Suggested teaching program

Chapter 1: Genetics

Time allocation: 5 weeks

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| Context and overview |
| In year 10, students explain the processes that underpin heredity by exploring the transmission of heritable characteristics from one generation to the next. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, and construct evidence-based arguments to communicate science ideas for specific purposes. |
| Syllabus outcomes addressed |
| Transmission of heritable characteristics from one generation to the next involves DNA and genes. (ACSSU184)  Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community [(ACSHE191)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSHE191)  Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries [(ACSHE192)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSHE192)  People use scientific knowledge to [evaluate](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=evaluate) whether they accept claims, explanations or predictions, and advances in science can affect people’s lives, including generating new career opportunities [(ACSHE194)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSHE194)  Values and needs of contemporary society can influence the focus of scientific [research](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=research) [(ACSHE230)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSHE230)  Formulate questions or hypotheses that can be investigated scientifically [(ACSIS198)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS198)  Plan, select and use appropriate [investigation](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=investigation) types, including field work and laboratory experimentation, to collect [reliable data](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=reliable+data); assess risk and address ethical issues associated with these methods [(ACSIS199)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS199)  Select and use appropriate equipment, including [digital technologies](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=digital+technologies), to collect and record [data](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=data) systematically and accurately [(ACSIS200)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS200)  [Analyse](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=analyse) patterns and trends in [data](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=data), including describing relationships between variables and identifying inconsistencies [(ACSIS203)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS203)  Use knowledge of scientific concepts to draw conclusions that are consistent with [evidence](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=evidence) [(ACSIS204)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS204)  [Evaluate](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=evaluate) conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the [data](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=data) [(ACSIS205)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS205)  Critically [analyse](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=analyse) the [validity](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=validity) of information in primary and secondary sources, and [evaluate](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=evaluate) the approaches used to solve problems [(ACSIS206)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS206)  Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate [scientific language](http://www.australiancurriculum.edu.au/glossary/popup?a=S&t=scientific+language), conventions and representations [(ACSIS208)](http://www.australiancurriculum.edu.au/curriculum/contentdescription/ACSIS208) |

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| Achievement standards |
| Students explain the processes that underpin heredity and evolution. Students analyse how the models and theories they use have developed over time and discuss the factors that prompted their review.  Students develop questions and hypotheses and independently design and improve appropriate methods of investigation, including field work and laboratory experimentation. They explain how they have considered reliability, safety, fairness and ethical actions in their methods and identify where digital technologies can be used to enhance the quality of data. When analysing data, selecting evidence and developing and justifying conclusions, they identify alternative explanations for findings and explain any sources of uncertainty. Students evaluate the validity and reliability of claims made in secondary sources with reference to currently held scientific views, the quality of the methodology and the evidence cited. They construct evidence-based arguments and select appropriate representations and text types to communicate science ideas for specific purposes. |

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| Student book section | AC Syllabus links | Suggested indicators of learning and understanding | Suggested teaching and learning activities | Resources |
| 1.1 Scientists review the research of other scientists  (pages 2–3) | Science Understanding  ACSSU184  Science as a human endeavour  ACSHE192,  ACSHE194  Science Inquiry Skills  ACSIS198, ACSIS199,  ACSIS200,  ACSIS204,  ACSIS205  ACSIS208 | By the end of this unit, students should be able to:  • describe how Mendel’s research on pea plants formed the basics of genetics today  • explain the principles of segregation and independent assortment  • describe the contributions of different scientists, including Rosalind Franklin to Watson and cricks research on DNA. | Experiment 1.1  Extracting DNA  Alternative DNA models  Work in groups to develop an alternative model to the double helix structure.  Children resemble their parents.  Watch this animation on Mendel’s experiments with pea plants. | Oxford Science 10 resources  • Extend your understanding 1.1, page 3  • Experiment 1.1, page 180 |
| Additional resources  Children resemble their parents  <http://www.dnaftb.org/1/animation.html> |
| 1.2 DNA consists of a sugar– phosphate backbone and four complementary nitrogen bases  (pages 4–5) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS199,  ACSIS204  ACSIS205  ACSIS208 | By the end of this unit, students should be able to:  • define DNA  • describe the structure of a nucleotide  • explain how nucleotides join to form a polynucleotide  • explain how complementary base pairs join  • explain the importance of DNA being able to make copies of itself and carry information. | Challenge 1.2:  Modelling the structure of DNA  Students construct a model of DNA that shows the complementary bases arranged in a double helix  Constructing a DNA ladder  Cut out and arrange nucleotides to form an antiparallel DNA ladder by complementary base pairing. | Oxford Science 10 resources  • Challenge 1.2, page 181  • Check your learning 1.2, page 5 |
| Additional resources    Constructing a DNA ladder  <https://www.biologycorner.com/worksheets/dna_model_nucleotides.html> |

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| 1.3 Chromosomes are DNA molecules carrying genetic information in the form of genes (pages 6–9) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS199,  ACSIS204  ACSIS205  ACSIS208 | By the end of this unit, students should be able to:  • define the terms DNA, gene and chromosome and explain the relationship between them  • interpret a human karyotype  • compare the nucleic acids DNA and RNA  • explain the role of DNA and RNA in processes of transcription and translation. | Skills lab 1.3  Making protein  Students can test their knowledge of complementary sequences for DNA and RNA  Karyotypes  Complete karyotypes for three different patients by matching homologous chromosomes. | Oxford Science 10 resources  • Check your learning, page 9  • Skills lab 1.3, page 182 |
| Additional resources  Karyotypes:  <http://www.biology.arizona.edu/human_bio/activities/karyotyping/karyotyping.html> |
| 1.4 Mitosis forms new somatic cells (pages 10–11) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS200,  ACSIS204,  ACSIS208 | By the end of this unit, students should be able to:  • describe the purpose of mitosis and cytokinesis  • distinguish between diploid and haploid  • describe the stages of mitosis  • explain how two diploid somatic cells are produced in mitosis  • explain how and why a cell undergoes apoptosis. | Skills lab 1.4  Cell division in action  Students identify cells at different stages of mitosis  The cell cycle game:  Match the different images with the descriptions of different stages of mitosis.  The handy model:  Use your hands to demonstrate the key stages of mitosis. | Oxford Science 10 resources  • Check your learning, page 11  • Skills lab 1.3, page 182 |
| Additional resources    The cell cycle game:  <http://www.rigb.org/education/games/human-body/the-cell-cycle>  The handy model:  Ideas can be taken from:  <https://www.jstor.org/stable/4448685?seq=1#page_scan_tab_contents> |
| 1.5 Meiosis forms gamete cells (pages 12–13) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS199,  ACSIS204  ACSIS205  ACSIS208 | By the end of this unit, students should be able to:  • describe the purpose of mitosis and cytokinesis  • describe the stages of meiosis I and II  • explain how four haploid gametes are produced in meiosis  • compare and contrast mitosis and meiosis. | Challenge 1.5:  Modelling meiosis  Students use pipe cleaners to model the different stages of meiosis. | Oxford Science 10 resources  • Challenge 1.5, page 183  • Check your learning, page 13 |
| 1.6 Alleles can produce dominant or recessive traits (pages 14–15) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS200,  ACSIS204,  ACSIS208 | By the end of this unit, students should be able to:  • describe alleles in relation to genes and chromosomes  • explain how combinations of dominant and recessive alleles produce different genotypes and phenotypes in individuals  • identify individuals as homozygous dominant, homozygous recessive, heterozygous, and carriers based on their genotype and phenotype  • predict genotypic and phenotypic ratios of a monohybrid cross using Punnett squares. | Experiment 1.6:  Zazzle genetics  Students create little creatures out of marshmallows and toothpicks to demonstrate how alleles determine a phenotype.  Genetic inheritance follows rules  Watch the animation to learn about monohybrid crosses. | Oxford Science 10 resources  • Check your learning, page 15  • Experiment 1.6, page 184  Additional resources  Genetic inheritance follows rules  <http://www.dnaftb.org/5/animation.html> |
| 1.7 Alleles for blood group traits co-dominate (pages 16–17) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS199,  ACSIS200,  ACSIS203, ACSIS204,  ACSIS208 | By the end of this unit, students should be able to:  • identify alleles such as A and B blood groups as being co-dominant  • describe the different genotypes and phenotypes of human blood groups  • predict genotypic and phenotypic ratios for blood groups using Punnett squares  • explain the function of different blood groups and rhesus markers and their importance. | Experiment 1.7:  Blood typing experiment  Students determine the inheritance of blood groups. | Oxford Science 10 resources  • Check your learning, page 17  • Experiment 1.7, page 185 |
| 1.8 Alleles on the sex chromosomes produce sex-linked traits (pages 18–21) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS199,  ACSIS200,  ACSIS204,  ACSIS208 | By the end of this unit, students should be able to:  • distinguish between autosomes and sex chromosomes  • identify a trait as one of the four patterns of inheritance (autosomal dominant, autosomal recessive, X-linked dominant, X-linked recessive)  • explain how and why sex-linked traits are inherited differently in males and females  • describe how different sex-linked traits such as haemophilia and red-green colour blindness are inherited  • predict genotypic and phenotypic ratios for sex-linked traits using Punnett squares. | Experiment 1.8:  Colour-blindness inheritance  Students examine the inheritance of X-linked traits. | Oxford Science 10 resources  • Check your learning, page 21  • Experiment 1.8, page 186 |
| 1.9 Inheritance of traits can be shown on pedigrees (pages 22–25) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS199,  ACSIS205  ACSIS204  ACSIS208 | By the end of this unit, students should be able to:  • identify the specific symbols used in constructing pedigrees  • analyse and interpret pedigrees to determine if a trait is dominant or recessive.  • analyse and interpret pedigrees to determine if a trait is autosomal or sex-linked  • analyse and interpret pedigrees to predict whether an individual will inherit a disease. | Interpreting pedigree charts  Analyse each pedigree and answer the questions to determine the pattern of inheritance. | Oxford Science 10 resources  • Check your learning, pages 24–25 |
| 1.10 Mutations are changes in the DNA sequence (pages 26–29) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS199,  ACSIS204  ACSIS208 | By the end of this unit, students should be able to:  • define mutagen and mutation  • identify different types of mutagens  • distinguish between genetic and chromosomal mutations  • explain how substitution mutations alter nucleotide and amino acid sequences of a protein  • explain how frameshift mutations alter nucleotide and amino acid sequences of a protein  • explain how non-disjunction occurs during meiosis to alter chromosomal numbers in gametes  • give examples of human syndromes caused by non-disjunction. | Skills lab 1.10:  Identifying mutations  Students analyse a normal an RNA sequence and a number of mutated variations to identify what mutations have occurred.  Mutations are changes in genetic information  Watch the animation on mutations. | Oxford Science 10 resources  • Check your learning, page 29  • Skills lab 1.10, page 187  Additional resources  Mutations are changes in genetic information  <http://www.dnaftb.org/27/animation.html> |
| 1.11 Genes can be tested (pages 30–31) | Science Understanding  ACSSU184  Science as a human endeavour  ACSHE192,  ACSHE194,  ACSHE230  Science Inquiry Skills  ACSIS204  ACSIS205  ACSIS208 | By the end of this unit, students should be able to:  • describe the purpose of genetic screening and testing  • give examples of diseases that are screened for and explain the need for these diseases to be tested  • outline the advantages and disadvantages of genetic screening and testing. | Understanding genetic testing in Australia  Information on the genetic screening and tests available in Australia as well as the ethical implications that need to be considered. | Oxford Science 10 resources  • Extend your understanding, page 31  Additional resources  Understanding genetic testing in Australia  <http://www.genetics.edu.au/Genetic-conditions-support-groups/Understanding-Genetic-Testing> |
| 1.12 Genes can be manipulated  (pages 32–33) | Science Understanding  ACSSU184  Science as a human endeavour  ACSHE192,  ACSHE194,  ACSHE230  Science Inquiry Skills  ACSIS204  ACSIS208 | By the end of this unit, students should be able to:  • define GMO and transgenic organisms  • give examples of different GMOs and explain the human need for these GMOs to be produced  • outline how a desirable gene can be inserted into a plant cell. | Create a transgenic organism:  Select different restriction enzymes to splice genes and plasmids to create transgenic organisms. | Oxford Science 10 resources  • Extend your understanding, page 33 |
| 1.13 Genetic engineering is used in medicine (pages 34–35) | Science Understanding  ACSSU184  Science as a human endeavour  ACSHE192,  ACSHE194,  ACSHE230  Science Inquiry Skills  ACSIS199,  ACSIS204,  ACSIS208 | By the end of this unit, students should be able to:  • define gene cloning and gene therapy  • outline the process of gene cloning.  • explain the purpose of using a microorganism to produce human proteins such as insulin.  • explain how gene therapy can be used for the treatment of medical conditions such as cystic fibrosis.  • describe the different types of stem cells and their uses in medicine.  • explain why the use of embryonic stem cells is controversial and the importance of producing induced pluripotent cells to medicine. | Challenge 1.13:  Edible genetic engineering  Students model how insulin can be genetically engineered.  Stem cell overview:  Covers stem cells – including types, their importance in medicine, how adult stem cells can become induced. | Oxford Science 10 resources  • Extend your understanding, page 35  • Challenge 1.13, page 188  Additional resources  Stem cell overview:  <https://stemcells.nih.gov/info/basics.htm> |
| **Review 1**  (pages 36–37) | Science Understanding  ACSSU184  Science Inquiry Skills  ACSIS208 | By the end of this unit, students should be able to:  • Define all Key Words listed on page 38  • Explain that ecosystem consist of interdependent abiotic and abiotic factors  • Explain how matter and energy flow through ecosystems  • Identify areas of personal strengths and weaknesses in their knowledge and understanding of the topic | **Revision activities**  • Students could play celebrity heads with the Key Words list  • Students can make dominoes with Key Words on one end and definitions/diagrams/examples on the other end  • Students can create mind maps, Venn diagrams or other graphic organisers to summarise the key concepts of this chapter  • Peer teaching: students can work in groups to reteach the content of the unit to the class for the purpose of revision. Each group could be allocated a double-page to summarise | **Oxford Science 10 resources**  • Review questions, pages 36–37  • Research topics, page 37  • Key Words list, page 38 |
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