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OCR
Oxford Cambridge and RSA

GCSE (9–1)
Delivery Guide

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

J257
For first teaching in 2016

Living together – food and ecosystems

Version 1

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

www.ocr.org.uk/biology

Introduction

GCSE (9–1) TWENTY FIRST CENTURY SCIENCE BIOLOGY B

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

'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 – B3.1 What happens during photosynthesis?

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

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Introduction

Subtopic 3 – B3.3 How are organisms in an ecosystem interdependent?

Subtopic 4 – B3.4 How are populations affected by conditions in an ecosystem?

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B3.1.1	a) describe the process of photosynthesis, including the inputs and outputs of the two main stages and the requirement of light in the first stage, and describe photosynthesis as an endothermic process b) describe practical investigations into the requirements and products of photosynthesis PAG5
B3.1.2	explain how chloroplasts in plant cells are related to photosynthesis
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 pH b) describe practical investigations into the effect of substrate concentration, temperature and pH on the rate of enzyme controlled reactions M2b, M2f, M4a, M4b, M4c PAG4
B3.1.4	a) explain the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis b) describe practical investigations into the effect of environmental factors on the rate of photosynthesis PAG5
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 reaction M1a, M1c b) translate information between graphical and numerical M4a c) plot and draw appropriate graphs selecting appropriate scales for axes M4a, M4c d) extract and interpret information from graphs, charts and tables M2c

Chloroplasts in plant cells are related to photosynthesis.

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General approaches:

Learners often approach this topic with some reservations as their interest in plant science is limited and as a result they find it difficult to engage with the content. Many of the concepts are not visible so to generate interest in the topic images, video clips and practical investigation should be used. Learners can conduct research and then plan investigations into the environmental effects on the rate of photosynthesis or the factors effecting enzyme activity therefore leading to a better understanding.

Practical tasks involve but are not limited to the effect of substrate concentration/pH/temperature on enzyme activity; the effects of temperature/light intensity/carbon dioxide concentration on the rate of photosynthesis; the use of microscopes to observe plant cells.

The use of video clips or animations of the processes are a great way of generating interest prior to embarking on the main investigation.

This section does have a large number of key terms that learners will find difficult to remember and a number of processes that learners are required to understand. Therefore it is important to build in numerous short, fun activities into lessons and to revisit them as starter activities or plenaries throughout the unit. This will not only reinforce the learners' learning but allow the teacher to make assessments as to when to introduce the next learning objective.

Common misconceptions or difficulties learners may have:

The majority of learners (and many adults) believe that a plant's biomass comes from the soil. This common misconception should be addressed early on by posing questions such as, "As you don't feed your plants soil every few weeks, where do they get the materials they use to make up their organs?".

Learners often believe that plants photosynthesise in the day and only respire at night. 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 for such a prolonged period of time.

A common misconception is that plants take in only carbon dioxide and give out all the oxygen they produce. This misconception could be addressed with the previous one. It could be of benefit when discussing respiration and photosynthesis in the early stages to show the products of both processes and how they are used in the other process.

The topic of enzymes often brings with it problem areas for learners. Misconceptions such as 'enzymes work best at 37°C' and 'enzymes are killed by high temperatures' can be approached by looking at what an enzyme is. Making learners aware that enzymes are found in a variety of organisms that inhabit a variety of different environments will allow you to challenge their idea of the optimum temperature being 37°C. Fish such as the arctic char (13°C) or reptiles such as the desert Iguana (41°C) could be used as examples. Learners should also be made aware of what enzymes are made of and that they are a very small component of cells. It is important to emphasise that that they can be denatured but not killed.

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 able to prepare slides to cover PAG 4 Microscopy, in appendix 5h. The understanding of cell structure is important when studying photosynthesis so references can be made back to cell structure in B1.1.1a but also has links with structure seen with an electron microscope in B4.2.1 and B4.2.2.

It can be of benefit to the learners to make links between polypeptides in B1.1.6 and protein synthesis in B1.1.9 when the learners are studying enzymes. This may help develop a better understanding of why factors affect enzymes, for example why temperatures cause enzymes to denature.

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Approaches to teaching the content

This topic lends itself to a wide range of practical activities and allows learners to develop both investigative and mathematical skills.
There are many activities that can be used as stand alone practicals or used to develop larger investigations. This is a particularly challenging topic for some learners, due to the co-ordination of the practical tasks and the representation of the data. However the use of the practical tasks can be used as the introduction upon which the course content can be built upon.

Photosynthesis.

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Activity 1

Introduction to photosynthesis

BBC
http://www.bbc.co.uk/bitesize/standard/biology/revision_videos/photosynthesis/video/

This 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.

Activity 2

Investigating *Cabomba*

Saps
http://www.saps.org.uk/secondary/teaching-resources/190-using-cabomba-to-demonstrate-oxygen-evolution-in-the-process-of-photosynthesis-

This practical explanation will allow teachers to plan investigations using the release of oxygen bubbles from *Cabomba* to indicate the rate of photosynthesis. The resource shows how the investigation can be modified in relation to the effect of light intensity on photosynthesis in *Cabomba*.

This practical relates to PAG 5.

Activity 3

What goes on inside plant cells?

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

http://www.saps.org.uk/secondary/teaching-resources/1219-photosynthesis-what-are-chloroplasts
This selection of animations 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 focusing specifically on chloroplasts that teachers can use to develop learners' understanding further.

Activity 4

Investigating enzymes

Nuffield foundation
http://www.nuffieldfoundation.org/practical-biology/factors-affecting-enzyme-activity

Nuffield foundation provide comprehensive teacher, learner and technician notes for investigating the effects of temperature, pH and concentration on enzyme activity.

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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 ions
B3.2.2	a) explain how substances are transported into and out of cells through diffusion, osmosis and active transport b) describe practical investigations into the processes of diffusion and osmosis PAG8
B3.2.3	explain how the partially-permeable cell membranes of plant cells and prokaryotic cells are related to diffusion, osmosis and active transport
B3.2.4	explain how water and mineral ions are taken up by plants, relating the structure of the root hair cells to their function
B3.2.5	a) explain how the structure of the xylem and phloem are adapted to their functions in the plant b) describe how to use a light microscope to observe the structure of the xylem and phloem PAG1
B3.2.6	a) describe the processes of transpiration and translocation, including the structure and function of the stomata b) describe how to use a light microscope to observe the structure of stomata PAG1 c) describe how to use a simple potometer 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 temperature b)) describe practical investigations into the effect of environmental factors on the rate of water PAG6
B3.2.8	in the context of water uptake by plants: a) use simple compound measures such as rate M1a, M1c b) carry out rate calculations M1a, M1c c) plot, draw and interpret appropriate graphs M4a, M4b, M4c, M4d d) calculate percentage gain and loss of mass M1c

Stomata on epidermis of rose leaf.

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General approaches:

This section continues to be quite difficult for the learners as many of the concepts lie within plant science and the structure of plants but it does allow a great deal of opportunity to use practical work to develop understanding.

Practical investigation can be used to engage learners in their learning but this can be mixed with a number of interesting images and short video clips. Learners can continue to conduct their own research and plan their own investigations.

Practical tasks involve but are not limited to the effect of substrate concentration on osmosis; use of light microscopes in identifying vascular tissue in roots and stems of dicotyledeonous plants; investigating water uptake by a plant and observation of root hair cells.

The topic allows a lot of scope for developing the learners' skills in carrying out mathematical processes and the presentation of data in graphical form.

This section has a number of key terms that learners are unlikely to have heard before such as xylem and phloem. It is recommended that learning is developed through a range of short, fun activities. Many of the practical investigation elements in the course allow for stretch and challenge opportunities as learners can be pushed beyond the lesson material and be asked to produce limitations, improvements and safety considerations about the investigation. This will not only reinforce the learners' learning but allow the learners to push their understanding.

Common misconceptions or difficulties learners may have:

Learners often believe that plants take in 'food' through their roots. This may be due to horticultural companies advertising fertilisers as 'plant food'. Another term used by learners is that plants 'eat'. Plants clearly do not 'eat' but learners should be made aware that humans can give plants fertilisers and the minerals found in fertilisers are used by the plant to grow. Plants can however meet their demands by absorption of those minerals directly from the soil.

When learners have studied potometers it is a common misconception that they think potometers are used to measure transpiration. An emphasis should be made during teaching to highlight the different ways in which water is used by a plant, for example in maintaining turgidity of cells and for photosysnthesis and not only for transpiration.

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 able to investigate transport across membranes to cover PAG 8, Transport in and out of cells, along with preparing slides to cover PAG 4 Microscopy, and investigate water uptake by a plant PAG 6 Physiology, responses and respiration in appendix 5h.

Learners may find it beneficial to make links back to the use of microscope in B1.1.1b but also the approach to practical investigations and representation of data in graphical form such as studied in B2.5.1 and B2.5.3.

There are also future links to B5.1.1 and B5.1.2 that provide links back to the transport of substances in B3.2.2 and B3.2.2.

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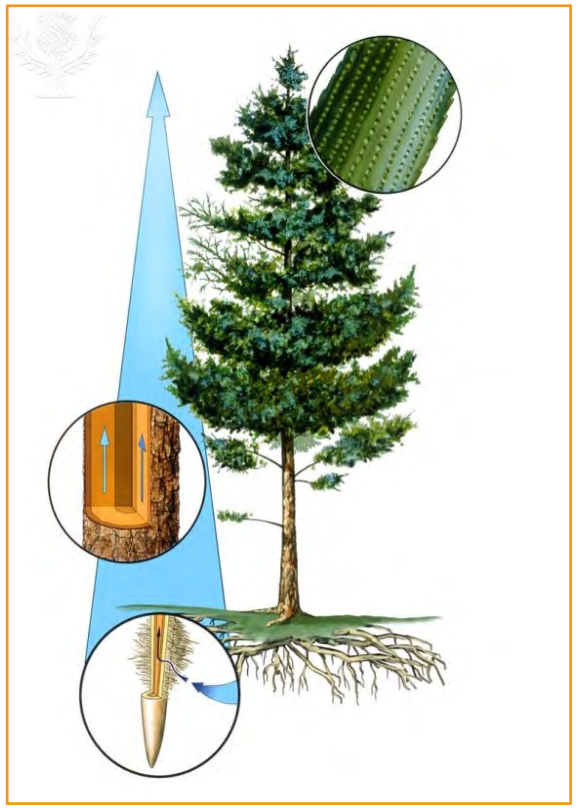
Approaches to teaching the content

This topic also lends itself to a wide range of practical activities. These include both practical investigations into osmosis and microscopy.

There are many activities that can be used to support learning particularly the use of microscopes or photomicrographs. Some of the topics and practical activities can be challenging for some learners. However the use of the practical tasks and microsope images can be used to generate interest in the topic before introducing more scientific content.

A range of activities will allows learners to develop both investigative and mathematical skills in particular the calculation of magnification and scale.



Tree water transport.

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Activity 1

Transport across membranes

BBC
http://www.bbc.co.uk/education/guides/zc9tyrd/video

http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_gateway/green_world/plantmineralsrev3.shtml

http://www.bbc.co.uk/education/guides/zc9tyrd/revision/1

The first two resources by the BBC are short video clips showing the process of membrane transport.

The third is a revision resource allowing learners to make notes on the topic and test their learning using the online quiz.

Activity 2

Blackcurrent potatoes

Nuffield foundation
http://www.nuffieldfoundation.org/practical-biology/investigating-effect-concentration-blackcurrant-squash-osmosis-chipped-potatoes

Nuffield foundation provides teachers with a comprehensive resource 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 practical relates to PAG 8.

Activity 3

Vascular tissues in plants

McGraw Hill
http://highered.mheducation.com/sites/9834092339/student_view0/chapter38/animation__-_phloem_loading.html

A short 3 minute animation is available to explain how the xylem and phloem are able to move water and dissolved substances from source to sink within the plant.

passmyexams
http://www.passmyexams.co.uk/GCSE/biology/transport-in-plants.html

The second resources gives detailed notes and a comparison table to allow learners to consolidate their learning on these vascular tissues.

Activity 4

Virtual microscope

University of Delaware
http://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 5

Stomata

BBC
http://www.bbc.co.uk/education/clips/zf3xn39

Timothy Walker with the BBC provides a short video clip showing the action of stomata and the regulation of carbon dioxide.

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Activity 6

Transpiration in plants

Passmyexams
http://www.passmyexams.co.uk/GCSE/biology/transpiration-stream.html

http://www.bbc.co.uk/bitesize/higher/biology/genetics_adaptation/maintaining_water_balance/revision/3/

Passmyexams provides an animation giving a detailed explanation of the process of transpiration. This could be used with the resource from the BBC.
Giving a visual representation of the process of transpiration, learners could use both resources to produce a poster summarising the process.

Activity 7

Passage of sucrose

Saps
http://www.saps.org.uk/secondary/themes/1274

Saps provide a short animation 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.

Activity 8

Measuring water uptake

http://www.nuffieldfoundation.org/practical-biology/measuring-rate-water-uptake-plant-shoot-using-potometer

This resource 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. This can be used to address a number of the mathematical learning objectives.

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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 proteins b) describe the use of qualitative tests for biological molecules PAG2
B3.3.2	describe photosynthetic organisms as the main producers of food and therefore biomass for life on Earth
B3.3.3	describe some of the substances transported into organisms in terms of the requirements of those organisms, including dissolved food molecules
B3.3.4	describe different levels of organisation in an ecosystem from individual organisms to the whole ecosystem
B3.3.5	explain the importance of interdependence and competition in a community
B3.3.6	describe the differences between the trophic levels of organisms within an ecosystem
B3.3.7	describe pyramids of biomass and explain, with examples, how biomass is lost between the different trophic levels
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 M1c
B3.3.9	recall that many different substances cycle through the abiotic and biotic components of an ecosystem, including carbon and water
B3.3.10	explain the importance of the carbon cycle and the water cycle to living organisms
B3.3.11	explain the role of microorganisms in the cycling of substances through an ecosystem
B3.3.12	calculate the percentage of mass, in the context of the use and cycling of substances in ecosystems M1c
B3.3.13	explain the effect of factors such as temperature and water content on rate of decomposition in aerobic and anaerobic environments
B3.3.14	calculate rate changes in the decay of biological material M1c

Photosynthetic organisms as the main producers of food and therefore biomass for life on Earth.

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General approaches:

There are a number of distinct topics in 'How are organisms in an ecosystem interdependent?' that need to be understood but it is important to highlight to the learners how topics can overlap, for example B3.3.1a, B3.3.2 and B3.3.3. This involves learners developing skills in analysis and interpretation. This can be done effectively by allowing learners an opportunity to produce spider diagrams showing how topics link with each other that can then be discussed with the rest of the class. However, it is still important that learners have a clear understanding of each subtopic as they can be assessed as a standalone question.

Common misconceptions or difficulties learners may have:

Learners often fail to understand that molecules such as carbohydrates and proteins are polymers of smaller molecules. To allow learners to visualise the anabolic formation of polymers learners could use cut and stick activities to build their own molecules. For more able groups learners could be taught the molecular structures of animo acids and the condensation reactions involved in polypeptides.

When studying trophic levels involved in an ecosystem learners often expect the producer trophic level to be the largest and the subsequent levels to get progressively smaller. Teachers may find it useful to introduce the topic with a unconventional pyramid of numbers before moving on to explain the pyramid on biomass.

Learners may find calculating the efficiency of biomass transfer between trophic levels difficult. This learning objective will allow learners to address the mathematical element M1c but it may be useful to allow the learners to attempt some simplified examples before using more complex examples.

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 able to investigate the contents of food to cover PAG 2, testing biological molecules, in appendix 5h.

Again it can be of benefit to the learners to make links between polypeptides in B1.1.6 and protein synthesis in B1.1.9, but also 3.1.3 when studying synthesis and breakdown of protein and the associated food tests.

The decay of biological material.

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Approaches to teaching the content

This topic also lends itself to learning through practical investigation, particularly the qualitative tests for biological molecules.

There are many activities that allow group work to support learning particularly the activity 'Investigating ecosystems' as learners follow instructions to develop an imaginary ecosystem.

A range of activities will allow learners to develop both investigative and mathematical skills in particular calculating rates and percentage change that meet learning objective M1c.

The trophic levels of organisms within an ecosystem.

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Activity 1

Testing food groups

Brilliant Biology Student
http://brilliantbiologystudent.weebly.com/iodine-test-for-starch.html

http://brilliantbiologystudent.weebly.com/biuret-test-for-protein.html

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.

http://brilliantbiologystudent.weebly.com/benedicts-test-for-reducing-sugars.html

Suitable food powders are:
Starch test – Maize starch
Protein test – Whey protein
Reducing sugar test – Glucose monohydrate
Non reducing sugar test - sucrose

http://brilliantbiologystudent.weebly.com/benedicts-test-for-non-reducing-sugars.html

After learners have tried each food test they can be given unknown samples of 'sports drink' to identify the ingredients.

Activity 2

Emulsion test

Brilliant Biology Student
http://brilliantbiologystudent.weebly.com/ethanol-emulsion-test-for-lipids.html

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.

It is strongly recommended that the emulsion test is not carried out with the reducing/non-reducing sugar test due to the flammability of the alcohol.

Activity 3

Investigating ecosystems

National geographic
http://education.nationalgeographic.co.uk/activity/marine-ecosystem-invention/

National geographic provide a comprehensive lesson plan and resources to allow learners to produce an imaginary marine ecosystem that includes fictitious organisms. It allows them to discuss the adaptive, trophic, and symbiotic relationships between the biotic and abiotic factors in the ecosystem.

Activity 4

Investigating trophic levels

MHHE
http://www.mhhe.com/biosci/genbio/virtual_labs/BL_02/BL_02.html

The resource allows learners to build their own pyramid of numbers or pyramid of energy in a variety of ecosystems. This will allow learners to build an appreciation of the carrying capacity of a variety of environments.

Activity 5

Biomass transfer

BBC
http://www.bbc.co.uk/education/guides/z2m39j6/revision/6

Learners can consolidate their learning on trophic levels before looking at energy transfer between the levels and taking the test to assess their level of understanding.

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Activity 6

Abiotic or biotic?

Kubbu
http://www.kubbu.com/student/?i=1&a=45900_abiotic_vs_biotic

This online sorting game allows learners to categorise abiotic and biotic factors and gain instant feedback to the score card on the side of the page. This could be used as a 5 minute starter or plenary activity.

Activity 7

Carbon cycle

Windows to the Universe
https://www.windows2universe.org/earth/climate/carbon_cycle.html

The resource allows learners a tour of the carbon cycle and has a few short true/false assessments to test them along the way. This would make an ideal homework or lesson plenary.

Rain forest alliance
http://www.rainforest-alliance.org/curriculum/climate/activity2

The rainforest alliance have produced a comprehensive main lesson activity on the carbon cycle with a full introduction and resources to conduct either one or two 50 minute lessons.

Activity 8

Water cycle

MET Office
http://www.metoffice.gov.uk/learning/weather-for-kids/water-cycle

Using the resource by the MET office, learners can read about and watch a short video clip about the water cycle and then use these resources to produce their own diagrammatic representation of the process.

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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
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 area M2d PAG3
B3.4.3	in the context of data related to organisms within a population: a) calculate arithmetic means M2b, M2f b) use fractions and percentages M1c c) plot and draw appropriate graphs selecting appropriate scales for the axes M4a, M4c d) extract and interpret information from charts, graphs and tables M2c, M4e

An abundance of organisms in an ecosystem.

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General approaches:

This section continues to be quite difficult for learners as they are only likely to have a superficial knowledge of the topic and much of it may have been influenced by media coverage.

This section does however allow for a variety of field work that can be used to develop understanding and stretch the learners' learning. It also allows for a number of the mathematical learning objectives to be addressed including calculating means, plotting graphs and extracting data from charts by using the data collected by the learners.

Common misconceptions or difficulties learners may have:

Learners may have a problem categorising abiotic and biotic factors affecting communities particularly when it comes to categorising factors such as disease causing organisms and environmental stresses.

Learners are likely to really enjoy the sampling investigations included in this topic but as a result may become complacent in their approach. It is important to use the enthusiasm of the learners to promote their learning.

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 able to sample the biodiversity of an ecosystem to cover PAG 3 Sampling techniques, in appendix 5h.

The recording and interpretation of data collected throughout this subtopic may have links to the recording of data in B2.5.3 and can be used as a reference to support learners' learning.

Student using a quadrat.

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Approaches to teaching the content

This section lends itself well to learning new skills, from outdoor practical activities involving learners using quadrats and pitfall traps to running full investigation involving species distribution and abundance, and the factors affecting population size.

Field investigations can be used to enhance the learners' team working and organisation skills along with their mathematical and analysis skills. Learners can run multiple mini investigations or do one large investigation encompassing a number of the factors effecting population size.

Theory can be built upon the findings of the investigation and the effect of abiotic and biotic factors can be discussed amongst the group.

Pitfall trap for monitoring arthropod populations.

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Activity 1

Abiotic or Biotic?

YouTube
https://www.youtube.com/watch?v=MdlwPtKg-VI

This 5 minute video clip gives an overview of the interactions of Abiotic and Biotic factors and their effect on ecosystems.

KUBBU
http://www.kubbu.com/student/?i=1&a=45900_abiotic_vs_biotic

Learners can then have a go at the second resource which is a game allowing the learners to sort a variety of factors into either Abiotic or Biotic and get scores along the way.

Activity 2

Basics of Abiotic and biotic factors

WGBH
http://www.pbslearningmedia.org/asset/lsps07_int_ecosystem/

The short game could be a homework or starter activity for lower ability learners. The game requies then to search an environment.

Activity 3

Sampling techniques

BBC
hhttp://www.bbc.co.uk/bitesize/standard/biology/biosphere/investigating_an_ecosystem/revision/2/

BBC provide a revision resource that allows learners to identify abiotic and biotic factors that effect an ecosystem along with sampling techniques. There are also self assessment questions that allows learners to test their understanding.

Activity 4

Practical sampling

Nuffield foundation
http://www.nuffieldfoundation.org/practical-biology/biodiversity-your-backyard

Nuffield foundation provide a detailed schedule for learners to undertake quadrat sampling. This resource can then be used to plot data and draw conclusions from it. This can address M2b, M2f, M4a, M4c, M2c and M4e.

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