

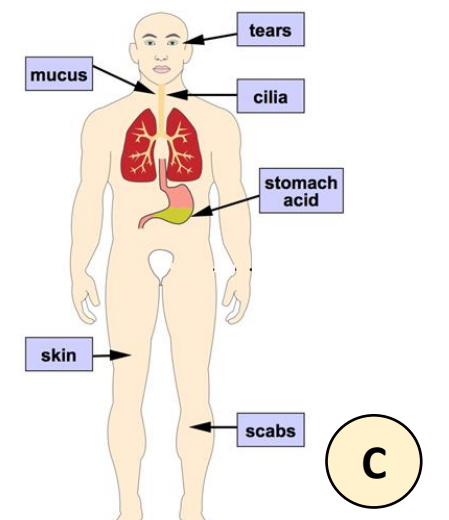


Infection and Response – Communicable Disease



Keyword	Definition
Communicable	A disease which can be spread to others.
Pathogens	Microorganisms that cause infectious disease.
Vector	Any organism which carries a pathogen and can spread it to another organism causing disease e.g. mosquitoes are vectors for malaria.
Droplet Inhalation	When a disease is spread through coughs and sneezes.
Antigen	A protein marker on the surface of a substance (often a pathogen) that triggers an immune response.
Antibodies	Proteins produced by some white blood cells (lymphocytes) which target a specific pathogen according to the antigen it carries.
Antitoxin	A chemical which cancels out toxins released by pathogens.
Phagocytosis	The process by which some white blood cells (phagocytes) engulf pathogens before digesting and destroying them.
Lymphocyte	A type of white blood cell that produces antibodies and antitoxins.
Vaccine	Small amount of dead or inactive pathogen which stimulates white blood cells to produce antibodies.
Herd Immunity	The protection given to a population against an outbreak of a disease when a very high percentage of the population have been vaccinated against it.
Antibiotics	A group of medicines that help to cure bacterial disease by killing infective bacteria inside the body.
Painkiller	A type of drug that treats the symptoms of an illness or disease but does not kill pathogens.
Antibiotic Resistance	The ability of bacteria to survive exposure to antibiotics. Occurs as a result of mutations in genes.

In05 Human Defence – Non-specific defences



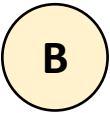
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Skin	A physical barrier to prevent pathogens entering body.
Scabs	Form over cuts to maintain a physical barrier.
Stomach Acid	Acid destroys pathogens ingested in food / drink.
Mucus	Lines airways to trap pathogens.
Cilia	Tiny hairs lining the trachea and bronchi to trap pathogens and move mucus.
Tears	Contain chemicals to kill pathogens.

In01 Pathogens

A Virus	Live and reproduce rapidly inside cells, causing cell damage. Unaffected by antibiotics. Difficult to develop drugs that kill viruses without damaging body's tissues.
Bacteria	Reproduce rapidly inside body. May produce toxins (poisons) that damage tissues and make us ill. Can be treated with antibiotics, although the emergence of strains resistant to antibiotics is of great concern.

In04 Types of Human Disease



Pathogen	Disease	Infected	Symptoms	Spread by	Prevention / Treatment
Virus	Measles	Human	Fever Red skin rash Can be fatal if complications arise	Droplet Inhalation	Most children vaccinated against measles.
	HIV	Human	Initial flu-like illness Later stages (AIDS) occurs when immune system so badly damaged that it cannot deal with other infections or cancers. Fatal.	Exchange of body fluids e.g. blood or semen by: - Unprotected sex - Sharing of needles by drug users	Progression of illness can be slowed with antiretroviral drugs.
	Tobacco Mosaic Virus (TMV)	Plants	"Mosaic" pattern of discolouration on the leaves. Stunted growth	Direct Contact	Remove infected leaves and burn Sterilise gardening tools and gloves.
Bacteria	Salmonella	Human	Fever Abdominal cramps Vomiting Diarrhoea	Ingestion of food prepared in unhygienic conditions.	Cook food thoroughly and in hygienic conditions. Take fluids to prevent dehydration. UK vaccinates poultry against Salmonella to control the spread.
	Gonorrhoea	Human	Thick yellow/green discharge from vagina or penis. Pain when urinating.	Sexually transmitted	Antibiotics (if not resistant) Use of barrier contraception e.g. condoms.
Fungal	Rose Black Spot	Plants	Black spots on leaves Stunted growth	Water or carried by wind.	Fungicides Removing and destroying the affected leaves.
Protist	Malaria	Human	Recurrent episodes of fever Can be fatal	Mosquito bite	Drugs to kill / prevent parasite. Spread controlled by preventing vectors from breeding and use of mosquito nets to avoid being bitten.

Required Practical: Microbiology

Mathematical Skills:

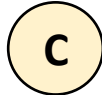
- Calculating the area of clear zones around antiseptic / antibiotic disks using πr^2
- Calculating the size of bacterial colonies after a time period when given the mean division time.

Relevant Modules:

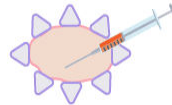


- Cells
- Enzymes (similarities with antibodies – specific nature)
- Inheritance (Protein Structure)

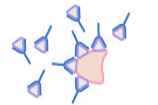
In06 Vaccination



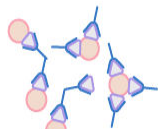
Inject small amount of dead or inactive pathogen (containing specific antigens).



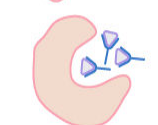
White blood cells produce antibodies until correct antibody identified.



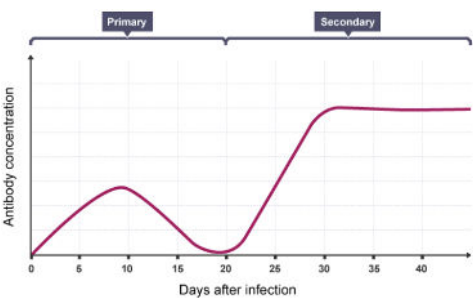
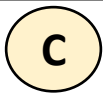
Antibodies attach to and clump pathogens together.



White blood cells engulf the pathogens. Phagocytosis occurs.



In06 Vaccination



Primary exposure (following vaccination):

- Antibodies increase slowly as white blood cells must produce different antibodies in order to find the correct one to match the antigen on pathogen.

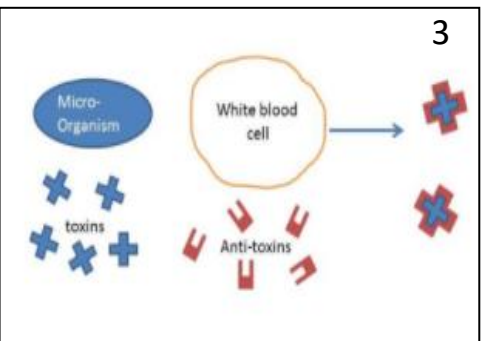
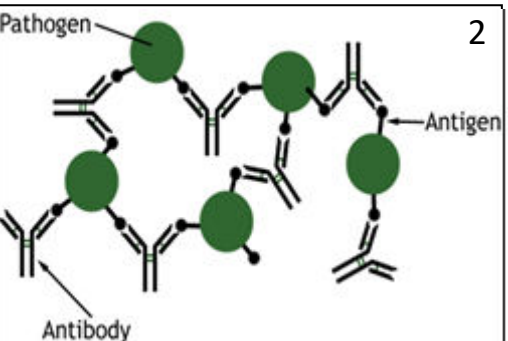
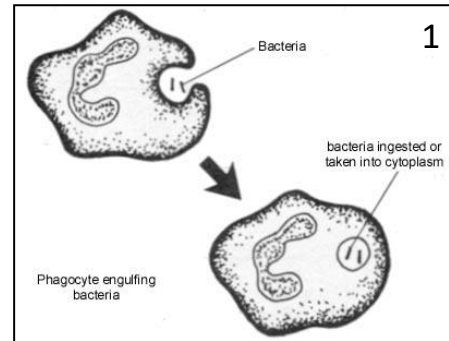
Secondary exposure (re-infection by "live" pathogen):

- White blood cells recognise same antigen and produce correct antibodies rapidly.
- Greater quantities of antibodies produced to prevent infection.

In05 Human Defence – White Blood Cells



1. Non-specific defence	Phagocyte performing phagocytosis to destroy pathogens.
2. Specific Defence	Antibodies cause pathogens to stick together, making it easier for phagocytes to perform phagocytosis.
3. Specific Defence	Antitoxins neutralise toxins produced by pathogens. Each antitoxin works for a specific toxin.



Useful YouTube links:



Pathogens and Immune System



Vaccination



Infection and response – Plants, drug development and non-communicable diseases.

Keyword	Definition
Benign tumours	Growths of abnormal cells which are contained in one area, usually within a membrane. They do not invade other parts of the body.
Causal mechanism	When scientists look for explanations behind correlations to establish a causal link between risk factors and disease.
Correlation	A relationship between two variables, such that when one set changes you would expect the other set to change as well.
Dosage	The most effective amount of drug needed to treat or cure the disease.
Double blind trial	During drug trials, some patients are given a placebo, neither the doctors nor the patients know who has received the real drug.
Efficacy	The ability of a drug to cure a condition or relieve symptoms.
Health	Health is the state of physical and mental well-being.
Hybridoma	Lymphocytes are combined with a particular kind of tumour cell to make a hybridoma cell. The hybridoma cell can both divide and make the specific antibody.
Lymphocyte	White blood cells which attack pathogens by producing antibodies.
Malignant tumour cells	Cancers which invade neighbouring tissues and spread to different parts of the body through the bloodstream where they form secondary tumours.
Non-communicable	A disease which cannot be transferred between individuals.
Placebo	A fake 'treatment', that does not contain the drug, used as a control in testing new drugs.
Risk factors	Factors linked to an increased rate of disease. E.g. a person's lifestyle or substances in the person's body or environment.
Toxicity	The ability of a drug to poison the body.

In08 Plant defences (Bio only)

Physical defence	Chemical defence	Mechanical adaptations
- Cellulose cell walls. - Tough waxy cuticle on leaves. - Layers of dead cells around stems (bark on trees) which fall off.	- Antibacterial chemicals. - Poisons to deter herbivores.	- Thorns and hairs deter animals. - Leaves which droop or curl when touched. - Mimicry to trick animals.

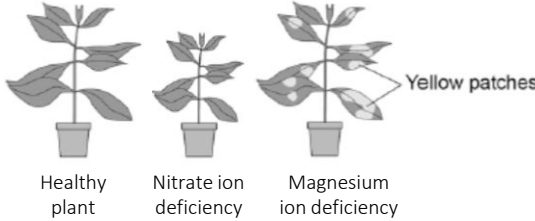
In08 Plant disease (Bio only)

Detecting plant diseases: stunted growth, spots on leaves, areas of decay, growths, malformed stems or leaves, discolouration and the presence of pests.

Identification can be made by:

- Reference to a gardening manual or website.
- Taking infected plant to a laboratory to identify the pathogen.
- Using testing kits that contain monoclonal antibodies.

- Plants can be infected by a range of pathogens as well as by insects, such as aphids.



In10 Benign and malignant tumours

Both types of tumour:

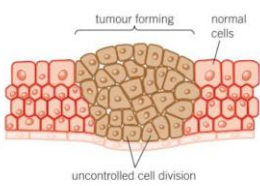
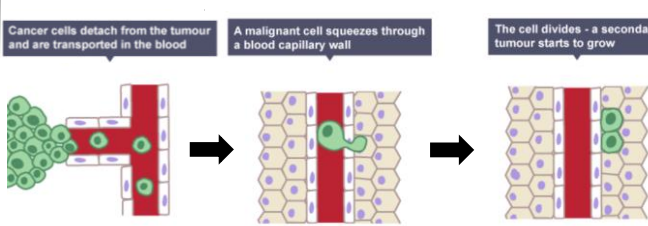


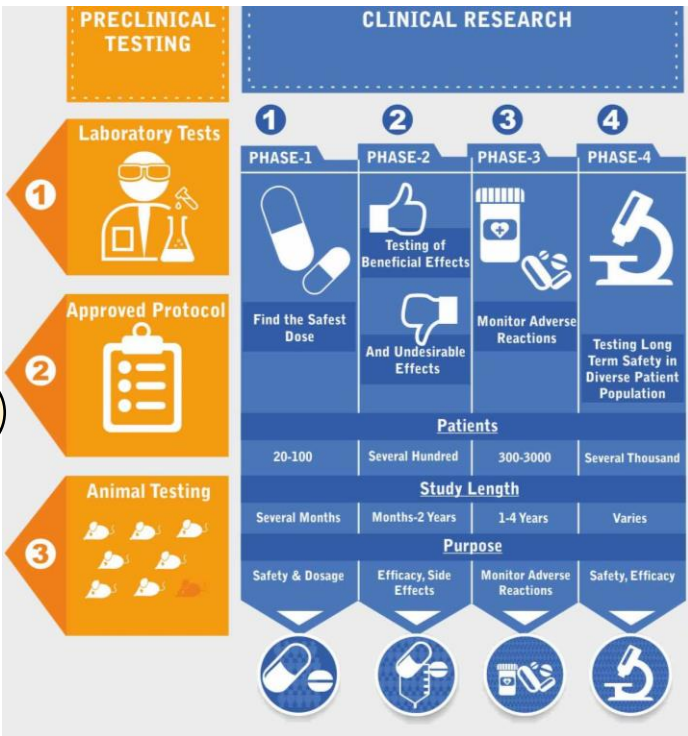
Figure 1 A tumour forms when there is uncontrolled cell division

Formation of secondary tumours by malignant tumours:



In09 Discovering and developing drugs

Drug	Digitalis	Aspirin	Penicillin
Use	Heart drug	Painkiller	Antibiotic
Origin	Foxgloves	Willow trees	Penicillium mould, discovered by Alexander Fleming

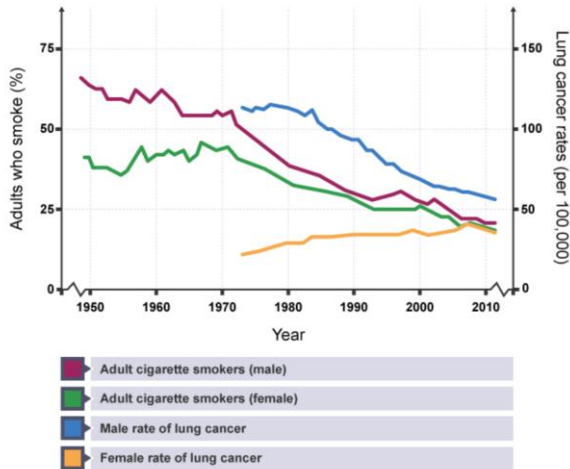


In11 Health issues

Different types of disease may interact.

- Defects in the immune system (e.g. HIV/AIDS) mean that an individual is more likely to suffer from infectious diseases.
- Viruses (e.g. HPV) living in cells can be the trigger for cancers.
- Immune reactions initially caused by a pathogen can trigger allergies such as skin rashes and asthma.
- Severe physical ill health can lead to depression and other mental illness.

In12 & 13 Factors affecting health

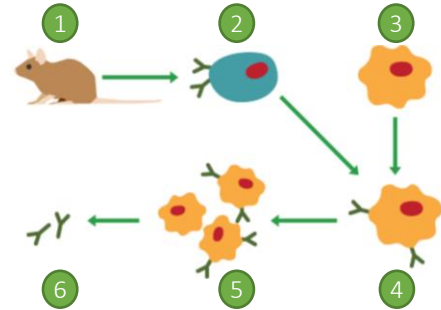


A causal mechanism has been proven for some risk factors, but not others:

- The effects of diet, smoking and exercise on cardiovascular disease.
- Obesity as a risk factor for Type 2 diabetes.
- The effect of alcohol on the liver and brain function.
- The effect of smoking on lung disease and lung cancer.
- The effects of smoking and alcohol on unborn babies.
- Carcinogens, including ionising radiation, as risk factors in cancer.

In14 Monoclonal antibodies (Bio only)

1. Mouse vaccinated to start production of antibodies.
2. Lymphocyte: Produces specific antibodies but cannot divide.
3. Tumour cell: Does not produce antibodies but divides.



4. Cells are fused to form a hybridoma.
5. Single hybridoma cell cloned to make identical cells.
6. Large amounts of monoclonal antibodies collected.

Required Practical:

None

Mathematical Skills:

- Draw and interpret tables and diagrams.
- Use a scatter diagram to identify a correlation between two variables.
- Translate information between graphical and numerical form.

Relevant Modules:

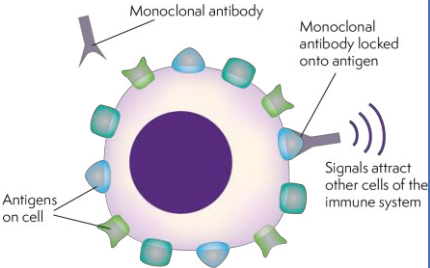
- Cells – cell division
- Organisation
- Photosynthesis

In15 Uses of monoclonal antibodies (Bio only)

- Pregnancy tests
- Measure levels of hormones or other chemicals in blood
- Locate specific molecules in cells
- Treating cancer

Monoclonal antibodies in treating cancer:

- A. Antibody attaches to antigens of cancer cell inhibiting growth hormones ability to attach, this slows growth of cancer cell.
- B. Antibody attaches to antigens of cancer cell and signals to white blood cells to destroy cancer cell.
- C. Chemical or radioactive substance attached to antibody to target cancer cell.



Issues of monoclonal antibodies:

- More side effects than expected.
- Not widely used.

Useful YouTube links:



Discovering and developing drugs



Monoclonal antibodies