B3: Infection and Response

What's the science story?

Pathogens are microorganisms such as viruses and bacteria that cause infectious diseases in animals and plants. They depend on their host to provide the conditions and nutrients that they need to grow and reproduce. They frequently produce toxins that damage tissues and make us feel ill. This section will explore how we can avoid diseases by reducing contact with them, as well as how the body uses barriers against pathogens. Once inside the body our immune system is triggered which is usually strong enough to destroy the pathogen and prevent disease. When at risk from unusual or dangerous diseases our body's natural system can be enhanced by the use of vaccination. Since the 1940s a range of antibiotics have been developed which have proved successful against a number of lethal diseases caused by bacteria. Unfortunately, many groups of bacteria have now become resistant to these antibiotics. The race is now on to develop a new set of antibiotics.

Previous knowledge:

- Organisms
- Body systems and respiration
- B1: Cell Biology
- B2: Organisation

Next steps…

B5: Homeostasis and Response

Keywords

Pathogen
Virus
Bacteria
Virus
Protist
Transmission
Prevention
Vector
Toxicity
Efficacy
Dose
Double blind
placebo

Viral
Measles
HIV
AIDS
Tobacco mosaic virus
Salmonella
Gonorrhoea
Spread
Immune system
Antibodies
Antigens
Memory lymphocytes

Rose black spot
Life Cycle
Repellent
Mosquito
Malaria
Phagocytes
Antibodies
Antitoxins
Antibiotics
Preclinical
Clinical
Synthesised
Pharmaceutical

AQA GCSE Combined Science Trilogy (8464)

Working scientifically skills:	**Assessments:**
WS1: Scientific methods = How theories change over time, does the data support the theory or not **WS4: Ethical arguments =** Rights and wrongs of technology **WS6: Peer review =** The importance of peer reviewing data - not biased	End of unit test (summative) Exit tickets x 2/3 (formative) • **Immune Response** •

Lesson No. and Title	Learning objectives	AQA Specification	Practical equipment
1. Communicable diseases	4 – To recall the four possible causes of disease. (A01) 5 – To describe how diseases may be spread from organism to organism. (A02) 6 – To suggest how the spread of diseases may be prevented. (A02)	Students should be able to explain how diseases caused by viruses, bacteria, protists and fungi are spread in animals and plants. Students should be able to explain how the spread of diseases can be reduced or prevented. Pathogens are microorganisms that cause infectious disease. Pathogens may be viruses, bacteria, protists or fungi. They may infect plants or animals and can be spread by direct contact, by water or by air. Bacteria and viruses may reproduce rapidly inside the body. Bacteria may produce poisons (toxins) that damage tissues and make us feel ill. Viruses live and reproduce inside cells, causing cell damage	
2. Viral Diseases	4 – State examples of viral diseases (A01) 5 – Describe symptoms of specific viral diseases (A02) 6 – Link the cause of the disease with it's symptoms (A02)	Measles is a viral disease showing symptoms of fever and a red skin rash. Measles is a serious illness that can be fatal if complications arise. For this reason most young children are vaccinated against measles. The measles virus is spread by inhalation of droplets from sneezes and coughs. HIV initially causes a flu-like illness. Unless successfully controlled with antiretroviral drugs the virus attacks the body's immune cells. Late stage HIV infection, or AIDS, occurs when the body's immune system becomes so badly damaged it can no longer deal with other infections or cancers. HIV is spread by sexual contact or exchange of body fluids such as blood which occurs when drug users share needles. Tobacco mosaic virus (TMV) is a widespread plant pathogen affecting many species of plants including tomatoes. It gives a distinctive 'mosaic' pattern of discolouration on the leaves which affects the growth of the plant due to lack of photosynthesis.	

3. Bacterial disease	4 – State examples of bacterial diseases (A01) 5 – Describe symptoms of specific viral diseases (A02) 6 – Link the cause of the disease with it's symptoms (A02)	Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in unhygienic conditions. In the UK, poultry are vaccinated against salmonella to control the spread. Fever, abdominal cramps, vomiting and diarrhoea are caused by the bacteria and the toxins they secrete. Gonorrhoea is a sexually transmitted disease (STD) with symptoms of a thick yellow or green discharge from the vagina or penis and pain on urinating. It is caused by a bacterium and was easily treated with the antibiotic penicillin until many resistant strains appeared. Gonorrhoea is spread by sexual contact. The spread can be controlled by treatment with antibiotics or the use of a barrier method of contraception such as a condom.	PRAC – Spreading of disease
4. Fungal and Protist disease	4 – To give an example of a fungal disease in plants. 5 – To determine how a fungal disease affects the growth of a plant. 6 – To explain and illustrate how malaria is caused and spread.	Rose black spot is a fungal disease where purple or black spots develop on leaves, which often turn yellow and drop early. It affects the growth of the plant as photosynthesis is reduced. It is spread in the environment by water or wind. Rose black spot can be treated by using fungicides and/or removing and destroying the affected leaves. The pathogens that cause malaria are protists. The malarial protist has a life cycle that includes the mosquito. Malaria causes recurrent episodes of fever and can be fatal. The spread of malaria is controlled by preventing the vectors, mosquitos, from breeding and by using mosquito nets to avoid being bitten.	
5. Human Defence systems	4 – To describe the body's non-specific defence mechanisms. 5 – To explain the role of the immune system in the defence against disease. 6 – To explore the specific role of white blood cells against pathogens.	Students should be able to describe the non-specific defence systems of the human body against pathogens, including the: • skin • nose • trachea and bronchi • stomach. Students should be able to explain the role of the immune system in the defence against disease. If a pathogen enters the body the immune system tries to destroy the pathogen. White blood cells help to defend against pathogens by: • phagocytosis • antibody production • antitoxin production.	

6. Vaccination	4 – To state the function of vaccines (AO1). 5 – To describe how a vaccine works (AO2). 6 – To explain how immunisation protects against infection	Students should be able to explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population. Vaccination involves introducing small quantities of dead or inactive forms of a pathogen into the body to stimulate the white blood cells to produce antibodies. If the same pathogen re-enters the body the white blood cells respond quickly to produce the correct antibodies, preventing infection. Students do not need to know details of vaccination schedules and side effects associated with specific vaccines.	
7. Antibiotics	4 – To define the term antibiotic (AO1). 5 – To explain why antibiotics are useful for treating bacterial infections (AO2). 6 – To explain why antibiotics cannot be used to treat all pathogens (AO2).	Students should be able to explain the use of antibiotics and other medicines in treating disease. Antibiotics, such as penicillin, are medicines that help to cure bacterial disease by killing infective bacteria inside the body. It is important that specific bacteria should be treated by specific antibiotics. The use of antibiotics has greatly reduced deaths from infectious bacterial diseases. However, the emergence of strains resistant to antibiotics is of great concern. Antibiotics cannot kill viral pathogens. Painkillers and other medicines are used to treat the symptoms of disease but do not kill pathogens. It is difficult to develop drugs that kill viruses without also damaging the body's tissues.	
8. Immunisation	4 – To describe the process of immunisation (AO1). 5 – To explain both the primary and secondary responses during infection (AO2). 6/7 – To fully compare the body's natural response to infection with immunization (AO3).		

9. Discovery and development of new drugs	4 – To state examples of drugs that come from plants and microorganisms (AO1). 5 – To describe the main steps in the development of a new drug (AO2). 6 – To explain the steps in the development of a new drug (AO2).	Students should be able to describe the process of discovery and development of potential new medicines, including preclinical and clinical testing. Traditionally drugs were extracted from plants and microorganisms. • The heart drug digitalis originates from foxgloves. • The painkiller aspirin originates from willow. • Penicillin was discovered by Alexander Fleming from the Penicillium mould. Most new drugs are synthesised by chemists in the pharmaceutical industry. However, the starting point may still be a chemical extracted from a plant. New medical drugs have to be tested and trialled before being used to check that they are safe and effective. New drugs are extensively tested for toxicity, efficacy and dose. Preclinical testing is done in a laboratory using cells, tissues and live animals. Clinical trials use healthy volunteers and patients. • Very low doses of the drug are given at the start of the clinical trial. • If the drug is found to be safe, further clinical trials are carried out to find the optimum dose for the drug. • In double blind trials, some patients are given a placebo.	