016.pdf) about the availability of the plants and their disposal (a login is needed). |
| 4–7 | B3.1.3 a) explain the mechanism of enzyme action including the active site, enzyme specificity and factors affecting the rate of enzyme catalysed reactions, including substrate concentration, temperature and pHb) describe practical investigations into the effect of substrate concentration, temperature and pH on the rate of enzyme controlled reactionsM2b, M2f, M4a, M4b, M4c*PAG4 (Separate Science) / PAG B3 (Combined Science)* | 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.**Investigating enzymes**The [Nuffield Foundation](http://www.nuffieldfoundation.org/practical-biology/factors-affecting-enzyme-activity) provides comprehensive teacher, learner and technician notes for investigating the effects of temperature, pH and concentration on enzyme activity.Other examples of practical activities to investigate the action of enzymes can be found [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 / PAG B3* |
| 8–10 | B3.1.4 a) explain the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesisb) describe practical investigations into the effect of environmental factors on the rate of photosynthesis*PAG5 (Separate Science) / PAG B4 (Combined Science)***B3.1**.**5 use the inverse square law to explain changes in the rate of photosynthesis with distance from a light source****B3.1.6 explain the interaction of temperature, light intensity and carbon dioxide concentration in limiting the rate of photosynthesis, and use graphs depicting the effects**B3.1.7 in the context of the rate of photosynthesis:a) understand and use simple compound measures such as the rate of a reactionM1a, M1cb) translate information between graphical and numerical formM4ac) plot and draw appropriate graphs selecting appropriate scales for axesM4a, M4cd) extract and interpret information from graphs, charts and tablesM2c | A basic simulation can be found [here](http://www.kscience.co.uk/animations/photolab.swf) (*you may need to open using Internet Explorer)* that allows learners to manipulate different factors that affect the rate of photosynthesis. This could be used to provide a link to these lessons based on limiting factors.[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 these lessons.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.A good information sheet about limiting factors can be found in the resources listed [here](https://edu.rsc.org/resources/challenging-plants-plant-science/880.article) 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.There are many activities that can be used to investigate the effect of environmental factors on the rate of photosynthesis. [This](http://www.saps.org.uk/secondary/teaching-resources/235-student-sheet-23-photosynthesis-using-algae-wrapped-in-jelly-balls) activity allows learners to consider the effect of light intensity on the rate of photosynthesis or the effect of different wavelengths of light.**Investigating *Cabomba***This [practical explanation](https://www.saps.org.uk/secondary/teaching-resources/190-using-cabomba-to-demonstrate-oxygen-evolution-in-the-process-of-photosynthesis-) will allow teachers to plan investigations using the release of oxygen bubbles from *Cabomba* to indicate the rate of photosynthesis. | 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 store 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* */ PAG B4.*As the variety of *Cabomba* commonly recommended in practical instructions is a non-native species, CLEAPSS have made new information available [here](http://science.cleapss.org.uk/Resource/Bulletin-156-Summer-2016.pdf) about the availability of the plants and their disposal (a login will be required). |

### B3.2 How do producers get the substances they need?

| Lessons | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1–3 | B3.2.1 describe some of the substances transported into and out of photosynthetic organisms in terms of the requirements of those organisms, including oxygen, carbon dioxide, water and mineral ionsB3.2.2 a) explain how substances are transported into and out of cells through diffusion, osmosis and active transportb) describe practical investigations into the processes of diffusion and osmosis*PAG8* | There are many videos available online, such as the one [here](https://www.youtube.com/watch?v=xPDYmvIcSzc), that can be used to show learners the process of diffusion in a liquid and this particular one indicates the difference between warm and cold liquids. However, it is quite straightforward to demonstrate using water and either food colouring or potassium permanganate crystals. Learners can be prompted, using the correct terminology, to explain what is occurring in the beakers.Learners need to know about the movement of substances into and out of a leaf, for example, so this could be considered by looking at a cross-section and identifying where diffusion is occurring and of what substances. This could then be developed by looking at the context for osmosis and active transport of mineral ions in a root hair cell. This could then be linked to the structure and function of a root hair cell in lesson 4.**Transport across membranes**The first two resources by the BBC are a short video clip showing the process of [membrane transport](https://www.bbc.co.uk/bitesize/guides/zc9tyrd/video) and a set of [revision pages](https://www.bbc.co.uk/bitesize/guides/zwkn7p3/revision/8) including animations. The third is another set of [revision pages](https://www.bbc.co.uk/bitesize/guides/zc9tyrd/revision/1) about membrane transport in the cells in more detail, allowing learners to make notes on the topic and test their learning using the online quiz.Practical investigations into the processes of diffusion and osmosis are numerous and offer opportunities for differentiation. With some classes, it may be appropriate to consider percentage change in mass or length of vegetable chips in solutes of different concentrations and to draw a variety of graphs. With other groups it may be better to consolidate ideas such as repeatability, the calculation of mean data and more simple graphical representations of collected data.**Blackcurrant potatoes**Nuffield Foundation provides teachers with a comprehensive [resource](http://www.nuffieldfoundation.org/practical-biology/investigating-effect-concentration-blackcurrant-squash-osmosis-chipped-potatoes) showing how to investigate osmosis in blackcurrant juice. It shows the effect of osmosis on the mass of potato chips quantitatively but also provides a qualitative assessment of osmosis. [This](https://pbiol.rsb.org.uk/exchange-of-materials/osmosis/observing-osmosis-plasmolysis-and-turgor-in-plant-cells) practical activity offers the opportunity to develop some of the skills linked to *PAG1* *(Separate Science) / PAG B1 (Combined Science)* as well as *PAG8* as it involves microscopy. You will find a set of well put together instructions [here](https://www.tes.com/teaching-resource/osmosis-investigation-worksheet-and-method-6193798) for the standard potato chips in a range of sucrose solutions practical including ideas about the processing of results and conclusions.[This](http://www.biology-resources.com/biology-experiments2.html) page has a range of activities that can be used to investigate diffusion and osmosis. | From the Key Stage 3 Programme of Study:* The role of diffusion in the movement of materials between cells.

There are lots of different procedures that could be carried out to demonstrate the processes relating to transport in and out of cells and these will cover the skills required for *PAG8*. |
| 4 | B3.2.3 explain how the partially-permeable cell membranes of plant cells and prokaryotic cells are related to diffusion, osmosis and active transportB3.2.4 explain how water and mineral ions are taken up by plants, relating the structure of the root hair cells to their function | It is useful to consider the root hair cells as an example of a specialised cell in terms of its adaptations for the uptake of water and minerals by osmosis and active transport. | From the Key Stage 3 Programme of Study:* The function of the cell membrane.

and* Plants gain mineral nutrients and water from the soil via their roots.
 |
| 5 | B3.2.5 a) explain how the structure of the xylem and phloem are adapted to their functions in the plantb) describe how to use a light microscope to observe the structure of the xylem and phloem*PAG1 (Separate Science) / PAG B1 (Combined Science)* | Learners need to be aware of the arrangement of the xylem and phloem tissues in both the root and the stem so annotated diagrams can be used to show this. **Vascular tissues in plants**A short 3-minute [animation](http://highered.mheducation.com/sites/9834092339/student_view0/chapter38/animation_-_phloem_loading.html) is available to explain how the xylem and phloem are able to move water and dissolved substances from source to sink within the plant. The second [resource](http://www.passmyexams.co.uk/GCSE/biology/transport-in-plants.html) gives detailed notes and a comparison table to allow learners to consolidate their learning on these vascular tissues.**Virtual microscope**This [virtual resource](http://www1.udel.edu/biology/ketcham/microscope/scope.html) allows learners to practice using a light microscope to view a number of different samples. | Learners can look at a range of different tissues from different plant material under the microscope and cover the skills required for *PAG1 (Separate Science) / PAG B1 (Combined Science).* |
| 6–8 | B3.2.6 a) describe the processes of transpiration and translocation, including the structure and function of the stomatab) describe how to use a light microscope to observe the structure of stomata*PAG1 (Separate Science) / PAG B1 (Combined Science)*c) describe how to use a simple photometer*PAG6*B3.2.7 a) explain the effect of a variety of environmental factors on the rate of water uptake by a plant, to include light intensity, air movement, and temperatureb) describe practical investigations into the effect of environmental factors on the rate of water uptake by a plantB3.2.8 in the context of water uptake by plants:a) use simple compound measures such as rateM1a, M1cb) carry out rate calculationsM1a, M1cc) plot, draw and interpret appropriate graphsM4a, M4b, M4c, M4dd) calculate percentage gain and loss of massM1c | These concepts follow on from looking at the structure and function of xylem and phloem tissue. Learners should know from study at KS3 that stomata are the site of gas exchange for a plant and they now have an opportunity to consider how a plant balances the need of carbon dioxide for photosynthesis with the implications of water loss through the stomata.Placing white flowers in dyed water is a clear demonstration of the movement of water through the xylem tissue.[This](https://www.youtube.com/watch?v=g7HbmUnqGlM) video clip is an excellent short introduction to ideas about water movement through a plant.**Stomata**Timothy Walker with the BBC provides a short [video clip](https://www.saps.org.uk/secondary/teaching-resources/799-video-clip-leaf-structure) showing the action of stomata and the regulation of carbon dioxide.**Transpiration in plants**Passmyexams provides an [animation](http://www.passmyexams.co.uk/GCSE/biology/transpiration-stream.html) giving a detailed explanation of the process of transpiration. This could be used with the [resource](https://www.bbc.co.uk/bitesize/guides/zps82hv/revision/3) from the BBC, giving a visual representation of the process of transpiration.You can find a circus activity for looking at xylem structure and transpiration [here](https://www.tes.com/teaching-resource/b4-ocr-gcse-transpiration-in-plants-6442416) with differentiated worksheets. There is also a Powerpoint and the activity includes looking at a potometer and some microscopy.**Passage of sucrose**SAPS provide a short [animation](https://www.saps.org.uk/secondary/themes/1274) showing the movement of water and sucrose throughout the roots, stem and leaves of a plant. It could be set as a homework task or discussed with the class as it is non-narrated.**Measuring water uptake**This [resource](https://pbiol.rsb.org.uk/exchange-of-materials/transpiration-in-plants/measuring-rate-of-water-uptake-by-a-plant-shoot-using-a-potometer) by the Nuffield Foundation provides comprehensive advice for the teachers and technicians on using potometers in class. The resource also has suggestions for the factors affecting transpiration that learners can investigate and can be used to calculate the volume of water up take. Science and Plants for Schools (SAPS) have a novel and effective way of setting up and manipulating a potometer [here](http://www.saps.org.uk/secondary/teaching-resources/1263-investigating-transpiration-with-a-potometer) that can be used to look at water uptake and the effect of a variety of environmental factors on this process. The activity has comprehensive technical support and questions for learners as well as the opportunity for mathematical skill development.  | From the Key Stage 3 Programme of Study:* The role of leaf stomata in gas exchange in plants.

Learners can look at stomata e.g. by taking a clear nail varnish impression under the microscope and cover the skills required for *PAG1 (Separate Science) / PAG B1 (Combined Science).*Looking at how a potometer can be used to measure water uptake by a plant is a practical activity that covers some of the skills required for *PAG6.* |

### B3.3 How are organisms in an ecosystem interdependent?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1  | B3.3.1 a) explain the importance of sugars, fatty acids and glycerol, and amino acids in the synthesis and breakdown of carbohydrates, lipids and proteinsb) describe the use of qualitative tests for biological molecules*PAG2* | Learners need to be considering here the link between the glucose made in photosynthesis and the requirements that living organisms have for a range of other biological molecules and how this is achieved.The ideas about metabolism could be presented using a demonstration involving building blocks such as Lego.There are various ways in which a practical to test foods for biological molecules can be put together – some ideas are found below and some can be found [here](http://www.biology-resources.com/biology-experiments2.html).**Testing food groups**The methods can be used to investigate different food types or can be adapted to use food powders in solution to produce different ‘unknown’ solutions for the learners to investigate. This will prevent the learners guessing the foods that contain the particular biological molecule they are investigating from their own knowledge.[View full activity in B3.3 How are organisms in an ecosystem interdependent? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-biology-b-j257-from-2016/delivery-guide/topic-gbb003-b3-living-together-food-and-ecosystems/delivery-guide-gbbdg012-b33-how-are-organisms-in-an-ecosystem-interdependent?activity=282227#282227)**Emulsion test**The two methods can be followed for either solid or liquid foods. Avocado and olives are great sources of solid high fat food but vegetable oil is a much cheaper alternative. [View full activity in B3.3 How are organisms in an ecosystem interdependent? – Online delivery guide](http://www.ocr.org.uk/qualifications/gcse-twenty-first-century-science-suite-biology-b-j257-from-2016/delivery-guide/topic-gbb003-b3-living-together-food-and-ecosystems/delivery-guide-gbbdg012-b33-how-are-organisms-in-an-ecosystem-interdependent?activity=282229#282229) | Testing foods for the presence of biological molecules are practical activities that cover the skills required for *PAG2.* |
| 2 | B3.3.2 describe photosynthetic organisms as the main producers of food and therefore biomass for life on EarthB3.3.3 describe some of the substances transported into organisms in terms of the requirements of those organisms, including dissolved food molecules | **Investigating ecosystems**National Geographic provide a comprehensive [lesson plan and resources](https://www.nationalgeographic.org/activity/marine-ecosystem-invention/) to allow learners to produce an imaginary marine ecosystem that includes fictitious organisms.  | From the Key Stage 3 Programme of Study:* The interdependence of organisms in an ecosystem including food webs and insect pollinated crops.
* How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.
 |
| 3 | B3.3.4 describe different levels of organisation in an ecosystem from individual organisms to the whole ecosystemB3.3.5 explain the importance of interdependence and competition in a community | The information on the first three pages [here](http://www.bbc.co.uk/education/guides/z2m39j6/revision/1) of this BBC Bitesize site introduces levels of organisation in an ecosystem and moves on to consider interdependence and competition.This is an [interactive animation](https://www.pbslearningmedia.org/asset/lsps07_int_ecosystem/) requiring learners to select abiotic factors in and ecosystem and biotic factors in an ecosystem. Great for lower ability learners. This [second interactive animation](https://www.learner.org/series/the-habitable-planet-a-systems-approach-to-environmental-science/ecology-lab/) allows learners to ‘build’ their own ecosystem, and explore the effects of interdepdence.There are activities designed to recap Key Stage 3 knowledge of interactions between organisms in ecosystems and interdependence on page 5 of the Interdependence Transition Guide found [here](http://www.ocr.org.uk/Images/289214-interdependence-ks3-ks4-transition-guide.pdf). Learners could also be provided with the Checkpoint tasks in order to assess their readiness to move on to consider the topics at Key Stage 4. The Checkpoint tasks can be found [here](http://www.ocr.org.uk/Images/289147-interdependence-checkpoint-task.doc).**Alternative resources:** A fox and rabbit predator prey [game](https://serc.carleton.edu/sp/mnstep/activities/26886.html) where learners drop 'fox' cards onto a table 'meadow' to catch 'rabbits'. Results are recorded over numerous 'years' and the population sizes are plotted on a graph. A video clip from David Attenborough's ['The Hunt'](https://www.youtube.com/watch?v=0mgnf6t9VEc) is great to show the class as an introduction to the relationship between predators and prey. (Teachers may want to warn learners that the video contain an animal be hunted and caught by another before showing the clip).   | From the Key Stage 3 Programme of Study:* The interdependence of organisms in an ecosystem including food webs and insect pollinated crops.
* How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.
 |
| 4 | B3.3.6 describe the differences between the trophic levels of organisms within an ecosystem*(separate science only)*B3.3.7 describe pyramids of biomass and explain, with examples, how biomass is lost between the different trophic levels*(separate science only)*B3.3.8 calculate the efficiency of biomass transfers between trophic levels and explain how this affects the number of organisms at each trophic level*(separate science only)*M1c | Pages 4 onwards [here](http://www.bbc.co.uk/education/guides/z2m39j6/revision/4) of the BBC Bitesize site move on to look at pyramids and energy transfer and then there is an activity and a test to look at, too.**Biomass transfer**Learners can consolidate their learning using these [pages](https://www.bbc.co.uk/bitesize/guides/z2m39j6/revision/6) on trophic levels before looking at energy transfer between the trophic levels and taking the test to assess their level of understanding.[This](https://www.tes.com/teaching-resource/construct-pupils-own-pyramid-of-numbers-biomass-6317122) is a PowerPoint which considers the ideas of pyramids of numbers and biomass and requires learners to construct their own using data.The activities [here](https://www.tes.com/teaching-resource/pyramids-of-number-biomass-and-energy-6313386) are differentiated and require students to consider the organisms in a freshwater ecosystem in terms of their trophic level and then draw bars on graph paper to build up a pyramid of numbers.[This](https://www.tes.com/teaching-resource/pyramids-of-numbers-and-biomass-for-lower-ability-6369477) is an activity for low ability learners to help them to recognise the difference between pyramids of numbers and biomass, still using mathematical skills. The Interdependence Transition Guide, page 7, has some activities to consider energy losses in ecosystems. It can be found [here](http://www.ocr.org.uk/Images/289214-interdependence-ks3-ks4-transition-guide.pdf). | From the Key Stage 3 Programme of Study:* The interdependence of organisms in an ecosystem including food webs and insect pollinated crops.
* How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.
 |
| 5 | B3.3.9 recall that many different substances cycle through the abiotic and biotic components of an ecosystem, including carbon and waterB3.3.10 explain the importance of the carbon cycle and the water cycle to living organisms | **Abiotic or biotic?**This is an [animated video](http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/ecosystems.htm) to introduce ecosystems and abiotic and biotic factors that affect them. This is a [PowerPoint presentation](http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=8&cad=rja&uact=8&ved=0ahUKEwiC2t_9oYbLAhWFfywKHaZtByAQFgg_MAc&url=http%3A%2F%2Fwww.pdst.ie%2Fsites%2Fdefault%2Ffiles%2FLesson%2520on%2520Biotic%2520and%2520Abiotic%2520Factors.pptx&usg=AFQjCNGMV6VHOsvyQRcaQ7Op-ufaPzo3mA&sig2=ny_qg6CcHIFKEfQ9z0Uo8w) about how abiotic and biotic factors affect communities including information, short activities and questions for learnersThere are a variety of activities designed to recap Key Stage 3 knowledge of cycles on page 5 of the Interdependence Transition Guide found [here](http://www.ocr.org.uk/Images/289214-interdependence-ks3-ks4-transition-guide.pdf). Page 7 of the Interdependence Transition Guide, found [here](http://www.ocr.org.uk/Images/289214-interdependence-ks3-ks4-transition-guide.pdf), shows some activities that can be used to consider cycling within ecosystems, including the carbon and water cycles.Pages 1 and 3 of the BBC Bitesize site [here](http://www.bbc.co.uk/education/guides/z72v4wx/revision/1) have information about the carbon and water cycles at the right level and there is also an activity which is based solely on the carbon cycle. The test could be used, for example as a class plenary, but it has a few questions on the nitrogen cycle which is not required for this specification.The presentation found [here](https://www.tes.com/teaching-resource/carbon-cycle-6157420) is a good description of the carbon cycle, at the right level, and concludes with a final slide that learners could have in their notes for revision.[This](https://www.tes.com/teaching-resource/carbon-cycle-active-learning-6138505) is an interesting active approach to the carbon cycle where learners are given a tray of key items and a large piece of paper and marker pens per group and asked to construct a carbon cycle. Hints can be given as the activity proceeds and discussion can come from it.A differentiated revision activity based on the carbon cycle can be found [here](https://www.tes.com/teaching-resource/differentiated-carbon-cycle-revision-worksheet-6426292). | From the Key Stage 3 Programme of Study:* The interdependence of organisms in an ecosystem including food webs and insect pollinated crops.
* How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.
 |
| 6 & 7 | B3.3.11 explain the role of microorganisms in the cycling of substances through an ecosystemB3.3.12 calculate the percentage of mass, in the context of the use and cycling of substances in ecosystemsM1cB3.3.13 explain the effect of factors such as temperature and water content on rate of decomposition in aerobic and anaerobic environments*(separate science only)*B3.3.14 calculate rate changes in the decay of biological material*(separate science only)*M1c | Page 7 of the Interdependence Transition Guide, [here](http://www.ocr.org.uk/Images/289214-interdependence-ks3-ks4-transition-guide.pdf), has links to some video clips about decay.[This](https://www.tes.com/teaching-resource/decay-powerpoint-6125129) presentation covers the main ideas about decomposition and the final slide gives some prompts about a possible investigation. The mathematical skills are important in this section so these could perhaps be covered by learners collecting their own data.  | From the Key Stage 3 Programme of Study:* The interdependence of organisms in an ecosystem including food webs and insect pollinated crops.
* How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.
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### B3.4 How are populations affected by conditions in an ecosystem?

| Lesson | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| 1 | B3.4.1 explain how some abiotic and biotic factors affect communities, including environmental conditions, toxic chemicals, availability of food and other resources, and the presence of predators and pathogens | [This](https://www.youtube.com/watch?v=00o4bZB4csA) is a really good video clip that describes the impact of Japanese knotweed on UK habitats that could be used to introduce the concept of competition.This [clip](https://www.youtube.com/watch?v=hx-Q1k_9SwA) moves on to look at competition for mates in the animal world, in quite a light hearted way. Learners are often surprised that the beauty of the birds belongs to the male of the species and that they go to extraordinary lengths to win the attention of the females.[This](https://www.tes.com/teaching-resource/competition-boardgame-6090168) is a link to a board game that can be used to help learners to grasp the consequences of competition and other influences on communities.**Abiotic or biotic?**This 5-minute [video clip](https://www.youtube.com/watch?v=MdlwPtKg-VI) gives an overview of the interactions of abiotic and biotic factors and their effect on ecosystems. **Basics of abiotic and biotic factors**The [short game](https://www.pbslearningmedia.org/asset/lsps07_int_ecosystem/) could be a homework or starter activity for lower ability learners. The game requires them to search an environment. |  |
| 2 & 3 | B3.4.2 describe how to carry out a field investigation into the distribution and abundance of organisms in an ecosystem and explain how to determine their numbers in a given areaM2d*PAG3 (Separate Science) / PAG B3 (Combined Science)*B3.4.3 in the context of data related to organisms within a population:a) calculate arithmetic meansM2b, M2fb) use fractions and percentagesM1cc) plot and draw appropriate graphs selecting appropriate scales for the axesM4a, M4cd) extract and interpret information from charts, graphs and tablesM2c | [This](https://www.youtube.com/watch?v=gLzY8FPJcfM) video clip introduces the techniques used by ecologists when sampling and also some of the environmental factors that affect the distribution of organisms and [this](https://www.youtube.com/watch?v=nsMWvSuJm08) clip shows some students looking at sampling buttercup populations, highlighting some of the main issues.[Here](https://www.tes.com/teaching-resource/estimating-sample-size-gcse-6003713) you will find a good summary presentation and some worksheets allowing learners to get the idea about sampling in the classroom.**Sampling techniques**BBC provide a [revision resource](https://www.bbc.co.uk/bitesize/guides/z83qcj6/revision/3) that allows learners to identify abiotic and biotic factors that affect an ecosystem along with sampling techniques. There are also self-assessment questions that allow learners to test their understanding.**Practical sampling**Nuffield Foundation provide a [detailed procedure](https://pbiol.rsb.org.uk/environment/fieldwork-techniques/biodiversity-in-your-backyard) for learners to undertake quadrat sampling. This resource can then be used to plot data and draw conclusions from it.  | This is an opportunity to carry out a practical activity that will cover the skills required for *PAG3 (Separate Science) / PAG B3 (Combined Science).*The mathematical skills are an important part of this activity so by collecting their own data, learners will be able to develop the required mathematical skills. |

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