

Overview

This unit traces, in outline, some of the developments that have led to modern chemotherapy. The central focus is on Paul Ehrlich's imaginative idea that it should be possible to find chemicals that target and kill disease-causing organisms while leaving normal body cells unharmed – 'magic bullets'. He first used the term to describe an antibody, and later a chemical that binds to and specifically kills microbes or tumour (cancer) cells. In that sense, the first modern chemotherapeutic agent was Paul Ehrlich's arsphenamine, an arsenic compound discovered in 1909 and used to treat syphilis. This was later followed by sulphonamides discovered by Gerhard Domagk and penicillin discovered by Alexander Fleming. Today monoclonal antibodies – many antibodies of the same type – are used to treat a wide array of human diseases including cancer.

The unit also highlights some of the characteristics of scientific research, because the quest for the first 'magic bullet' was a long and arduous team effort.

The activities

There are two activities in this unit. The unit would be suitable after work on drugs and disease. The second activity could also be used for a cover lesson with the questions for homework, before or after the first activity. If students have access to computers, the first part of 'A story of drug discovery' could be done on screen.

The search for the magic bullet timeline

The Presentation gives an overview of the story and is intended to stimulate discussion. A commentary for each slide is provided in the guidance for teachers. The students are then asked to produce a timeline of events and answer questions.

A story of drug discovery

This is a 'directed activity related to the text' (DART), intended to draw out aspects of 'how science works'. The students are first asked to read and sort passages of text and provide sub-headings for an article. The aim of this is to encourage them to read the passages carefully and gain an overall sense of the ideas in the article. Then students answer questions that test comprehension, some of which highlight aspects of 'how science works'.

Curriculum links (for students aged 14–16)

How Science Works (from POS KS4 for England)

Data, evidence, theories and explanations

1a how scientific data can be collected and analysed

1b how interpretation of data, using creative thought, provides evidence to test ideas and develop theories

1c how explanations of many phenomena can be developed using scientific theories, models and ideas

Communication skills

3a recall, analyse, interpret, apply and question scientific information or ideas

3c present information, develop an argument and draw a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools

Applications and implications of science

4c how uncertainties in scientific knowledge and scientific ideas change over time and about the role of the scientific community in validating these changes

GCSE or equivalent 14–16 specifications

England (GCSE)

AQA Science A 4461

Unit Biology 1a: Human Biology

11.3 How do we use/abuse medical and recreational drugs?

11.4 What causes infectious diseases and how can our bodies defend themselves against them?

AQA Science B 4462

Biology Unit 1

11.3 How do we use/abuse medical and recreational drugs?

11.4 What causes infectious diseases and how can our bodies defend themselves against them?

AQA Biology 4411

Biology Unit 1

11.3 How do we use/abuse medical and recreational drugs?

11.4 What causes infectious diseases and how can our bodies defend themselves against them?

AQA Applied Science (Double Award) 4861

Science for the Needs of Society Unit 2

11.2 Health and medicine – Illnesses, diseases, and their diagnosis and treatment

Edexcel 360 Science 2101

Biology B1b: Topic 4 – Use, misuse and abuse

Edexcel 360 Biology 2105

Biology B3: Topic 1 – Biotechnology

OCR Science A (21C science) J630

Module B2: Keeping healthy

OCR Biology A (21C) J633

Module B2: Keeping healthy

OCR Science B (Gateway Science) J640

Module B1: Understanding ourselves; Item B1c: Keeping healthy; Item B1e: Drugs and you

OCR Biology B (Gateway Science) J643

Module B1: Understanding ourselves: Item B1c: Keeping healthy Item B1e: Drugs and you

OCR Applied Science (Double Award) J649

Unit 2: Science for the needs of society

2.2 Humans as living organisms; 2.2.3 Diseases caused by micro-organisms

Scotland (SCE standard grade)

No direct links

Wales (WJEC GCSE)

Biology

Module B3: 5. Microbes and disease

NI (CCEA GCSE)

Science (Single Award)

Module 2 Human activity and health: Disease and body defences;

Biology

3.4 Microbiology

Learning objectives

By working through the unit, students come to understand:

- that some drugs come from natural sources, others are natural compounds modified chemically while others are completely synthetic
- how the discovery of synthetic dyes led to their use in distinguishing bacteria and then later as drugs for treating disease
- how imaginative thinking by Paul Ehrlich, inspired by the selective staining of cells, led to the idea of 'magic bullets' – chemicals that can target cells that cause disease
- that the search for new drugs is a long drawn out process involving much testing
- that chemotherapy involves the use of chemicals to treat disease, and that it is now important for treating cancer.

Teaching and learning approaches

Learning Skills, learning by/from:

- discussing ideas in a small group (LSS2)
- reflective reading (LSS1, LSS3)
- interacting with a variety of audio-visual media
- 'case-studies' in a variety of contexts (LSS3)
- devising 'visual' ways of expressing and communicating ideas (including maps, diagrams, charts) (LSS3) (LSS6)
- gathering information from a variety of sources (LSS1).

For further information about Learning Skills for Science (LSS) click **here**.

References

Anthony S. Travis, 'Paul Ehrlich: A Hundred Years of Chemotherapy 1891–1991', *The Biochemist*, Vol 13, No. 5, see
www.animalresearch.info/en/medical/lectures/Ehrlich_thebiochemist

Acknowledgements

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