

SUBJECT: **Cross-curricula**

LEVEL/YEAR GROUP: **16+**

LENGTH OF SESSION: **60 minutes**

Women in Science

A cross-curricula resource which could be used in lessons for science, sociology, history, or English, depending on how it is adapted and which entries are included. This activity could be used for International Women's Day, general presentation practice, or individual projects such as the EPQ.

ICE BREAKER/OPENING QUESTION

TIME: **5 minutes**

Ask the class to name as many male and female scientists as they can, along with what these scientists are known for.

DISCUSSION

TIME: **5-10 minutes**

Discuss reasons why the list is filled with more male scientists than female (if this is the case), considering factors such as historic gender inequality.

- Do students think that this could have led to female scientists using pseudonyms in some cases? What other means do you think may have been used to combat gender inequality?
- To what extent do students think that male partners historically taking the majority of the credit was a problem? (Women are under-represented in the scientific literature as a whole and therefore fewer of them end up being cited in the *OED*.)

MAIN ACTIVITIES

TIME: **35-45 minutes**

10-15 minute task: In pairs or groups, ask students to list the *OED* entries in which a particular scientist might be mentioned without looking online. You can provide the students with a selection of names from the list at the end of this resource. Students should give a reason for each scientist being associated with a certain entry. E.g. linking Florence Nightingale with 'hospital' because she was a social reformer, statistics innovator, and the founder of modern nursing.

5-10 minute task: Use the *OED* online to check these answers either by searching for the entry terms and exploring the quotations, or by using the advanced search to look for the name of the scientist and the entries they feature in. You can also search for any scientists who weren't mentioned in the previous task.

20 minute group task: Women are under-represented in science literature as a whole and therefore fewer of them end up being cited in the *OED*. And while the *OED* doesn't cite people based on their credibility, status, or achievements, which women would you would like to see cited in the *OED*? Using a scientist from the list at the end of this document or a scientist of your own choosing, create a 5-10 minute presentation on who this scientist is and which entries they could be cited in. Include specific publications and specific quotations if you can.

EXTENSION/HOME TASK

Using what has been discussed in this lesson, the following articles, and independent research, write 500-1000 words on the developments of feminism and equality in the STEM industries.

www.bbc.co.uk/news/science-environment-41861232

www.bbc.co.uk/news/science-environment-43460528

Quotes from set novels, ideas from studied theorists, and other lesson resources can be used alongside *OED* entries and the articles.

Women in the *OED* to match up with entries

Mary Somerville

Science writer, polymath, physicist, and mathematician

More than 150 mentions in the *OED*, including: acceleration, alkaline, allotropic, ammonia, analysing, asteroid, cobalt, conductive, conductivity, correlation, elasticity, electricity, empirical, equator, insulate, lunar, physics, solar, thermic, vibration.

1869 M. SOMERVILLE *Molecular & Miscrosc. Sci.* I. i. ii. 90 A spiral wire electrized by the great battery..at the London Institution.

Professor Alice Roberts

Evolutionary biologist and anthropologist, medical doctor, anatomist, osteoarchaeologist

2014 A. ROBERTS *Incredible Unlikeness of Being* 205 Most bony fish, from gobies to sturgeon, possess a swim bladder.

2014 A. ROBERTS *Incredible Unlikeness of Being* 18 The fact that, as a tiny embryo, you had a yolk sac, even a small, un-yolky one, reveals something about your ancestry and the links between embryology and evolution.

Side note: Alice Roberts's book was read for a specific *OED* reading programme, which is why she is cited so often. This is just one reason why one scientist may be cited more than another.

Rosalind Franklin

Crystallographer and chemist who contributed to the understanding of DNA, RNA, and viruses.

Franklin was never nominated for a Nobel Prize, although her work was fundamental to the discovery of the molecular structure of DNA, for which James Watson, Francis Crick, and Maurice Wilkins received the Nobel Prize.

Mentions in the *OED*: woman, paradigm.

2002 B. MADDOX *Rosalind Franklin* (2003) ix. 128 UCL women, when polled, chose to retain the status quo.

2001 *Kenyon Rev. & Strand* Spring 243 The paradigm case of the scientific victim is Rosalind Franklin, researcher in crystallography at Cambridge and London, who played a crucial part in the discovery of DNA.

The 2001 quotation shows that Rosalind Franklin has been retrospectively credited as fundamental to the discovery of DNA. Why do students think it may be difficult to find work published by Franklin herself? One reason for this is that we don't tend to give the names of authors of scientific papers (although there are reasons why we might do, including when the word is a coinage or if the scientist is very famous).

1953 R. FRANKLIN & R. GOSLING in *Nature* 25 Apr. 740/1 Sodium Thymonucleate fibres give two distinct types of X-ray diagram. The first corresponds to a crystalline form, structure A, obtained at about 75 per cent relative humidity..At higher humidities a different structure, structure B, showing a lower degree of order, appears and persists over a wide range of ambient humidity. The change from A to B is reversible.

This quotation is the first example of the use of the word B-DNA in the *OED*.

Women in Science

Mary Anning

Palaeontologist and the first to find ichthyosaur and plesiosaur fossils.

Although not directly cited in the *OED*, she is mentioned in two quotations.

- 1969 J. FOWLES *French Lieutenant's Woman* viii. 50 Although many scientists of the day gratefully used her [sc. Mary Anning's] finds to establish their own reputation, not one native type bears the specific anningii.
- 1829 C. LYELL *Jrnl.* 20 Feb. in *Life, Lett. & Jrnls.* (1881) I. x. 247 I announced Mary Anning's new Pterodactyle of Lyme.

Lise Meitner

Chemist and nuclear physicist who was one of three leaders of the team of scientists who discovered nuclear fission. Her colleague, Otto Hahn, received the Nobel Prize for work on nuclear fission in 1944.

- 1939 MEITNER AND FRISCH in *Nature* 11 Feb. 239/2 By bombarding thorium with neutrons, activities are obtained which have been ascribed to radium and actinium isotopes. Some of these periods are approximately equal to periods of barium and lanthanum isotopes resulting from the bombardment of uranium...We should.. like to suggest these periods are due to a 'fission' of thorium.
- 1939 MEITNER AND FRISCH in *Nature* 11 Feb. 240/1 'Fission' of the nucleus.

Mentions in the *OED*:

- 2007 P. RIFE *Lise Meitner & Dawn Nucl. Age* iii. 52 Their work—on the thorium decay series, uranium 'Y'...and the magnetic spectra of beta rays of radioactive products of uranium—produced new questions.
- 1939 MEITNER AND FRISCH in *Nature* 11 Feb. 239/2 It seems..possible that the uranium nucleus has only small stability of form, and may, after neutron capture, divide into two nuclei of roughly equal size... The whole 'fission' process can...be described in an essentially classical way.

This mention announces that an element will be named after Meitner:

- 1992 *Science* 18 Sept. 1626/4 109 is to be meitnerium after the German nuclear physicist Lise Meitner.

Caroline Herschel

The world's first professional female astronomer who discovered several comets and worked alongside her brother William, recording observations, helping him construct telescopes, reading his manuscripts for errors etc. Her 1787 paper ('An account on a new comet') was one of the first papers by a female author to appear in any scientific journal throughout the world, and it was the first paper by a woman to be read to the Royal Society.

www.ncbi.nlm.nih.gov/pmc/articles/PMC4360080

Mentions in the *OED*:

- 1835 R. SOUTHEY *Doctor* III. 218 Miller talked to him of Herschel's performances in sky-sweeping and comet-hunting.

And these are some of her quotes included in the entries for 'focus' and 'magnifier':

- 1786 C. HERSCHEL *Let.* 2 Aug. in *Philos. Trans. 1787* (Royal Soc.) 77 2 The object in the center is like a star out of focus... and I suspect it to be a comet.
- 1786 C. HERSCHEL *Let.* 4 Aug. in *Mem. & Corr.* (1876.) ii 71 I found it [sc. a comet] with a magnifier of about 30, with a field of about 1½ degree.

Women in Science

Dr Elizabeth Blackwell

First US woman to graduate from medical school (where she was advised to disguise herself as a man in order to study). Dr Blackwell founded the London School of Medicine for Women in 1874.

OED mention:

1895 E. BLACKWELL *Pioneer Work* ii. 38 I added a description of the goodness, purity, and the angelicalness of his nephew.

Vera Rubin

Astronomer and cosmologist who proved the existence of dark matter in galaxies. Published more than 150 scientific papers and has one mention in the *OED* at LONG adj.1:

1996 V. RUBIN *Bright Galaxies, Dark Matters* 1. 40 We must obtain the spectra across a long projected path. At large distances from the galactic nucleus the velocities of individual stars are still too difficult to obtain.

List of scientists for the 20 minute group task

Dorothy Hodgkin: (1910–1994) chemist and X-ray /protein crystallographer who confirmed the structure of penicillin and discovered the structure of vitamin B12 and insulin. Awarded Nobel Prize for Chemistry.

Prof. Jocelyn Bell Burnell: astrophysicist and astronomer who discovered the radio pulsar. Many people criticize her omission from the Nobel Prize, which was awarded to Matthew Ryle and her supervisor, Antony Hewish. She has published many articles and books since 1968, and constructed a radio telescope.

Ellen Stofan: former NASA chief scientist and the inventor of various probes, including the 'Boat' probe to send to Saturn's moon, Titan.

Ada Lovelace: (1815- 1852) English mathematician and writer who wrote the first computer programme and worked with Charles Babbage on the idea for the first computer, the Analytical Engine.

(It is difficult to find quotes by Ada Lovelace in the *OED* because of the many changes to her name in her short life).

Hertha Ayrton: (1854-1923) Electrical Engineer, the inventor of an improved electrical arc lamp, and the first female member of the Institute of electrical Engineers. Her husband is cited in the *OED* but not her.

Jo Dunkley: Oxford Astrophysicist.

Helen Czerski: Physicist and Oceanographer.

Alison Woollard: Oxford geneticist, evolutionary scientist, and Royal Institution Christmas lecturer.

Sophie Wilson FRS FREng: (born Roger Wilson in 1957) Computer Scientist and Software Engineer, Inventor of the ARM microprocessor/architecture in 1985, which is the processor used in most 21st century smartphones, including the iPhone. She still works on phone/computer processor architectures.

Danielle George: Radio-frequency engineer, electronic engineer, and Royal Institute lecturer.

*This list is in no way exhaustive.

Adaptation examples

TO ADAPT FOR AN ENGLISH CLASS

- Use women in literature, or search for specific texts on the curriculum cited in the *OED*, to ask why it can be hard to find women in the *OED*. Think about the scientific discoveries and events from this lesson in relation to texts such as *Frankenstein*, *The Time Machine* and *Dracula*. How do the authors react to the scientific discoveries of their period?
- If your class is focussing on a certain novel or author, look for the entries in which the text and/or author are mentioned. Why do you think this is? E.g. pick five entries and senses cited by Jane Austen. What do you think this says about the Georgian or Victorian era and the authors' social commentaries? To practise A04, compare and contrast this to a modern author or scientist's citations.
- George Eliot is the most-cited woman in the *OED*. Further discussions using this information could focus specifically on the use of pseudonyms in history.

TO ADAPT FOR A SCIENCE CLASS

- Use more science-focussed entries, such as specific chemical elements and investigation techniques or equipment, with each group focussing on a specific discovery and any controversy that surrounds it.

Curriculum requirements/objectives

How this resource meets the current curriculum requirements/ curriculum objectives for students to bear in mind when carrying out the tasks:

ENGLISH LITERATURE AND LANGUAGE

A01 (1c): Use coherent written expression.

A02: Analyse ways in which meanings are shaped in texts, emphasising the ability to analyse.

A03: Demonstrate understanding of the significance and influence of the contexts in which texts are produced and received (the question of context is a fundamental concern for the suite of English subjects as a whole, each text has its own unique context, such as genre, period, social, historical, geographical, and regional context).

A05: Demonstrate expertise and creativity in the use of English to communicate in different ways (accuracy and control of style for audience, form and purpose, as well as originality and producing engaging writing).

SOCIOLOGY

A02: Apply sociological theories, concepts, and evidence and research methods to a range of issues.

A03: Analyse and evaluate sociological theories, concepts, evidence, and research methods in order to present arguments, make judgements, and draw conclusions.

BIOLOGY, CHEMISTRY, AND PHYSICS

A01: Demonstrate a knowledge and understanding of scientific ideas, processes, techniques, and procedures.

HISTORY

A01: Demonstrate, organise and communicate knowledge and understanding to analyse and evaluate the key features related to the periods studied, making substantiated judgements and exploring concepts, as relevant, of cause, consequence, change, continuity, similarity, difference and significance.

A03: Analyse and evaluate, in relation to the historical context, different ways in which aspects of the past have been interpreted.