

PROVISIONAL



TRANSITION GUIDE

Topic: You and your genes

February 2015

GCSE (9–1) Twenty
First Century Science
Suite, Biology B

KS3–KS4



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Welcome

Welcome to the KS3–KS4 transition guide for **GCSE (9–1) Twenty First Century Science Suite, Biology B.**

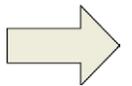
Key Stage 3 to 4 Transition Guides focus on how a particular topic is covered at the different key stages and provide information on:

- 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.

Go to topic comparison



Key Stage 3 Content

Key Stage 3 National Curriculum 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 differences between species
- Reproduction in humans, including: gametes and fertilisation
- Reproduction in plants including wind and insect pollination and fertilisation.



Key Stage 4 Content

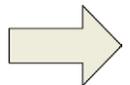
GCSE Content

- Explain the terms chromosome, gene, allele, variant, genotype and phenotype, gamete, homozygous, heterozygous, dominant and recessive
- How the genome, and its interaction with the environment, influence the development of the phenotype
- Most phenotypic features are the result of multiple, rather than single, genes
- **Recall that all genetic variants arise from mutations**
- Explain single gene inheritance, including dominant and recessive alleles and use of genetic diagrams
- Development of genetics including: **Mendel and the modern-day use of genome sequencing**
- Sex determination in humans
- Potential importance for medicine of our increasing understanding of the human genome...genetic testing of individuals
- Practical and ethical considerations, of using gene technology in modern agriculture and medicine.



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Explore the Guide



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Differences in the demand from Key Stage 3 to Key Stage 4

Students' knowledge of simple chromosome models, genes and DNA from Key Stage 3, is built on at Key Stage 4. All students should know that the genetic material is carried by DNA, and all the genetic material of an organism is known as its genome. Genes are sections of very long DNA molecules that make up chromosomes; each chromosome contains many genes. Chromosomes usually occur in pairs. The two chromosomes in a pair each carry the same gene in the same place (locus), and the two copies of the gene can be the same or different genetic variants or alleles.

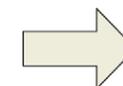
Students need to know that the genotype of an organism is the combination of alleles it has for each gene, and the phenotype is the observable characteristic that results from this combination. Most of an organism's characteristics result from the interaction between genetic instructions and environmental factors.

To know that heredity is the process by which genetic information is passed from one generation to the next is required at Key Stage 3. However, by Key Stage 4 students should be able to build on that knowledge. Learners should learn how to use genetic diagrams, such as family trees and Punnett squares, to model and predict outcomes of the inheritance of characteristics that are determined by a single gene. For example they could look at a characteristic of an individual (e.g. eye colour) and work out the possible genotype.

At Key Stage 3 students are expected to understand how the structure and function of gametes the basic process of fertilisation plays a role in sexual reproduction. At Key Stage 4 students should further understand that during sexual reproduction, each offspring inherits two alleles of each gene; one allele from each gamete. The two alleles can be the same (homozygous) or different (heterozygous). An allele can be dominant or recessive, and the combination of alleles determines what effect a gene has. They should be able to use this information to make predictions of the potential genotypes and phenotypes from various genetic crosses. A human individual's sex is determined by the inheritance of one gender gene, which is provided on the sex chromosome from each parent. How these genes work can be discussed, for example the development of testes being triggered by genes on the Y chromosome.

Students also need to understand DNA is a polymer made from four different nucleotides. Each nucleotide consists of a common sugar and phosphate group with one of four different bases attached to the sugar. The sequence of bases in the genes codes for specific proteins. This code in the gene enables the cells to make the specific protein using the amino acids found in the cytoplasm.

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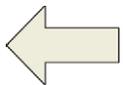
Challenges students face when tackling this topic at GCSE

Some students have difficulty with the key words and terminology within this unit. Using key words each lesson and slowly introducing them helps, avoiding an overload of terminology. For lower ability students anagrams and mnemonics can be a fun way of getting the students to practice the correct spelling of the words. To help with the understanding of the words you could use sentences or paragraphs with missing words to fill in, to give the students an understanding of their meaning. Mini white board activities work well with middle to higher ability students too.

Punnett squares can be another area of difficulty. There are multiple activities available for this but the only true way is for students to keep practicing them.

Students also generally struggle with the ethical aspect of genetic engineering. Some students may be shy of speaking out in a class discussion and so different ways to get students to engage may be necessary. Some students also find it difficult to understand that science does not always have defined answers, with many topics still unanswered. With ethical debates there is no right or wrong answer, a concept that some find difficult. Depending on the group, initial homework for students to formulate their own ideas, or discussions within small groups may assist in gradually building confidence.

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Possible Teaching Activities (KS3 focus)



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What is DNA?

Smart Learning

A short animation accompanied with notes to give students a clear foundation of DNA and key terms. It could be used by the teacher as an early introduction. It covers key terminology and illustrates the structure clearly.

Resources: <http://smart-learning.co.uk/teachers-club/science/free-video-dna/>



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Sexual vs Asexual Reproduction

Slideshare – Vicki Dunk

This provides a good introduction to the different types of reproduction and provides examples to better enable understanding. It may be a useful starting point either for making notes or for making summary/ comparison tables of the differences between sexual and asexual reproduction and could lead to discussion on the advantages and disadvantages of each.

Resources: http://www.slideshare.net/bsvab/asexual-vs-sexual-reproduction-mod?next_slideshow=1



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Fertilisation worksheet

9Aa2 Explore Science Worksheet

Useful worksheet as it helps students visualise the joining of DNA from each parent. It is also a useful recap of the genetic key words. This is a resource designed for the consolidation of learning key ideas which will need to have been introduced before attempting this worksheet.

Resources: http://www.sciwebhop.net/sci_web/science/ks3/worksheets/word/default.asp?topic=9A

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Checkpoint Tasks



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The checkpoint activities are a selection of sheets designed to check the key areas from Key Stage 3 before moving forward to Key Stage 4. The activities can be done individually or together.

Activity 1 is a true or false quiz about DNA.

www.ocr.org.uk/Images/202649-you-and-your-genes-checkpoint-task-activity.doc

It can either be asked to the class with each student having an individual sheet or by using mini white boards. As an extension task students could write their own questions and then test each other.

The answers to the questions are:

1. True
2. False
3. True
4. False
5. False
6. True
7. True
8. True

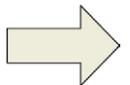
9. False

10. False

Activity 2 is a diagram of fertilisation.

For lower ability groups the questions should be answered on the sheet. For middle to higher ability students the questions in the boxes should be a starting point for further development of notes and questions. This development could be done individually or in pairs.

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Checkpoint Tasks

Activity 3 is a summary of sexual and asexual reproduction.

For lower ability groups the first letter of each word could be included (Activity 3a).

For middle ability groups the sheet works as it is (Activity 3b).

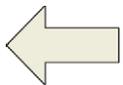
For higher ability groups the students could use the information on the sheet as a starting point for completing a table (as seen below) on the advantages and disadvantages of both types of reproduction.

Missing words:

One, genetic, clones, two, fusion, female, mixture, bacteria, cell, fertilisation, embryo, pollen, ovule, seed, wind.

	Asexual	Sexual
Advantages		
Disadvantages		

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DNA model

Syngenta

The website shows a useful and fun way of making a model. This can be used either as an introduction lesson or as a consolidation task. The link provides an easy to follow step-by-step guide. This task really enables students to understand the organisation of base pairs and how they must always be with their 'matching pair'. It also helps students to visualise the overall double helix structure.

Resources: http://www3.syngenta.com/country/uk/en/about/learning-zone/KS345/biology/Pages/Edible_DNA.aspx

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Mendelian Inheritance

Lab Center at DNALC

This site can provide appropriate background reading for students and contains many links to other useful websites. There are also a range of different activities such as making pedigrees that students can work through. There is a brief introduction given and then students have the ability to select from various different options. This could be teacher guided depending on the group and the type of tasks desired.

Resources: http://labcenter.dnalc.org/labs/mendeliangenetics/mendeliangenetics_d.html

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Also useful

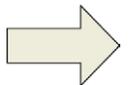
PBS Learning Media

This link provides a step-by-step animation of the work and findings of Mendel. Students could use it for initial learning, making notes from or revision summary.

<http://www.pbslearningmedia.org/resource/hew06.sci.life.gen.mendelinherit/mendels-laws-of-genetic-inheritance/>

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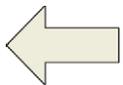
Punnett Squares and Pedigree Analysis

This provides a collection of practice questions. Some or all could be attempted. It allows students to try some examples of Punnett squares and pedigree charts. It is a useful consolidation tool, but not so useful for initial introduction to the ideas. There are a range of questions, some more suited to higher ability students or to stretch the middle ability. For lower ability groups it may be useful to select just a few key questions for practice.

Resources: http://fc.wellesley.k12.ma.us/~Ken_Bateman/FOV1-00018918/FOV1-000201B2/FOV1-000201B9/Punnett%20Square%20Practice%20Problems.pdf?Plugin=Loft

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Protein synthesis activities

TES.co.uk

This link enables pupils to illustrate the stages of protein synthesis (with added keywords) OR write the captions for the already illustrated comic strip. The 'Be able to' activity allows students to determine the amino acid sequence from the DNA sequence. It also includes some extension questions.

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Resources: <https://www.tes.co.uk/teaching-resource/Protein-synthesis-activities-6291262>



Genetic Engineering

Abpi – making insulin for humans

The website contains an animation, notes and questions on the step-by-step process of the genetic engineering of human insulin. The initial animation can be enlarged onto a full-screen and could be used by the teacher as an introduction (or a recap) of the topic of genetic engineering with a specific example. The interactive question could be used to check understanding or as revision by the student.

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Resources: http://www.abpischools.org.uk/page/modules/diabetes/diabetes6.cfm?coSiteNavigation_allTopic=1

DNA model

Getting the students to model the structure of DNA at Key Stage 4, enables the students to visualise the interaction of the sugar phosphate backbone, double helix and interaction of the bases. The model could be constructed by using 5 different colours of pipe cleaners (2 of the same colour). The 2 (same coloured) pipe cleaners can be used as the sugar phosphate backbone. The other 4 differently coloured pipe cleaners can be cut in half and used as base pairs, matching them up according to their complimentary pair.

Pipe cleaners are simple as they can be twisted together and so a model can be made very quickly and easily (and with relatively little mess).

It helps to consolidate the idea of base pairs as students need to assign colours to each base pair and then coordinate matching them up.

Once the ladder structure is made modelling clay can be used to attach the ladder to a small piece of thick card. Students can then twist the structure to form the double helix. Higher level students could then use sticky labels to annotate with explanations of coding for proteins and amino acids if desired by the teacher.

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Resources, links and support



**Additional
Topic 1**



**Additional
Topic 2**



**Additional
Topic 3**

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