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| **Background information** |
| Throughout the history of medicine, until the year 1860, disease was greatly misunderstood. Beliefs about the causes ranged from the superstitious (magic and witchcraft), to scapegoating (anti-Semitic blame for the Black Death) and basic attempts at scientific explanation (miasma, an imbalance of the four humours and spontaneous generation).  When Louis Pasteur discovered that germs cause disease (Germ Theory) in 1860, this was a true revolution in the history of medicine. This discovery opened the door to countless developments in science, treatment of disease, and public health. |

**How was Germ Theory developed?**

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| **Medieval** people and doctors believed diseases to be caused by miasmas, God, an imbalance of humours or supernatural phenomena. They had no understanding of germs or microbes. | |
| **1677** | The microscope was invented. Microbes could now be seen. No link was made between microbes and disease. |
| **1699** | Italian biologist Francesco Redi conducted an experiment. He boiled a liquid and sealed it from the air. No microbes appeared in the liquid, so he concluded that infections came from outside sources like a ‘miasma’. He had used clean equipment – but he didn’t realise that this would affect his experiment. |
| **1748** | A British scientist, John Needham, repeated Redi’s experiment and found microbes in the liquid after a couple of days. His experiment had not used clean equipment. He concluded that infections were caused by spontaneous generation. This was the idea that microbes could appear spontaneously when something rotted. Like many other scientists in the 18th century Needham believed that spontaneous generation of microbes happened because of infection, they did not understand that microbes were the cause of the infection. People who believed in spontaneous generation also believed that all microbes were the same. |
| In the **19th century** some people began to question the idea that all microbes were the same.Scientists began to find evidence of this.In 1835 Italian scientist Agostino Bassi linked a specific microbe to a specific disease in silk worms. This was known as specificity, but was not widely accepted. | |
| **1840** | ASwiss professor of anatomy, Friedrich Henle was the first person to suggest that microbes were the cause of infection. Henle based his work on Bassi, but people did not believe him. |
| **1860** | Louis Pasteur conducted experiments on wine. He used a ‘swan-necked’ flask that prevented air from entering the liquid in the flask. He concluded that as long as air was kept out, the liquid would not ‘go off’. Pasteur identified the specific microbe that made wine go bad and showed that if you heated it to the right temperature, you could kill the microbes.  Pasteur’s work proved that Germs did not come alive on their own, and that they infected things and turned them bad. He concluded that ‘bacteria’ or germs were the cause of disease and decay.  In 1861 Pasteur published his work which was known as ‘Germ Theory’. His work was published in French. His ideas began to be built upon in Europe, but in Britain the idea of spontaneous generation remained prevalent. In the age of the British Empire, it was difficult for people to believe that a tiny microbe could cause the death of a human! |

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| **1861** | Prince Albert (Queen Victoria’s husband) died of typhoid. This was important because it generated public interest in the cause of disease. If the Queen’s husband could die of typhoid it seemed less likely that the cause was a miasma. |
| **1864** | Thomas Wells, a British Surgeon, used Pasteur’s work to argue against spontaneous generation. He said that infections (or sepsis) were not created by a chemical reaction, it was caused by microbes. He suggested that surgeons used antiseptic substances to prevent microbes from infecting patients. He presented his ideas to the British Medical Association, but was he was mostly ignored. |
| **1866** | A cattle plague struck Britain. It was assumed that the disease had started spontaneously. Farmers did not want to kill their cattle, so the disease spread quickly across Britain. It soon became clear that the only way to stop the spread of disease was to slaughter cattle – this led to food shortages and price rises. Therefore, the government appointed the leading user of the microscope, professor Lionel Beale, to investigate the crisis. Beale identified the specific microbe that caused the disease and was able to provide evidence that disease could be contagious. The idea that germs were the cause of disease was first noted by vets, not doctors. |
| **1867** | A British surgeon, Joseph Lister, published the result of his work on the successful use of antiseptics in surgical procedures. He had used the work of Louis Pasteur to explain his techniques, so by publishing his work in Britain, he was also publicising the work of Pasteur. In the same year Lister lectured British surgeons where he argued that wound infections were caused by microbes in the air. Although he had evidence to prove he was correct, he was met with many criticisms. Many people in the medical profession still believed in spontaneous generation as a cause of disease and infection. |
| **Throughout the 1860s** there were many who argued against the idea of microbes as a cause of disease. One of the most influential was Charlton Bastion. He lectured and wrote about spontaneous generation and directly argued against the work of Joseph Lister and the evidence of Beale. | |
| **1868** | Professor John Bennett gave a lecture at Edinburgh university in favour of spontaneous generation. He argued that dying cells could generate new microbes spontaneously. |
| **1870** | A British physicist, John Tyndall, argued against Bastion and defended Pasteur’s Germ Theory. He gave lectures about how dust could carry microbes and demonstrated with light how tiny microbes can be seen in ordinary air. Bastion was able to bring together the work of Pasteur and Lister. This was important in changing British opinions on the cause of disease. |
| **1873-5** | British scientists began to publish work on germs. Dallinger and Drysdale published a paper on ‘the life cycle of microbes’ in 1874.Germs were beginning to be accepted as the cause of disease by British scientists. |
| **1876** | John Tyndall gave a lecture to British doctors about Pasteur’s Germ Theory and the cause of anthrax. Tyndall was explaining work carried out by Robert Koch, a German microbiologist, who had identified the specific microbe to cause anthrax. This was important as is helped to convince doctors that disease was caused by microbes. |
| **1877** | William Roberts, a doctor from Manchester who supported Tyndall’s criticisms of spontaneous generation, developed a doctor’s version of the Germ Theory of disease. He linked all the laboratory research work with the practical evidence of surgeons and public health doctors. He used Koch’s work to draw attention to germs and their role in human infections. |

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| **1879** | William Cheyenne, Joseph Lister’s deputy surgeon, translated the work of Robert Koch into English. Cheyenne also wrote a medical paper, using the work of Koch, explaining that some microbes do not cause disease in humans. |
| **1880** | Koch identified the bacillus that causes tuberculosis. |
| **1884** | The cause of cholera was identified by Koch. |
| **1891** | The germ that causes diphtheria was identified by Koch. Germs that caused, typhoid, pneumonia, plague, tetanus and whooping cough were later identified by his team. |

**Tasks**

1. Read the background information. Highlight or annotate the key terms and dates in this information.
2. Read through the timeline.
   1. Decide whether each date/event represents **progress** (understanding getting better), **regression** (understanding getting worse), or **stagnation** (understanding staying the same).
   2. Now go back over the timeline and decide how much each event affected **medicine in Britain**.
3. Highlight or annotate all **key individuals** in the timeline.
   1. Who are your top five? Summarise their contributions in a sentence each.
   2. Would this top five change if you are only asking about **the understanding of disease in Britain**?
4. Exam style question:

‘Explain the significance of the work of Louis Pasteur (8 marks).

* 1. For this question you are expected to write two paragraphs, each using detailed evidence and developed explanation of the **impact of Pasteur**.
  2. Your first paragraph should be about the immediate effects of Pasteur’s work and discovery. The second should be about the long-term or later effects.

**Bonus**

Create a storyboard of eight key events that led to the understanding of disease. You can use the dates from the timeline, but you may also choose to separate events or combine them.

N.B. ‘dual coding’ (representing information in pictures) is one of the most effective techniques for ensuring knowledge stays in your head long-term.