WHAT IS CANCER?

Teacher notes

KEY STAGE 4/4TH LEVEL
Science lesson plan with links to PSHE

CANCER RESEARCH UK
OVERVIEW

Subjects
England: Science (with links to PSHE)
Wales: Science (with links to PSE)
Scotland: Sciences (with links to Health and Wellbeing)
Northern Ireland: Science (with links to Learning for Life and Work)

Age
Key Stage 4/4th Level

Time required
1 lesson (approx 35mins)

AROUND 1 IN 2 PEOPLE IN THE UK WILL DEVELOP CANCER
INTRODUCTION

Around 1 in 2 people in the UK will develop cancer during their lifetime. Almost everybody will know someone who has been affected by cancer at some stage in their life. Because cancer is so common, it’s important that people understand how cancer develops and what they can do to help reduce their risk.

The aim of this lesson is to explain the biology of cancer and address some of the myths about the causes of cancer. This lesson builds on learning about the cell cycle and introduces ideas about what can happen when it goes wrong.

LEARNING OBJECTIVES

- Students will be able to name the four most common types of cancer
- Students will know that cancer is caused by damaged DNA
- Students will know that many things can damage DNA, but we can control some of them
- Students will understand that living a healthy lifestyle is a way to reduce the risk of developing cancer

RESOURCES

Download:
- Teachers’ notes (including background info for teachers)
- Animation
- Cause Cards
- PowerPoint presentation (including control vs cases slide)

from cruk.org/lessons

CURRICULUM LINKS

SCIENCE
Cell cycle
PSHE
Healthy living

NOTE

If students are currently affected by cancer, for example a family member has the disease, they may find this lesson upsetting. We recommend that you discuss with the student whether they would like to join the class beforehand and if not agree an alternative activity with them.

To talk in confidence about cancer, call CRUK’s information nurses on freephone 0808 800 4040.
These notes will be helpful when explaining the biology of cancer to your class.
WHAT IS CANCER?

• All living things are made up of cells. They are the smallest units of life.

• Our bodies are made up of a hundred million million cells. You can fit 100 cells on the top of a pinhead. These cells are grouped together to make up our tissues and organs. We have over 200 different cell types in our body – brain cells, lung cells and blood cells, to name a few.

• Most cells have a nucleus, cytoplasm and cell membrane. The nucleus is the cell’s “control centre” which holds the cell’s DNA. Your DNA carries all the instructions needed to build your body and maintain its functions. The information stored in our DNA would fill 200 telephone directories! Each instruction is carried on a unique piece of DNA called a gene.

• Our cells grow and multiply by a process called mitosis. This is needed when our bodies are growing or repairing damage. Cell growth and multiplication happens through a process called the cell cycle.

• To move through the different stages of the cell cycle each cell has to go through a series of checkpoints. These checkpoints act a bit like traffic lights and they only give the green light to cells that are healthy and ready to go through to the next stage in the cycle.

• Cancer is caused by damage to our DNA. This accumulates over time, so cancer is generally a disease of old age.

• This DNA damage can be the result of mistakes in normal biological processes in our cells, or things in our lifestyle, such as smoking, drinking alcohol, being overweight, eating an unhealthy diet, lack of exercise or overexposure to the sun. We can also inherit damage from our parents.

• Normally, when DNA gets damaged, it can be repaired. If cells have DNA damage that cannot be repaired, the cell is killed.

THESE NOTES WILL BE HELPFUL WHEN EXPLAINING THE BIOLOGY OF CANCER TO YOUR CLASS
Sometimes damaged DNA instructions tell the cell to multiply at the wrong time, or in the wrong place. Sometimes the checkpoints themselves are faulty or the damaged cells are able to side-step them. If the cell isn’t able to repair itself, and it avoids being killed, the damaged cell can multiply out of control. This is how cancer starts.

Each time a cancer cell multiplies it passes on the damaged DNA, so the new cells multiply out of control too. The group of cells keeps multiplying and forms a lump, or tumour.

Sometimes cancer cells can break off from the main tumour and enter the bloodstream or lymphatic system. This allows the cancer cells to travel around the body and may lead to secondary cancers forming in another part of the body – a process that is called metastasis.

It’s much easier to treat cancer successfully before it has spread to other parts of the body. That is why early diagnosis is so important - to improve the chances of survival.

Although children can get cancer, it is very rare. Around 325,000 people are diagnosed with cancer every year. Of these, only around 1,600 cases are diagnosed in people before the age of 15. The risk of a child in Britain being diagnosed with cancer before the age of 15 is very low - about 1 in 500 (compared to around 1 in 2 people over the course of their whole lifetime).

Childhood cancer is different to adult cancer and the causes are largely unknown.

The outlook for children diagnosed with cancer is generally very good. Today, 3 out of 4 children with cancer are cured, compared to around 1 out of 4 in the 1960s. However, the treatments mean that some children have long term side effects which may continue to affect their health in the future.
MORE THAN 4 IN 10 CANCERS COULD BE PREVENTED BY CHANGES TO LIFESTYLE
<table>
<thead>
<tr>
<th>Stage</th>
<th>Time</th>
<th>Delivery notes</th>
<th>Resources</th>
</tr>
</thead>
</table>
| Introduction                        | 5 mins | • Around 1 in 2 people in the UK develop cancer at some point in their lifetime.  
• Cancer is a disease of cells, it’s a result of the cell cycle going wrong and cells dividing out of control.  
• Revisit key points of cell cycle (if needed).                                                                 | • None required                     |
| Types of cancer–brainstorm and discussion | 5 mins | • Ask the class to shout out the different types of cancer they have heard of and write them up on the board.  
• The four most common types of cancer are breast, lung, prostate and bowel cancers. Together these make up over half of the cases of cancer diagnosed in the UK.  
• How many types of cancer do the students think there are altogether?  
  o (A: over 200). Display slide 3 which shows the most common types of cancer diagnosed in the UK  
• Why are there so many types?  
  o (A: cancer is a disease of cells, and each different type of cell (e.g. skin cells, lung cells etc) gives rise to a different type of cancer.)  
• Different types of cancer can have different causes and be treated in different ways. We are still better at treating some types of cancer than others, but we’re making great progress across the board.  
• Cancer survival in the UK has doubled over the last 40 years.                                      | • PowerPoint slides 1-3             |
| How cancer develops – animation     | 5 mins | • Show animation, which explains how damage to DNA can lead to loss of cell cycle control and in some cases this can result in cancer developing.  
• There is more information in the “Background information for teachers” section on pages 3-4 of this booklet which can help you answer any questions the students have. | • What is Cancer animation  
• Background notes                   |
| Causes of cancer – discussion       | 5 mins | • Cancer is the result of damage to our DNA.  
• Ask the students what things they think can damage our DNA and cause cancer. Write them up on the board.  
• Sometimes damage can happen as a result of random mistakes, but there are also things that can damage our DNA and increase the risk of cancer. One bit of damage to our DNA most probably wouldn’t lead to cancer, but damage builds up over time. This is why cancer is more common among older people – there’s been more time for damage to build up and it’s more likely that an individual cell will have accumulated enough damage to make it a cancer cell. | • Background notes                  |
### Cause Cards - activity

**10 mins**

- Divide the class into groups of 4. Give each group a set of Cause Cards. Each set is the same and contains 10 cards, showing different things that may or may not cause cancer.
- For each question (see below), each group should decide which card(s) they think show the answer and hold them up. Ask some of the groups to explain their choices. Do all the groups agree? Why/why not?

**Q1.** Which ones have **no good evidence** that they can cause cancer?
- A. Deodorants, plastic bottles, stress. These 3 cards aren’t needed for the rest of the game, so ask students to take all 3 of these cards out of their set and put them to one side. The other 7 cards all show something that can cause cancer in people.

**Q2.** Which ones can **you control**?
- A. Smoking, diet/weight/physical activity, alcohol, UV.

**Q3.** Which 2 are the **biggest causes** of cancer in the UK?
- A. Smoking and diet/weight/physical activity

**Q4.** Which one causes fewer cases of cancer in the UK than any of the others?
- A. Radiation
  - Information about each of the Cause Cards can be found on pages 10-11.
  - Show the control vs cases graphic on slide 4. Ask 7 students to come up to the front, one for each of the 7 remaining causes. With the help of the rest of the class, ask them to stick the card on the graph where they think it should go – this will depend on:
    - how many UK cancers they think each one causes, compared to the others.
    - how much they think they can control each one, compared to the others.
    - An example answer can be found on page 11 and slide 5.

### Quiz - consolidation

**5 mins**

- Using slides 6-14 deliver a quiz to recap. The answer for each question is revealed on the slide on the second click.

### Resources
- Cause Cards
- Sticky tape / Blu Tack
- PowerPoint slides 4-5
- Cause Cards notes - see pages 10-11
- PowerPoint slides 6-14
Extension activities:

• Students could research bowel cancer (or other type of their choice) to find out about the ways we can reduce the risk of developing the disease.
• Students could pick a story about lifestyle and cancer from the media and research it in more depth. See ‘Cancer in the news’ links on page 12.
• Students could research something they think might affect the risk of cancer (e.g. something that was suggested earlier), which they’d like to know more about.
• Students could create a presentation for other students about reducing the risk of cancer.
ANSWERS

AS WELL AS LUNG CANCER, TOBACCO IS LINKED TO AT LEAST 13 OTHER TYPES
The table below summarises each of the 10 cards and includes some extra information to give to students.

Q1 = Which ones have no good evidence that they can cause cancer?
Q2 = Which ones can you control?
Q3/4 = Proportion of UK cancers caused

<table>
<thead>
<tr>
<th>Cause Card</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3/4</th>
<th>Other info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>Yes</td>
<td>20%</td>
<td></td>
<td>• As well as lung cancer, tobacco is linked to at least 13 other types of cancer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Tobacco is the most important preventable cause of cancer.</td>
</tr>
<tr>
<td>Diet/weight/physical activity</td>
<td>Yes</td>
<td>15%</td>
<td></td>
<td>• Work individually and together to reduce the risk of cancer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• A balanced diet includes includes plenty of fruit, vegetables and fibre with not too much red and processed meat, saturated fat or salt.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Under-18s should aim to do at least an hour a day of activity, adults should do at least 2 ½ hours a week.</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Yes</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UV</td>
<td>Yes</td>
<td>3.5%</td>
<td></td>
<td>• Includes sunbeds and UV from the sun.</td>
</tr>
<tr>
<td>Infections</td>
<td>Partly*</td>
<td>3%</td>
<td></td>
<td>• E.g. human papillomavirus (HPV), girls in the UK are offered vaccination in year 8.</td>
</tr>
<tr>
<td>Inherited genes</td>
<td>No</td>
<td>5-10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation</td>
<td>No</td>
<td>2%</td>
<td></td>
<td>This includes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Natural sources of background radiation, like radon gas and radiation from space. This is most people’s biggest exposure to radiation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Medical radiation: x-rays, body scans, radiotherapy to treat cancer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Fallout from atomic bombs and tests makes up a tiny proportion (less than 1%) of the radiation people are exposed to.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• (NB: This category is specifically ionising radiation).</td>
</tr>
</tbody>
</table>

*e.g. vaccination, safe sex
**Q1** = Which ones have **no good evidence** that they can cause cancer?
**Q2** = Which ones can you control?
**Q3/4** = Proportion of UK cancers caused

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| Deodorant  | No good evidence | N/A Doesn't cause cancer | N/A Doesn't cause cancer | • This is a rumour started by a hoax email.  
• There is no evidence that deodorants increase people's risk of cancer. |
| Plastic bottles | No good evidence | N/A Doesn't cause cancer | N/A Doesn't cause cancer | • Another hoax email scare.  
• There is no evidence that plastic bottles increase people’s risk of cancer. |
| Stress     | No good evidence | N/A Doesn't cause cancer | N/A Doesn't cause cancer | • Stress can lead to people taking up unhealthy habits, like smoking or eating a less healthy diet, and that might increase their risk of cancer. But stress itself doesn’t cause the disease. |

**Example answer graphic**

- **Tobacco**
- **Diet/weight/activity**
- **Alcohol**
- **Inherited genes**
- **Infections**
- **UV**
- **Radiation**

**Causes more cases**

**More controllable**
USEFUL LINKS

General information
Cancer Research UK website
cruk.org
CRUK cancer prevention pages
cruk.org/health
CRUK stats
cruk.org/cancerstats/
CRUK information about how many UK cancers result from lifestyle and environmental causes
www.cancerresearchuk.org/cancer-info/cancerstats/causes/comparing-causes-of-cancer/
CRUK information about improving survival rates
www.cancerresearchuk.org/cancer-info/spotcancerearly/

Cancer in the news
CRUK science update blog
cruk.org/blog
NHS Behind the Headlines
www.nhs.uk/news/Pages/NewsIndex.aspx

Other resources
Department of Health smoking health harms video
(every 15 cigarettes causes a mutation)
www.youtube.com/watch?v=QrRwp5KXfrg