 Year 12 Investigating Science Module 8

Module 8 – Influence of economic, social and political forces on scientific research[[1]](#footnote-1)

Duration

12-15 hours

Description of unit

Advancements in science and human progress go hand in hand. Students will explore the costs of scientific investigation, as well as the impacts key scientific discoveries, have had on human health and wellbeing, and as a result, economic progress. They will also explore the decisions and roles that various stakeholders play in the decisions regarding the directions of scientific research, and the role societal perspectives can have on influencing the direction of science.

Inquiry question

How do economic, social and political influences affect scientific research?

Working scientifically

Students design and evaluate questions to investigate and research in order to obtain secondary data and information. This will include both quantitative and qualitative data. Students will process, analyse, interpret and evaluate that data and communicate their understanding in both informative and persuasive texts.

Outcomes

A student:

* INS11/12-5 analyses and evaluates primary and secondary data and information
* INS11/12-6 solves scientific problems using primary and secondary data, critical thinking skills and scientific processes
* INS11/12-7 communicates scientific understanding using suitable language and terminology for a specific audience or purpose
* INS12-15 evaluates the implications of ethical, social, economic and political influences on science

Assessment

* Formative assessments through the unit
* Depth study

| Outcomes and content | Teaching and learning | Evidence of learning |
| --- | --- | --- |
| Students:* Evaluate the costs involved in space exploration compared to investments in social issues, such as poverty and human global food supply
* Derive trends, patterns and relationships in data and information (INS11/12-5)
* Assess the relevance, accuracy validity and reliability of primary and secondary data and suggest improvements to investigations (INS11/12-5)
* Construct evidence-based arguments and engage in peer feedback to evaluate an argument or conclusion (INS11/12-7)
 | To engage students in the topic draw scatter plots on butchers’ paper * As a percentage of GDP, the amount spent on space exploration vs the amount spent on social services in the USA.
* How much I think the USA spends on Space exploration/year vs how much I think the USA should spend on space exploration
* How many people in the USA live in poverty vs how many people is it considered to be acceptable to live below the poverty line

Class discussion justifying points of view. Could substitute Australia or any other country for the USA Students place coloured dots on the plot as to where their ‘view’ lies. Students divided into two teams to do debate: ‘Spending money on space exploration is a waste of money’.Students brainstorm ideas and use the internet to identify points for and against using post-it notes. Each student gathers data on a different point related to their team’s allocated view. A shared One Note could be used to place data and ideas for debate. The following resources can be used to help students:* [Space exploration is a waste of time and money](https://debatewise.org/debates/137-space-exploration-is-a-waste-of-money/) (DebateWise)
* Useful websites include:
	+ [Infographic: How much does Australia spend on science and research?](https://theconversation.com/infographic-how-much-does-australia-spend-on-science-and-research-61094) - The Conversation
	+ [Which countries spend the most on space exploration?](https://www.weforum.org/agenda/2016/01/which-countries-spend-the-most-on-space-exploration/) - World Economic Forum
	+ [Australia in space: looking out and looking in](https://theconversation.com/australia-in-space-looking-out-and-looking-in-4494) - The Conversation
	+ [Global Poverty Line Update](http://www.worldbank.org/en/topic/poverty/brief/global-poverty-line-faq) - The World Bank
	+ [World Food Situation](http://www.fao.org/worldfoodsituation/en/) - Food and Agriculture Organisation of the United Nations
	+ [Our World in Data](https://ourworldindata.org/grapher/social-spending-oecd-longrun?time=1880..2016) – includes graphs of social expenditure by country over time
	+ [OECD Space and Innovation](https://read.oecd-ilibrary.org/science-and-technology/space-and-innovation_9789264264014-en#page69) Details government expenditure on space research in OECD countries. OECD (2016), Space and Innovation, OECD Publishing, Paris.

After the debate, provide students with fresh scatter plots and ask them to reassess their point of view  | Students formulate and answer questions regarding world poverty, global food supply and cost of space exploration.Students demonstrate skills in obtaining information from secondary sources, including graphs and tables.Post-it note activity to identify arguments.Students collaborate to formulate arguments for the affirmative or the negative side of the debate.Students complete a personal reflection on the issues surrounding the cost of space exploration versus investment in social issues, how the debate affirmed or changed their view and use this to complete fresh scatterplots.  |
| 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
* Use scientific evidence and critical thinking skills to solve problems (INS11/12-6)
 | Read and discuss ‘[Science is the Great Giver](https://www.gatesnotes.com/Health/European-Innovation)’, by Bill Gates. The teacher guides students through drawing a mindmap to summarise the main points in this article Students choose one of the five options provided in the syllabus (or another of their choice) and prepare a mindmap to summarise the benefits to society of this discovery and related technology, the economic impact and the effect on human progress (both positive and negative aspects).Suggested resources for stimulus material:* Nuclear power
	+ [The economics of nuclear power](http://www.world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx) (World Nuclear Association)
	+ [New Research Projects Could Revitalize Nuclear Power (Climate Central)](https://www.climatecentral.org/news/nuclear-research-targets-emissions-19113)
	+ [This new technology could save the troubled nuclear power industry (Guardian News and Media)](https://www.theguardian.com/sustainable-business/2016/oct/16/safer-small-nuclear-reactors-power-plant-technology)
* Antimicrobial drugs
	+ Lewis, D. (2017) Outsmarting Superbugs. COSMOS, Issue 76, p27-35.
	+ [Basic research on antimicrobial drug resistance (National Institute of Allergy and Infectious Disease).](https://www.niaid.nih.gov/research/antimicrobial-resistance-basic-research-support)
* Genetically modified foods
	+ [Genetically modified foods: A critical review of their promise and problems (Science Direct)](https://www.sciencedirect.com/science/article/pii/S2213453016300295)
	+ [Beyond just promise, CRISPR is delivering in the lab today (the Conversation)](https://theconversation.com/beyond-just-promise-crispr-is-delivering-in-the-lab-today-77596)
* Petroleum products
	+ [Petroleum (The Environmental Literacy Council)](https://enviroliteracy.org/energy/fossil-fuels/petroleum/)
	+ [Synthetic fuels could eliminate entire U.S. need for crude oil, create ‘new economy’ (Princeton University)](https://www.princeton.edu/news/2012/11/27/synthetic-fuels-could-eliminate-entire-us-need-crude-oil-create-new-economy)
* Robotics and use of drones
	+ [14 ways drones will change the world](http://www.ibtimes.com/14-ways-drones-will-change-world-1517486) (IB Times)
	+ [10 Benefits of Drone-Based Asset Inspections](https://www.uasvision.com/2018/01/17/10-benefits-of-drone-based-asset-inspections/) (UAS Vision)
	+ [12 Benefits of drones (Futurism)](https://futurism.com/images/benefitsofdrones)
	+ [38 Ways Drones Will Impact Society: From Fighting War to Forecasting Weather, UAVs Change Everything](https://www.cbinsights.com/research/drone-impact-society-uav/) (CB Insights)
 | Mind map showing the flow-on effects of scientific research  |
| 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
* Use scientific evidence and critical thinking skills to solve problems (INS11/12-6)
* Select and use suitable forms of digital, visual, written and/or oral forms of communication (INS11/12-7)
* Derives trends, patterns and relationships in data and information (INS11/12-5)
 | Students to consider the question ‘[Where would we be without …? Impacts of science on health and wellbeing](https://docs.google.com/presentation/d/1gFZeQkDQ6fDLWADq6dpWanqQST_KvU8lEYV9QPpcQXQ/edit#slide=id.p)’ by examining the images provided in the slideshow.**Medical surgical devices** Use the following website, and others, to design a table showing five modern (must be invented in the last five years) medical surgical devices, what they are used for, how they work and the benefit of the device. [Top 5 medical technology innovations (ASME)](https://www.asme.org/engineering-topics/articles/bioengineering/top-5-medical-technology-innovations) Students read the following article: [Advances in medical technology and its impact on health care in developing countries](https://medcraveonline.com/IJRRT/IJRRT-02-00022.pdf) (International Journal of Radiology and Radiation therapy)Students answer the question: What are the limitations to the use of high technology devices in developing countries?**Surgical procedures** Show video of Fred Hollows work. Or [Fiona Woods](https://www.youtube.com/watch?v=KlJnHme9b6I); or [Spray-on skin](https://www.youtube.com/watch?v=1ITD-w3nkOM) or [Repairing burn wounds through skin regeneration](https://www.youtube.com/watch?v=xY7kVVS2HVY)Students to write one page explaining what the doctors have done, that is, their research, device and applications, and how this has impacted on world health and human well-being.**Water purification and wastewater treatment:*** Visit local water purification and wastewater treatment facilities. Students to design a presentation (for example, written report, poster, PowerPoint) about the processes occurring to ensure clean water. What quality control/standards do the facilities have to meet?
* Use the following web site to compare data on the water on improved drinking water, open defecation and child mortality between a developing nation and Australia.

[Clean Water](https://ourworldindata.org/water-access) (World in Data) [Water sanitation](https://www.who.int/water_sanitation_health/monitoring/coverage/jmp-update-2017-graphics/en/)Good overview: [WHO: How does safe water impact global health.](https://www.who.int/features/qa/70/en/) **Vaccination programs:*** View film [Hilleman: A perilous quest to save the world’s children](https://hillemanfilm.com/film). This does require purchasing (DVD = $15) but is highly recommended.
* Eradication of smallpox: View videos:
	+ [The eradication of smallpox: invisible killers](https://www.youtube.com/watch?v=dVmkYSkQEN8) (Discovery UK)
	+ [Learning from smallpox: How to eradicate a disease](https://www.youtube.com/watch?v=oBSandHijDc) (TED-ed)

Students answer the following: What were the challenges in attempting to eradicate smallpox. Explain how smallpox was eradicated. What are the benefits of other eradication programs? * Anti-vaccine lobby and recurrence of ‘old’ diseases:

Class discussion about what vaccinations they have had as children and what do they know about the reasons anti-vaxxers have for being opposed to vaccines. * + View video at SBS [Measles surge in Europe: What does it mean for Australia?](https://www.sbs.com.au/news/measles-surge-in-europe-what-does-it-mean-for-australia). Answer the question: What is herd immunity? Why is herd immunity important?
	+ Use [Measles in Australia](https://www.aihw.gov.au/getmedia/c828baef-75d9-4295-9cc9-b3d50d7153a2/aihw-phe-236_Measles.pdf.aspx)  (Australian Institute of Health and Welfare) to observe graphs and report on the effectiveness of MMR vaccination.
	+ View video: [No link between measles vaccine and autism, major study confirms](https://www.sbs.com.au/news/no-link-between-measles-vaccine-and-autism-major-study-confirms) (SBS World News). What was the underlying premise for anti-vaxxers opposing the MMR vaccine? Was this valid? What does the latest study show about the connection between MMR and autism?

Students write a letter to the editor of a newspaper in a low vaccination rate area, encouraging parents to vaccinate their child against measles (or another named disease).  | Students write a structured discussion — appropriate scaffolding as required.Students report on Fred Hollows or Fiona WoodsReport on visit to water purification and wastewater plantsStudents use data to demonstrate the link between clean water and healthLetter to editor  |
| Students:* Use examples to 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 Indigenous intellectual and cultural property
* Use scientific evidence and critical thinking skills to solve problems (INS11/12-6)
* Select and use suitable forms of digital, visual, written and/or oral forms of communication (INS11/12-7)
 | Stimulus articles for discussion:* Zolith, L. Street Fighting Mien: Should scientists be getting political? Cosmos, Autumn 2017, p34.
* [Donald Trump’s know nothing science budget](https://www.newyorker.com/news/daily-comment/donald-trumps-know-nothing-science-budget) (The New Yorker)

Option 1Students investigate opportunities to interview a scientist, either in person or via video conference, or visit a university or industry-based research organisation. This will include students formulating the questions to ask the scientist, recording the responses and preparing a summary report.Organisations to assist planning could include:* CSIRO
* Universities (Outreach programmes)
* ANSTO
* Private companies
* Regional Development Australia

The following links provide useful background information:* [Behind the scenes at Science Meets Parliament 2016](https://australiascience.tv/vod/behind-the-scenes-at-science-meets-parliament-2016/) (Australia’s Science Channel)
* [Science and Research Priorities (Australian Government)](http://www.science.gov.au/scienceGov/ScienceAndResearchPriorities/Pages/default.aspx)
* [Let’s spend more wisely on research in Australia](https://theconversation.com/lets-spend-more-wisely-on-research-in-australia-29053) (The Conversation)
* [Australian Antarctic Division: Leading Australia’s Antarctic Program](http://www.antarctica.gov.au/science) (Australian Antarctic Division)
* [Indigenous knowledge consultation](https://www.ipaustralia.gov.au/about-us/public-consultations/indigenous-knowledge-consultation) (IP Australia)
* [Examining the link between science and economic growth](https://www.the-scientist.com/?articles.view/articleNo/18467/title/Examining-The-Link-Between-Science-And-Economic-Growth/) (The Scientist)
* [Making an Impact: when science and politics collide](https://www.theguardian.com/science/2012/jun/01/making-impact-scientists) (The Guardian)

Option 2A case study investigating the history of tobacco smoking, the establishment of the link between cigarettes and lung cancer, the role of governments, tobacco companies and the medical profession, and the current situation regarding tobacco smoking, plain packaging and economy of cigarette smoking Option 3A case study that investigates the current debate between climate change scientists and sceptics, and the role that governments, coal mining companies and renewable energy providers play in the debate. Have a Q&A style panel where students take the role of each protagonist with questions from the class.  | Interview reportDevelop an annotated timeline of tobacco regulation noting influences of the tobacco lobby and government agenciesEngagement in a class panel discussion |
| 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
* Use scientific evidence and critical thinking skills to solve problems (INS11/12-6)
 | These resources can be used to stimulate discussion:* [How humankind has changed our planet](http://www.abc.net.au/radionational/programs/greatmomentsinscience/how-humankind-has-changed-our-planet/8273806), presented by Karl Kruszelnicki
* TED Talk – [The Danger of Science Denial](https://www.ted.com/talks/michael_specter_the_danger_of_science_denial) by Michael Specter
* TED Talk – [Battling Bad Science](https://www.ted.com/talks/ben_goldacre_battling_bad_science) by Ben Goldacre

Other topics or resources could include the ‘Supersize Me’ fast food debate.Students then conduct a debate about the directions they believe scientific research should follow into the future. This includes analysing their reasons for this from a personal, cultural and socioeconomic perspective. Students then write a persuasive article or blog post to summarise their views.Alternatively,As a group, prepare a Q and A style discussion with a variety of perspectives represented in the panel, and an audience to pose questions | Q and A debate preparation* This could be filmed or presented to an audience of other peers.
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Reflection and evaluation

What worked well?

What needed improving?

New resources and ideas?

Signature:

Date commenced:

Date completed:

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