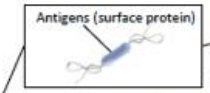
Health and immunity L45-59

Phagocytes	*Phagocytosis*	Phagocytes engulf the pathogens and digest them.
Lymphocytes	*Antibody production*	Specific antibodies destroy the pathogen. This takes time so an infection can occur. If a person is infected again by the same pathogen, the lymphocytes make antibodies much faster.
	Antitoxin production	Antitoxin is a type of antibody produced to counteract the toxins produced by bacteria.



Pathogens are identified by white blood cells by the different proteins on their surfaces **ANTIGENS.**

White blood cells are part of the immune system

Immune system

Non-specific defence systems

The human body has several non specific ways of defending itself from pathogens getting in

	*Nose*	Nasal hairs, sticky mucus and cilia prevent pathogens entering through the nostrils.
	*Trachea and bronchus (respiratory system)*	Lined with mucus to trap dust and pathogens. Cilia move the mucus upwards to be swallowed.
	*Stomach acid*	Stomach acid (pH1) kills most ingested pathogens.
	*Skin*	Hard to penetrate waterproof barrier. Glands secrete oil which kill microbes

AQA GCSE INFECTION AND RESPONSE part 1

Human defence systems

Plants have several ways of defending themselves from pathogens and animals

Physical	*Mechanical*
Thick waxy layers, cell walls stop pathogen entry	Thorns, curling up leaves to prevent being eaten
Chemical	
Antibacterial and toxins made by plant	

Detection and identification of plant diseases (bio only)

Detection	**Identification**
Stunted growth	Reference using gardening manual or website, laboratory test for pathogens, testing kit using monoclonal antibodies.
Spots on leaves	
Area of decay	
growths	
Malformed stem/leaves	
Discolouration	
Presence of pests	

Nitrate ions needed for protein synthesis – lack of nitrate = stunted growth.

Magnesium ions needed to make chlorophyll – not enough leads to chlorosis – leaves turn yellow.

Pathogens may infect plants or animals and can be spread by direct contact, water or air

Pathogen	*Disease*	Symptoms	Method of transmission	Control of spread
Virus	*Measles*	Fever, red skin rash.	Droplet infection from sneezes and coughs.	Vaccination as a child.
Virus	*HIV*	Initially flu like systems, serious damage to immune system.	Sexual contact and exchange of body fluids.	Anti-retroviral drugs and use of condoms.
Virus	*Tobacco mosaic virus*	Mosaic pattern on leaves.	Enters via wounds in epidermis caused by pests.	Remove infected leaves and control pests that damage the leaves.
Bacteria	*Salmonella*	Fever, cramp, vomiting, diarrhoea.	Food prepared in unhygienic conditions or not cooked properly.	Improve food hygiene, wash hands, vaccinate poultry, cook food thoroughly.
Bacteria	*Gonorrhoea*	Green discharge from penis or vagina.	Direct sexual contact or exchange of body fluids.	Use condoms. Treatment using antibiotics.
Protists	*Malaria*	Recurrent fever.	By an animal vector (mosquitoes).	Prevent breeding of mosquitoes. Use of nets to prevent bites.
Fungus	*Rose black spot*	Purple black spots on leaves.	Spores carried via wind or water.	Remove infected leaves. Spray with fungicide.

Bacteria may produce toxins that damage tissues and make us fell ill

Viruses	Bacteria (prokaryotes)	Protists (eukaryotes)	Fungi (eukaryotes)
e.g. cold, influenza, measles, HIV, tobacco mosaic virus	*e.g. tuberculosis (TB), Salmonella, Gonorrhoea*	*e.g. dysentery, sleeping sickness, malaria*	*e.g. athlete's foot, thrush, rose black spot*
DNA or RNA surrounded by a protein coat	No membrane bound organelles (no chloroplasts, mitochondria or nucleus). Cell wall. Single celled organisms	Membrane bound organelles. Usually single celled.	Membrane bound organelles, cell wall made of chitin. Single celled or multi-cellular

Pathogens are microorganisms that cause infectious disease

Pathogens

Communicable diseases

Viruses live and reproduce inside cells causing damage

AQA INFECTION AND RESPONSE

Antibiotics and painkillers

Antibiotics have greatly reduced deaths from infectious bacterial disease

antibiotics	*e.g. penicillin*	Kill infective bacteria inside the body. Specific bacterial infections require specific antibiotics.
Painkillers and other medicines	*e.g. aspirin, paracetamol, ibuprofen*	Drugs that are used to treat the symptoms of a disease. They do not kill pathogens

Antibiotics cannot be use to treat viral pathogens

It is difficult to develop drugs to kill viruses without harming body tissues because viruses live and reproduce inside cells

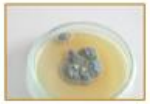
Bacteria can mutate

Sometimes this makes them resistant to antibiotic drugs.

Discovery and drug development

Most new drugs are synthesised by chemists in the pharmaceutical industry.

Traditionally drugs were extracted from plants and microorganisms

Digitalis	*Aspirin*	*Penicillin*
Extracted from foxglove plants and used as a heart drug	A painkiller and anti-inflammatory that was first found in willow bark	Discovered by Alexander Fleming from the *Penicillium* mould and used as an antibiotic
		

Drugs have to be tested and trialled before to check they are safe and effective

New drugs are extensively tested for:	
Efficacy	Make sure the drug works
Toxicity	Check that the drug is not poisonous
Dose	The most suitable amount to take

Preclinical trials - using cells, tissues and live animals - must be carried out before the drug can be tested on humans.

Clinical trials use healthy volunteers and patients

Stage 1	*Stage 2*	*Stage 3*	*Stage 4*
Healthy volunteers try small dose of the drug to check it is safe record any side effects	A small number of patients try the drug at a low dose to see if it works	A larger number of patients; different doses are trialled to find the optimum dose	A double blind trial will occur. The patients are divided into groups. Some will be given the drug and some a placebo.

Double blind trial: patients and scientists do not know who receives the new drug or placebo until the end of the trial. This avoids bias.

A placebo can look identical to the new drug but contain no active ingredients

Vaccination

Used to immunise a large proportion of the population to prevent the spread of a pathogen

Vaccination	*Small amount of dead or inactive form of the pathogen*	*1st infection by pathogen*	White blood cells detect pathogens in the vaccine. Antibodies are released into the blood.
		Re-infection by the same pathogen	White blood cells detect pathogens. Antibodies are made much faster and in larger amounts.

A person is unlikely to suffer the symptoms of the harmful disease and it's spread in a population is prevented

Created more side effects than expected (fatal in some cases) and are not as widely used as everybody hoped when first developed.

Monoclonal antibodies (Biology only HT)

Monoclonal antibodies

Identical copies of one types of antibody produced in laboratory

1. A mouse is injected with pathogen
2. Lymphocytes produce antibodies
3. Lymphocytes are removed from the mouse and fused with rapidly dividing mouse tumour cells
4. The new cells are called hybridomas
5. The hybridomas divide rapidly and release lots of antibodies which are then collected

Specific to one binding site on the antigen. Can target specific chemicals or cells in the body

Monoclonal antibodies can be used in a variety of ways

Diagnosis	*Detecting pathogens*	*Detecting molecules*	*Treatment*
e.g. pregnancy test – measure the level of hormones	Can detect very small quantities of chemicals in the blood	Fluorescent dye can be attached so it can be seen inside cells or tissues	Bound to radioactive substance, toxic drug or chemical Cancer cells are targeted to normal body cells are unharmed

Cancer

Non-communicable diseases

The result of changes in DNA that lead to uncontrolled growth and division

Benign tumour	Contained in one area of the body (usually by a membrane) – not cancer.
Malignant tumour	Invade tissues and spread to different parts of the body to form secondary tumours.

Some cancers have genetic risk factors.

Carcinogens and ionising radiation increase the risk of cancer by changing/ damaging DNA

Risk factors for heart/lung disease and certain types of cancer include drinking alcohol, diet, obesity and smoking

These risks factors can also affect the brain, liver and the health of unborn babies