

**GCSE (9–1)**  
*Transition Guide*

# **GATEWAY SCIENCE**

# **BIOLOGY A**

J247  
For first teaching in 2016

**KS3–KS4 focus**  
**Topic B5 Genes,  
inheritance and selection**

Version 1



**GCSE (9–1)*****GATEWAY SCIENCE BIOLOGY A***

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.

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## Key Stage 3 Content

- heredity as the process by which genetic information is transmitted from one generation to the next
- a simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model
- the concept of species and variation between individuals within a species being continuous or discontinuous
- the variation between species and between individuals of the same species meaning some organisms compete more successfully, which can drive natural selection
- changes in the environment which may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction



## Key Stage 4 Content

- B5.1a - explain the following terms: gamete, chromosome, gene, allele/variant, dominant, recessive, homozygous, heterozygous, genotype and phenotype
- B5.1b - describe the genome as the entire genetic material of an organism
- B5.1c - describe that the genome, and its interaction with the environment, influence the development of the phenotype of an organism
- B5.1d - recall that all variants arise from mutations, and that most have no effect on the phenotype, some influence phenotype and a very few determine phenotype
- B5.1e - describe how genetic variants may influence phenotype:
  - in coding DNA by altering the activity of a protein
  - in non-coding DNA by altering how genes are expressed
- B5.1f - explain some of the advantages and disadvantages of asexual and sexual reproduction in a range of organisms
- B5.1g - explain the terms haploid and diploid
- B5.1h - explain the role of meiotic cell division in halving the chromosome number to form gametes
- B5.1i - explain single gene inheritance
- B5.1j - predict the results of single gene crosses
- B5.1k - describe sex determination in humans using a genetic cross
- B5.1l - recall that most phenotypic features are the result of multiple genes rather than single gene inheritance
- B5.1m - describe the development of our understanding of genetics
- B5.2a - state that there is usually extensive genetic variation within a population of a species
- B5.2b - describe the impact of developments in biology on classification systems
- B5.2c - explain how evolution occurs through the natural selection of variants that have given rise to phenotypes best suited to their environment
- B5.2d - describe evolution as a change in the inherited characteristics of a population over time, through a process of natural selection, which may result in the formation of new species
- B5.2e - describe the evidence for evolution
- B5.2f - describe the work of Darwin and Wallace in the development of the theory of evolution by natural selection and explain the impact of these ideas on modern biology

## Comment

Learners should begin the GCSE course with a stable grounding of the concept of DNA as the material of heredity, its basic structure and where it is to be found within cells as well as some understanding about variation within species and between them. They should be able to apply what they have learned to the notion that some species are more adapted to their environments than others, the implications of this and the cause of this variation. Learners should be able to cite factors which are controlled solely through genetic means, those controlled by an individual's environment and those which are a mixture of the two. These may be simplistic in nature and will rarely go beyond physical traits such as hair colour. Learners are often eager and to discuss complexities here, for example, hair colour being influenced by the environment (bleaching from the sun) as well as through genetics. Care should be taken to avoid complicating things lest confusion reign.

The subject of inheritance is one which learners typically find interesting and will engage well with given the correct context. If delivered in the abstract, learners will struggle to engage with the topic and so it is best delivered in context. There are numerous opportunities to do this, for example through the use of celebrity families and the analysis of visual traits. Learners experience difficulty with several key aspects of the genetics and inheritance topics which can be the result of ingrained misconceptions (which many adults still hold). For example, the belief that each characteristic is controlled by a single gene that is either present or absent in an individual. This overly simplistic view can hamper learning. Specialist language poses a significant barrier to accessing the topic for some learners (e.g. allele, phenotype etc.) and these should be securely embedded otherwise learners will find themselves unable to access even the most simplistic of exam questions. Learners enjoy problem solving with respect to simple inheritance patterns and these are often the subject of extended examination questions. More able learners can be challenged significantly in this regard by providing an incomplete family phenotype/genotype and tasking them with finding the likely parent. TV shows such as *Jeremy Kyle* provide a popular vehicle for such tasks.

With respect to evolution, learners often struggle to grasp the notion that many slight mutations, compounding over generations leads to evolutionary change as opposed to single large scale events from one generation to the next. Furthermore that mutations in these species is not always positive or negative but can in fact be neutral. Their notions of mutation and mutagen are usually influenced by the media and this must be overcome. The concept of selection pressure is one that some learners fail to appreciate and the way that this drives evolutionary change. Some learners may be able to discuss negative mutations (e.g. genetic disorders) and the reason for their perpetuation in the gene pool and this should be encouraged. There are some excellent examples of the origins of genetic diseases stemming from single families which can be used (e.g. Huntington's disease).

## Activities

### Variation and inheritance cloze

Resources: <http://www.sunderlandschools.org/test4071/variation.pdf>

Learners should choose the most appropriate word from a selection to complete the blanks in the passage.

### Evolution game

Resources: <https://www.tes.com/teaching-resource/evolution-6110518>

Evolution game prompts learners to think about adaptations and survival and the ultimate result of survival and how this affects the development of the species.

### Evolution discussion circus

Resources: <https://www.tes.com/teaching-resource/evolution-6110518>

Cards are placed around the room, learners rotate and discuss the questions posed. Can be used to discuss ideas and dismiss misconceptions.

## Checkpoint task

Learners should work through these questions to assess their prior understanding of the KS3 content. The questions are scaffolded to assist them and of increasing difficulty.

This checkpoint task will hopefully separate out the learners that are 'just saying the right words' from those that truly understand the concept. As can be seen from the specification there are three assessment objectives being tested. AO1 demonstrating knowledge and understanding, AO2 apply knowledge and understanding and AO3 analysing information and ideas. Simple recall of a scientific fact is not sufficient and so students need to be introduced to the apply and analyse strands.

### Teacher preparation

Questions in this activity can be asked in the form of a worksheet or a visual display. If using a worksheet the question should be cut and pasted into an appropriate word processing package and printed. Alternatively the questions could be projected by PowerPoint – one question per slide. The answers can also be projected up for peer review/self marking.

Answers to the task sheets can be found on the teacher sheets.

### Checkpoint Task:

[www.ocr.org.uk/qualifications/Images/349136-genes-inheritance-and-selection-checkpoint-task.docx](http://www.ocr.org.uk/qualifications/Images/349136-genes-inheritance-and-selection-checkpoint-task.docx)

## Activities

### Harry potter genetics (worksheets and answers): NLM

<https://www.nlm.nih.gov/exhibition/harrypottersworld/education/lessonplans/science.html>

This activity applies science to the popular Harry Potter stories to understand key aspects of genetics and inheritance.

### Explaining diversity: Nuffield Foundation

<http://www.nuffieldfoundation.org/science-society/activities-evolution>

Learners are shown a number of pictures and then prompted to answer a series of questions related to "Can evolution explain all of the observable diversity". This can be run as a discussion if appropriate.

### Evolution Activity: Nuffield Foundation

<http://www.nuffieldfoundation.org/science-society/activities-evolution>

Learners are tasked with explaining examples and deciding whether they occurred as a result of natural selection.

## Activities

### Genetics – Extension activities

[http://serendip.brynmawr.edu/sci\\_edu/waldron/pdf/GeneticsProtocol.pdf](http://serendip.brynmawr.edu/sci_edu/waldron/pdf/GeneticsProtocol.pdf)

A worksheet aimed at extending the more able learner. They can read through the passages, adding answers as they go to develop their deeper understanding of inheritance and genetics.

### Genetics Puzzle

[http://sciencespot.net/Media/gen\\_reviewpuzzle.pdf](http://sciencespot.net/Media/gen_reviewpuzzle.pdf)

Learners complete the missing words to solve the joke at the end of the worksheet.

### Writing Scientific articles: Nuffield foundation

<http://www.nuffieldfoundation.org/science-society/activities-evolution>

Learners are given a guidance sheet on how to write scientifically and are tasked with writing an article on Evolution for GCSE learners. This can be extended into homework if required.

## Resources, links and support

Science Spotlight – Our termly update Science Spotlight provides useful information and helps to support our Science teaching community. Science Spotlight is designed to keep you up-to-date with Science here at OCR, as well as to share information, news and resources. Each issue is packed full with a series of exciting articles across the whole range of our Science qualifications: [www.ocr.org.uk/qualifications/by-subject/science/science-spotlight/](http://www.ocr.org.uk/qualifications/by-subject/science/science-spotlight/)

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To find out more about GCSE and A Level reform please visit: <http://www.ocr.org.uk/qualifications/gcse-and-a-level-reform>



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