

# IGCSE Co-ordinated Sciences 0654

## Unit 7: Genetics and evolution

### Recommended Prior Knowledge

An understanding of sexual reproduction will be helpful, and also knowledge of the adaptations of organisms to survive in their environment.

### Context

This Unit covers Topics B14 and B15. The whole of B15 is for extension candidates only. There are links with P17 Radioactivity (in causing mutations).

### Outline

This Unit follows on from work on sexual reproduction to a consideration of why organisms vary and how these variations are passed from parents to offspring. Students learn to handle simple genetics problems, using the correct terminology. They look very briefly at some of the issues associated with gene technology. Evolution by natural selection is then dealt with.

| Topic | Learning outcomes   | Suggested Teaching activities   | Learning resources  |
|-------|---|---|---|
| B14   | Appreciate that variation shown by organisms is partly inherited, and partly results from environmental influences.                     | Ask students to look around the class and list three variations between people that they think are probably inherited, and three variations that they believe are caused by the environment.  | <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G pages 126–128   |
|       | <b>Understand the differences between continuous and discontinuous variation and be able to describe one example of each in humans.</b> | Students can collect data about a characteristic that shows continuous variation in humans or plants (for example length of middle finger, length of leaf), record their data in tally charts, group their results and draw histograms. | <a href="http://www.bbc.co.uk/scotland/revision/biology">http://www.bbc.co.uk/scotland/revision/biology</a><br><i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 128 |
|       | Know that chromosomes are found in the nucleus and that genes are carried on chromosomes.   |   | <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G page 119  |

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|       | <p>Know that genes are 'coded instructions' for making proteins and that DNA is the chemical which stores the coded instructions.</p>   |   | <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G page 119</p>   |
|       | <p>Appreciate that gametes contain half the normal number of chromosomes and that fertilisation restores the normal number.</p>   | <p>Once pupils have absorbed this concept for humans (46 chromosomes in body cells, 23 in gametes), test their understanding by asking questions about other numbers of chromosomes in other organisms (either real or imaginary) – for example, if a species of fly has 20 chromosomes in its body cells, how many are there in its sperm?</p> |  |
|       | <p>Understand the meaning of the terms <i>dominant</i>, <i>recessive</i>, <i>phenotype</i>, <i>genotype</i>, <i>allele</i>, <i>homozygote</i>, <i>heterozygote</i> and <i>mutation</i>.</p>                               | <p>It is best to deal with these terms as they arise in the work on genetics. When they have all been covered, provide groups with a set of cards containing each of these terms, and a set of definitions – some correct and some not (so there will be more 'definitions' cards than 'terms' cards). Ask them to match them.</p>              | <p>Introduction to chromosomes:<br/> <a href="http://gslc.genetics.utah.edu">http://gslc.genetics.utah.edu</a><br/><br/>           Definitions:<br/> <a href="http://www.brooklyn.cuny.edu">http://www.brooklyn.cuny.edu</a></p> |
|       | <p><b>Appreciate that mutation may occur naturally but that the chances of mutation are increased by exposure to ionising radiation.</b></p>  |   | <p>Down's syndrome as an example of mutation:<br/> <a href="http://http://www.bbc.co.uk/scotland/revision/biology/inheritance">http://http://www.bbc.co.uk/scotland/revision/biology/inheritance</a></p>                         |
|       | <p><b>Understand that mutation in a body cell is likely to be harmless unless it leads to uncontrolled division of the cell (cancer), but that a mutation in a gamete-forming cell may be passed on to offspring.</b></p> |   | <p>Skin cancer incidence:<br/> <a href="http://info.cancerresearchuk.org">http://info.cancerresearchuk.org</a></p>   |
|       | <p>Be able to calculate and predict the results of a</p>  | <p>Students can carry out a simple experiment</p>   | <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones</p>  |

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|       | simple cross involving 1:1 or 3:1 ratios.   | 'breeding' beads. This can help them to understand what they are doing when they draw a genetic diagram.  | G pages 120–126   |
|       | Know one example of an inherited disease (e.g. cystic fibrosis, thalassaemia or sickle-cell anaemia).   | Assign an inherited disease to each group; ask them to research it and report back to the class.  | <p>The genetics of PKU:<br/> <a href="http://www.ess.sunysb.edu">http://www.ess.sunysb.edu</a></p> <p>Inheritance patterns in monogenic disorders:<br/> <a href="http://www.gig.org.uk/education2.htm">http://www.gig.org.uk/education2.htm</a></p> <p>Sickle cell disease:<br/> <a href="http://www.cuhk.edu.hk/med/paf/slides/hematolo/xv-19.htm">http://www.cuhk.edu.hk/med/paf/slides/hematolo/xv-19.htm</a></p> <p>Inheritance of sickle cell anaemia<br/> <a href="http://www.sicklecellsociety.org/education.htm">http://www.sicklecellsociety.org/education.htm</a></p> |
|       | Understand that modern cloning techniques, such as tissue culture, enable the production of plants with identical genes.  |   |   |
|       | Appreciate that this can have benefits for agriculture.   |   |   |
|       | <b>Appreciate that genetic engineering may involve the transfer of desirable genes into crop plants or animals farmed for food and be able to discuss some of the possible problems associated with Genetic engineering (details of the techniques or</b> | Collect articles from the press, and ask students to do the same; use information in them and also the students' biological knowledge to conduct a formal debate on a topic such as 'Should we produce food from GM organisms?' |   |

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| B15   | <p>processes involved are not required).</p> <p><b>Understand that organisms vary and that some variations give advantages over others in the 'struggle for existence'.</b></p> <p><b>Understand that variations caused by genes can be passed on to offspring and that genes conferring advantageous adaptations are more likely to be passed on than others.</b></p> <p><b>Know the term <i>natural selection</i>.</b></p> <p><b>Understand that, if the environment changes, different genes may become advantageous, so leading to a change in the characteristics of a population of organisms.</b></p> <p><b>Know one example of natural selection (e.g. peppered moths in Britain).</b></p> <p><b>Understand artificial selection, with reference to one type of crop plants or animal.</b></p> | <p>Groups could search on the internet for recent examples of selection taking place (for example horn length in bighorn sheep in the USA, leg length in cane toads in Australia) and report back to the class.</p> <p>A visit to a farm could be used to challenge students to suggest the desirable characteristics of a particular farmed animal or crop plant, and to consider how these characteristics could be maintained or improved from generation to generation.</p> | <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G pages 129–132</p> <p>Simulation of evolution.<br/><a href="http://home.pacbell.net">http://home.pacbell.net</a></p> <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G pages 131–132</p> <p>Antibiotic resistance as an example of selection<br/><a href="http://www.hpa.org.uk/">http://www.hpa.org.uk/</a></p> <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G pages 131–132</p> <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G page 133</p> |