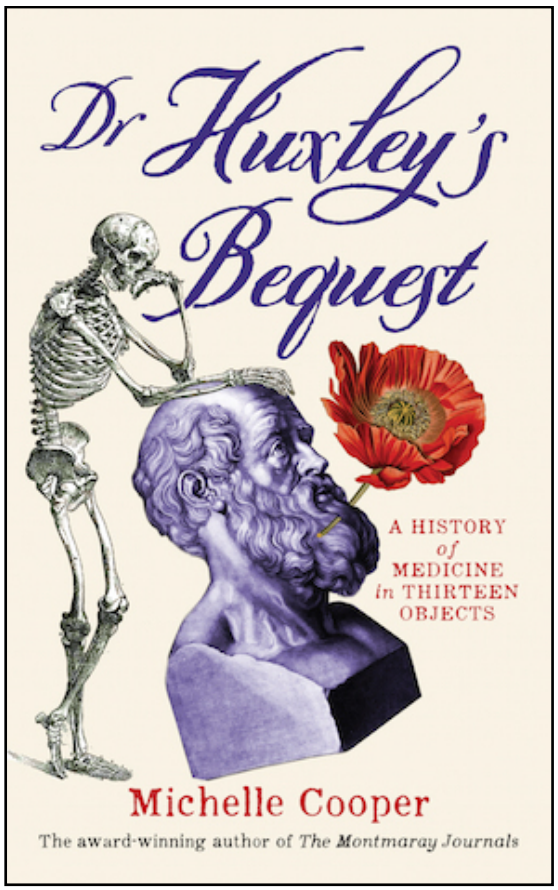

Dr Huxley's Bequest

A History of Medicine in Thirteen Objects

by Michelle Cooper

Teaching Resources

Prepared by Michelle Cooper

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Paperback edition includes illustrations, author's note, bibliography and comprehensive index.
Dr Huxley's Bequest is also available in ePub and Kindle editions.

Contents

Introduction

A mysterious bequest sends Rosy and Jaz on a race against time to identify thirteen strange and wonderful objects – which turn out to tell the story of medicine, from the superstitions of ancient Egypt to the modern-day ethical dilemmas of genetic testing.

Can unicorns cure leprosy?
What secrets of the brain did Michelangelo conceal in his Sistine Chapel paintings?
Did a zombie discover the cure for scurvy?
Does homeopathy actually work?
Is grapefruit evil?
Did the bumps on Ned Kelly's head predict his fate?
And how exactly did parachuting cats save a village from the plague?

An exploration of the beauty and power of scientific reasoning, for thoughtful readers aged twelve years and up, from the award-winning Australian author of *The Montmaray Journals* trilogy.

"Strong characters and a believable purpose combine with a deft writerly touch to produce an interesting and engaging narrative that educates and, as I mentioned, provides a positive perspective on research and the quest for knowledge, and this cannot be undervalued. I can see this being picked up by young readers for pleasure, but I would also commend it to teachers to consider as a class text, due to its quality and relevance to learning."

Tehani Croft

Summary of *Dr Huxley's Bequest*

Rosy and Jaz are two, very different, thirteen-year-old girls who are thrown together on a university campus one summer because their parents are working at the same college. A mysterious bequest to the college – and an unfortunate incident involving a turtle – means the girls must race against time, and all over the campus, to identify thirteen strange and wonderful objects collected by the late Dr Huxley. In their search for clues, Rosy and Jaz visit the university's museums, libraries and monuments, search books and websites, interview scientists and historians, and dodge an overzealous security guard. Meanwhile, Rosy's relationship with her scientist mother evolves in surprising ways and Jaz has to decide whether to reveal her family's secret to her new friend. And then there's the puzzle of Rosy's Midnight Visitor to solve …

Woven into the mystery-solving and joke-telling is a history of medicine, from the superstitions of ancient Egypt to the ethical dilemmas of clinical drug trials and genetic testing. The girls find themselves arguing with Hippocrates, Aristotle and Galen; being horrified by the Black Death, body-snatching and eighteenth-century surgical techniques; and scrutinising modern homeopathy and the anti-vaccine movement. They uncover the secrets of the brain's anatomy in Michelangelo's Sistine Chapel paintings and find a link between herbal medicine and Vincent Van Gogh's masterpieces. They learn how the discovery of penicillin demonstrated the benefits of having an untidy desk, why an Australian scientist thought it would be a good idea to drink dangerous bacteria, and how traditional Aboriginal remedies might save lives when modern medicine fails.

Dr Huxley's Bequest also explores how scientific reasoning can answer questions in ordinary life. Rosy, confronted with a mysterious Midnight Visitor, works scientifically to formulate her questions, develop hypotheses, plan and carry out an investigation, and draw conclusions. Rosy and Jaz use first-hand observations and secondary sources to identify the thirteen items in Dr Huxley's collection and they use critical thinking to evaluate the claims of alternative medicine practitioners. The girls also learn about significant historical discoveries by scientists including Harvey, Lind, Pasteur, Koch, Snow, Semmelweis and present-day Nobel-winning Australian scientists.

Dr Huxley's Bequest will be of interest to those wanting to encourage teenage girls to explore STEM subjects – particularly girls who are interested in history, stories and people, but believe science is difficult, boring or only for boys. The book contains the stories of famous women scientists, including Marie Curie, Rosalind Franklin, Margaret Jennings, Jean Orr-Ewing and Elizabeth Blackburn, as well as that of American schoolgirl Emily Rosa, whose research was published in *The Journal of the American Medical Association* when she was eleven years old.

The two opening chapters of *Dr Huxley's Bequest* introduce Rosy, Jaz and their quest to identify the thirteen objects in Dr Huxley's collection. Each subsequent chapter explores a different development in medical history:

Chapter Three 'I have no special talents. I am only passionately curious.' Albert Einstein
Ancient Egyptian medicine
Chapter Four 'The scientific mind does not so much provide the right answers as ask the right questions.' Claude Lévi-Strauss
Ancient Greek medicine, featuring Hippocrates, Aristotle, Herophilus and Erasistratus Ancient Roman medicine, featuring Celsus and Galen
Chapter Five 'The deepest sin against the human mind is to believe things without evidence.' Attributed to T. H. Huxley
Medieval European medicine, featuring dancing mania and the Black Death
Chapter Six 'Formerly, when religion was strong and science weak, men mistook magic for medicine…' Thomas Szasz
Women in medieval medicine, featuring Hildegard of Bingen, Jacqueline Felicie, village wise women and the persecution of witches Alchemy, featuring Paracelsus, Avicenna, Rhazes and the Islamic Golden Age
Chapter Seven 'Good science and good art both require imagination.' Jenny Pollak
Anatomy and art, featuring Vesalius, Michelangelo, Rembrandt and Leonardo Body-snatching, featuring Burke and Hare Modern ethical issues involving human bodies, including the ethics of blood donation, organ transplantation and the display of preserved cadavers
Chapter Eight 'Science is nothing but trained and organised common sense.' T. H. Huxley
Introduction to the scientific method and how to design a scientific experiment Blood circulation, featuring Galen, Harvey and others

Chapter Nine ‘Chance favours only the prepared mind.’ Louis Pasteur
Germ theory, featuring Pasteur, Koch and Snow Microscopes and Petri dishes Introduction to bacteria and viruses Introduction to the principles of immunisation
Chapter Ten ‘Science moves, but slowly, slowly…’ Alfred, Lord Tennyson
Surgery, anaesthetics and antisepsis, featuring Davy, Liston, Simpson, Ombredanne, Paré, Semmelweis, Nightingale and Lister
Chapter Eleven ‘Science is much more than a body of knowledge. It is a way of thinking.’ Carl Sagan
Introduction to designing medical trials, featuring Lind’s trial of scurvy treatments Diet and malnutrition, featuring Lunin, Dumas, Hopkins, Funk and Szent-Györgyi Public health education dilemma - Vitamin D deficiencies and skin cancer
Chapter Twelve ‘… now, when science is strong and religion weak, men mistake medicine for magic.’ Thomas Szasz
Pseudoscience and alternative therapies, featuring phrenology, homeopathy and chiropractic More on designing and critiquing medical trials, featuring Emily Rosa’s Therapeutic Touch study Includes placebo effect, randomisation, controlling for variables and correlation vs causation
Chapter Thirteen ‘Cured yesterday of my disease, I died last night of my physician.’ Matthew Prior
Pharmaceutics, featuring aspirin, heroin and thalidomide
Chapter Fourteen ‘What is a weed? A plant whose virtues have not been discovered.’ Ralph Waldo Emerson
Plants in medicine, featuring chocolate, garlic, grapefruit and foxglove Traditional Aboriginal plant medicines Traditional Chinese medicine, featuring herbal remedies and acupuncture
Chapter Fifteen ‘In science, the credit goes to the man who convinces the world, not to the man to whom the idea first occurs.’ Francis Darwin
Antibiotics, featuring penicillin and the rise of antibiotic-resistant superbugs

Chapter Sixteen ‘It is those who know little, not those who know much, who so positively assert that this or that problem will never be solved by science.’ Charles Darwin
Immunisation, featuring smallpox, polio and the modern anti-vaccination movement
Chapter Seventeen ‘Mystics exult in mystery and want it to stay mysterious. Scientists exult in mystery for a different reason: it gives them something to do.’ Richard Dawkins
Using the scientific method to solve problems Malaria and the difficulties of eradicating a disease
Chapter Eighteen ‘We’ve never had a woman in the laboratory before, and we think you’d be a distracting influence.’ Gertrude B. Elion
Radiation and medical imaging, featuring Roentgen, Becquerel and Curie DNA and genetic testing Women in medical science, featuring Jex-Blake, Edwards, Curie, Joliot-Curie and Franklin
Chapter Nineteen ‘It is a good morning exercise for a research scientist to discard a pet hypothesis every day before breakfast.’ Konrad Lorenz
Australian Nobel Prize winners, featuring Marshall and Warren’s discovery of *H. pylori*’s role in gastric ulcers Modern developments in medical science, including hormonal contraception, chemotherapy, cardiopulmonary resuscitation, SIDS prevention and HIV/AIDS treatment
Chapter Twenty ‘Did science promise happiness? I don’t think so. It promised truth…’ Émile Zola
Huntington’s Disease and genetic testing

Australian Science Curriculum Years 7-10

Dr Huxley's Bequest provides opportunities for curriculum-based learning, corresponding to Stages 4 and 5 of the Australian Science Curriculum. This includes the Content Strands of 'Working Scientifically' and 'Knowledge and Understanding: Living World'. Learning activities based on *Dr Huxley's Bequest* can be used to work towards the following NSW Board of Studies Outcomes:

Stage 4 (Year 7 and 8)

Values and Attitudes

A student:
SC4-1VA appreciates the importance of science in their lives and the role of scientific inquiry in increasing understanding of the world around them
SC4-2VA shows a willingness to engage in finding solutions to science-related personal, social and global issues, including shaping sustainable futures
SC4-3VA demonstrates confidence in making reasoned, evidence-based decisions about the current and future use and influence of science and technology, including ethical considerations

Skills: Working Scientifically

A student:
SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge
SC4-5WS collaboratively and individually produces a plan to investigate questions and problems
SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually
SC4-7WS processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions
SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems
SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations

Knowledge and Understanding: Living World

A student:
SC4-15LW explains how new biological evidence changes people's understanding of the world

> **LW4** Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed people's understanding of the world. (ACSHE119, ACSHE134)
> Students:
> a. research an example of how changes in scientific knowledge have contributed to finding a solution to a human health issue
> b. recount how evidence from a scientific discovery has changed understanding and contributed to solving a real world problem, eg animal or plant disease, hygiene, food preservation, sewage treatment or biotechnology
> c. describe, using examples, how developments in technology have contributed to finding solutions to a contemporary issue, eg organ transplantation, artificial joints/limbs, treatment for diabetes, asthma, kidney or heart disease
> d. give examples to show that groups of people in society may use or weight criteria differently in making decisions about the application of a solution to a contemporary issue, eg organ transplantation, control and prevention of diseases and dietary deficiencies

Stage 5 (Year 9 and 10)

Values and Attitudes

A student:
SC5-1VA appreciates the importance of science in their lives and the role of scientific inquiry in increasing understanding of the world around them
SC5-2VA shows a willingness to engage in finding solutions to science-related personal, social and global issues, including shaping sustainable futures
SC5-3VA demonstrates confidence in making reasoned, evidence-based decisions about the current and future use and influence of science and technology, including ethical considerations

Skills: Working Scientifically

A student:
SC5-4WS develops questions or hypotheses to be investigated scientifically
SC5-5WS produces a plan to investigate identified questions, hypotheses or problems, individually and collaboratively
SC5-6WS undertakes first-hand investigations to collect valid and reliable data and information, individually and collaboratively
SC5-7WS processes, analyses and evaluates data from first-hand investigations and secondary sources to develop evidence-based arguments and conclusions
SC5-8WS applies scientific understanding and critical thinking skills to suggest possible solutions to identified problems
SC5-9WS presents science ideas and evidence for a particular purpose and to a specific audience, using appropriate scientific language, conventions and representations

Knowledge and Understanding: Living World

A student:
SC5-15LW explains how biological understanding has advanced through scientific discoveries, technological developments and the needs of society

> **LW3** Advances in scientific understanding often rely on developments in technology, and technological advances are often linked to scientific discoveries. (ACSHE158, ACSHE192)
> Students:
> b. identify that during reproduction the transmission of heritable characteristics from one generation to the next involves DNA and genes (ACSSU184)
> c. identify that genetic information is transferred as genes in the DNA of chromosomes
> d. outline how the Watson-Crick model of DNA explains:
> – the exact replication of DNA
> – changes in genes (mutation)
> e. describe, using examples, how developments in technology have advanced biological understanding, eg vaccines, biotechnology, stem-cell research and in-vitro fertilisation
> f. discuss some advantages and disadvantages of the use and applications of biotechnology, including social and ethical considerations
> **LW4** The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence. (ACSSU185)
> Students:
> c. explain, using examples, how natural selection relates to changes in a population, eg in the development of resistance of bacteria to antibiotics and insects to pesticides
> d. outline the roles of genes and environmental factors in the survival of organisms in a population

From NSW Board of Studies (2017) *Science K–10 (incorporating Science and Technology K–6) Syllabus Outcomes and Content Mapping Grids Stage 4 and Stage 5*

Stage 4 Questions and Activities

Questions can be used for group discussion or for individual written responses.
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Website references listed for each activity are suggested resources only and may not be appropriate for all students. For further resources, see page 29 of this guide.

Working Scientifically

> 'Science is much more than a body of knowledge. It is a way of thinking.'
> Carl Sagan (p 163)

> 'Science is nothing more than trained and organised common sense.'
> T. H. Huxley (p 107)

1. Define **science**, in your own words.

http://www.ducksters.com/science/scientificmethod.php
http://sethgodin.typepad.com/seths_blog/2017/04/what-does-science-mean.html

> Aristotle 'said theories should be based on facts, and facts came from observing the world. If you found a new fact that went against your theory, he reckoned you should either change your theory or come up with a new one.' (p 52)

2. Why is Aristotle known as the 'Father of Science'?

http://www.ducksters.com/history/ancient_greece/aristotle.php
http://www.sciography.com/aristotle.htm

> 'Galen was convinced he was right. "It is I, and I alone, who have revealed the true path of medicine."' (p 57)

3. Was Galen a scientist? Why or why not?

http://www.bbc.co.uk/history/historic_figures/galen.shtml
https://www.britannica.com/biography/Galen-of-Pergamum

‘That’s my hypothesis,’ said Rosy. ‘I thought it up just now. A hypothesis is an idea that explains something.’ (p 43)

4. Rosy comes up with some creative ideas to explain why the papers on her desk were disturbed and how her apple disappeared. One of her ideas is that an ancient Egyptian mummy escaped from the museum and broke into her room. (pp 63-64)

Explain what a **hypothesis** is, in your own words. Is Rosy’s idea a hypothesis?

‘I *know* what a hypothesis is,’ Jaz huffed. ‘Anyway, there’s no point having a hypothesis unless you can back it up with evidence.’ (p 43)

5. How could Rosy prove (or disprove) that an ancient Egyptian mummy broke into her room and disturbed her papers?

6. Rosy uses the scientific method to solve the mystery of her Midnight Visitor. (pp 116-119, 258-261)
Write a scientific report about Rosy’s investigation. Your report should include:

Hypothesis
Method
Results
Conclusion

You may want to include tables, diagrams or other representations in your report.

‘It’s dancing mania. Dad told me about it. In Europe in the Middle Ages, there were these epidemics of compulsive dancing, where crowds of people would dance till they dropped. They couldn’t stop themselves. It would go on for days, or even weeks, and some of them actually died from heart attacks and exhaustion and stuff …’ (p 69)

7. Rosy and Jaz use **secondary sources** to discover some possible causes of dancing mania (pp 69-70).

What is a **primary source**? What is a **secondary source**? List some of the secondary sources Rosy and Jaz use to identify Dr Huxley’s thirteen objects.

https://www.youtube.com/watch?v=cqXHO7bTPnw (Primary vs Secondary Sources)
https://www.library.unsw.edu.au/study/information-resources/primary-and-secondary-sources

‘But there was this one doctor in London, John Snow, who was convinced that the miasma theory was wrong …’ (p 142)

8. How did John Snow discover the cause of the Soho cholera epidemic in 1854? What was his hypothesis? Did he use primary sources, secondary sources or both when gathering evidence?

http://www.bl.uk/learning/histcitizen/21cc/publichealth/sources/source13/snow2.html
http://www.ph.ucla.edu/epi/snow/snowcricketarticle.html

9. There are lots of mysteries, large and small, in everyday life. Choose one mystery in your life that you’d like to solve. Then brainstorm some possible explanations for this mystery. Can each explanation be tested? Write down one hypothesis and how you might test it.

Stage 5 Questions and Activities

Questions can be used for group discussion or for individual written responses.
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Working Scientifically

> 'The great tragedy of Science – the slaying of a beautiful hypothesis by an ugly fact.'
> T. H. Huxley (p 182)

1. What did Huxley mean by this? Why is it difficult for some scientists to abandon their initial hypothesis, even when they have strong evidence that it's wrong?

> 'I'm convinced that a controlled disrespect for authority is essential to a scientist.'
> Luis W. Alvarez (p 13)

2. Is science about accepting current ideas or challenging them? What do you think Alvarez meant by '**controlled** disrespect'? Who or what is 'authority' for a scientist?

Discuss Alvarez's statement with examples of famous scientists who 'disrespected authority'. Examples might include:

- Vesalius questioning Galen's anatomical texts (p 95)
  https://evolution.berkeley.edu/evolibrary/article/history_02

- Semmelweis's work on puerperal fever (pp 158-159)
  https://www.npr.org/sections/health-shots/2015/01/12/375663920/the-doctor-who-championed-hand-washing-and-saved-women-s-lives

- Marshall and Warren's work on gastric ulcers (pp 290-292)
  http://discovermagazine.com/2010/mar/07-dr-drank-broth-gave-ulcer-solved-medical-mystery

3. Describe how Louis Pasteur (pp 133-141) used the scientific method to:

a) disprove spontaneous generation
b) develop a method for preventing food spoilage
c) develop vaccines for chicken cholera, anthrax and rabies

https://www.famousscientists.org/louis-pasteur/
https://www.youtube.com/watch?v=JumRSmdZe3s (Pasteur on Spontaneous Generation)
https://www.youtube.com/watch?v=qIHnCleRDr4 (The History of Pasteurization: Killer Milk?!)
https://www.vbivaccines.com/wire/louis-pasteur-attenuated-vaccine/

> 'But that's the beauty of science,' said Naomi, smiling at her. 'New tests come along and we learn new facts, then we have to change our ideas.' (p 39)

4. Describe how developments in technology have advanced our biological understanding, using examples from the history of medical science. Examples might include:

- Koch's Postulates (p 145)
  https://www.britannica.com/biography/Robert-Koch
  https://www.historyofvaccines.org/content/koch's-postulates

- Watson and Crick's discovery of the double-helix structure of DNA (p 284)
  https://www.dnalc.org/view/15014-Franklin-s-X-ray-diffraction-explanation-of-x-ray-pattern-.html
  http://cen.xraycrystals.org/dna.html

- Marshall and Warren's discovery of the relationship between *Helicobacter pylori* and gastric ulcers (pp 290-292)
  https://www.theguardian.com/education/2005/oct/03/research.highereducation
  http://discovermagazine.com/2010/mar/07-dr-drank-broth-gave-ulcer-solved-medical-mystery

‘Gabrielle thinks mobile phones cause brain cancer …’ (p 45)

5. Use secondary sources to evaluate the claim that mobile phones cause brain cancer. What is the evidence for and against this claim? How did you determine whether the source of your data was reliable and valid?

https://www.cancercouncil.com.au/86093/cancer-information/general-information-cancer-information/cancer-questions-myths/environmental-and-occupational-carcinogens/mobile-phones-do-not-cause-brain-cancer/
https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/cell-phones-fact-sheet

‘Did you know that the Black Death killed more than twenty million people in only three years? Twenty million! That’s almost the entire population of Australia. In some parts of France and Spain, three out of every four people died.’ (p 70)

6. The Black Death killed vast numbers of Europeans in the mid-fourteenth century. Most scientists believe the Black Death was bubonic plague, caused by bacteria called *Yersinia pestis*, but there is some debate about this.
Describe the evidence for and against the hypothesis that *Yersinia pestis*, carried in fleas, caused the Black Death. What is your conclusion?

http://www.bbc.co.uk/history/british/middle_ages/black_01.shtml
https://www.newscientist.com/article/mg17223184-000-did-bubonic-plague-really-cause-the-black-death/
http://aetiologyblog.com/2008/01/17/did-yersinia-pestis-really-cau-1/ and http://aetiologyblog.com/2008/01/18/did-yersinia-pestis-really-cau-2/

7. When scientists want to find out whether a new medicine works, they often compare a group of people taking the medicine with a group of people taking a placebo.
What is a **placebo**? What is a **control group**? Why would researchers testing a new medicine use a placebo group, rather than comparing the group taking the medicine with a group not taking any medicine?

https://www.nhs.uk/livewell/complementary-alternative-medicine/pages/placebo-effect.aspx
https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/placebo-effect

In a well-designed medical research study (also called a clinical trial or medical treatment trial), the **research subjects** (the people who've agreed to take part in the trial) aren't told whether they're taking the medicine or a placebo, until after the trial is finished. Why aren't they given that information at the start of the trial?
Define **blinding** in the context of a medical research study. What is **double-blinding**?
Why are the research subjects randomly assigned to either the medicine group or the control group? How do researchers achieve true **randomisation**?

https://www.australianclinicaltrials.gov.au/what-clinical-trial/how-clinical-trials-work
https://www.eupati.eu/clinical-development-and-trials/concept-blinding-clinical-trials/

8. Homeopathy is an alternative therapy in which diseases are treated by tiny, almost nonexistent, doses of substances that in larger amounts would produce symptoms of that disease. Homeopaths claim that their therapy is effective in treating and preventing diseases.

Is homeopathic therapy more effective than placebo medicine?
Summarise the current medical evidence on the effectiveness of homeopathy.

https://nccih.nih.gov/health/homeopathy
https://www.nhs.uk/conditions/homeopathy/
https://sciencebasedmedicine.org/reference/homeopathy/

‘Okay, according to A. S. Hamilton, “travelling phrenologist”, Ned Kelly had huge organs of destructiveness and combativeness and ambition, and tiny organs of cautiousness and conscientiousness.’ (p 190)

9. Phrenology hypothesised that different parts of a person’s brain were related to different skills and personal characteristics. Phrenologists examined the bumps on a person’s skull to determine the size of these parts and matched them to the person’s skills and personality. (pp 189-191). Compare this to modern theories about the way the human brain works.

https://www.verywellmind.com/what-is-phrenology-2795251
http://www.historyofphrenology.org.uk/overview.htm
http://www.brainwaves.com/index.html
http://theconversation.com/the-brain-a-radical-rethink-is-needed-to-understand-it-74460

What is **bias**? Did the phrenologists who studied the skulls of bushrangers such as Ned Kelly and Captain Moonlite show bias in their work?

https://www.quirks.com/articles/9-types-of-research-bias-and-how-to-avoid-them

Why are **randomisation** and **blinding** necessary to achieve a valid result in a scientific study? Design a scientific study to test the claims of phrenology.

‘Just because two things happen together doesn’t mean that one of them caused the other,’ explained Alison. ‘It could be a coincidence. Or it could be that they’re both related to something else, which is the real cause.’ (pp 204-205)

10. Define these terms:

a) **coincidence**

b) **correlation**

c) **causation**

How do scientists work out if the results of their experiment are a coincidence or a real, meaningful effect? If scientists find a real relationship between two events, how can they work out if one is causing the other?

https://www.sciencenewsforstudents.org/article/explainer-correlation-causation-coincidence-and-more
http://theconversation.com/clearing-up-confusion-between-correlation-and-causation-30761
https://www.youtube.com/watch?v=HSNp5MlTE-c (Correlation vs Causation Psy101)

‘A girl called Emily Rosa designed a scientific study to see whether Therapeutic Touch really worked,’ said Jaz, wearing an expression made up of equal parts admiration and resentment. ‘Her research was so good that it got published in *The Journal of the American Medical Association*. In fact, she’s the youngest person ever to have a research paper published in a proper medical journal. And she was *nine years old*.’ (p 201-202)

11. Read Emily Rosa’s research paper: https://jamanetwork.com/journals/jama/fullarticle/187390 . Summarise her research using the following headings: Hypothesis, Method, Results and Conclusion.

Therapeutic Touch practitioners objected to Emily’s research: https://www.quackwatch.org/01QuackeryRelatedTopics/ttresponse.html
Do you think Emily’s research was a well-designed scientific experiment? Does her experiment prove that Therapeutic Touch does not work?

‘Oh, and while we’re on the subject of medical disasters caused by pharmaceutical companies, what about thalidomide, eh?’ (p 214)

12. Chemie Grünenthal, a German pharmaceutical company, developed a drug called thalidomide in the 1950s. Thalidomide was used to treat morning sickness during pregnancy, but was withdrawn from sale several years later after some doctors realised it caused severe birth defects. Some people say that the thalidomide tragedy shows that ‘science doesn’t work’.
Did Chemie Grünenthal use science to prove that thalidomide was a safe and effective treatment for morning sickness before putting the drug on the market?
How did the thalidomide tragedy change the way medical drugs were developed and sold?
Describe the process a new medicine needs to go through now before it can be sold in Australia.

https://theconversation.com/infographic-a-snapshot-of-the-thalidomide-tragedy-50968
http://www.sciencebasedmedicine.org/index.php/oh-yeah-thalidomide-wheres-your-science-now/
http://www.smh.com.au/national/the-50year-global-coverup-20120725-22r5c.html
https://theconversation.com/regulations-have-improved-since-thalidomide-but-drug-scares-are-still-possible-48661
http://www.tga.gov.au/sites/default/files/tga-education-medicines-1.pdf

‘There are hundreds of plants that have been used as traditional medicines. You should see this list. Chamomile, peppermint, evening primrose, garlic, ginger, St John’s wort, tea tree, valerian, cacao ... Hey, that’s chocolate!’ (p 219)

13. Choose one of the following natural substances. Research its medicinal properties. Write a summary of your research findings, including evidence of the substance’s effectiveness as a medicine and any side effects.

Cacao/chocolate
Chamomile
Garlic
Ginger
Honey
Peppermint
Foxglove

‘Now there are superbugs that can’t be killed by any known antibiotic. Too bad if you get infected with one of those bugs the next time you go into hospital.’ (p 237)

14. What is **drug resistance**? Describe how bacteria become resistant to antibiotics. ‘Superbugs’ that can’t be killed by any known drugs are becoming more widespread. What problems does this cause for the health system? What steps should be taken to reduce antibiotic resistance?

http://www.abc.net.au/news/health/2017-02-28/superbugs-what-are-they-and-how-are-they-treated/8310556
https://www.statnews.com/2016/07/26/superbug-antibiotics-bacteria/
https://theconversation.com/how-common-are-superbugs-in-australia-and-what-do-we-do-when-the-antibiotics-dont-work-80318

‘Yes, Plasmodium became resistant to not just chloroquine, but practically any new drug we could invent…’ (p 271)

How has resistance to drugs and pesticides made it difficult to control malaria?
How might environmental and social changes increase the number of cases of malaria worldwide?

https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/malaria
https://www.gsk.com/en-gb/behind-the-science/access-to-healthcare/the-fight-against-malaria/
https://www.yourgenome.org/stories/the-ongoing-battle-against-drug-resistant-malaria

‘ … she went online and found this doctor in London who’d published a scientific paper saying the measles vaccine *did* cause autism, because it isn’t just the measles virus in that vaccine, it has mumps and rubella viruses in it as well, and that’s all too much for babies to cope with.’ (p 247)

15. How do vaccines prevent disease? What is **herd immunity**?

https://www.historyofvaccines.org/content/how-vaccines-work
https://www.historyofvaccines.org/content/herd-immunity-0
https://theconversation.com/explainer-what-is-herd-immunity-52377

Does the Measles Mumps Rubella (MMR) vaccine cause autism? Summarise the current evidence for and against this claim.

http://www.immunise.health.gov.au/internet/immunise/publishing.nsf/Content/F466A36DFA42DD93CA257F0F000216D7/$File/What-about-austism.pdf
http://theconversation.com/muddied-waters-setting-the-record-straight-about-mmr-vaccinations-and-autism-3391
https://theconversation.com/no-combination-vaccines-dont-overwhelm-kids-immune-systems-82377

‘Fleming didn’t know enough about chemistry to be able to make any pure, stable penicillin. Fleming gave up. What he really needed was … a team.’ (p 233)

16. The Nobel Prize in Physiology or Medicine is a prestigious award for medical discoveries, but can only be awarded to three people, at most, for each prize. Why is this rule controversial?

‘Let’s do a survey of everyone we can find, asking them what they think is the most important discovery in modern medicine.’ (p 292)

17. What do *you* think is the most important medical discovery of the past 100 years?

https://www.britannica.com/topic/history-of-medicine/Medicine-in-the-20th-century
http://ignoringfriction.blogspot.com.au/2008/11/top-ten-medical-advancements-of-20th.html
https://www.medpagetoday.com/infectiousdisease/publichealth/17594

‘Here’s a letter from the Director General of Public Health,’ said the woman. ‘It says, “In 1883, the rabbits had increased in such alarming proportions that the government of New South Wales offered a reward of £25,000 to anyone who could discover or provide a reliable method of destroying rabbits …”’ (p 130)

18. Rabbits were introduced to Australia by European settlers.
What were the effects of rabbits on the Australian environment?

Louis Pasteur sent his nephew to Australia to attempt to eradicate rabbits with chicken cholera.
How successful was this?
What other biological methods have been used to control the rabbit population in Australia? Have these methods been successful?
What other introduced species have caused environmental destruction in Australia? Choose one introduced pest and describe its introduction to Australia, its effect on the environment and attempts made to control or eradicate it.

http://www.rabbitfreeaustralia.com.au/rabbits/the-rabbit-problem/#history
http://www.abc.net.au/radionational/programs/earshot/louis-pasteur-and-the-$10m-rabbit-reward/6703072
http://www.rabbitfreeaustralia.com.au/rabbits/controlling-rabbits/
http://www.environment.gov.au/biodiversity/invasive-species/feral-animals-australia

Activity Sheet 1

How well do you understand the scientific method and medical research trials?

Draw a line from the term to its correct definition:

hypothesis	a factor that can be changed, kept the same or measured in an experiment
evidence	asking people a set of questions to gather data
blinding	a prediction that can be tested in an experiment
double-blinding	a relationship where one thing causes the other thing
variable	someone or something that is experimented on
randomisation	when the subjects in an experiment don't know if they're in the treatment group or the control group
control group	reliable data that supports a hypothesis
experiment	when neither the subjects nor the experimenters know which subjects are in the treatment group or the control group
correlation	when subjects in an experiment are randomly put in either the control group or the treatment group
causation	a group in an experiment that is not given any treatment, with the results measured
treatment group	a scientific procedure to test a hypothesis
placebo	a relationship where two things tend to happen together
data	information gathered in an experiment, used to draw conclusions
survey	a group in an experiment that is given medicine or some other type of treatment, with the results measured
subject	something that looks like a medicine or medical treatment, but doesn't have any medical properties

Activity Sheet 2

How well do you understand microbes?

It's important to understand whether diseases are caused by bacteria or viruses, because antibiotics only work against bacteria. Are these diseases bacterial or viral? The first one has been done for you.

Disease	Bacterial or Viral?
cholera	bacterial
hepatitis B	
Zika	
leprosy	
diphtheria	
influenza	
AIDS	
bubonic plague	
typhoid	
poliomyelitis	
rabies	
measles	
tuberculosis	
mumps	
smallpox	
puerperal fever	
Ebola	
tetanus	
common cold	

Medical Ethics

1. Rosy and Jaz wonder about the relevance of the Hippocratic Oath to modern doctors (p 50). Look up the old and modern versions of the Hippocratic Oath. Do Australian doctors still swear this oath when they begin their medical careers? Could any parts of the oath be harmful to patients?

> 'They had to observe patients' symptoms carefully, and ask about their lifestyle, and keep detailed medical records …' (p 51)

2. Why do doctors and other health professionals have to keep records about their patients' healthcare?

How long do Australian health professionals need to keep medical records for

a) adult patients?
b) child patients?

Who is able to access these records?

In the past, doctors kept medical records on paper. Now, many doctors keep digital medical records. What are the advantages and disadvantages of each form of record keeping?

https://www.avant.org.au/resources/start-a-practice/practice-operations/systems-and-procedures/medical-records/

> 'Sicily was the first place to require doctors to pass an exam and get a medical licence, and that was in 1140.' (p 82)

3. Why do doctors need to register with a medical board before they are allowed to work as doctors?

4. Experiments on animals have helped scientists learn about how the human body works, which has led to advances in medicine.

Describe three examples of historical scientific discoveries that used animal experimentation. Examples might include:

- William Harvey's work on the blood circulation system (pp 110-115)
- Louis Pasteur's development of vaccines for cholera, anthrax and rabies (pp 136-141)
- David Ferrier's work on epilepsy and neurology (pp 191-192)

What are the arguments for and against using animals in medical experiments? Do you think that animals should be used in medical experiments?

http://www.bbc.co.uk/ethics/animals/using/experiments_1.shtml
http://www.ethics.org.au/on-ethics/blog/december-2014/animal-surgery-experiments
http://animalsaustralia.org/factsheets/animal_experimentation.php

'….in 1377, Ragusa, a Venetian colony, decided to isolate ships for forty days after they arrived, to make sure sailors and cargo were truly free of the plague before they left the ship. That's why it's called quarantine now, because *quarantina* is Italian for "forty days". And in Milan ... Oh. When the plague reached Milan, authorities bricked up the doors and windows of the three affected households, sealing all the people and animals inside.' (p 74)

5. Define **isolation** and **quarantine**. Describe two historical examples of quarantine. Examples might include:

- plague villages (http://www.bbc.com/news/uk-england-35064071)
- Typhoid Mary (http://www.history.com/news/10-things-you-may-not-know-about-typhoid-mary)
- North Head Quarantine Station, Sydney (http://www.naa.gov.au/collection/fact-sheets/fs143.aspx)

Under which circumstances are isolation or quarantine used today? Can authorities force quarantine on people with infectious diseases? Discuss the ethical issues associated with quarantining a person or groups of people.

http://www.health.gov.au/quarantine
http://www.health.nsw.gov.au/Infectious/Pages/notification.aspx

‘I mean, once I’m dead, what does it matter what happens to my body? I’m not using it anymore. Better to have it educating medical students than rotting in the ground.’ (pp 99-100)

6. Who ‘owns’ a dead body?

Would you agree to give your body, after death, to medical science:

a) to educate medical students?
b) to be experimented upon?
c) to be exhibited in educational displays?

Some people have objected to Gunther von Hagens’ exhibitions of dead bodies (pp 100-104). Why? Would you visit a Body Worlds exhibition if you had the opportunity?

https://bodyworlds.com/exhibitions/
https://bodyworlds.com/about/faq/
https://www.theguardian.com/education/2002/mar/19/arts.highereducation

‘What if it’s her decision not to donate any of her organs after she dies?’ said Jaz. ‘And meanwhile, sick people are spending their lives hooked up to oxygen tanks or kidney dialysis machines and little kids are dying waiting for a heart transplant?’ (p 100)

7. Doctors can now take the heart, lungs, kidneys, liver, pancreas and other organs from a dead body and transplant them into patients who need them. Australians who would like to donate their organs after their death can sign up to the Australian Organ Donor Register.

Do you want your organs to be donated after your death? Why or why not?

Do you think anyone should be able to receive transplanted organs? Why or why not?

Organs can only be used for transplants if the donor dies in hospital under certain conditions. Only about 1% of Australians die in these circumstances, so there is a long waiting list for organs. Even if a person has registered with the Australian Organ Donor Register, their family can refuse to allow their organs to be donated after death.

Why do doctors ask permission from family members? Why might family members refuse permission?

Organ donation rates are measured in Donors Per Million of Population (DPMP). The country with the highest number of organ donors is Spain, with 43.8 DPMP. In 2016, Australia had 20.7 DPMP, less than 50% of world leading practice.

What factors affect the rate of organ donation in a country?

https://transplant.org.au/the-facts/
http://www.donatelife.gov.au/discover/facts-and-statistics
http://www.donatelife.gov.au/understanding-donation-process
http://www.sharelife.org.au/organ-donation-myths-and-facts

Living donors can donate one of their kidneys or part of their liver. Usually they donate their organ to a family member or close friend.
Why do living donors usually donate their organ to someone they know? Why do living donors need to be 18 years or older?

http://kidney.org.au/your-kidneys/support/organ-donation/living-donors

In Australia, you need to be over 18 years old to donate blood. Why?
Do you plan to become a blood donor when you turn 18? Why or why not?

http://www.donateblood.com.au/age-change-faqs

‘Yeah, but, Jaz, I was thinking,’ said Rosy, ‘maybe genetic tests aren’t so great. I mean, what if they told you that you were going to get some incurable fatal disease?’ (p 286)

8. Genetic testing is now available for some diseases. Some companies offer home genetic testing kits online to anyone who wants to pay for it.

How accurate is genetic testing in making predictions about a person’s health?
What factors other than genes can affect a person’s health?
What are the problems associated with genetic testing done online, without personal medical supervision?

http://www.hnekidshealth.nsw.gov.au/site/info-genetictesting
https://www.theguardian.com/science/2017/jul/23/what-i-learned-from-home-dna-test-kits-are-they-accurate-or-worthwhile

Some genetic tests can be done before birth – for example, to determine whether a baby will be born with Down Syndrome.
Discuss the ethical issues associated with prenatal testing.

https://www.betterhealth.vic.gov.au/health/healthyliving/pregnancy-prenatal-tests
https://www.todaysparent.com/pregnancy/ethics-prenatal-testing/
https://www.downsyndrome.org.au/documents/resources/prenatal/DSA_prenatal_resource_updated_Nov_16.pdf

Huntington’s Disease is caused by a defective gene that destroys brain cells. At the moment, there is no cure for Huntington’s Disease. There is a genetic test available for people with a family history of the disease, but anyone having the test needs to have counselling first.
Why is counselling important before deciding to have genetic testing?
How might it affect a person’s life if they discover they have the gene that causes Huntington’s Disease?

https://www.huntingtonsnsw.org.au/information/hd-facts/what-huntingtons-disease

Further Resources

For a comprehensive bibliography of the sources used in *Dr Huxley's Bequest*, see pp 319-329.

For a virtual tour of the real-life setting of *Dr Huxley's Bequest*, see http://www.michellecooper-writer.com/huxleyplaces.html

Timelines of medical discoveries

Brief timeline from ancient Egypt to 21st Century: http://www.datesandevents.org/events-timelines/10-history-of-medicine-timeline.htm

Detailed timeline from Stone Age to 21st Century: https://en.wikipedia.org/wiki/Timeline_of_medicine_and_medical_technology

History of anaesthetics: http://www.ozemedicine.com/wiki/doku.php?id=h_anaesthesia

History of vaccines: https://www.historyofvaccines.org/timeline

Biographies of famous medical scientists

https://www.famousscientists.org/top-biologists/

History of medical research

James Lind Library. Includes illustrated timeline, articles and essays illustrating the development of fair tests of treatments in health care: http://www.jameslindlibrary.org

Scientific literacy

Australian Skeptics Educational Resources: https://www.skeptics.com.au/resources/educational/

Science in Medicine: http://www.scienceinmedicine.org.au/what-do-we-stand-for/position-document/