Lesson 6: Understanding viruses, bacteria and antibodies

Humanimal Trust
ONE Medicine for humans and animals

These are difficult concepts to differentiate, and the problem we are beginning to face regarding antibiotic resistance is something we need to be addressing now. One of the research grants Humanimal Trust has given was a study looking at alternative methods of treating dogs with phages rather than antibiotics and this had very positive results.

Learning Objectives

Students will learn:

- What a virus is
- what bacteria is
- how a virus and bacteria are treated differently
- what antibiotics can do
- why we have a current and more serious problem with antibiotics looming.

Learning Outcomes

By the end of the lesson, students will be able to:

- Explain what a virus is
- explain what bacteria is
- be able to articulate what the problem is with antibiotic use

Resources Required

Resource 1:
Powerpoint

Resource 2:
Teacher's notes

Resource 3:
A4 paper for origami antibody, scissors and colours

Key Words

virus, bacteria, antibodies, zoonotic, bacteria, immune system, MRSA, antibiotics, origami

NC Links

Aims and objectives of Science: understand how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society

Science
Working scientifically - informing students of the role of science in understanding the causes of and solutions to some of the challenges facing society.
Development of scientific thinking: appreciating the power and limitations of science and considering ethical issues which may arise

Art curriculum - to increase their proficiency in the handling of different materials

The ethics of healthcare and problem solving: Health ethics promotes the consideration of values in the prioritization and justification of actions by health professionals, researchers and policymakers that may impact the health and well-being of patients, families, and communities.

PSHE – dealing with complex issues and mental health

Activity	Description	Timing
Introduction	Assess the students knowledge on this topic - can they explain what a virus is in comparison to bacteria? Do they know what antibodies are? Slide 2 - Discuss what zoonotic diseases are and what infectious means (further information is in the teacher's notes) Who are WHO?	15 min
What is ???	Further information on this section is available in the teacher's notes Slide 3 - discuss what a virus is - ask students if they can name any viruses, answers are in the powerpoint Slide 4 what is bacteria? ask students then discuss information in teacher's notes Slide 5: MRSA a super bacteria Slide 6: antibiotics (antibiotics work by killing or preventing bacteria from spreading) Slide 7: antimicrobial resistance, some causes and One Medicine Slide 8: Research study funded by Humanimal Trust: See notes	20 min
An origami antibody	Visit the link to British Society for Immunology for the video how to make an origami antibody. There is a link to a PDF version that can be printed out to use. Give each student a piece of A4 paper and create an origami antibody together. These can be decorated and given names, use colours, little craft eyes British Immunology antibody origami	15 min
Plenary	Students can work in pairs to create a definition of a virus and/or a bacteria. Discuss definitions and write them up individually to create part of a display	10 min

Key questions:

What do you know about One Medicine?
How can One Medicine help with the problem of antimicrobial resistance?
What can you do to be part of the solution?

Plenary/ Assessment of Learning

Assessing Progress

Can the students complete the plenary activity?
Can they create a definition of a virus? Can they create a definition of a bacteria?

Can they give you a definition of One Medicine?

In pairs, can they create Fib Test for each other and give correct true/false responses? (the Fib Test is where one student makes up three statements on the topic, one of which is incorrect. Then they ask the other student if the statement is true or false.

Extension activities

On the British Society for Immunology website, there are instructions on how to make an origami virus. This is more complicated, but some students may like to give it a go!

Divide the class into groups of 3-4 students. Each group should research and create a poster on one of the following topics:
Choose a specific bacteria or virus. eg: influenza, salmonella.
Each poster should include:
their structure, where they can be found, how they affect humans or animals, whether that is in a useful or harmful way and what do they need to multiply/grow

Teacher's Notes / Observations

Teacher's Notes

Additional Information:

Slide 3: What is a virus?
Viruses are thought to be so small that 500 million rhinoviruses (which cause the common cold) could fit on to the head of a pin. We need a microscope to be able to see them
2. The cell they multiply in is called the host cell. The viral replication process begins when a virus infects its host by attaching to the host cell and penetrating the cell wall or membrane.
3. The primary way to prevent viral infections is vaccination, in order to increase the individual's immunity to the disease.
This image is of COVID-19 coronavirus is seen in yellow, emerging from cells (in blue and pink) cultured in the lab. This image is from a scanning electron microscope.

Slide 4: What is bacteria?
You also have good bacteria within and on your own body. Did you know that you have ten times more bacterial cells in your body than you have human cells? Most of these bacteria are in your digestive system. Many of them are in our guts and help us digest our food. The two most common species of helpful bacteria found in our gut microbiome are Lactobacillus and Bifidobacteria.
examples of bacterial infections that make you ill are: Streptococcus, e-coli, tuberculosis (TB), pneumonia, wound infections, salmonella, Lyme disease (bitten by ticks)

Slide 5: What is MRSA?
Staphylococcus aureus is a very common bacteria often found growing harmlessly on the skin. Although originally responsive to penicillin, strains soon emerged that were resistant to the antibiotic. When a derivative of penicillin called methicillin was developed to combat these strains, Methicillin-resistant staphylococcus aureus (MRSA) materialised. The antibiotic resistance of MRSA strains continue to become stronger and some strains of this superbug are now resistant to virtually all know treatments.

The immune system of healthy individuals can usually ward off an MSA infection without the need for antibiotics, but in the infirm it can be very serious. The best way to to prevent the spread of MRSA is simple attention to hygiene, particularly hand washing. Also if someone is prescribed antibiotics by a doctor you must complete the dose, If you stop as soon as you feel a bit better, you may have only dispatched the weaker strains of the bacteria, allowing the deadlier ones to survive and flourish.

This is one of the diseases that has become antibiotic resistant and why we should be looking at this from a One Medicine approach, only using antibiotics when absolutely necessary and working together to find alternative solutions.

Teacher's Notes

Additional Information:

Slide 8: Anti-microbial resistance

1. Antibiotics underpin modern medicine and since the 1940s have also been used in animals, both therapeutically and non-therapeutically.
The development of antimicrobial resistance is a naturally occurring process for bacteria, the spread of multi-resistant strains has been accelerated by the excessive and inappropriate use of antibiotics. Because of this, antibiotic use has been recognised for a long time as a significant contributor to the AMR crisis.

2. Research on antibiotic use has focused on its use in the livestock industry, farming, where antibiotics have been used as growth-promoting agents and prophylactics (as a preventative). Concerns about AMR and the cross-over into human medicine, the use of antibiotic growth promoters were banned in the EU in 1997. However, the complexities of managing health and disease in livestock as well as ensuring food safety, means that the use of antibiotics in livestock is still very high.

Slide 9: Research subjects funded by Humanimal Trust

Visit the Humanimal Trust website for full details of this study: Bacteriophages as an alternative to antibiotics
https://www.humanimaltrust.org.uk/what-we-do/research/phd-studentships/bacteriophages-alternative-antibiotics

Slide 10: The Immune System

1.A non-specific line of defence could be hand washing, using a tissue or coughing into the crook of your arm.
2. The immune system consists of white blood cells and Y-shaped proteins called antibodies.
White blood cells attack harmful bacteria.
Even if there are symptoms, so someone has been infected, the immune system can usually cope and fend off the infection. However, sometimes the number of harmful bacteria are excessive and the immune system cannot get rid of them all, this is when antibiotics can be useful.
3. Antibodies work by grabbing onto suspicious antigens using the tips of their arms and holding fast until other immune system cells have a chance to neutralise the threat.
4. By giving a sneaky peek at epitopes found on genuine threats, the vaccines train antibodies to respond quickly if they encounter the same threat again, allowing the body to neutralize it before it has a chance to fully develop.