

B5: Health, Disease and the Development of Medicines

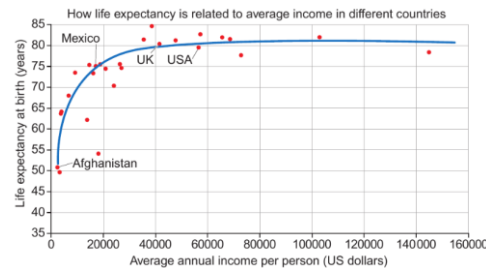
Lesson sequence

1. Health and disease
2. Non-communicable disease
3. Cardiovascular disease
4. Pathogens
5. Spreading disease
6. Viruses life cycles
7. Plant defences
8. Plant diseases
9. Physical and chemical barriers
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11. The immune system
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1. Health and disease

Physical health	Being free from disease, active, fit, sleeping well and no substance abuse.
Mental health	Feeling good about yourself and being free of conditions such as depression and anxiety.
Social health	Having healthy relationships, loving and being loved.
WHO	World Health Organization – part of the UN responsible for monitoring global health.
Disease	Any problem with the body not caused by injury.
Communicable diseases	Diseases caused by pathogens, can be passed on.
Non-communicable diseases	Diseases caused by genes or, lifestyle. Cannot be passed on.

Correlated diseases	Getting one disease increases your chance of another due to diseases weakening organ systems, damaged immune system, weaker defences.
Immune System	Defends the body against infection.



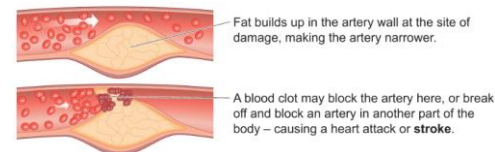
2. Non-communicable disease

Genetic disorders	Diseases caused by inheriting faulty genes from your parents.
Malnutrition	Diseases caused by poor diet.
Anaemia	Lack of iron. Causes fewer and smaller red blood cells and low energy.
Kwashiorkor	Lack of protein. Swollen belly, small muscles, stunted growth.
Rickets	Lack of calcium or vitamin D. Causes weak bones leading to bowed legs.
Scurvy	Lack of vitamin C. Swollen bleeding gums, muscle and joint pain, lack of energy.
Ethanol	The drug found in all alcoholic drinks.
Drugs	Chemicals that change the way your mind and body works.
Cirrhosis	A fatal liver disease caused by drinking too much alcohol over a long period of time.
Social problems of alcohol	Missed workdays, increased risk of other diseases, risky sexual behaviour, increased violence.

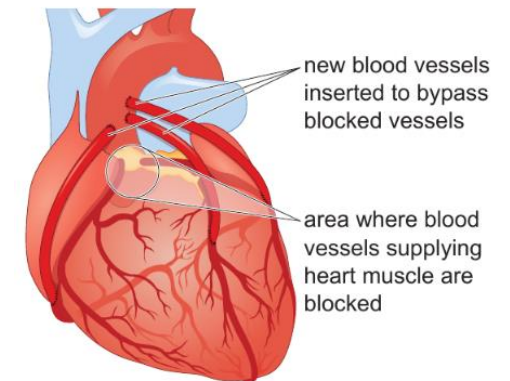
Nutrient	Disease caused by deficiency of nutrient	Symptoms of disease	Good sources in diet
protein	kwashiorkor	enlarged belly, small muscles, failure to grow properly	meat, fish, dairy, eggs, pulses (e.g. lentils)
vitamin C	scurvy	swelling and bleeding gums, muscle and joint pain, tiredness	citrus fruits (e.g. oranges) and some vegetables (e.g. broccoli)
vitamin D and/or calcium	rickets or osteomalacia	soft bones, curved leg bones	vitamin D: oily fish calcium: dairy products
iron	anaemia	red blood cells that are smaller than normal and in reduced number, tiredness	red meat, dark green leafy vegetables, egg yolk

3. Cardiovascular disease

Obesity	Being overweight to the extent that your health is at risk.
BMI	Body mass index, over 30 = obese.
BMI calculation	$BMI = \frac{mass (kg)}{height^2 (m^2)}$
Problems with BMI	Someone with a lot of muscle could have high BMI without being obese.
Waist:hip ratio	The ratio of waist width to hip width. Over 0.9 (women) or 1.0 (men) = obese.
Calculating waist:hip ratio	$\frac{Waist: hip ratio}{= \frac{waist width}{hip width}}$
Stroke	A serious life-threatening medical condition that happens when the blood supply to part of the brain is cut off.
Angina	Chest pain that occurs when the blood supply to the muscles of the heart is restricted.



Cardiovascular disease	Harmful substances in blood build up in the arteries around the heart. Blockages can form leading to heart attacks.
Stents	Used to treat cardiovascular disease. A tube of metal mesh is fed into the narrowed artery and opened, holding the artery open.
Treating heart disease with lifestyle	More exercise and a better diet can treat cardiovascular disease, but this takes time.



4. Pathogens

Pathogen	Microorganism that causes disease.
Types of pathogen	Bacteria, virus, protist, fungi.
Tuberculosis	Bacteria. Serious lung damage, bloody cough, fever.
Cholera	Bacteria. Severe life-threatening diarrhoea.
Chalara ash dieback	Fungi. Kills the leaves of ash trees, killing the tree.
Malaria	Protist. Sickness, fever and weakness.
Haemorrhagic fever	Virus, e.g. Ebola. Liver and kidney damage, internal bleeding.

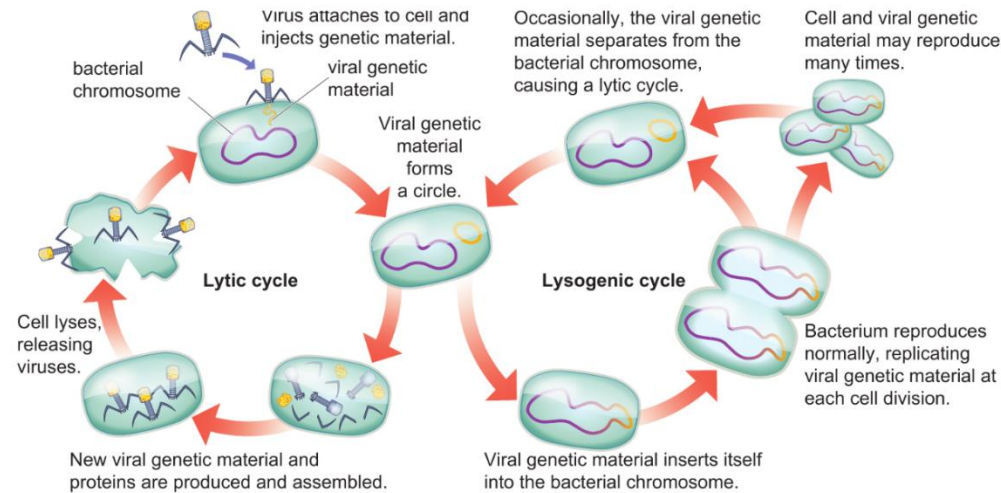
HIV	Human immunodeficiency virus attacks white blood cells, causing AIDS.
AIDS	Acquired Immunodeficiency Syndrome. Weakened immune system making simple infections deadly. Caused by HIV.
Opportunistic pathogens	Pathogens that live in us causing no harm, but become dangerous when given the opportunity, such as <i>Helicobacter pylori</i> which cause stomach ulcers.

Exam-style question

Describe a communicable disease caused by (a) a fungus, (b) a protist, and describe the symptoms of each disease. Use one example for each answer. (2 marks)

5. Spreading disease

Airborne	Spreading through the air, such as colds and flu in infected droplets of saliva, and chalara ash dieback by fungal spores.
Waterborne	Spreading through contaminated water such as cholera.
Oral route	Eating food contaminated with a pathogen.
Vectors	Animals that spread pathogens in their bites, such as malaria that is spread by mosquitoes.
Bodily fluids	Spreading through contact with infected body fluids such as blood or semen, for example, HIV.
Epidemic	A widespread occurrence of an infectious disease in a community at a particular time.

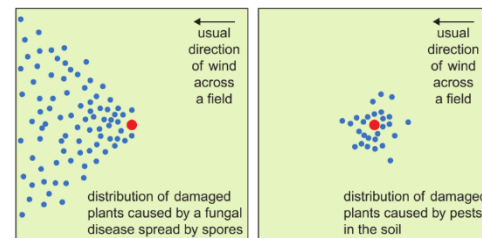


6. Virus life cycle

Capsid	The virus's protein coat.
Lytic pathway	The viral DNA exists as a separate free floating molecule within the bacterial cell, and replicates separately from the host bacterial DNA.
Lysogenic pathway	The viral DNA exists as a separate free floating molecule within the bacterial cell, and replicates separately from the host bacterial DNA.
Bacterial lawn	When all the individual colonies on a petri-dish agar plate merge to form a field or mat of bacteria.
Zone of inhibition	The region of a bacterial lawn where the bacteria has been killed.
Nutrient agar	A general purpose medium supporting growth of a wide range of non-fastidious organisms.
Cross sectional area	Cross sectional area = πr^2 (where r is the radius of the circle).
Viral plaque	The visible structure formed within a cell culture, such as bacterial cultures within some nutrient medium (e.g. agar). the region killed by the virus.

7. Plant defences

Cuticle	A water-impervious protective layer covering the epidermal cells of leaves and other parts.
Pests	An insect that feed on, compete for food with, or transmit diseases to humans and livestock.
Pesticides	Are substances that are meant to control pests, including weeds.
Plant Symptoms	A visible effect of disease on the plant.



Key

- first infected plant
- plants infected from first infected plant

8. Plant diseases

Yield	The amount of product obtained.
Lesions	Any damage or abnormal change in the tissue of an organism.
Distribution analysis	Looks at where the damaged plant occurs.
Diagnosis	The process of determining which disease or condition explains an organism's symptoms and signs.

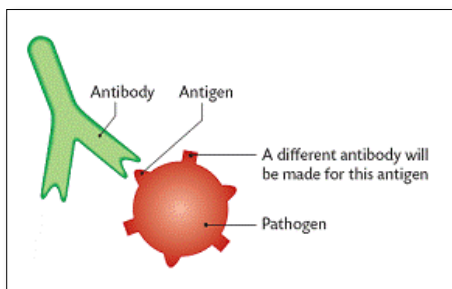
Exam-style question

Explain how one natural physical barrier and one chemical defence stop pathogens from entering the body. (2 marks)

9. Physical and chemical barriers

Physical barrier	Provides a physical block against pathogens from entering the plant
Chemical barrier	There are two main chemical barriers to infection, the relatively low pH of parts of the body and antimicrobial molecules.
Lysozyme	An enzyme produced in tears, perspiration, and saliva can break down cell walls and thus acts as an antibiotic (kills bacteria).
Mucus membranes	Produce mucus that trap microbes.
Ciliated cells	Cells that line the upper respiratory tract traps and propels inhaled debris to throat.
Hydrochloric acid	The acid found in your stomach that kills microorganisms.
Sexually transmitted infections (STIs)	Are infections you can get by having sex with someone who has an infection.
Chlamydia	A bacterial infection usually spread through sex or contact with infected genital fluids.
Screening	The evaluation or investigation of something as part of a methodical survey, to assess suitability for a particular role or purpose.

10. Preventing infection	
Chemical defences	Kill pathogens before they can infect us.
Lysozyme	Enzyme found in mucus, tears and sweat that kills <i>some</i> bacteria.
Hydrochloric acid	Found in the stomach, kills most bacteria on food.
Physical barriers	Block or trap pathogens so they can't enter the body.
Mucus	Sticky substance in most body openings that traps pathogens.
Ciliated cells	Have hairs that sweep mucus up and out of the body.
Skin as a physical barrier	Blocks pathogens from entering.
STIs	Sexually transmitted infections. Pathogens spread through sexual activity.
Preventing STIs	Use barrier contraception (such as condoms) to prevent mixing of fluids (semen, vaginal lubrication, blood).
Screening for STIs	Large scale testing of people to check if they have an STI so they can be treated. This helps to reduce the spread of STIs.

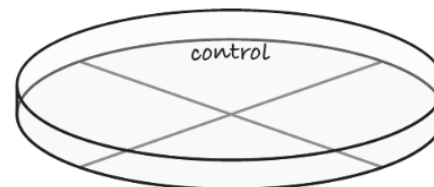


11. The immune system	
Immune system	Destroys pathogens that manage to infect us.

Primary immune response	How the body responds the first time it meets a new pathogen.
Antigens	Chemical markers on the surface of pathogens (and other cells) that identify them as a pathogen. Antigens are unique to each pathogen.
Lymphocyte	White blood cells that produce antibodies. Each lymphocyte makes a different antibody.
Antibodies	Chemicals with a specific shape that can stick to the antigens on a pathogen and kill it.
Activated lymphocyte	When an antigen sticks to an antibody, it activates the lymphocyte causing it to make many copies of itself that make the same antibodies.
Memory lymphocyte	Lymphocytes left over after an infection that retain the ability to fight the pathogen.
Immunity	When the body has the memory lymphocytes to fight a pathogen, so it can't be harmed by it.
Vaccine	A weakened version of a pathogen that trains the body to fight it, without causing disease.
How vaccines work	Vaccines are harmless versions of pathogen that still have the antibodies on them, so the immune response is triggered without any risk of disease.
Vaccine safety	Vaccines are safe, preventing about 6 million deaths per year.

12. Antibiotics	
Antibiotics	Substances that kill bacteria without harming human cells.
How antibiotics work	They inhibit (stop) an enzyme that maintains bacterial cell walls. This kills the bacteria.

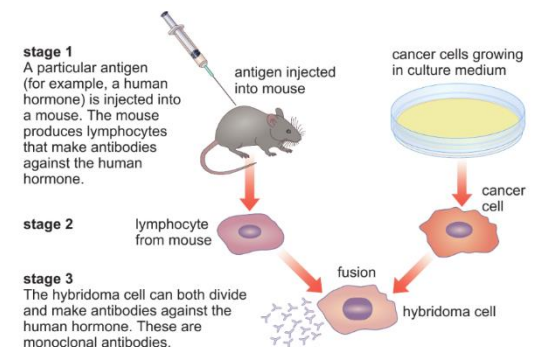
Resistance	Widespread use of antibiotics has led to resistance, meaning many antibiotics don't work as well as they once did.
Drug development	Developing new medicines involves many stages that take a of time and money.
Discovery phase	Developing new chemicals that might work as medicines.
Pre-clinical testing	Testing on cells grown in the lab, or on animals, to see if the chemical has any useful effect.
Small clinical trial	Testing on a few healthy people to check for safety.
Large clinical trial	Testing on many patients to discover how effective the drug is and determine the dose.
Side effects	Unwanted effects of the medication, that can be quite harmful.



13. Core practical: antibiotics (CP5)	
CP5 - Aim	To investigate how changing the concentration of an abiotic effects bacterial growth.
CP5 - Setup	A petri-dish with a bacterial lawn that is exposed to different concentrations of antibiotics.
CP5 - Data collection	Place the antibiotic disc in each zone and monitor the zone of inhibition after 24 hours.
CP5 - Dependent variable	The size of the zone of inhibition.

CP5 - Independent variable	Concentration of antibiotic.
CP5 - Results	As the concentration increase the zone of inhibition increases.

14. Monoclonal antibodies	
Monoclonal antibodies	An antibody produced by a single clone of cells.
Hybridoma cells	A hybrid cell used as the basis for the production of antibodies.
Cancer cells	A disease caused by an uncontrolled division of abnormal cells in a part of the body.
Platelets	Found in large numbers in the blood and involved in clotting.
PET Scan	Positron emission tomography (PET) scan is an imaging test that uses a special dye containing radioactive tracers.
Chemotherapy	An aggressive form of chemical drug therapy meant to destroy rapidly growing cells in the body.
Radiotherapy	A cancer treatment that uses high doses of radiation to kill cancer cells and shrink tumours.



Exam-style question

Describe how monoclonal antibodies can be used to find the position of cancer cells in the body. (2 marks)