

GCSE (9–1)

Transition Guide

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

J257

For first teaching in 2016

KS3–KS4 focus
Interdependence

Version 1

Can also be
used for teaching:

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



GCSE (9–1)

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

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

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

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

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



'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 (2017 for AS Level qualifications).'

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Key Stage 3 Content

Interactions and interdependencies relationships in an ecosystem

- the interdependence of organisms in an ecosystem, including food webs and insect pollinated crops
- the importance of plant reproduction through insect pollination in human food security
- how organisms affect, and are affected by, their environment, including the accumulation of toxic materials.



Key Stage 4 Content

- B3.3.2 describe photosynthetic organisms as the main producers of food and therefore biomass for life on Earth
- 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 (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)
- 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
- B3.3.13 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)

Comment

Differences:

This topic displays a fair few differences between the Key Stage 3 and Key Stage 4 content. At Key Stage 3, learners learn about food chains and food webs and are aware that organisms affect one another. They should be able to use these models effectively to describe feeding relationships in ecosystems. They also know, in relation to the photosynthesis topic, that sunlight is the source of energy for all living organisms and that producers use this to produce their own food in the form of organic molecules. This is a concept they are expected to retain for Key Stage 4 and build upon.

Learners should be able to describe factors that affect the number of organisms in an ecosystem and specifically explain the effect of chemicals such as pesticides. Learners will probably be familiar with pyramids of numbers and at Key Stage 4 they will learn about pyramids of biomass and be able to calculate the efficiency of transfers between the trophic levels. Learners will learn the reasons why biomass decreases as the trophic levels increase.

From Key Stage 3 Chemistry, learners should have an understanding of the carbon cycle and be able to list the ways that human activity causes a production in carbon dioxide and how this impacts the environment. At Key Stage 4 this is expanded on and learners will be able to give specific details on different processes that are involved in the carbon cycle such as decomposition. Learners will learn about decomposition in detail and be able to explain how the rate of decay can vary. There are a few mathematical ideas linked in with decomposition and learners will have to calculate the percentage of mass and rate changes in the decay of biological material.

Learners may be familiar with aspects of the water cycle from Key Stage 3 Geography, although transferring knowledge between subjects is something they find challenging. The water cycle is a new concept for Biology and learners will need to be able to discuss the various ways that water is cycled through an ecosystem.

Challenges learners face when tackling this topic at GCSE:

There are a large amount of key words that learners will encounter in this topic, some of these will be unfamiliar, others will be words learners have heard of but they will need to learn how to explain what the words mean and be able to use them effectively. Quite often, learners are able to list key words, especially with the cycles, but they are not always able to say what they mean and link them to the cycles correctly. Learners often get muddled up between the processes and how they are involved e.g. whether they add or remove carbon dioxide from the atmosphere.

It is important to encourage learners to link processes together, rather than seeing them as standalone ideas. One idea to do this is to have the key words written on sheets of paper (these could be offered by learners), a class discussion would follow for ordering the statements and learners could hold the words up and be instructed to move around. This allows learners to really consider how words fit together and link them more effectively. It enables learners not only to understand the processes individually but incorporate them together, as they are in the cycles. This activity would work well for the carbon and water cycles. Following the discussion, learners could then write an extended answer (this could be based on an exam question) and the resulting piece of work is likely to be of much higher quality in terms of understanding and developing ideas.

Learners will be required to make links with other topic areas to fully understand decomposition and will have to use the knowledge learnt from enzymes and respiration. Lower ability learners will find this difficult and it will be important to make these ideas clear to them. Learners often find the pyramids of biomass a difficult concept to grasp, especially if they have previously learnt about pyramids of numbers. It is a good idea to introduce the idea of biomass fully before drawing pyramids and discussing why biomass decreases through the food chain.

Activities

Water cycle and weathering: Science resources

Resources: http://www.science-resources.co.uk/KS3/Chemistry/Water_Cycle/water_cycle_and_weathering.htm#sthash.tvTmDsuK.dpbs

A short animation with notes, which goes through some key terms and processes to do with the water cycle. This could be used to introduce this concept or recap key phrases.

KS3 Water Cycle: Metlink

Resources: <http://www.metlink.org/secondary/key-stage-3/ks3-water-cycle/>
http://www.metlink.org/wp-content/uploads/2015/02/water_cycle21.swf

This link opens up a selection of activities that could be used with a class, including a wordsearch and practical tasks. There is a good animation "an animation of the hydrological cycle", which goes through key processes in the cycle.

The Carbon Cycle Game: Windows2universe

Resources: https://www.windows2universe.org/earth/climate/carbon_cycle.html

This is a basic animation which goes through the key ways that carbon is cycled, by going through the journey of a carbon atom. Key pieces of information pop up along the journey to explain key processes, as well as some quiz questions.

Food Chains with Tim & Moby: Brain Pop UK

Resources: <http://www.brainpop.co.uk/science/variationclassificationandevolution/foodchains/>

This is a short cartoon about key parts of food chains and key words used to describe different organisms involved. There is a quiz at the end of the cartoon and an opportunity to read further.

All About Carbon Dioxide: US EPA

Resources: <http://www3.epa.gov/climatechange/kids/basics/today/carbon-dioxide.html>

There is a small bit of text to introduce carbon dioxide and the video clip talks through the various aspects of the carbon cycle, with an emphasis on the environmental impact.

Checkpoint task

The idea of checkpoint task 1 is to identify what learners remember about interpreting food webs. The work at GCSE will build on some of these concepts, so it is important that the foundations are there. Some questions in examinations may rely on interpreting such diagrams and then linking these to calculations or discussing how energy is transferred in the food web, in terms of biomass. Some of the questions require learners to give more extended answers and critically consider aspects of the food web. Others are more straightforward and will allow you to assess whether the basic aspects of interdependence from Key Stage 3 need to be covered before moving onto the GCSE content.

The second checkpoint task allows learners to carefully think about a selection of key words and decide which is the odd one out. They should consider each key word in the row and discuss what this means before deciding which does not fit with the other two. All of the words link to the GCSE content in some way. Learners may know the words from the other Sciences and not know them as specifically linked to interdependence, but it will assess their understanding and allow you to decide how to introduce them into the GCSE lessons.

Teacher preparation

Strengthening Teaching and Learning of Interdependence, Secondary Teaching Strategy
<https://www.stem.org.uk/elibrary/resource/29861/strengthening-teaching-and-learning-of-interdependence-secondary-national>

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

Checkpoint Task:

<http://www.ocr.org.uk/Images/289147-interdependence-checkpoint-task.doc>

Activities

The Ocean in Action: The Carbon Cycle: Science Learning Hub – The University of Waikato

<http://sciencelearn.org.nz/Contexts/The-Ocean-in-Action/Sci-Media/Interactive/Carbon-cycle>

This interactive diagram allows the processes and stores of the carbon cycle to be explored. There are some video links which provide further information.

Jack and the Beanstalk: Planet SciCast

<http://scicast.org.uk/films/2011/06/jack-and-the-beanstalk.html>

This video clip uses the story of Jack and the Beanstalk to talk about some key phrases that link to food chains and interdependence. As well as recapping some Key Stage 3 ideas, there are quite a few unfamiliar new terms mentioned here.

Energy Loss in Food Chains Quiz: Education Quizzes

<http://www.educationquizzes.com/gcse/biology/unit-1-energy-loss-in-food-chains/>

There is a small summary of key information at the top of the page and a multiple choice quiz following from this. It considers key ideas about the losses in biomass and parts of the food chain.

Interdependence: Energy Transfer

<https://19105.stem.org.uk/energyFlows/index.html>

There are a selection of tabs on this link to follow, including one that looks at pyramids of biomass. On the teacher view section there are various questions that could be used when teaching, including challenge questions.

Study Jams: Ecosystem: Scholastic

<http://studyjams.scholastic.com/studyjams/jams/science/index.htm>

An example of a link: the carbon cycle

<http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/carbon-cycle.htm>

There are several activities that can be found on here. The 'ecosystem' selection includes videos and quizzes on food chains, the carbon cycle, food webs etc. Several key ideas are introduced and key words are explained.

Decay Videos: YouTube

Decay Videos – Search YouTube e.g. fruit bowl, apple, rat

<https://www.youtube.com/watch?v=c0En-BVbGc>

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

<https://www.youtube.com/watch?v=2OJ73BJheBA>

These are good to stimulate discussion of what is happening to the 'stuff'. Learners could guess which fruit in the bowl will rot first and the videos often generate a lot of ideas and discussion. The conditions for decay and organisms involved can be discussed after.

Ordering the Words

Select an exam question/cycle. Ask learners to name key words and hold at the front on pieces of paper. As a class, discuss the ordering of the words and move them around. This is a good literacy task to help develop extended answers.

Activities

The Carbon Cycle: McGraw Hill

http://www.mhhe.com/biosci/bio_animations/MH13_CarbonCycle_Web/

This is a detailed animation about the carbon cycle. It discusses some A Level ideas which could be used to extend some of the concepts learnt about at Key Stage 4.

The Carbon Cycle

http://www.mhhe.com/biosci/genbio/tlw3/eBridge/Chp29/animations/ch29/1_carbon_cycle.swf

This animation includes numbers for the different processes and could be used as a basis of some calculation questions and data interpretation of the carbon cycle.

Interactive Labs: Ecology Lab; Annenberg Learner: The Habitable Planet

<https://www.learner.org/courses/envsci/interactives/ecology/>

This animation includes numbers for the different processes and could be used as a basis of some calculation questions and data interpretation of the carbon cycle.

Ecosystems Video: Annenberg Learner: The Habitable Planet

<https://www.learner.org/courses/envsci/unit/text.php?unit=4&secNum=1>

The video looks at the interdependence in a rainforest, the role of ecologists and some of the changes that ecosystems face.

Mapping KS3 to KS4

Possible Teaching
Activities (KS3 focus)

Checkpoint task

Possible Teaching
Activities (KS4 focus)Possible Extension
Activities (KS5 focus)Resources, links
and support

Resources, links and support

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