



Introduction

This lesson plan covers immunity and vaccinations, and highlights the importance of getting vaccinated, not just for an individual's health but for others in the population. Interactive slides help students to clarify common myths and misconceptions about vaccinations. Students learn the impact the media may have on vaccine uptake through the example of the measles, mumps and rubella (MMR) scare in the early 2000s.

Learning outcomes

- Vaccination helps individuals to develop immunity against an infection(s) and helps to fight off the infection(s)
- Why vaccines are important to students now and throughout their life
- The important diseases prevented by vaccines, and why these are important to young people, including students
- How the media, and epidemics, can affect vaccine uptake positively and negatively

Exam specification links

This lesson plan covers several topics found in the AQA, OCR, Edexcel and WJEC exam specifications for A-level Biology, Human Biology and related subjects. For more information, please visit the 'Examination links' webpage.

Key words

Antibodies, Antigen, Vaccination, Immunisation, Innate immunity, Acquired immunity, Immune system, Herd immunity

Available web resources

Animations, interactive slides, PowerPoint presentations and many other resources are available in the young adult vaccination section at www.e-Bug.eu.

Materials required

Graph paper for completion of the main activity.





Background information

Vaccinations have been one of the most effective methods to prevent disease and have helped to lower mortality associated with infectious diseases worldwide.

How vaccines provide immunity

Vaccines are preventative, that is, they only protect the individual before they get an infectious disease. When an individual is vaccinated, the processes in the immune system that are stimulated to mimic the body's natural immunity include: antigen recognition, antibody production and formation of a memory response. These processes occur without causing the damage that an infection usually causes because the vaccine contains the antigen of the infectious disease, or a toxoid (an inactive version of a toxin) in an inactive, safe form. These infectious agents have been inactivated by being killed or denatured by heat, radiation or other harmful conditions. The antigen is the same but the microorganism can no longer cause the infectious disease.

Vaccines provide immunity by stimulating the immune system to produce antibodies to fight a particular infection or prevent the effects of a toxin. These antibodies stay in the body and provide long term protection. Antibodies fight a particular infection or toxin by identifying a matching antigen. Antigens are a pattern or structure found on the microorganism or toxin, and the antigen is a complimentary match for the antibody that will be produced.

Types of immunity

If an individual has not been vaccinated against a disease and they have contact with it, they will usually acquire some **natural active immunity** through exposure to antigens of the microorganism or toxin. However, there are risks associated with contracting an infection as some can leave the individual with long term complications, or worse, cause death. **Artificial active immunity** occurs through vaccination or inoculation. **Passive immunity** arises through acquisition of protective antibodies (most commonly through injection or transfusion of blood products) that will help fight the infection without the individual having had exposure to the infection or having been vaccinated. Natural passive immunity can also occur between mum and baby through the placenta during pregnancy or through breast feeding. In some cases, passive immunity can be artificially acquired through the transfer of antibodies from other humans or animals into an individual's bloodstream. Passive immunity is used when there is no time for an individual to generate their own specific antibodies to microorganisms. An example of this is after a gardening injury when there is a danger of tetanus, so a tetanus anti-toxin is given to those who have never had the tetanus vaccination.





Herd Immunity

If enough of a population is vaccinated, herd immunity is attained. Herd immunity in a population prevents outbreaks of an infection. This is due to the inability for the disease to infect vaccinated individuals and through the inability for unvaccinated individuals to come into contact with the disease due to its decreased prevalence.

It is important to maintain herd immunity as some people are unable to have vaccinations. Individuals who may not be able to have a vaccine include those who are immune-compromised, individuals with allergies to the components of vaccines and very young children.

Routine and other vaccinations

Countries have routine vaccinations for diseases that are considered to be high risk in that country. Some vaccines contain antigens for more than one disease. Examples of these include the polio, diphtheria and tetanus vaccine, and MMR (measles, mumps and rubella). In some cases, one pathogen can cause more than one disease. Human papillomavirus, also known as HPV, can cause genital warts and if left unmonitored in women, can lead to cervical cancer. The new HPV vaccination can prevent cervical cancer in women, but it will also reduce genital warts.

International travel is increasingly popular and it is important for students to understand that travel to different regions comes with increased risk of infection. Increased risk can be due to poor sanitation or hygiene, or higher occurrence of different infections in those countries, for example rabies, meningitis or Japanese encephalitis. Students can visit the e-Bug website for more information, their travel vaccination practitioner at their GP surgery, or visit <http://www.fitfortravel.nhs.uk>. Travel vaccinations are important and in some cases are required for entry into a country. An example includes the proof of vaccination against meningitis for entry into Saudi Arabia for the Hajj pilgrimage.

Some diseases require boosters to maintain antibodies at a high enough level to prevent infection. Boosters maintain high antibody levels in the blood. An example is the pneumococcal vaccines. The genetic make-up of some microorganisms mutates quickly, leading to changes in their antigen structure, and so these infections require annual vaccinations. This is why annual flu vaccines are developed to prevent infection from new flu strains circulating in the community.





Introduction (15mins)

1. Provide an introduction for students, describing that they are going to learn about vaccinations, and why vaccination is so important. Students will be learning the truth about common myths and misconceptions surrounding vaccinations, and the influence of others when making decisions about vaccinations. Students will learn about the influence of the media on vaccine uptake, subsequent disease rates and herd immunity.
2. Ask students what they already know about vaccinations. Questions to be discussed could include:
 - Do you know what a vaccination is? How does a vaccination work?
 - What vaccinations do children usually have, and at what ages?
 - What vaccinations have you had?
 - Why do you think you need vaccinations against diseases such as the flu, or measles, mumps and rubella (MMR)?
 - Do students know what herd immunity is? Ask students to describe this in their own words. (The herd immunity animation at www.e-Bug.eu could be used if students are still confused about herd immunity).

Main activity (20-25 mins)

1. Present the interactive vaccination myth slides from the e-Bug young adult website. These cover five myths and misconceptions about vaccines that young people may have, and provide answers based on the students views. Involve the students in answering yes or no to each myth and then review the background information provided.
2. Provide students with student worksheet 1, which contains data related to the MMR scare and controversy. Begin the PowerPoint about the influence of the media on vaccines.
3. Ask students to complete the worksheet and use the provided data to plot a graph.
4. After students have completed the worksheet, finish the PowerPoint and review the correct graph with the students.





Plenary (10 mins)

Discuss the worksheet answers with the students.

What are the student's different interpretations of the graph?

Reflect back on herd immunity. Ask the students to describe how herd immunity was impacted in this example, and what the result of this was.

Extension activity

1. There is currently no vaccine for HIV or Ebola. Choose an infection that is prevented by vaccines and write a research report outlining and comparing why some infections, like HIV or Ebola, are still not prevented by vaccines.
2. A zombie apocalypse has infected the earth. Public Health England (PHE) is working on a vaccine to combat the infection that causes humans to become zombies, and you are a Vaccine Scientist working on this vaccination. Write a news article to describe the plan you and your team at PHE are working on to stop the spread of the zombie apocalypse.
3. Assign students to watch the immunisation animation clips available at www.e-Bug.eu as homework. Ask students to complete student worksheet 2, which accompanies these animations.

Acknowledgements

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Advance preparation

Locate and download the interactive vaccination myths and misconceptions slides and the PowerPoint presentation at www.e-Bug.eu.

In preparation for the lesson, you can ask students to complete their own personalised vaccination timeline, available at www.e-Bug.eu. This timeline will detail all the vaccinations students should have had, and they can discuss this at home with their parents. However, the immunisations that students have or have not had are not for class discussion. Students may be very surprised at the number of immunisations they have had.

