# Sample Unit: Biology – Year 12

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***Sample for implementation for Year 12 from Term 4, 2018***

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| **Module 6: Genetic Change** | **Duration** | 20 hours plus 10 hours for Depth Study |
| **Content focus**  During this unit students learn about the natural and human-induced causes and effects of genetic change, including the study of mutations and environmental pressure. Students will also investigate how the processes of inheritance and evolution are applied.  The work of scientists in various fields, including agriculture, industry and medicine, can be explored within the context of biotechnology. The impact of biotechnology on biological diversity is also considered.  **Working scientifically**  Students’ skills development in this unit will focus on analysing trends and patterns and solving problems using evidence from data and information. Students also focus on communicating ideas about genetic change for a specific purpose.  This unit includes personalised adjustments to meet the needs of a student with disability. Read [Aiden’s case study](http://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/Diversity-in-learning/stage-6-special-education/case-studies/aiden). | | |
| **Outcomes**   * develops and evaluates questions and hypotheses for scientific investigation BIO11/12-1 * selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media BIO11/12-4 * solves scientific problems using primary and secondary data, critical thinking skills and scientific processes BIO11/12-6 * communicates scientific understanding using suitable language and terminology for a specific audience or purpose BIO11/12-7 * explains natural genetic change and the use of genetic technologies to induce genetic change BIO12-13 | | |
| **Inquiry questions**   * How does mutation introduce new alleles into a population? * Does artificial manipulation of DNA have the potential to change populations forever? * How do genetic techniques affect Earth’s biodiversity? | **Formal assessment**  Depth Study: Role of developmental genes in evolution | |
| **Depth Study (10 hours) –** The role of developmental genes in evolution  **The following is a teacher-developed Depth Study.**  Time is to be allocated to explain the role of developmental genes in evolution. Students are required to develop a research question concerning this topic and carry out research to produce a multimedia presentation that will inform their peers about the conclusions drawn from their research question.  Depth Study Task – Students conduct a case study on the role of developmental genes in evolution. | | |

| **Topic: Mutation** | | |
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| **Inquiry question:** How does mutation introduce new alleles into a population? | | |
| **Content** | **Teaching, learning and assessment** | **Personalised adjustments**  **(Case study: Aiden)** |
| **Students:**   * explain a range of mutagens, including but not limited to:  Information and communication technology capability icon * electromagnetic radiation sources * chemicals * naturally occurring mutagens | * Students outline some examples of the effects of a range of mutagens, eg the effects of nuclear weapons in Japan, the story of mesothelioma in Australia, Devil Facial Tumour Disease in Tasmanian devils, cervical cancer and the HPV virus. * Students define the terms mutation and mutagen. * Students view the video [Disease and Mutation: DNA Damage](https://www.dnalc.org/resources/3d/18-dna-damage.html) to illustrate the chemical nature of mutagenesis. * Students explain how the following mutagens act: * electromagnetic radiation sources * chemicals * naturally occurring mutagens such as viruses. | Prior to commencing the unit, Aiden can watch an introductory video on mutagens.  Aiden can explore one of the mutagens listed to classify the mutagen as either electromagnetic, chemical or naturally occurring. Provide Aiden with a graphic organiser for him to list the effects of the mutagen.  Provide Aiden with examples of cause and effect language to assist him in explaining how the mutagens act. |
| **Students:**   * compare the causes, processes and effects of different types of mutation, including but not limited to:  Information and communication technology capability icon Numeracy icon * point mutation * chromosomal mutation | * Students explain how mutagens can cause point mutations such as silent, nonsense and missense mutations, and outline the effects of each on the sequence of bases in DNA. * Students explain how mutagens can cause chromosomal mutations such as trisomy, resulting in conditions such as Down and Klinefelter syndrome, using the website [Learn Genetics: Chromosomal Abnormalities](http://learn.genetics.utah.edu/content/disorders/chromosomal/). * Students use an animation to explain how mutagens can cause deletions and insertions, resulting in frameshift mutations. * Students outline the effects of each of the above on the sequence of bases in DNA. * As a class, students construct a table to compare the causes, processes and effects of point mutations, chromosomal mutations and frameshift mutations. | Provide Aiden with a cause and effect graphic organiser to assist him to explain the causes and effects of point mutations.  Aiden can use the website to explore EITHER Down syndrome OR Klinefelter syndrome. Direct Aiden to use the website headings to decide which section of the web page will provide an explanation of how mutagens cause the chromosomal mutation he is exploring. |
| **Students:**   * distinguish between somatic mutations and germ-line mutations and their effect on an organism (ACSBL082, ACSBL083)  Information and communication technology capability icon | * Students view the YouTube video [Somatic vs germ-line mutations](https://www.youtube.com/watch?v=pYQdc6P7qq8) and explain the consequences of a somatic mutation in comparison to a germ-line mutation. | The diagram of [somatic vs germ-line mutations](http://ib.bioninja.com.au/standard-level/topic-3-genetics/33-meiosis/somatic-vs-germline-mutatio.html) can be provided to assist Aiden’s understanding. Aiden can complete a Venn diagram or a comparison chart to compare the consequences of somatic and germ-line mutations. |
| **Students:**   * assess the significance of ‘coding’ and ‘non-coding’ DNA segments in the process of mutation (ACSBL078)  Information and communication technology capability icon Numeracy icon | * Students use an animation of protein synthesis such as [Genes: Protein Synthesis](http://tlf.dlr.det.nsw.edu.au/learningobjects/Content/L5921/object/index.html) to help them identify the roles of coding and non-coding DNA segments. * Students use a table of codons or anticodons to trace the production of polypeptides from DNA. They then alter a base sequence to simulate a point and frameshift mutation and predict the effect on the polypeptide chain produced. |  |
| **Students:**   * investigate the causes of genetic variation relating to the processes of fertilisation, meiosis and mutation (ACSBL078) Numeracy icon | * Students analyse an animation of meiosis such as [How Meiosis Works](http://highered.mheducation.com/sites/0072495855/student_view0/chapter28/animation__how_meiosis_works.html) or [Sumanas Meiosis](http://www.sumanasinc.com/webcontent/animations/content/meiosis.html) and annotate a diagram of meiosis to show how random segregation of chromosomes and crossing over result in non-identical gametes. * Students create a flow chart or infographic explaining the random nature of fertilisation and the role of sexual reproduction in increasing variation, including meiosis and mutation. | An alternative video to explain meiosis, [Meiosis made easy](https://www.youtube.com/watch?v=nMEyeKQClqI) could be provided to Aiden. Ensure Aiden can access the video on a personal device so that he can refer to it when annotating his diagram.  Aiden can use an online infographic tool, such as [Canva](https://www.canva.com/create/infographics/), to assist him to create his infographic. |
| **Students:**   * evaluate the effect of mutation, gene flow and genetic drift on the gene pool of populations (ACSBL091, ACSBL092) Numeracy icon | * Students participate in a class discussion to review the process of natural selection. * Students view the following multimedia presentations [Genetic Drift Animation](https://www.youtube.com/watch?v=VTC3SpXWd-E) or [Founder Effect, Bottle Necking, and Genetic Drift](https://www.youtube.com/watch?v=Q6JEA2olNts) and discuss and compare gene flow, genetic drift, the founder effect and bottle necking. * Students annotate diagrams to highlight the important features of gene flow and genetic drift. * Students summarise the causes of genetic variation and their effects on natural selection and evolution. | Provide Aiden with a scaffold for his summary, or sentence starters to assist him to develop a summary. |

| **Topic: Genetic Technologies** | | |
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| **Inquiry question:** Does artificial manipulation of DNA have the potential to change populations forever? | | |
| **Content** | **Teaching, learning and assessment** | **Personalised adjustments**  **(Case study: Aiden)** |
| **Students:**   * compare the processes and outcomes of reproductive technologies, including but not limited to: Ethical understanding icon  Information and communication technology capability icon * artificial insemination * artificial pollination | * Students research the processes and outcomes of artificial insemination, artificial pollination and IVF. * Students construct a table to compare the methods and results of these reproductive technologies. | Provide Aiden with appropriate texts (media articles, reports, web pages, videos) to use to research the processes and outcomes of artificial insemination, artificial pollination and IVF. |
| **Students:**   * investigate and assess, through secondary sources, the effectiveness of cloning, including but not limited to: Ethical understanding icon Critical and creative thinking icon * whole organism cloning * gene cloning | * Students analyse secondary sources to outline the steps involved in whole organism cloning, gene cloning and therapeutic cloning. The following resources will assist: [Learn Genetics: Cloning](http://learn.genetics.utah.edu/content/cloning/), [Click and Clone](http://learn.genetics.utah.edu/content/cloning/clickandclone/). * Students assess the effectiveness of the methodologies of whole organism cloning, gene cloning and therapeutic cloning. | Provide Aiden with accessible secondary sources, such as [Therapeutic cloning](http://www.explorestemcells.co.uk/TherapeuticCloning.html) (copy and paste removing the web advertisements), or sources that use visual images to support the text. Aiden can use a graphic organiser to outline the steps of whole organism cloning, gene cloning and therapeutic cloning.  Aiden can use a scaffold with sentence starters to prepare his ‘assess’ response. |
| **Students:**   * describe techniques and applications used in recombinant DNA technology, for example: * the development of transgenic organisms in agricultural and medical applications (ACSBL087) | * Students view the animations to discuss each technique and/or application: [Early Genetic Engineering Experiment](https://highered.mheducation.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::/sites/dl/free/0072437316/120078/bio38.swf::Early%20Genetic%20Engineering%20Experiment) or [Experiments and Techniques: Mechanism of Recombination](https://www.dnalc.org/resources/3d/20-mechanism-of-recombination.html) or [DNA Interactive: Techniques](http://www.dnai.org/b/index.html?m=2,1) or [Gene Splicing](http://www.mhhe.com/biosci/genbio/virtual_labs/BL_22/BL_22.html). * Students analyse recombinant DNA technologies in terms of agricultural or medical applications, including: * transgenesis * ‘knock-out’ animals * identification, mapping and sequencing of genes to determine their function * [gene therapy](http://learn.genetics.utah.edu/content/genetherapy/) * ELISA or western blot techniques to diagnose infections * [CRISPR gene editing](http://www.yourgenome.org/facts/what-is-crispr-cas9) | Provide Aiden with key questions to guide his analysis of recombinant DNA technologies. |
| **Students:**   * evaluate the benefits of using genetic technologies in agricultural, medical and industrial applications (ACSBL086) Sustainability icon Ethical understanding icon | * Students access a variety of online resources to describe the uses and advantages of current genetic technologies that induce genetic change, for example: * transgenesis * chromosome engineering * mutation * breeding * microbial vectors * Students evaluate the benefits of using these technologies in agricultural, medical and industrial applications. | Aiden can work with a peer who he is comfortable with to complete the research. Alternatively, he can research two genetic technologies and complete a table outlining the uses and advantages.  Model using the information gathered in the table to evaluate the benefits in one application (agricultural, medical or industrial). Aiden can use the model to evaluate the benefits of using the technologies in the other two applications. |
| **Students:**   * evaluate the effect on biodiversity of using biotechnology in agriculture Sustainability icon | * Students conduct a case study on the production, benefits and any disadvantages of the production of golden rice, focusing on: * techniques by participating in the [genetic engineering challenge](http://serendip.brynmawr.edu/exchange/bioactivities/geneticengineer) * [evaluating the pros and cons](http://serendip.brynmawr.edu/exchange/bioactivities/GoldenRice). * Students evaluate the effect on biodiversity of using biotechnology in agriculture, using specific examples as evidence. | Aiden can view the video [GMO debate grows over golden rice in the Philippines](https://www.youtube.com/watch?v=Ayv_EYi43E8) to take notes on the production, benefits and disadvantages of golden rice. Other accessible sources can be provided to Aiden to support his understanding.  Aiden can use the model for an evaluation previously completed by the teacher to develop his evaluation on the effect of biotechnology on biodiversity, using golden rice and Bt cotton as his examples. |
| **Students:**   * interpret a range of secondary sources to assess the influence of social, economic and cultural contexts on a range of biotechnologies Ethical understanding icon  Information and communication technology capability icon Intercultural understanding icon Difference and diversity icon | * Students explore a variety of resources to assess the influence of social, economic and cultural contexts on a range of biotechnologies, for example: * social, economic and cultural impacts on the adoption of GM foods * social, economic and cultural impacts on the use of cloned animals in agriculture. * Students assess the relevance, accuracy, validity and reliability of the researched information. | Aiden can use the video above on golden rice to outline:   * a social reaction, eg Greenpeace vs the scientists * economic concerns and benefits * cultural concerns, eg the reactions of the local people.   Provide Aiden with the resources [How cloning could change farming](http://abcnews.go.com/Technology/story?id=98410&page=1) and [Pros and cons of animal cloning](http://healthresearchfunding.org/pros-cons-animal-cloning/) to complete a table outlining the social, economic and cultural impacts of cloned animals in agriculture.  Aiden can then assess either the social, economic and cultural impacts on the adoption of GM foods OR on the use of cloned animals in agriculture. Provide a scaffold to assist Aiden to develop an ‘assess’ response. |
| **Students:**   * investigate the uses and advantages of current genetic technologies that include genetic change | * Students summarise the methods, uses and advantages of current genetic technologies that include genetic change. * Students formulate a response to the inquiry question. | Aiden can use a graphic organiser, such as a mind map, for his summary, including mutation, genetic variation, reproductive technology, cloning, biotechnology and agriculture.  Aiden can respond to the inquiry question using a medium of his choice, such as a written response or multimedia presentation. |

| **Topic: Biotechnology** | | |
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| **Inquiry question:** How do genetic techniques affect Earth’s biodiversity? | | |
| **Content** | **Teaching, learning and assessment** | **Personalised adjustments**  **(Case study: Aiden)** |
| **Students:**   * investigate the uses and applications of biotechnology (past, present and future), including: (ACSBL087) * analysing the social implications and ethical uses of biotechnology, including plant and animal examples Sustainability icon Ethical understanding icon  Information and communication technology capability icon Civics and citizenship icon * researching future directions of the use of biotechnology Critical and creative thinking icon  Information and communication technology capability icon * evaluating the potential benefits for society of research using genetic technologies Sustainability icon Ethical understanding icon Personal and social capability icon * evaluating the changes to the Earth’s biodiversity due to genetic techniques Sustainability icon Ethical understanding icon Personal and social capability icon | * Students investigate a variety of resources to: * analyse the social implications and ethical uses of biotechnology, including plant and animal examples * describe future directions of the use of biotechnology * evaluate the potential benefits for society of research using genetic technologies * predict ways Earth’s biodiversity may change due to genetic techniques. * Students assess the relevance, accuracy, validity and reliability of the researched information. * Students formulate a response to the inquiry question. | Aiden can use the [Biotechnology timeline](https://www.bio.org/articles/history-biotechnology) to identify current uses of biotechnology in plants and animals. Aiden can predict some changes that may occur in these areas in the future and research whether any of these predictions are possible or being developed. Aiden can use this information to outline possible consequences on biodiversity. He can address the inquiry question using a medium of his choice. |

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| **Resources**  Video: Disease and Mutation: DNA Damage <https://www.dnalc.org/resources/3d/18-dna-damage.html>  Video: Stated Clearly Part 1: How Does New Genetic Information Evolve? Point Mutations <https://www.youtube.com/watch?v=DlhpvcgK_28>  Learn Genetics: Chromosomal Abnormalities <http://learn.genetics.utah.edu/content/disorders/chromosomal/> How Meiosis Works <http://highered.mheducation.com/sites/0072495855/student_view0/chapter28/animation__how_meiosis_works.html>Sumanas Meiosis <http://www.sumanasinc.com/webcontent/animations/content/meiosis.html>Video: Genetic Drift Animation <https://www.youtube.com/watch?v=VTC3SpXWd-E>Video: Founder Effect, Bottle Necking, and Genetic Drift <https://www.youtube.com/watch?v=Q6JEA2olNts>Genes: Protein Synthesis <http://tlf.dlr.det.nsw.edu.au/learningobjects/Content/L5921/object/index.html> Learn Genetics: Cloning <http://learn.genetics.utah.edu/content/cloning/>  Click and Clone <http://learn.genetics.utah.edu/content/cloning/clickandclone/>  Early Genetic Engineering Experiment <https://highered.mheducation.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::/sites/dl/free/0072437316/120078/bio38.swf::Early%20Genetic%20Engineering%20Experiment>  Experiments & Techniques: Mechanism of Recombination <https://www.dnalc.org/resources/3d/20-mechanism-of-recombination.html>  DNA Interactive: Techniques [http://www.dnai.org/b/index.html?m=2,1](%20http:/www.dnai.org/b/index.html?m=2,1)  Gene Splicing <http://www.mhhe.com/biosci/genbio/virtual_labs/BL_22/BL_22.html>  Learn Genetics: Gene Therapy <http://learn.genetics.utah.edu/content/genetherapy/>  Plasmid Cloning [http://www.sumanasinc.com/webcontent/animations/content/plasmidcloning.html](%20http:/www.sumanasinc.com/webcontent/animations/content/plasmidcloning.html)  Golden Rice: Genetic Engineering Challenge <http://serendip.brynmawr.edu/exchange/bioactivities/geneticengineer>  Golden Rice: Evaluating the Pros and Cons <http://serendip.brynmawr.edu/exchange/bioactivities/GoldenRice>  Genetic Engineering, Ethics and Religion <http://www.abpischools.org.uk/page/modules/geneticengineeringnew/ethics.cfm?coSiteNavigation_allTopic=1>  CRISPR gene editing <http://www.yourgenome.org/facts/what-is-crispr-cas9>  The Ethics of Genetic Manipulation [http://www.pbs.org/wgbh/nova/body/ethics-of-manipulating-genes.html](%20http:/www.pbs.org/wgbh/nova/body/ethics-of-manipulating-genes.html)  BEEP Bioethics Education [http://www.beep.ac.uk/content/130.0.html](%20http:/www.beep.ac.uk/content/130.0.html)  The conversation - GM Foods <http://theconversation.com/because-we-can-does-it-mean-we-should-the-ethics-of-gm-foods-28141>  Ethical Issues and GM <http://www.abpischools.org.uk/page/modules/geneticengineeringnew/mediaactivity.cfm?coSiteNavigation_allTopic=1>  Markkula Ethics Centre <https://www.scu.edu/ethics/focus-areas/bioethics/resources/genetically-modified-food/> |

**Resources, reflection and evaluation**

Teacher sign-off……………………………………………………….Date commenced………………………………………………Date completed…………………………….

Program evaluation and recommended amendments

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Recommended additional text/resources

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