

GCSE (9–1)

Transition Guide

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

J257

For first teaching in 2016

KS3–KS4 focus
Natural Selection

Version 1



GCSE (9–1)

TWENTY FIRST CENTURY SCIENCE BIOLOGY B

Key Stage 4 to 5 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.

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Key Stage 3 Content

Genetics and evolution

- differences between species
- the variation between individuals within a species being continuous and discontinuous, to include measurement and graphical representation of variation
- the variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection
- changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully to reproduce, which in turn may lead to extinction



Key Stage 4 Content

B6.1 How was the theory of natural selection developed?

- B6.1.1 state that there is usually extensive genetic variation within a population of a species
- B6.1.2 recall that genetic variants arise from mutations, and that most have no effect on the phenotype, some influence phenotype and a very few determine phenotype
- B6.1.3 explain how evolution occurs through natural selection of variants that give rise to phenotypes better suited to their environment
- B6.1.4 explain the importance of competition in a community, with regard to natural selection
- B6.1.5 describe evolution as a change in the inherited characteristics of a population over a number of generations through a process of natural selection which may result in the formation of a new species
- B6.1.6 explain the impact of the selective breeding of food plants and domesticated animals
- B6.1.7 describe how fossils provide evidence for evolution
- B6.1.8 describe the work of Darwin and Wallace in the development of the theory of evolution by natural selection
- B6.1.9 describe modern examples of evidence for evolution including antibiotic resistance in bacteria
- B6.1.10 explain the impact of these ideas on modern biology and society

Comment

Key Stage 3 gives learners a great platform of scientific knowledge that they can build on in Key Stage 4. At Key Stage 3, learners will have studied many of the fundamental aspects of natural selection. These include how individuals in a population are different and how living organisms show adaptations to their environment. They will also be aware that evolution is as a result of the process of natural selection and takes into account biodiversity and how organisms are all related to varying degrees.

Learners should be able to recall basic terms used in describing the process of natural selection. These are terms they are expected to retain for Key Stage 4 and build upon to including applying the terms to unfamiliar examples.

From Key Stage 3, learners should be able to explain basic ideas of variation and how this variation can lead to natural selection.

They will be able to state that variation between individuals means that some organisms compete more successfully. They should also be able to identify a particular trait that gives a group of individuals a selective advantage. Learners should be able to state that some changes in the environment may leave individuals less well adapted which in turn may lead to extinction. However they are unlikely to be familiar with key terminology such as 'selection pressure'.

At Key Stage 4, learners will begin to identify selection pressures along with favourable traits in an organism but will also be able to give specific details about selection pressures and why some traits are advantageous in some environments but not in others. They will begin to describe evolution as a change in the inherited characteristics of a population leading to the formation of a new species or 'speciation'.

Challenges learners face when tackling this topic at GCSE:

There are a large number of key words that learners will encounter in this topic. They will come across words that are unfamiliar and others that learners have heard of but they will need to learn how to explain what the words mean and be able to use them effectively. There are likely to be terms and concepts that learners sometimes use incorrectly such as 'as an organism evolves to its environment'. It is best to emphasise from the start that species evolve not individuals within a species.

Learners are likely to be enthusiastic about this topic but explain key concepts without key terminology. One way of supporting learners in this is to provide the learners with cards that have a single key word on them that learners must use to help them formulate their answers to the questions. For greater support, the cards could have the definitions on the the reverse.

This can be followed up with group work where 4-5 learners are posed a question or given an organism to identify different traits, selection pressures etc. that they answer using the cards before the work is swapped with a second group that tries to expand on their answers whilst making corrections.

This makes the learners use correct terminology whilst giving them pointers to develop a more complete answer. It also allows learners to develop understanding from their peers.

Learners often have good ideas of natural selection and evolution but describe it in the wrong way. Learners may state 'giraffes have grown longer necks so they can reach the tops of trees', 'polar bears have turned white so they are camouflaged' or 'animals evolve so they don't become extinct'.

Learners need to be aware that evolution is a consequence of natural selection and that natural selection is as a result of a population having differences, some of which give a selective advantage and others that do not.

It may be worth highlighting humans as an example. We have a variety of differences such as hair colour; so why hasn't one colour become dominant? Simply, there is no selective advantage to any particular hair colour over another.

Learners need to be able to recall the events that occur in all the different processes and be able to apply them to a range of different scenarios.

Learners may be assessed on this in the exam via one of the longer extended answer questions. Asking learners to identify the different traits as well as the selection pressure and then the potential consequence should allow learners to develop well structured answers.

Activities

Clippy Island: BBSRC

Resources: <http://www.bbsrc.ac.uk/engagement/schools/keystage3/natural-selection/>

This fantastic resource by BBSRC provides a resource pack, learner worksheet and teacher guidance to allow learners to develop an understanding of how organisms show variation and how that variation changes over time.

Darwin's finches: Discovering Galapagos.org

Resources: <http://www.discoveringgalapagos.org.uk/teacher-zone/ks3-resources/ks3-charles-darwin-natural-selection-lesson-plan/>

Learners can watch a video clip and use their fact file to develop an understanding of how natural selection results in the evolution of a species or its extinction.

Fossils in Evolution: BBC and Teaching Channel

Resources: http://www.bbc.co.uk/schools/gcsebitesize/science/ocr_gateway_pre_2011/environment/4_survival_of_fittest1.shtml

<https://www.teachingchannel.org/videos/teaching-natural-selection>

Learners are able to learn how fossil evidence can be used to support the theory of evolution using these key notes from the BBC along with the video clips that support the theory.

Checkpoint task

Task 1

The idea of Checkpoint task 1 is to assess if learners can use the information given to develop their understanding of natural selection. The work at GCSE will help the learners develop their understanding of these concepts further.

The style of examination questions at GCSE may require learners to apply their knowledge of natural selection in a similar way. There may be some simple recall questions such as a gap fill activity but this topic is more commonly assessed by asking the learners to give more extended answers and apply their knowledge to unfamiliar situations. The simple natural selection concepts such as those studied in Key Stage 3 need to be covered in detail before moving onto the GCSE content and the application for this knowledge.

Task 2

The second checkpoint task is more challenging as it requires the learners to carefully think about natural selection as well as predict outcomes. The learners could complete this task after a homework task looking at the behaviour of wolves. This task is designed to push the learners' knowledge and highlight those learners that may know the basic ideas of natural selection without being able to apply it to different situations. This can be a good guide to decide when and at what level to introduce the GCSE content to the lessons.

Checkpoint Task:

<http://www.ocr.org.uk/Images/308131-natural-selection-checkpoint-task.doc>

Activities

Speciation: SAPS/BBC

<http://www.saps.org.uk/secondary/teaching-resources/814-fairchild-speciation-and-evolution>

SAPS provides information along with a video clip by the BBC on speciation. The clip shows how Thomas Fairchild produced a new species of plant.

Natural selection: Royal institute of Science

<http://www.rigb.org/christmas-lectures/teaching-resources/2013-life-fantastic/natural-selection>

Learners can watch short video clips from the Royal Institute of Science Christmas lectures on natural selection. There are summary questions and discussion questions that can be used with the videos to direct the learners.

Playing with Evolution: University of Colorado

<https://phet.colorado.edu/en/simulation/natural-selection>

Learners can use the game to show how changes to the selection pressure results in different phenotypic traits becoming common. This could be ideal as a starter or homework task.

Evolution: BBC

http://www.bbc.co.uk/schools/gcsebitesize/science/ocr_gateway/understanding_environment/natural_selectionact.shtml

BBC provide an interactive activity that provides learners with a range of facts on natural selection before assessing them on the information. This activity would make an ideal plenary.

Activities

Selection in action: Nuffield foundation

<http://www.nuffieldfoundation.org/practical-biology/selection-action-%E2%80%93-banded-snails>

Nuffield Foundation provides a wealth of information and resources to allow learners to develop an understanding of variation within banded snails. The information would allow learners to conduct their own investigation or they could use the data provided to complete the task.

Selective breeding: Learn genetics

<http://learn.genetics.utah.edu/content/selection/artificial/>

Learners can use this animated presentation to develop an understanding of the similarities between natural selection and artificial selection.

Antibiotic resistance: Understanding evolution

http://evolution.berkeley.edu/evolibrary/article/0_0_0/bergstrom_03

Learners can analyse data and look at how the evolution of antibiotic resistant bacteria is being tackled.

Resources, links and support

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