# Sample Unit: Investigating Science – Year 12

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

| **Unit title** | Science and Society | **Duration** | 22 hours including 8 hours for Depth Studies |
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| **Unit description** | **Content Focus**Those who pursue the study of science have created processes, tools and products that challenge and influence society and some of its belief systems, ethics and societal norms. In response, society debates and regulates science in order to prevent harmful developments and unacceptable outcomes, and to allow for new and beneficial products, processes and ideas. Science can also be affected by society, as well as governments, industry, economic interests and cultural perspectives. Students explore the impacts of ethical, social, economic and political influences on science and its research.**Working Scientifically**Students focus on analysing and evaluating primary and secondary data to solve problems and communicate scientific understanding about the position and application of science in society. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course. |
| **Outcomes*** develops and evaluates questions and hypotheses for scientific investigation INS11/12-1\*
* analyses and evaluates primary and secondary data and information INS11/12-5
* solves scientific problems using primary and secondary data, critical thinking skills and scientific processes INS11/12-6
* communicates scientific understanding using suitable language and terminology for a specific audience or purpose INS11/12-7
* evaluates the implications of ethical, social, economic and political influences on science INS12-15

*\*INS11/12-1 is not a focus outcome for this module but has been included for the purposes of Depth Study assessment requirements.* |
| **Resources*** Text/sources on meltdowns of nuclear reactors, development of the smallpox vaccine, development of flight, positive and negative aspects of damming rivers.
* Text/sources on scientific fields that are regulated have ethical considerations and codes of conduct.
* Example text/sources on how science aids economic development and human progress, world health and human wellbeing.
* Text/sources on how governments and large corporations influence market opportunities, university research, governmental budgets, research using ICIP.
* Text/sources on how personal, cultural and socioeconomic perspectives influence scientific research.
 | **Formal assessment – The Depth Study**A series of depth studies have been suggested throughout the unit to provide for differentiation and student engagement. |

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| **Incidents, Events and Science** **Inquiry question:** How do science-related events affect society’s view of science? |
| **Content** | **Teaching, learning and assessment** | **Differentiation and resources** |
| **Students:*** investigate case studies of past events to consider how they have affected the public image of science, including but not limited to:
* meltdowns of nuclear reactors
* development of the smallpox vaccine
* development of flight
* positive and negative aspects of damming rivers
 | * Students conduct a secondary-sourced investigation in groups to research one case study from one of the following past events:
* meltdowns of nuclear reactors
* development of the smallpox vaccine
* development of flight
* positive and negative aspects of damming rivers

Issues to address include:* the people affected by the events
* the potential benefits and negative impacts of the event
* ways in which evidence is/was argued and means of resolution
* Groups then presents their research as a debate explaining different perspectives to the class.
* Students use a scaffold to make a summary of the different perspectives and how the events affected the public image of science.
 | **Possible Depth Study**Students choose to investigate an event of interest to them and present a report on how it is perceived in society. For example oil spills and their clean-up. |

| **Regulation of Scientific Research****Inquiry question:** Why is scientific research regulated? |
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| **Content** | **Teaching, learning and assessment** | **Differentiation and resources** |
| **Students:*** investigate the need for the regulation of scientific research in, for example:
* genetic modification of sex cells and embryos
* development of biotechnological weaponry
* testing of pharmaceuticals
* products and processes of the nuclear industry
* protection of Indigenous Cultural and Intellectual Property (ICIP)
 | * Students work in different groups and chose one area from the examples given below to investigate:
* Genetic modification
* Biotechnological warfare
* Pharmaceutical testing
* Nuclear industry
* ICIP
* Students brainstorm the following question with regard to their area of research:

‘What are the scientific consequences of not placing restrictions on the research undertaken in the field that you have chosen?’Tabulate the positive and the negative consequences of this.Students present arguments for and against the ethical concerns versus the scientific gains. | A teacher example may be supplied to guide the students through the task, eg, ICIP.Web resource: “Artists in the Black: ICIP”<https://www.artslaw.com.au/images/uploads/aitb/AITB_information_sheet_-_Indigenous_cultural_and_intellectual_property_ICIP_2.pdf>Outline how Aboriginal and Torres Strait Islander communities should be approached for permission and consent to participate and be acknowledged in research. Approaches to benefit sharing should also be discussed. Web resources:“Working with Aboriginal Communities” <http://ab-ed.bostes.nsw.edu.au/files/working-with-aboriginal-communities.pdf> “Aboriginal and Torres Strait Islander Principals and Protocols” <http://ab-ed.bostes.nsw.edu.au/principles-and-protocols>  |
| **Students:*** investigate and assess ethical issues surrounding current scientific research in, for example:
* use of radiation
* pharmaceutical research
* gene manipulation in biotechnology
* mining practices
* bioprospecting
 | * Students conduct a secondary-sourced investigation on their chosen area of research for requirements relating to:
* legislation
* ethical practices and approvals (usually conducted by the supervising research body)
* documented codes of conduct (usually produced by the supervising research body)
* Students present a report justifying the purpose of legislation, ethics and codes of conduct in their chosen field and discuss how such restrictions can limit scientific research, requiring scientists to find alternative methods to address their inquiry questions.
 | A teacher example may be supplied to guide the students through the task, for example:* the ethics of bioprospecting for new medicinal plants from Aboriginal and Torres Strait Islander Communities.

Web resource:Frankel & Co. 1998 “Our Culture: Our Future” <http://www.terrijanke.com.au/our-culture-our-future>  |
| **Students:*** investigate a range of international scientific codes of conduct in regard to scientific research and practice in the areas of, for example:
* cloning
* stem cell research
* surrogacy
* genetically modified foods
* transplantation of organs
 | * Using the article ‘[List of 2017 Emerging ethical Dilemmas and Policy Issues in Science and Technology](http://reilly.nd.edu/news-and-events/news/reilly-center-releases-2017-list-of-emerging-ethical-dilemmas-and-policy-issues-in-science-and-technology/)’ students discuss how regulation of science is a continually evolving process that moves with society.
* Students examine, justify and compare the codes of conduct for research and practice in TWO of the following areas:
* cloning
* stem cell research
* surrogacy
* genetically modified foods
* transplantation of organs
* Students present this as a poster, or other media file that could be used as a display.
 | Web resource:<http://reilly.nd.edu/news-and-events/news/reilly-center-releases-2017-list-of-emerging-ethical-dilemmas-and-policy-issues-in-science-and-technology/> |
| **Students:*** evaluate the effectiveness of international regulation in scientific research and practice
 | * Students review the website, ‘[Ethical Dilemmas in Scientific Research and Professional Integrity](http://www.actsi.org/discovery/ethics-center.html)’. View the media clip and identify the factors that Dr John Banja says contribute to medical errors and violations of ethics.
* Teachers select three case scenarios from the website and give students the scenarios to discuss and debate, then decide upon what would be an appropriate ethical response.
* Teachers will hand out the ‘Expert Opinion’ from the website for the scenarios and have students compare their response to that of the experts.

*Assessment for Learning** Students respond to the inquiry question citing evidence:

 **‘**Why is scientific research regulated?’ * The teacher observes students responses and uses a variety of questioning techniques to deepen students understanding of the concept of regulation in scientific research.
 | Web resource:[*http://www.actsi.org/discovery/ethics-center.html*](http://www.actsi.org/discovery/ethics-center.html)Teachers extract three scenarios from this site and edit the handout to show only the dilemma. Following group discussion give students the expert opinion for comparison.**Possible Depth Study**Web resource: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3521635/>Using this website report on how new technology and scientific advancement create new ethical dilemmas. |

| **Influence of Economic, Social and Political Forces on Scientific Research****Inquiry question:**How do economic, social and political influences affect scientific research? |
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| **Content** | **Teaching, learning and assessment** | **Differentiation and resources** |
| **Students:*** evaluate the costs involved in space exploration compared to investments in social issues, for example poverty and human global food supply
 | * Hold a class debate on:

 ‘W*here should we spend the money: space or poverty*?’Students use the two web resources provided as a starting point to research the arguments for and against. | Web resources:<http://astronomy.swinburne.edu.au/sao/downloads/HET610-M19A01.pdf> and <https://www.anglicare.org.au/sites/default/files/public/Hard%20Choices%20Food%20Insecurity%20Final%20Report%202013.pdf>**Possible Depth Study**How market forces affect both scientific research and poverty. |
| **Students:*** evaluate how scientific research aids economic development and human progress in relation to, for example:
* nuclear power generation
* use of antimicrobial drugs
* genetically modified foods
* use of petroleum products
* robotics and the use of drones
 | * Students select an example from the list below to use as a case study:
	+ nuclear power generation
	+ use of antimicrobial drugs
	+ genetically modified foods
	+ use of petroleum products
	+ robotics and the use of drones
* Students conduct a secondary-sourced investigation on their choice of topic to investigate how scientific research aids economic development and human progress and build a case study for a report.

Points to address include:* + The research development costs and time
	+ The potential to improve the life and wellbeing of people
	+ Seen and unforeseen side effects that affect people and the environment
	+ Possible alternative development solutions.
 | **Possible Depth Study**Students may elect to conduct a secondary - sourced investigation into a research area of their choice. |
| **Students:*** evaluate the impacts of scientific research, devices and applications on world health and human wellbeing, including but not limited to:
* medical surgical devices
* surgical procedures
* water purification and wastewater treatment
* vaccination programs for the eradication of disease
 | * Using an example from the syllabus content, students conduct in groups a secondary-sourced investigation to evaluate the impacts of scientific research, devices and applications on world health and human wellbeing. They build a case study report to present the findings to the class. Points to address include:
	+ research development costs and time
	+ potential to improve the life and wellbeing of people
	+ seen and unforeseen side effects that impact on people
	+ possible alternative development solutions.
 | **Possible Depth Study**Students may elect to conduct a secondary - sourced investigation into a research area of their choice |
| **Students:*** using examples, analyse the impacts that governments and large corporations have on scientific research, including but not limited to:
* corporations and market opportunities
* university research project budgets
* governmental budgets and limited time priorities
* benefit-sharing in research using ICIP
 | * As a class discuss the impacts that governments and large corporations are having and on scientific research.

Students investigate the effects of:* + corporations and market opportunities
	+ university research project budgets
	+ governmental budgets and limited time priorities
	+ benefit-sharing in research using ICIP

Points to address include:* + nature of the impact
	+ the limitations imposed on scientific research by the impacts
	+ the potential consequences of these limitations
 | Web resources: Useful references include:1. [Government funding for CSIRO](http://www.news.com.au/finance/economy/federal-budget/140-million-government-funding-cuts-to-the-csiro-will-have-huge-impacts-on-scientific-research-in-australia/news-story/26d9a3f1e457930b205575e9c09a38d8)
2. [Spending](https://theconversation.com/infographic-how-much-does-australia-spend-on-science-and-research-61094) on Science and Research
3. [Science priorities for Australia’s future](https://theconversation.com/we-need-to-fund-more-than-just-science-priorities-for-australias-future-50243)
4. [Abriculture](http://www.abriculture.com/)
5. [Science research and development](http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/FlagPost/2011/November/Australias_current_spending_on_science_research_and_development)
6. [Focus on STEM](https://theconversation.com/focus-on-stem-risks-sidelining-social-science-innovation-51398)
7. [The Sugar Industry and Science](http://bigthink.com/sean-curry/big-sugar-has-been-paying-off-science-for-decades-are-you-surprised?utm_campaign=Echobox&utm_medium=Social&utm_source=Facebook%20-%20link_time=1480952427)
8. [Benefit-sharing and traditional knowledge: the need for international guidance](http://www.benelexblog.law.ed.ac.uk/2014/07/08/benefit-sharing-and-traditional-knowledge-the-need-for-international-guidance/) (ICIP)
9. [Introduction to access and benefit-sharing](https://www.cbd.int/abs/infokit/brochure-en.pdf)
10. [University Research: The role of federal funding (USA)](http://www.aau.edu/workarea/downloadasset.aspx?id=11588)

**Possible Depth Study**Students may elect to conduct a secondary-sourced investigation to determine the impact that funding and market priorities have on a scientific field of their choice. |
| **Students:*** evaluate how personal, cultural and socioeconomic perspectives can influence the direction of scientific research, for example:
* perceptions about diet in a multicultural society
* investigating traditional medical treatments
* mining practices
 | * Investigate how a growing recognition and respect for Aboriginal and Torres Strait Islander Peoples have resulted in change in research directions towards native medicinal plants of Country and Place
* Using the examples given in the syllabus content, students discuss and note the influences that shape their own opinion on one of the fields of science of interest to them, for example:
	+ past experience
	+ social group
	+ cultural assumptions
* Students locate a minimum of two research papers and identify how their influences and perspective do or do not align with that of the researcher(s).
* Students identify perspectives that have influenced the research and suggest alternative perspectives that could be investigated.
 | Web resources: Merne Altyerre-ipenhe (Food from the Creation time) Reference Group, Douglas J.And Walsh F. 2011 *Aboriginal people, bush foods knowledge and products from**central Australia: Ethical guidelines for commercial bush food research, industry and enterprises*<http://www.nintione.com.au/resource/NintiOneResearchReport_71_BushFoodGuidelines.pdf>**Possible Depth Study**Students may elect to conduct a secondary- sourced investigation to determine different epistemological approaches to the same scientific issue. |

| **Reflection and Evaluation**Teacher sign off………………………………… Date commenced……………………………. Date completed…………………………….Program evaluation and recommended amendments………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………..Recommended additional resources1. ………………………………………………………………………………………………………………………………………………………………
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