3.2 William Harvey and the discovery of the circulation of the blood

Harvey had a keen interest in dissection and observing the human body to improve his knowledge of human anatomy.

Discovery of the circulation of the blood	Impact of Harvey
Harvey's research involved dissecting human corpses and cutting open cold-blooded animals because they had a slower heartbeat and this enabled their blood to be observed while they were still alive Harvey's research proved that arteries and veins were linked together in one system Harvey's theory was that blood must pass from arteries to veins through tiny passages invisible to the naked eye. Today we know these to be capillaries Harvey corrected Galen and showed that only the veins carried blood and that the heart acted as a pump	Harvey's theory encouraged other scientists to experiment on actual bodies However, his discovery had little practical use in medical treatment and led to very little change Some openly criticised Harvey because he did not have a powerful enough microscope to prove that capillaries existed. He was said to be mad

Support or challenge

Below is an exam-style question which asks how far you agree with a specific statement. Below this are a series of general statements which are relevant to the question. Using your own knowledge and the information throughout this key topic, decide whether these statements support or challenge the statement in the question and tick the appropriate box.

'Individuals had the most significant impact on medical training between c.1500 and c.1700.' How far do you agree? Explain your answer. (16 marks, with a further 4 marks available for spelling, punctuation and grammar.)

You may use the following in your answer:

- **Vesalius**
- **The Royal Society**

You must also use some information of your own.

Statement	Support	Challenge
More powerful microscopes were being developed and, in 1683, one allowed for the observation of tiny 'animalcules'		
The Royal Society first met in 1660 to share scientific knowledge and encourage new ideas		
The Theory of the Four Humours was starting to be rejected by physicians		
Doctors and anatomists were starting to observe the human body themselves rather than relying on old books		
Thomas Sydenham encouraged doctors to observe their patients and note down their symptoms		
The newly developed printing press allowed for medical information to be spread quickly and accurately		
Vesalius dissected human corpses and proved around 300 ideas of Galen incorrect		
Harvey discovered that blood circulated around the body and that the heart acted as a pump		
Without a microscope, Harvey was unable to prove that capillaries existed and so many physicians ignored his ideas		

Once you have completed this table, write an answer to this question.

c.1700–c.1900: Medicine in eighteenth- and nineteenth-century Britain

From 1700, the Church began to lose its influence over disease and illness as there was a focus on scientific explanations. This period saw the growth of cities, which brought threatening diseases such as smallpox, tuberculosis and typhus.

1 Ideas about the cause of disease and illness

REVISED

Intellectual movements such as the **Enlightenment** encouraged others to think for themselves to find answers – including about disease and illness.

1.1 Continuity and changes in explanations of the cause of disease and illness

Ideas about the cause of disease had not changed by the eighteenth century and people still believed in the Theory of the Four Humours and miasma, but this theory was losing popularity. Scientific thinking led to a change in medical understanding at the end of this period when the **Germ Theory** was developed.

Spontaneous generation theory

Microscopes had improved so that scientists could see **microbes** on decaying matter. This led some scientists to develop the theory of spontaneous generation in the early eighteenth century. They argued that the microbes were a product of the decay, rather than the cause of it, and that they spread by miasma.

1.2 The influence of Pasteur's Germ Theory

In 1861, **Louis Pasteur** published his discovery of the Germ Theory. He proved that germs were causing liquids to decay. This disproved the spontaneous generation theory. This discovery led him to the theory that germs might cause disease in the human body.

Impact

- Little immediate impact on medicine because doctors and surgeons could not see Pasteur's microbes.
- Some impact on the work of Joseph Lister, who linked the Germ Theory to infection in his patients (see page 20). Unfortunately, Lister's ideas were doubted as he could not prove his theory. With the presence of microbes in the organs of healthy people, it seemed impossible to some that they could be the cause of disease and illness.
- In the long term, Pasteur's discovery led to changes in preventing disease with vaccinations and the introduction of antiseptic and aseptic surgery.

1.3 Koch's work on microbes

Robert Koch developed the work of Pasteur by successfully identifying the different microbes that caused common individual diseases:

- 1876: Koch discovered the bacteria that caused anthrax.
- 1882: Koch went on to discover the bacteria that caused tuberculosis and typhoid.
- 1883: Koch discovered cholera.
- Koch's co-workers also went on to discover the microbes for diphtheria, pneumonia, meningitis, the plague and tetanus.

Key terms

Enlightenment A European intellectual movement of the late seventeenth and eighteenth centuries that emphasised reason and individualism rather than tradition

Germ Theory The theory that germs cause disease, often by infection through the air

Microbes A living organism that can only be seen with a microscope. Microbes include bacteria

Key individuals

Robert Koch A German doctor who identified specific bacteria that caused disease in humans

Louis Pasteur A French chemist who discovered germs before going on to develop vaccines

Key factors

Attitudes in society The Enlightenment encouraged questioning and new theories about medicine to develop

Science and technology Scientific experiment, microscopes, the swan-neck flask and the Petri dish were all vital instruments in the discovery of germs and development of vaccines

Koch's influence in Britain	
Positive	**Negative**
Koch made it easier to see microbes by developing a dye that would stain them Koch's new method of growing microbes enabled other scientists to study specific diseases Koch's work inspired other scientists to look for the microbes responsible for other diseases	The discovery of germs and different bacteria alone did not have an impact on medical treatment. It took time for cures and vaccines to be developed Initially the British government rejected the idea of the Germ Theory. Even when Koch went to Calcutta and proved that cholera was caused by microbes in the drinking water, they ignored this and continued to believe in miasma

Revision task

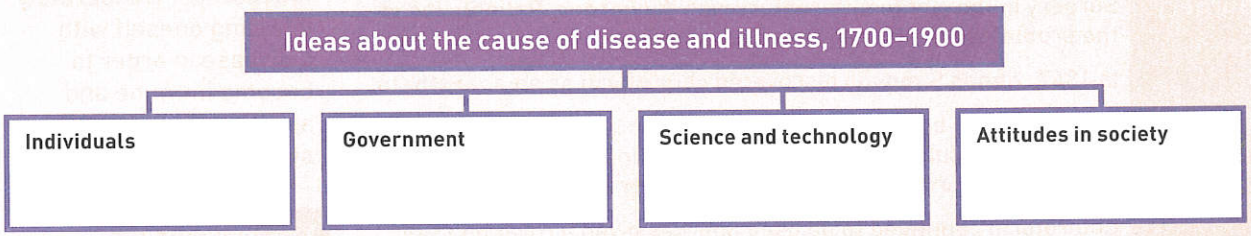
Create a timeline showing the development of the Germ Theory. Include the work of Pasteur and Koch.

Analysing factors

You need to understand the role that factors had on the ideas about cause of disease and illness in the eighteenth and nineteenth centuries. Copy and complete the diagram below. For each factor in the diagram, explain how it led to advances in the understanding of the cause of disease and illness during this period. If a factor contributed in multiple ways, you will want to have more than one explanation.

Once you have completed the diagram, decide which factor you think was the most significant and why.

For a reminder about each factor see page 5.



Complete the paragraph

Below are an exam-style question and a paragraph which is part of an answer to this question. The paragraph gives an argument for agreeing with the statement and some historical support but does not go on to develop the explanation.

1 Rewrite the paragraph with extra precise supporting knowledge and a full explanation linking back to the statement.

2 Complete the answer to this question.

'There was complete change in ideas about the cause of disease and illness in the period c.1700–c.1900.' How far do you agree? Explain your answer. (16 marks, with a further 4 marks available for spelling, punctuation and grammar.)

You may use the following information in your answer.

- **Germ Theory**
- **Robert Koch**

You must also use information of your own.

There was complete change in the ideas about the cause of disease and illness in the period c.1700–c.1900 because science prevailed and microbes were identified and understood. In 1861, Louis Pasteur discovered and published his Germ Theory. Although Pasteur had only proven that microbes caused decay in liquids, he inspired other scientists to look for a similar cause to explain disease in the human body. Robert Koch followed Pasteur and identified the microbes that caused anthrax, tuberculosis and cholera.

2 Approaches to prevention and treatment 1

REVISED

2.1 The extent of change in care and treatment

Hospital care	From the eighteenth century more people were treated in a hospital, but this led to less sanitary conditions **Florence Nightingale** trained as a nurse in Germany and Paris before being sent by the government to the Crimea to improve hospitals during the Crimean War Nightingale noticed the high death rate among soldiers Alongside 38 nurses, Nightingale made changes. The wards were cleaned of any dirt, organisation was improved and patients were given clean bedding and meals. Within six months the death rate fell from 40 per cent to 2 per cent Nightingale returned to Britain, campaigning for cleaner hospitals and improved training for nurses. In 1859 she wrote *Notes on Nursing*. In 1860 she set up the Nightingale School for Nurses Nightingale also influenced the way hospitals were designed. By 1900 they looked very different; they were built from materials that could easily be cleaned and had separate wards
Surgery	Surgery in the eighteenth century was dangerous. Patients faced the problems of pain, infection and bleeding In 1847, **James Simpson** discovered chloroform as an **anaesthetic** Doctors had to be careful using chloroform because the dosage had to be carefully controlled. In 1848, Hannah Greener died from an overdose during an operation to have her toenail removed Chloroform continued to be used and was given a royal blessing in 1853 when Queen Victoria used it during the birth of her son The problem of infection was overcome in 1865 by **Joseph Lister** Lister used carbolic acid to clear bacteria from the wounds of patients. This became known as **antiseptic surgery** Unfortunately, Lister's ideas faced opposition because the medical profession took time to understand the Germ Theory. The carbolic spray was unpleasant to use; it dried out the skin of surgeons and left an odd smell. From 1890, **aseptic surgery** was performed

2.2 New approaches to prevention: vaccination

Throughout the eighteenth century, smallpox epidemics threatened Britain. Smallpox spread quickly and killed many. There was no understanding about its cause or how to prevent it.

Initially, **inoculation** was used to prevent the spread of smallpox. It was expensive and only available to the rich. Inoculation was dangerous as some patients died from the dose that they were given.

Edward Jenner, a country doctor, observed that milkmaids who had previously suffered from cowpox did not catch smallpox during the epidemics. He believed the two were connected and went on to test his theory in 1796. He gave James Phipps a dose of cowpox and six weeks later infected him with smallpox, but Phipps did not catch it. Jenner repeated his experiment with the same success before publishing his findings.

Key terms

Anaesthetic A chemical used to make a patient unconscious during surgery and so remove pain

Antiseptic surgery The removal of bacteria from an operation. Lister used carbolic acid to wash a surgeon's hands, soak bandages and ligatures, and spray the air directly around the wound

Aseptic surgery Surgery that takes place in a strictly controlled germ-free environment

Inoculation Deliberately infecting oneself with a disease in order to become immune and avoid catching a more severe form later on

Key individuals

Edward Jenner A country doctor who developed the smallpox vaccine following careful observation of milkmaids

Joseph Lister A surgeon who discovered that carbolic acid can be used in the operating theatre to remove germs; known as antiseptic surgery

Florence Nightingale A British nurse in the Crimean War who encouraged better hygiene in hospitals and improved training of nurses to reduce the death rate

James Simpson A surgeon and professor of midwifery who discovered that chloroform can be used as an anaesthetic

It took some time before Jenner's **vaccination** was accepted:

- People opposed the vaccine because Jenner was unable to explain how or why it worked. Pasteur did not publish his Germ Theory until 1861 and so Jenner did not know that bacteria caused disease.
- The idea of infecting someone with an animal disease was considered strange and unacceptable. Many religious believers thought it was against God's law to give people an animal disease.
- Inoculators were against it because their business was under threat.
- The Royal Society refused to publish Jenner's findings because it was thought that his ideas were too revolutionary.
- The Anti-Vaccine Society was set up in 1866 to oppose vaccination. It did this by publishing cartoons to scare people into not trusting the vaccine. One such cartoon showed people who had the vaccine turning into cows.

In 1852, the British government made the smallpox vaccination compulsory, and smallpox was eradicated as a disease in 1980. Jenner's work inspired other scientists, like Pasteur and Koch, to develop vaccines. Pasteur went on to develop vaccines for chicken cholera, anthrax and rabies.

Key term

Vaccination The injection into the body of killed or weakened organisms to give the body resistance against disease. The smallpox vaccine was the only one to use a different disease and so is known as a 'dead-end' vaccine

Key factor

Individuals The work of Nightingale, Simpson, Lister and Jenner in the nineteenth century was crucial to the prevention and treatment of disease and illness.

Revision task

Summarise the contributions of the following individuals to medical advances during the eighteenth and nineteenth centuries:

- Jenner
- Nightingale
- Simpson
- Lister.

Understand the chronology

The events of the eighteenth and nineteenth centuries that led to a change in the prevention and treatment of disease and illness are very complex. Using pages 18 and 20, place the events listed below in the correct chronological sequence in the timeline.

A Nightingale set up the Nightingale School of Nurses

B Koch identified the microbe for anthrax

C Simpson discovered that chloroform was an anaesthetic

D Jenner developed the smallpox vaccine

E Queen Victoria used chloroform during childbirth

F The British government made the smallpox vaccine compulsory

G Nightingale wrote *Notes on Nursing*

H Hannah Greener died from a chloroform overdose

I Koch identified the microbes for tuberculosis and typhoid

J Lister used the carbolic spray in the operating theatre

K Nightingale went to the Crimea to improve hospitals

L Louis Pasteur published his Germ Theory.

Date	Event
1796	
1847	
1848	
1852	
1853	
1854	
1859	
1860	
1861	
1865	
1876	
1882	

3 Approaches to prevention and treatment 2

REVISED

3.1 New approaches to prevention: fighting cholera

Cholera was a terrible disease that caused sickness and diarrhoea and was usually fatal. Doctors were unable to treat it because they did not know its cause. It was still believed that disease was caused by miasma and so local councils took steps to clean cities.

In 1854, cholera broke out in Soho, London. People tried to prevent its spread by:

- burning barrels of tar to remove the bad air
- smoking cigars to protect against the bad air
- praying and burning the clothes and bedding of victims.

The 1854 outbreak of cholera prompted **John Snow** to investigate.

- Snow created a spot map to show the deaths from cholera that occurred around Broad Street in the Soho district of London.
- This led Snow to notice a pattern; that the deaths were all connected to the water pump.
- Snow removed the handle of the water pump and prevented people from using it.
- There were no more deaths in the Broad Street area from cholera.
- Snow inspected the well underneath the water pump and found that it was close to a cesspit with a cracked lining. This caused waste to seep into the water and spread cholera.

Snow was able to prove that cholera was spread by dirty water and he presented his evidence to the House of Commons. Snow's evidence and the **Great Stink** led the government to agree to a new sewer system, which was planned by Joseph Bazalgette. By 1865, 1300 miles of sewers had been built in London and this project was completed in 1875.

Snow had no scientific evidence to explain the cause of cholera so many rejected his work. It would need Pasteur's Germ Theory and Koch's identification of the cholera microbe before Snow's theory could be explained.

Key individual

John Snow A surgeon who lived in Soho, London, and became one of the city's leading anaesthetists. He was popular and well respected. During the 1848 cholera epidemic, he observed and concluded that the disease was caused by drinking dirty water

Key terms

Great Stink The hot, dry summer of 1858 caused an awful smell from the exposed sewage on the banks of the River Thames in London. This became known as the Great Stink

Laissez-faire From the French for 'leave alone' and is used to describe the British government's attitude to public health in the early nineteenth century

3.2 New approaches to prevention: Public Health Acts

In the early nineteenth century, the British government had a *laissez-faire* attitude and believed it was not their role to intervene in the health of the people. However, during the century this attitude began to change. This was as a result of a variety of reasons, including:

- Cholera continued to return to Britain and it killed more people. The government listened to Snow (see above) and Pasteur (see page 18).
- In 1842, Edwin Chadwick published his *Report on the Sanitary Conditions of the Labouring Classes*. Chadwick had spent years researching the lives of the poor in Britain's cities. He concluded that people living in the cities had a lower life expectancy because of the filthy conditions. He believed all cities should have a Board of Health that ensured the supply of clean water and disposal of sewage. Initially, there was opposition to Chadwick's ideas due to the need to increase taxes and for the government to get involved in local matters.
- The British government did very little at first, but as more scientific evidence emerged that showed clean water was important for a healthy population, the government took more action.
- 1866–67 saw the last cholera epidemic in Britain and it had a lower death count than previous cholera epidemics.

Key factor

Government During the nineteenth century, the British government became more supportive and increased their role in the prevention of disease and illness. This was as a consequence of the increase in scientific evidence and understanding.

Exam tip

It is important that you can explain government action during this period. Link cause and consequence directly.

The first Public Health Act in 1848	The second Public Health Act in 1875
Cities were encouraged to set up Boards of Health and provide clean water supplies. However, because it was not compulsory many did not	Cities were now forced to improve sanitary conditions by: • providing clean water to stop the spread of disease • disposing of sewage to avoid pollution • building public toilets • employing a public officer of health to monitor conditions and outbreaks of disease • creating street lighting

RAG: Rate the timeline

Below are an exam-style question and a timeline. Read the question, study the timeline and, using three coloured pens, put a red, amber or green star next to the events to show:

Red: events that have **no** relevance to the question

Amber: events that have **some** significance to the question

Green: events that have **direct** relevance to the question

Explain why the government increased its role in preventing disease and illness during the period c.1700–c.1900. (12 marks)

You may use the following in your answer:

- **Cholera**
- **Public Health Acts**

You must also use information of your own.

1796 Edward Jenner discovered the smallpox vaccine

1842 Edwin Chadwick published his *Report on the Sanitary Conditions of the Labouring Classes*

1847 Simpson discovered chloroform as an anaesthetic

1848 First Public Health Act

1852 Government made the smallpox vaccine compulsory

1854 Cholera epidemic

1854 John Snow proved that cholera was caused by dirty water

1858 The Great Stink

1859 Nightingale wrote *Notes on Nursing*

1861 Pasteur published his Germ Theory

1875 Second Public Health Act

1883 Koch discovered the microbe that caused cholera

Spot the mistakes

Below is a paragraph which is part of an answer to the question above. However, the paragraph has a series of factual mistakes. Once you have identified the mistakes, rewrite the paragraph.

In 1846 the British government passed the first Public Health Act. This was because the deadly disease typhoid returned to Britain. The government had listened to the advice from John Snow and passed an Act that would provide vaccinations to its citizens. Unfortunately, it had little impact because the measures were too expensive. When typhoid returned in 1854, Florence Nightingale was able to prove that it was spread by sour milk. But she was unable to explain how or why. In 1861, Robert Koch published his Germ Theory. He did this after experimenting with mice. The new understanding of the cause of disease and illness led to the government passing the second Public Health Act in 1865. This Act was compulsory and shows the change in attitudes towards the individual's role in public health.

c.1900–present: Medicine in modern Britain

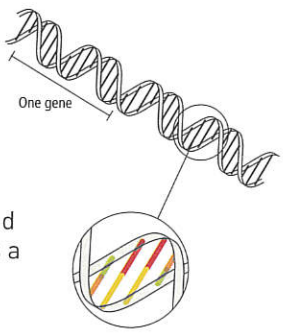
The twentieth century saw great changes in medical diagnosis, treatment and prevention as a result of advancing science and technology. After accepting its responsibility for the health of the people, the government adopted a major role in providing medical care.

1 Ideas about the cause of disease and illness

REVISED

1.1 The influence of genetic factors on health

By 1900, it was clear to scientists that microbes did not cause all disease and illness. The causes of **hereditary diseases** were still unknown. The puzzle of hereditary diseases was solved in 1953 when **DNA** was discovered. It is now understood that Down's syndrome and cystic fibrosis are hereditary diseases.

The discovery of the human gene	Mapping of the human genome
In 1953, James Watson and Francis Crick saw the X-rays of DNA created by Rosalind Franklin and Maurice Wilkins Watson and Crick built their own model of DNA. Franklin corrected it and Wilkins shared clearer images with the team This helped Crick and Watson to understand the structure of DNA: that it was shaped as a double helix 	Once the structure of DNA was understood, scientists were able to break it apart and look at the parts that caused hereditary diseases such as **haemophilia** The Human Genome Project began in 1990 and was completed in 2000. Scientists all over the world worked to decode and map the human **genome**. This map is used to look for mistakes in the human genome of people suffering from genetic conditions

Impact of the discovery

The understanding of DNA has not led to the treatment of genetic conditions. However, it has given options to prevent diseases after the identification of particular genes. An example of this is breast cancer. Women can have their breasts removed if the gene linked to the disease is identified in their DNA in order to prevent them from possibly developing cancer

1.2 The influence of lifestyle factors on health

Our understanding of how lifestyle is linked to disease and illness has improved:

- Smoking is linked to a range of diseases including high blood pressure, cancers and heart disease.
- Diet has a huge impact on our health and we are advised to maintain a healthy food intake. For example, too much sugar can lead to type 2 diabetes and too much fat can lead to heart disease.
- Drinking too much alcohol can lead to liver disease and kidney problems.
- The sharing of bodily fluids, for example by having unprotected sex, can lead to the spread of certain diseases.
- Skin cancer can be caused by too much exposure to the sun without sunscreen.

Key terms

DNA Short for deoxyribonucleic acid. DNA carries genetic information about a living organism. DNA information determines characteristics such as hair and eye colour

Key terms

Genome The complete set of genes (DNA) in a particular organism. Every human being has unique DNA, unless they are identical twins

Haemophilia A medical condition in which the ability of the blood to clot is severely reduced, causing the sufferer to bleed severely from even a slight injury

Hereditary diseases Disease and illness caused by genetic factors and passed on from parents to their children