Edward Jenner and active immunisation

Edward Jenner was born in 1749. At that time, there were several different infectious diseases which repeatedly developed to become epidemics from which many people died, often during childhood. One of those was smallpox (also known as the pox), which was triggered by *Orthopoxvirus variola:* In addition to pharyngitis, back pain and fever, pus spots and pustules containing the virus developed all over the body. Apart from the scars caused by the drying of the pustules, the disease caused paralysis, blindness, deafness or brain damage and was fatal for one-third of the patients. As the infection was transmitted by droplets, smallpox was able to spread very quickly.

Edward Jenner became a doctor and worked in the countryside, where, over the course of several years, he noticed that not everyone contracted smallpox. People who worked in byres or cowsheds, and were infected by the cows with the (non-fatal) cowpox, did not contract smallpox or, if so, then only mildly.

Based on this observance, he hypothesised that the cowpox disease had to be protecting people from contracting smallpox. He tested this hypothesis on children: his gardener's son and, thereafter, his own son.

Jenner extracted pus from the pustules of a woman suffering from cowpox and transferred it to the boy by lightly scratching his arm. The pus contained the cowpox pathogens and, as planned, the boy contracted cowpox. After the disease subsided, Jenner infected the boy in the same way, but with smallpox – the boy remained healthy, even after a second attempt. A few years later, it did, however, emerge that protection against smallpox generally wears off between the ages of 20 to 25, and that lifelong immunity can only be ensured with a second vaccination.

Edward Jenner had thus paved the way for vaccination: Through the infection with a harmless pathogen, he prevented the disease caused by similar, yet much more dangerous, pathogens. This principle is still used in **active immunisation (preventive vaccination)** today.

Assignments:

1. Prepare a 'smallpox disease' factsheet. ☆ Aid 1

2. Show the sequence of Jenner's experiment schematically. ☆ Aid 2

3. Watch the video entitled 'Vaccines I: The Immune System and Immunisation (2019)', in particular, minute 1:18 to 1:46. Explain how active immunisation, by means of vaccination, works today.

Link to the video: www.mediatheque.lindau-nobel.org/videos/38130/vaccine-i

Emil von Behring and passive immunisation

Emil von Behring was born in 1854. At that time, there were several different infectious diseases which repeatedly developed into epidemics from which many people died. One of the most feared childhood diseases was diphtheria, which adults could contract, too, and indeed still can today. The disease is characterised by fever, sore throat, fatigue and, later, by tonsillitis and pharyngitis. The neck can swell, thus causing suffocation; in addition, it can also cause myocarditis or inflammation of the kidneys. The infection is transmitted by droplets and thus diphtheria was able to spread very quickly. The majority of sufferers – above all, children – died, and even today, more than a third of patients die if they do not receive treatment.

In 1884, the *Corynebacterium diphteriae* was discovered as the trigger of the disease. In 1888, it became known that this bacterium forms a toxin (poison) which causes the symptoms of the disease.

Emil von Behring was one of the doctors who worked towards finding a cure for diphtheria and this toxin. He knew that animals could be infected with diphtheria pathogens, yet did not become ill and showed no traces of the toxin in the blood. From this, he concluded that these animals must have the antitoxin (antidote) in their blood. A little later, he was actually able to prove the existence of this antitoxin and even transferred it to other animals with the disease which were then cured by it. In the next step, Behring administered the antitoxin from the animals' blood to people who were ill, and he was successful; the patients recovered and became healthy again. Emil von Behring was awarded the first Nobel Prize for physiology or medicine for this.

From Behring's research, **passive immunisation (therapeutic vaccination)** developed. This vaccine, and the preventive diphtheria vaccine that was developed later on, ensure that hardly anyone has to die of diphtheria nowadays, at least not in the industrialised nations.

Assignments:

1. Prepare a 'diphtheria disease' factsheet.

☆ Aid 1

2. Show the sequence of the discovery of the diphtheria bacteria up to the successful (curative) vaccination of people schematically.

☆ Aid 2

3. Watch the video entitled 'Vaccines I: The Immune System and Immunisation (2019)', in particular, minute 1:46 to 2:19. Explain how passive immunisation works today.

Link to the video: www.mediatheque.lindau-nobel.org/videos/38130/vaccine-i

Aid 1

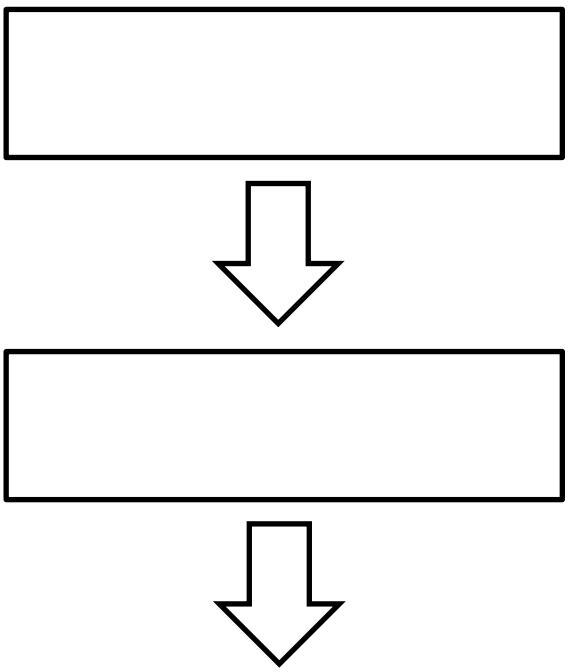
Contents of the fact sheet:

- name of the pathogen
- disease symptoms
- path of infection
- mortality

You can find all the information that you need in the text.

Aid 2

The schematic presentation should provide a clear overview of the most important steps, so that the observer is informed of the essential aspects, even without seeing the text. An arrow diagram could be used for this:



You can, of course, also use other forms of presentation – the main thing is that it is clear and comprehensible!

