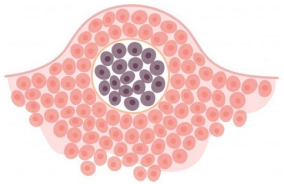
AQA B3b: Preventing and Treating Disease
Triple Biology (Page 1 of 3)
RP – Culturing microorganisms (Biology only RP)

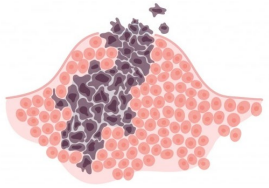
Key word	Definition
double blind trial	Patients and scientists do not know who receives the new drug or placebo until the end of the trial.
placebo	Can look identical to the new drug but contain no active ingredients.
efficacy	Make sure the drug works.
toxicity	Check that the drug is not poisonous.
dose	The most suitable amount to take.
antibiotics	Kill infective bacteria inside the body. Specific bacterial infections require specific antibiotics e.g. penicillin.
painkillers	Drugs that are used to treat the symptoms of a disease. They do not kill pathogens.
virus pathogens	cannot be treated using antibiotics as the virus is usually found inside body cells. It is also very difficult to develop drugs that kill viruses without also damaging the body's tissues.

Cancer
Cancer is caused by changes in cells that leads to uncontrolled cell growth and division.
Scientists have identified lifestyle risk factors for various types of cancer.
There are also genetic risk factors for some cancers.

Benign tumours are growths of abnormal cells which are contained in one area, usually within a membrane. They do not invade other parts of the body. They are NOT cancerous.



Malignant tumour cells are **cancers**. They invade neighbouring tissues and spread to different parts of the body in the blood where they form secondary tumours.



Traditionally drugs were extracted from plants and microorganism.

digitalis	aspirin	penicillin
Extracted from foxglove plants. Used as a heart drug.	Painkiller and an anti-inflammatory that was first found in willow bark.	Penicillin antibiotic 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.

Drugs have to be tested and trialled before use to check for toxicity, efficacy and dose.

Preclinical testing is done in the laboratory using cells, tissues and live animals.

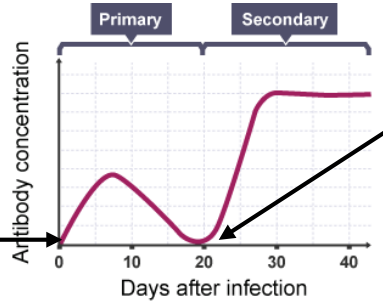
This must be carried out before the drug can be tested on humans.

Stages of clinical trials (use healthy volunteers and patients)

Stage 1	Stage 2	Stage 3	Stage 4
Healthy volunteers try a 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	The drug is trialled on a larger number of patients. Different doses are trialled to find the optimum dose	A double blind trial will take place. The patients are divided into groups. Some will be given the drug and some a placebo.

Vaccination
Prevents illness in an individual by 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.
the spread of pathogens can be reduced by immunising a large proportion of the population.

1st infection by pathogen: White blood cells detect pathogens in the vaccine. Antibodies are released into the blood.



Re-infection by same pathogen:
White blood cells detect pathogens. Antibodies are made much faster and in larger amounts.

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Key ideas	Information
Human impact of risk factors	How risk factors affect your quality of life, life expectancy, other people you are close to.
Financial impact of risk factors	How risk factors impact on e.g. the NHS in terms of treatment, research etc. e.g. families may have income affected by disease.
Local	The area where you live e.g. your individual choices affect the incidence of disease in your local area
national	Your country - England e.g. Nationally people are more likely to have a poor diet, smoke, drink alcohol and not exercise in deprived areas, so incidences of non-communicable diseases are higher
global	Different countries in the world. e.g. in developed countries non communicable diseases are more common as people have more money and can but high fat food – obesity and type 2 diabetes are more common.

Risk factors increase your chance of getting a disease (they don't guarantee you will get the disease though).
A causal mechanism has been proven for some risk factors, but not in others. This means that data may show a positive correlation but might not cause a disease directly.
Remember that many diseases are caused by the interaction of a number of risk factors, not just one factor alone.

Risk factor	Examples and disease risk
aspects of a person's lifestyle	Amount of exercise, a person's diet
substances in the person's body	Asbestos fibres – these can build up in the body and cause disease and cancer later in life
substances in the environment	Air pollution
smoking	Cardiovascular disease, lung cancer, lung disease, risk to unborn baby in pregnancy
alcohol	Liver disease, brain function – damage to nerve cells and loss of volume, risk to unborn baby in pregnancy
carcinogens	e.g. ionising radiation (X rays, UV rays) are risk factors in cancer
obesity	a risk factor for Type 2 diabetes and some cancers
genes	Faulty genes (mutations) can make you more susceptible to cancer e.g. the BRCA gene is linked to an increased risk of breast and ovarian cancer

Monoclonal antibodies are antibodies that are specific to one binding site on one protein antigen and so are able to target a specific chemical or specific cells in the body.

How to produce monoclonal antibodies:

1. Stimulate a mouse lymphocytes to make a particular specific antibody by injecting the mouse with a pathogen.
2. Lymphocytes will begin to produce antibodies but this cell can't divide.
3. Combine the lymphocytes with a particular kind of tumour cell to make a cell called a hybridoma cell. This cell can now divide **and** produce antibodies.
4. Single hybridoma cells are cloned to produce many identical cells that all produce the same antibody.
5. A large amount of the antibody can be collected and purified.

Monoclonal antibodies can be used in a variety of ways:

- For diagnosis such as in pregnancy tests
- In laboratories to measure the levels of hormones and other chemicals in blood, or to detect pathogens
- In research to locate or identify specific molecules in a cell or tissue by binding to them with a fluorescent dye
- To treat some diseases: for cancer the monoclonal antibody can be bound to a radioactive substance, a toxic drug or a chemical which stops cells growing and dividing. It delivers the substance to the cancer cells without harming other cells in the body.

Monoclonal antibodies create more side effects than expected. They are not yet as widely used as everyone hoped when they were first developed.

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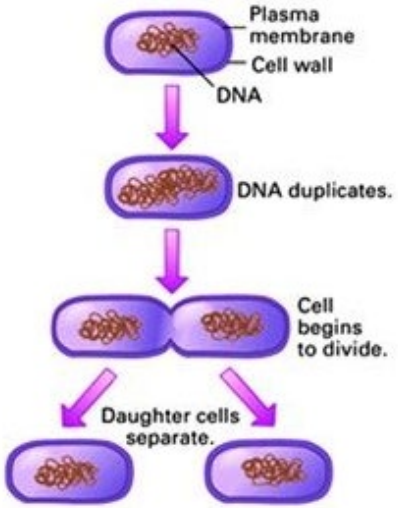
Bacteria multiply by simple cell division (binary fission).

Bacteria can multiply as often as once every 20 minutes if they have enough nutrients and a suitable temperature.

Bacteria can be grown in a nutrient broth solution or as colonies on an agar gel plate.

Uncontaminated cultures of microorganisms are required for investigating the action of disinfectants and antibiotics.



nutrient broth solution

agar gel plate

You might be asked to calculate the number of bacteria in a population after a certain time if given the mean division time.

Calculate the number of bacteria in the final population using the formula:

$$\text{bacteria at the end of the growth period} = \text{bacteria at the beginning of the growth period} \times 2^{\text{number of divisions}}$$

How to prepare an uncontaminated culture using aseptic technique.

Glass petri dishes and **agar gel** must be sterilised before use by using an **autoclave**, or pre-sterilised plastic petri dishes can be bought	**Reason** - this will kill any unwanted **bacteria** that are present in the solution or on the petri dishes.
Sterilise the **inoculating loop**, by heating it in the Bunsen burner flame. Leave it to cool. Alternatively, sterilise it by placing it in pure alcohol for a few seconds.	**Reason** - kills any unwanted bacteria that are present on the loop.
Replace the lid of the petri dish as soon as possible and secure with tape	**Reason -** The lid stops additional unwanted bacteria in the air contaminating the plate.
Allow the plate to dry then invert the plate and store it upside down.	**Reason -** Do not fully seal the lid, as this will stop oxygen reaching the bacterium, and this may encourage harmful anaerobic bacteria to grow.
Incubate at a maximum temperature of 25°C in schools and colleges.	**Reason** - this reduces the chance of growing harmful pathogens, which would grow at 37°C in a human body. Hospital laboratories would incubate plates at 37°C (body temperature) to allow quick growth and identification.

You might be asked in your RP to calculate cross-sectional areas of colonies or clear areas around colonies using πr^2.

πr^2

$3.142 \times \text{radius}^2$