STEM LEARNING

BORN TO ENGINEER

Born to Engineer teaching resources

# Teachers' notes – Cancer



## Curriculum links

Cancer features in the English GCSE subject content for Combined Science (2015) in the biology section under 'Growth and development of cells' and under 'Non-communicable diseases in humans'.

It also appears in the Scottish N4 Biology curriculum under 'Cell biology'.

## The science of cancer

Cancer is a disease affecting a large proportion of the population, and as the average age of the population continues to increase, the numbers of cases of cancer are set to rise in future. Currently about one in three of the population are expected to develop some form of cancer in their lifetime.

There are multiple factors influencing the onset of cancer, with frequent media stories announcing new potential carcinogens in our environment. Although cancer can affect very many different parts of the body, the disease is linked to abnormal cell growth due to changes in the genome. This can give rise to groups of cells that function differently to the surrounding tissue, forming a tumour.

Some tumours are benign and do not spread around the body, whereas cancerous tumours can spread to other body parts, triggering further cancerous growths (metastases) in organs, lymph nodes and bones.

Treatments include surgery, using radiation to destroy cancerous cells, and chemicals used to disrupt cell growth. Early diagnosis is essential for these treatments to be effective.

Dr Eleanor Stride is developing a treatment for cancer that encloses cancer-treating drugs in bubbles that can be directed by magnetic fields to the cancer site before releasing the drug. This targeted approach avoids some of the damaging side effects of traditional chemotherapy, which is untargeted, and results in healthy cells being destroyed. One unfortunate side effect of traditional chemotherapy is the damage caused to the immune system which increases the risk of infection to patients.

This activity provides students with a better understanding of the biology of cancer. A further resource (Bubbles), focused on the work of Eleanor Stride, considers how engineers can create bubbles to deliver drugs.

## Expected outcomes

Students will be able to:

- explain cause, effect and treatment of cancer in humans
- describe how scientific principles can be used to create engineering solutions
- recognise the personal attributes and motivations of people choosing a career in engineering

## Introducing the activity

Use the video clip of biomedical engineer Eleanor Stride produced by the ERA Foundation and available on the Born to Engineer website, or from STEM Learning.

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Video clips are an effective way of familiarising students with a topic, and can provide a useful introduction at the start of a lesson. You could choose one of these four activities to help to direct attention to specific points, or to ensure that students have an opportunity to consider key messages.

## 1. Adapting for different audiences

Working in small groups of two to three students, suggestions are made on how the video clip could be repurposed for a different audience, such as a class of children in primary school, aged 10 and 11.

Watch the entire video clip as a class, and then set the task to small groups, asking them to consider different modifications, such as:

- What content needs to be removed?
- What additional content could be helpful?
- What changes should be made to the language used?
- What additional images would help convey the key messages?

The video clip should then be made available for groups to review whilst making their suggestions. Set a time limit for the activity after which groups feed back their main points.

## 2. Going further

Generate questions that could be put to the presenter to find out more about the topic.

Watch the entire video as a class, and then ask students individually to generate one question that they would like to ask the presenter. In addition, you could ask individuals to generate one question that could be answered from the video clip. Students could then exchange questions with a partner, and attempt to answer each other's questions after watching the clip a second time.

## 3. Designing a quiz

Individual students generate questions and these are used as a quiz for the class.

Watch the video clip as a class. Set each student the task of generating one question that can be answered from the clip, and which has a single word answer.

Collect up the questions and insert the initial letter from each answer into a cell in the Blockbuster grid template. This will work best if each student is allocated a different letter of the alphabet as the initial letter of their answer.

To play the quiz, you take on the role of question master. Divide the class into teams. Two teams can take part in the quiz at once – one team moves from A to B on the grid, the other from C to D. The team that reaches their destination first is the winner. To move on the grid the team select a letter, and you read out the corresponding question. If they answer correctly, they 'own' that cell, which can be filled in in a specific colour to indicate ownership. A team's cells must touch to make a pathway from their start point to their destination. Use presentation software such as Keynote to display the grid to the class and to fill cells with different colours.

## 4. Supporting evidence

Does the presenter use evidence (verbal, visual, implied) to give the key messages credibility?

Watch the video clip as a class, and then ask the class to suggest the key messages that they took from the video. Refine the list of suggestions using discussion to reach a class consensus, and agree on a list of no more than three key messages.

Watch the video for a second time, and ask the class to note any evidence used to support the three key messages. Finally, have a brief class discussion to share views on the evidence presented.

A poster featuring Eleanor Stride is available for download from the Royal Academy of Engineering.

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# Student activity

## Research phase

This activity asks students to consider the biology of cancer, and to use the information they research to produce a document summarising their main points.

The source of information for this activity is a TEDx talk – The Complex Biology of Cancer (or Why Haven't We Cured It Yet?) (17:17) – by Dr Glenn Begley, who is Head of Oncology (Cancer) Research at Amgen, the world's largest biotechnology company.

A much simpler explanation is given in a TED-Ed lesson – How do cancer cells behave differently from healthy ones? (3:50) – which could be used as an introduction. This video also contains a multiple-choice series of questions and links to further resources.

There is also information appropriate for 15 year olds available via BBC Science: 'Why is cancer so common?'.

Students will need to be taught how to extract information from video. One approach is to watch the video through in its entirety, noting the various key messages. Then replay the video, pausing at each key message to give students time to make notes. Finally, ask the class to identify evidence provided to support the key message, or any conflicting evidence in a class discussion. A blank table with columns headed 'key message', 'explanation' and 'evidence' could be used to help structure their research.

## Publication phase

Ask students to produce an information sheet for patients, for distribution via GP surgeries.

The publication:

- should be written for an adult audience
- must explain any technical jargon used
- should include images where these clarify the text
- must be informative but should not cause alarm
- should suggest sources of additional information or support
- should be either a single A4 sheet, or an A4 sheet folded to form an A5 booklet

## Assessment phase

Discuss with the class the key ideas about the causes, effects and treatment of cancer in humans.

Decide on a short list of assessment criteria based on the publication task set.

Ask small groups of pupils to peer assess each other's publications, and to provide positive feedback to the authors.

## Alternative ideas for publications

- Mythbusters – produce a table showing common myths surrounding cancer, and the current scientific view as outlined in the TEDx video.
- Write a script for a 'debate' between a medical practitioner and a believer in holistic medicine proposing that a change in diet can eradicate some cancers.
- Produce a brief animated video describing the process of cell division, and the division of cancerous cells.
- Create a mathematical model to show growth rate of cancer cells compared to the growth rate of healthy cells, using a spreadsheet.

## Health and safety issues

This topic will need to be handled with sensitivity as it is very likely that there will be individuals in the class with direct links to people affected by cancer, or who may have suffered a childhood cancer themselves.

## Extension activity

Cancer is not only a human disease; this interactive from the Your Genomics website provides more detail on the genetic causes of cancer, and how a species is threatened with extinction because of this disease.

## Summary activity

A suggested summary activity is included to help focus students on the characteristics of this sort of engineering career.

Provide students with the sheet with Eleanor's photo in the centre and three coloured pens. You may find it useful to print this in A3, or stick the photograph in the centre of a larger sheet.

Working in small groups or pairs, give students five minutes to discuss and write down what they think they know about biomedical engineering and Eleanor's career in one colour around the photo.

Watch the film of Eleanor again and see if they can add anything to their sheets.

Then give students a further five minutes to discuss and write down what they would like to find out in another colour.

Draw out some of the ideas about her career/work as a biomedical engineer. Ask groups to feed back some of the questions they would like to find out more about. Elicit ideas of how and where they could find this out. They can then carry out research to find out what they wanted to know.

You could provide prompt questions to scaffold the activity:

- Eleanor does not work in isolation. What are the jobs involved in developing new cancer treatments?
- What do you think excites Eleanor about her job?
- What qualifications do you need to be a biomedical engineer?
- How much do engineers earn?
- What personal skills do you think Eleanor uses in her job?
- How is biomedical engineering changing people's lives?

### Useful sources of information on careers in engineering include:

https://www.borntoengineer.com

http://www.tomorrowsengineers.org.uk/students/career-finder/

http://faraday.theiet.org/careers/case-studies/index.cfm

http://www.raeng.org.uk/education/what-is-engineering/engineer-case-studies