# Sample Unit – Biology – Year 11

***Sample for implementation for Year 11 from 2018***

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| **Module 3: Biological Diversity – A Trip to the Galapagos** | **Duration** | 20 hours + 10 hour depth study (total 30 hours) |
| **Unit description** | In this contextualised unit, students are presented with a scenario in which they have won a class trip to the Galapagos Islands. The students, as keen biologists, are to determine which islands they will visit, and which organisms they will see. Throughout the topic, students will learn about the Theory of Evolution by Natural Selection and the effect of various selective pressures, focusing on species found on the Galapagos Islands. They will investigate types of adaptations, the process of natural selection and the evidence for evolution, using Galapagos species as examples. |
| **Outcomes**A student:* develops and evaluates questions and hypotheses for scientific investigation BIO11/12-1
* designs and evaluates investigations in order to obtain primary and secondary data and information BIO11/12-2
* communicates scientific understanding using suitable language and terminology for a specific audience or purpose BIO11/12-7
* describes biological diversity by explaining the relationships between a range of organisms in terms of specialisation for selected habitats and evolution of species BIO11-10
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| **Resources*** Galapagos Conservation Trust: Galapagos Wildlife <http://galapagosconservation.org.uk/about-galapagos/wildlife/>
* Galapagos Conservation Trust: Charles Darwin http://galapagosconservation.org.uk/about-galapagos/history/charles-darwin/
* Galapagos Conservation Trust: Giant Tortoises http://galapagosconservation.org.uk/about-galapagos/history/giant-tortoises/
* Discovering Darwin <http://evolution.discoveringgalapagos.org.uk/evolution-zone/discovering-darwin/>
* Galapagos Adaptations <http://evolution.discoveringgalapagos.org.uk/evolution-zone/galapagos-adaptations/>
* PBS Evolution <http://www.pbs.org/wgbh/evolution/index.html>
* PBS Learning Resources: Evolution http://www.pbs.org/wgbh/evolution/index.html
* Natural Selection: Empirical Studies in the Wild https://ncse.com/files/pub/evolution/excerpt--evolution.pdf
* The work of Rosemary and Peter Grant on Galapagos finches http://www.pbs.org/wgbh/evolution/library/01/6/l\_016\_01.html
* Natural Selection in Real Time http://www-tc.pbs.org/wgbh/evolution/educators/teachstuds/pdf/natural\_selection.pdf
* Grants' Finch Study Data https://www-tc.pbs.org/wgbh/evolution/educators/course/session4/grants\_finch\_data.pdf
* Grants' Finch Study Data Answers http://www-tc.pbs.org/wgbh/evolution/educators/teachstuds/pdf/key\_darwins\_finches.pdf
* Sorting Finch Species http://www.hhmi.org/biointeractive/sorting-finch-species
* Evolution in Action: Data Analysis http://www.hhmi.org/biointeractive/evolution-action-data-analysis
* Natural Selection and the Evolution of Darwin's Finches http://www.hhmi.org/biointeractive/natural-selection-and-evolution-darwins-finches
* Beaks As Tools: Selective Advantage in Changing Environments http://www.hhmi.org/biointeractive/beaks-tools-selective-advantage-changing-environments
* Speciation Mechanisms <http://life9e.sinauer.com/life9e/pages/23/232002.html>
* Founder Effect and Speciation http://life9e.sinauer.com/life9e/pages/23/232001.html
* Anole Lizards: An Example of Speciation http://www.hhmi.org/biointeractive/anole-lizards-example-speciation
* Wellcome Trust Tree of Life video <http://www.wellcometreeoflife.org/video/>
* Wellcome Trust Tree of Life interactive <http://www.wellcometreeoflife.org/interactive/>
* Absolute dating rock layers http://sciencelearn.org.nz/Contexts/Dating-the-Past/Sci-Media/Animations-and-Interactives/Absolute-dating-rock-layers
 | **Formal assessment**Students:Create and present an educational tour through the Galapagos Islands suitable for people interested in the evolutionary development of species living in the Galapagos. The tour information:* describes the route taken – visiting five islands in the group
* justifies the choice of those five islands
* includes a range of different organisms that will be studied, explaining:
* adaptations of the organisms
* evolutionary changes in the organisms
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| **Inquiry questions**1. How do adaptations increase the organism’s ability to survive?
2. How do environmental pressures promote a change in species diversity and abundance?
3. What is the relationship between evolution and biodiversity?
4. What is the evidence that supports the Theory of Evolution by Natural Selection?
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| **Working Scientifically skills****Questioning and Predicting – BIO11/12-1**A student develops and evaluates questions and hypotheses for scientific investigationStudents:* develop and evaluate inquiry questions and hypotheses to identify a concept that can be investigated scientifically, involving primary and secondary data (ACSBL001, ACSBL061, ACSBL096)
* modify questions and hypotheses to reflect new evidence

**Planning Investigations – BIO11/12-2**A student designs and evaluates investigations in order to obtain primary and secondary data and informationStudents:* assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning an investigation (ACSBL031, ACSBL097)
* justify and evaluate the use of variables and experimental controls to ensure that a valid procedure is developed that allows for the reliable collection of data (ACSBL002)
* evaluate and modify an investigation in response to new evidence

**Conducting Investigations – BIO11/12-3A**A student conducts investigations to collect valid and reliable primary and secondary data and informationStudents:* employ and evaluate safe work practices and manage risks (ACSBL031)
* use appropriate technologies to ensure and evaluate accuracy
* select and extract information from a wide range of reliable secondary sources and acknowledge them using an accepted referencing style

**Processing Data and Information – BIO11/12-4**A student selects and processes appropriate qualitative and quantitative data and information using a range of appropriate mediaStudents:* select qualitative and quantitative data and information and represent them using a range of formats, digital technologies and appropriate media (ACSBL004, ACSBL007, ACSBL064, ACSBL101)
* apply quantitative processes where appropriate
* evaluate and improve the quality of data

**Analysing Data and Information - BIO11/12-5**A student analyses and evaluates primary and secondary data and informationStudents:* derive trends, patterns and relationships in data and information
* assess error, uncertainty and limitations in data (ACSBL004, ACSBL005, ACSBL033, ACSBL099)
* assess the relevance, accuracy, validity and reliability of primary and secondary data and suggest improvements to investigations (ACSBL005)

**Problem Solving - BIO11/12-6**A student solves scientific problems using primary and secondary data, critical thinking skills and scientific processesStudents:* use modelling (including mathematical examples) to explain phenomena, make predictions and solve problems using evidence from primary and secondary sources (ACSBL006, ACSBL010)
* use scientific evidence and critical thinking skills to solve problems

**Communicating - BIO11/12-7**A student communicates scientific understanding using suitable language and terminology for a specific audience or purposeStudents:* select and use suitable forms of digital, visual, written and/or oral forms of communication
* select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSBL008, ACSBL036, ACSBL067, ACSBL102)
* construct evidence-based arguments and engage in peer feedback to evaluate an argument or conclusion (ACSBL034, ACSBL036)
 | **Depth Study**This module will provide students with the opportunity to plan and conduct investigations, as well as processing data and information. The focus should be placed on the development of skills related to planning and conducting investigations, as well as processing and communicating information. Rather than a teacher developed Depth Study being incorporated in this module, students should be given feedback about the development of their investigative and data analysis skills, so that these may be formally assessed later in the Year 11 course.Possible areas of further investigation in Year 11 include, for example:* Test Darwin’s hypothesis that seeds can be immersed in sea water and still germinate. Analyse the data from this investigation and relate it to the colonisation of the Galapagos. ***Develop skills of practical investigation.***
* Analyse the modern data of Peter and Rosemary Grant on natural selection in Galapagos finch populations in response to changes in biotic and abiotic factors. ***Develop skills of data analysis.***
* Charles Darwin’s *On the Origin of Species by means of Natural Selection* (1859) continues to influence modern Evolutionary Biology. Compare the evidence that Darwin used to support his arguments with the evidence currently used to support the Theory of Evolution by means of Natural Selection. ***Develop skills of processing information.***
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| **Topic: Adaptations** |
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| **Inquiry Question:** How do adaptations increase the organism’s ability to survive? |
| **Content** | **Teaching, learning and assessment** | **Differentiation** |
| **Students:*** conduct practical investigations, individually or in teams, or use secondary sources to examine the adaptations of organisms that increase their ability to survive in their environment, including: Critical and creative thinking icon  Information and communication technology capability icon Work and enterprise icon
* structural adaptations
* physiological adaptations
* behavioural adaptations
 | * briefly outline the geological history of the Galapagos and propose hypotheses to explain the origin of the original inhabitants of the Galapagos
* collect and analyse the observations and data that were obtained by Charles Darwin about groups of closely related Galapagos species to support the Theory of Evolution by Natural Selection, choosing from:  Information and communication technology capability icon
* Tortoises
* Iguanas
* Finches
* Mockingbirds
* Frigatebirds
* Cormorants
* Boobies
* Seals and Sea Lions
* Whales
* Dolphins
* define the terms structural, physiological and behavioural adaptations
* choose at least three pairs of closely related Galapagos species from the above list and construct a table to compare their distinguishing structural, physiological and behavioural adaptations. Link these adaptations to biotic and abiotic factors and their chances of survival. Critical and creative thinking icon
 | **Structured*** define the terms biotic and abiotic factors
* define the term adaptation
* observe a number of animal and plant characteristics to determine which of these provide an organism with an advantage for survival
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| **Students:*** investigate, through secondary sources, the observations and collection of data that were obtained by Charles Darwin to support the Theory of Evolution by Natural Selection, for example:  Information and communication technology capability icon Literacy icon
* finches of the Galapagos Islands
* Australian flora and fauna
 | * test Darwin’s hypothesis that seeds could be immersed in sea water and still germinate, by conducting a practical investigation, focusing on: Critical and creative thinking icon Literacy icon Numeracy icon
* posing hypotheses
* controlling variables
* selection of appropriate technologies
* the use of variables and experimental controls
* validity, reliability and accuracy
* calculation of means
* presentation of data using a range of formats, digital technologies and appropriate media
* uncertainty and limitations in the data
* suggest ways to improve the quality of data. Compare results with Darwin’s and write a scientific report. Discuss the implications for the colonisation of the Galapagos Islands by mainland species Critical and creative thinking icon
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| **Topic: Effects of the Environment on Organisms** |
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| **Inquiry Question:** How do environmental pressures promote a change in species diversity and abundance? |
| **Content** | **Teaching, learning and assessment** | **Differentiation** |
| **Students:*** predict the effects of selection pressures on organisms in ecosystems, including: (ACSBL026, ACSBL090)
* biotic factors
* abiotic factors
 | * define the term selection pressure
* outline the process of natural selection with diagrams and/or an animation such as [Evolution lab](http://biologyinmotion.com/evol/), using Darwin’s postulates, which are:  Information and communication technology capability icon
* individuals within a population vary in their traits.
* some of these variable traits are heritable
* more offspring are produced than can survive because of limited resources
* individuals with advantageous traits will survive and reproduce
* using a Galapagos species as an example, construct a flow chart to examine past changes in a population of Galapagos organisms over time, eg Galapagos finches using a video, such as [The Origin of Species: The Beak of the Finch](http://www.hhmi.org/biointeractive/origin-species-beak-finch) Critical and creative thinking icon
 | **Extension*** conduct a simulation of natural selection in Galapagos finches, eg [This Lab is for the Birds](https://richarddawkins.net/2015/03/this-lab-is-for-the-birds/) or [Beaks As Tools: Selective Advantage in Changing Environments](http://www.hhmi.org/biointeractive/beaks-tools-selective-advantage-changing-environments) and relate the data collected to the evolution of finches in the Galapagos  Information and communication technology capability icon
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| **Students:*** investigate changes in a population of organisms due to selection pressures over time, for example: (ACSBL002, ACSBL094) Sustainability icon Critical and creative thinking icon  Information and communication technology capability icon Literacy icon Numeracy icon
* cane toads in Australia
* prickly pear distribution in Australia
 | * outline some statistical methods to determine error and uncertainty, such as mean, standard deviation and standard error Numeracy icon
* use the following resources to analyse the data of Peter and Rosemary Grant on natural selection in Galapagos finch populations in response to changes in biotic and abiotic factors Critical and creative thinking icon  Information and communication technology capability icon Numeracy icon
* [Natural Selection in Real Time](http://www-tc.pbs.org/wgbh/evolution/educators/teachstuds/pdf/natural_selection.pdf)
* [Finch Beak Data Sheet](http://www.pbs.org/wgbh/evolution/library/01/6/l_016_01.html)
* [Evolution in Action: Data Analysis](http://www.hhmi.org/biointeractive/evolution-action-data-analysis)
* [Effects of Natural Selection on Finch Beak Size](http://www.hhmi.org/biointeractive/effects-natural-selection-finch-beak-size)
* [Natural Selection and the Evolution of Darwin's Finches](http://www.hhmi.org/biointeractive/natural-selection-and-evolution-darwins-finches)
* [Beaks As Tools: Selective Advantage in Changing Environments](http://www.hhmi.org/biointeractive/beaks-tools-selective-advantage-changing-environments)
* write a scientific report, describing the findings, that includes: Literacy icon Numeracy icon
* means
* standard deviation and standard error
* appropriate graphs
* interpretation of the data
* identify the specific data that supports each of Darwin’s postulates and discuss the implications of the research Critical and creative thinking icon
* analyse secondary data on modern selection pressures in the Galapagos Islands, including biotic and abiotic factors and those caused by humans to make predictions about the future pathway of evolution
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| **Topic: Theory of Evolution by Natural Selection** |
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| **Inquiry Question:** What is the relationship between evolution and biodiversity? |
| **Content** | **Teaching, learning and assessment** | **Differentiation** |
| **Students:*** analyse how an accumulation of microevolutionary changes can drive evolutionary changes and speciation over time, for example: Sustainability icon Critical and creative thinking icon Literacy icon (ACSBL034, ACSBL093)
* evolution of the horse
* evolution of the platypus
 | * define microevolution and macroevolution and outlinehow an accumulation of microevolutionary changes can drive evolutionary changes and speciation over time, using Galapagos finches or other species as an example as an example
* use an animation on speciation to illustrate speciation in the Galapagos islands, eg [Speciation Mechanisms](http://life9e.sinauer.com/life9e/pages/23/232002.html) or [Founder Effect and speciation](http://life9e.sinauer.com/life9e/pages/23/232001.html) or [Anole Lizards: An Example of Speciation](http://www.hhmi.org/biointeractive/anole-lizards-example-speciation) or [Speciation: An Illustrated Introduction](https://www.youtube.com/watch?v=8yvEDqrc3XE)
 | **Extension*** consider the likelihood and characteristics of future speciation
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| **Students:*** explain, using examples, how Darwin and Wallace’s Theory of Evolution by Natural Selection accounts for:
* convergent evolution
* divergent evolution
 | * define and explain convergent and divergent evolution
* analyse an example of divergent evolution in the Galapagos, eg iguanas, tortoises, finches, mockingbirds, and draw a flow chart to illustrate the process by which it occurred Critical and creative thinking icon
* analyse an example of convergent evolution in the Galapagos, eg seals and sea lions and draw a flow chart to illustrate the process by which it occurred Critical and creative thinking icon
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| **Students:*** explain how punctuated equilibrium is different from the gradual process of natural selection
 | * use the information, eg at [Understanding Evolution](http://evolution.berkeley.edu/evolibrary/article/0_0_0/evo_51) to construct a table to compare gradualism to punctuated equilibrium Critical and creative thinking icon
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| **Students:*** explain biological diversity in terms of the Theory of Evolution by Natural Selection by examining the changes in and diversification of life since it first appeared on the Earth (ACSBL088)
 | * develop an overview of the tree of life to create an online timeline of the significant steps in the evolution of living things by using, for example Critical and creative thinking icon
* [Wellcome Trust Tree of Life video](http://www.wellcometreeoflife.org/video/)
* [Wellcome Trust Tree of Life interactive](http://www.wellcometreeoflife.org/interactive/)
* select two Galapagos species to reveal the evolutionary relationship between them Critical and creative thinking icon
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| **Topic: Evolution – the Evidence** |
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| **Inquiry Question:** What is the evidence that supports the Theory of Evolution by Natural Selection? |
| **Content** | **Teaching, learning and assessment** | **Differentiation** |
| **Students:*** investigate, using secondary sources, evidence in support of Darwin and Wallace’s Theory of Evolution by Natural Selection, including but not limited to:  Information and communication technology capability icon Literacy icon
* biochemical evidence, comparative anatomy, comparative embryology and biogeography (ACSBL089)  Information and communication technology capability icon Literacy icon
* techniques used to date fossils and the evidence produced  Information and communication technology capability icon Literacy icon
 | * research and analyse the evidence for evolution: Critical and creative thinking icon
* biochemical evidence, eg similarities in DNA
* comparative anatomy, eg pentadactyl limb
* comparative embryology, eg fish, reptile, bird and mammal pentadactyl limbs
* biogeography
* transitional species, eg [transitional whale species](http://evolution.berkeley.edu/evolibrary/article/evograms_03)
* suggest evolutionary relationships between some Galapagos species
* use the animations, such as [Absolute dating rock layers](http://sciencelearn.org.nz/Contexts/Dating-the-Past/Sci-Media/Animations-and-Interactives/Absolute-dating-rock-layers) and [Australian Museum Dating Dinosaurs and Other Fossils](http://australianmuseum.net.au/dating-dinosaurs-and-other-fossils) to analyse techniques used to date fossils and the evidence produced Critical and creative thinking icon  Information and communication technology capability icon
 | **Extension*** consider and analyse information that disputes collected evidence for evolution
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| **Students:*** explain modern-day examples that demonstrate evolutionary change, for example:  Information and communication technology capability icon Literacy icon
* the cane toad
* antibiotic resistant strains of bacteria
 | * analyse some modern examples of evolutionary change in the Galapagos Islands, eg speciation in [finches](https://www.wired.com/2009/11/speciation-in-action/), [tortoises](http://news.ubc.ca/2015/10/23/new-giant-tortoise-species-found-in-galapagos-archipelago/) and [marine iguanas](http://atlasofscience.org/hybridisation-masks-speciation-in-marine-iguanas/) Critical and creative thinking icon
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**Reflection and Evaluation**

# TEACHER: CLASS:

**DATE UNIT COMMENCED: DATE UNIT CONCLUDED:**

* **Variations to program:** (List additional resources and outline alternative strategies used.
* **The most effective teaching/ learning strategies and resources in this unit were:** (Please nominate 3 at least)
* **Less effective teaching strategies and resources for this unit were:** (Please nominate 2 at least)

**TEACHER’S SIGNATURE\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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