



Topic 3 – Infection and response

Table of Content

3.1 Communicable diseases.....	2
3.1.1 Communicable (infectious) diseases	2
3.1.2 Viral diseases	2
3.1.3 Bacterial diseases.....	3
3.1.4 Fungal diseases	3
3.1.5 Protist diseases	4
3.1.6 Human defence systems	4
3.1.7 Vaccination	5
3.1.8 Antibiotics and painkillers	5
3.1.9 Discovery and development of drugs.....	6
3.2 Monoclonal antibodies (biology only) (HT only)	6
3.2.1 Producing monoclonal antibodies.....	7
3.2.2 Uses of monoclonal antibodies	7
3.3 Plant disease (biology only)	7
3.3.1 Detection and identification of plant diseases	7
3.3.2 Plant defence responses	8



3.1 Communicable diseases

3.1.1 Communicable (infectious) diseases

Pathogens	<ul style="list-style-type: none"> • Microorganisms that cause communicable diseases • Eg bacteria, viruses, protists, fungi 	
How cause?	Bacteria	<ul style="list-style-type: none"> • Produce toxins - damage tissues - ill • Reproduce rapidly in binary fusion
	Viruses	<ul style="list-style-type: none"> • Live & reproduce rapidly inside cell - cell damage
How spread?	By air	<ul style="list-style-type: none"> • Droplet infection • Ppl sneeze - expel droplet with pathogens from breathing system - other ppl breath in
	By water	<ul style="list-style-type: none"> • Dirty water - cholera
	Direct contact	<ul style="list-style-type: none"> • Cuts - give excess to blood eg HIV • Shake hands
How prevent?	<ol style="list-style-type: none"> 1. Wash hands 2. Drink clean water 3. Good hygiene 4. Isolate infected individuals 5. Destroy / control vectors eg mosquitoes 6. Vaccination 	

What is pandemic? (1)

- A disease affecting ppl in many countries

3.1.2 Viral diseases

Measles

Spread by	<ul style="list-style-type: none"> • Inhalation of droplets from coughs/sneezes
Symptoms	<ul style="list-style-type: none"> • Fever, red skin rash • (serious - blindness, brain damage, fatal)
Prevention	<ul style="list-style-type: none"> • Vaccination • Isolate infected individuals

HIV/AIDs

Spread by	<ul style="list-style-type: none"> • Exchange of body fluids eg blood when share needles • Unprotected sexual contact with infected person
Symptoms	<ul style="list-style-type: none"> • Flu-like illness • Virus attack & remain hidden in immune system • AIDs (last stage of HIV) occurs when immune system becomes so badly damaged - X deal with other infections
Treatment	<ul style="list-style-type: none"> • Antiretroviral drugs to control attack

Prevention	<ul style="list-style-type: none"> • Use condoms • Don't share needles • Use HIV +ve mother bottle to feed children
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Tobacco mosaic virus (TMV)

Spread by	<ul style="list-style-type: none"> • Contact between healthy & infected plants & vectors
Symptoms	<ul style="list-style-type: none"> • Give distinctive 'mosaic' pattern of discoloration on leaves coz viruses destroy cells
How affect growth of plants?	<ul style="list-style-type: none"> • Less chlorophyll - less photosynthesis - less glucose • A) Less respiration - less energy released for growth • B) Less amino acids/cellulose for growth
Prevention	<ul style="list-style-type: none"> • Good field hygiene • Good pest control • Wash tools

All viral diseases - **no treatment**

3.1.3 Bacterial diseases

Salmonella food poisoning

Caused by	<ul style="list-style-type: none"> • Food prepared in unhygienic condition - food contaminated with salmonella from raw meat • Eat uncooked food - bacteria not killed by heat
Spread by	<ul style="list-style-type: none"> • Bacteria ingested in food - disrupt balance of natural gut bacteria
Symptoms	<ul style="list-style-type: none"> • Fever, abdominal cramps, vomiting & diarrhoea • 8-72hrs
Prevention	<ul style="list-style-type: none"> • Vaccination • Cook meat thoroughly • Keep raw meat away from cooked food • Avoid washing raw meat - spread bacteria around kitchen

Gonorrhoea - sexually transmitted disease (STD)

Spread by	<ul style="list-style-type: none"> • Unprotected sexual contact with infected person
Symptoms	<ul style="list-style-type: none"> • Thick yellow / green discharge from vagina / penis • Pain on urinating
Prevention	<ul style="list-style-type: none"> • Use condom • Reduce no of sexual partners • Antibiotics
Treatment	<ul style="list-style-type: none"> • Antibiotic penicillin

3.1.4 Fungal diseases

Rose black spot

Spread	<ul style="list-style-type: none"> • In environment by wind & water
Symptoms	<ul style="list-style-type: none"> • Purple / black spots develop on leaves

	<ul style="list-style-type: none"> Weaken plant & affect growth coz reduce area available for photosynthesis - turns yellow & drop early
Treatment	<ul style="list-style-type: none"> Use fungicides
Prevention	<ul style="list-style-type: none"> Remove / burn affected leaves / stems

3.1.5 Protist diseases

Malaria

Spread by	<ul style="list-style-type: none"> Mosquitos (act as vectors coz they transmit disease)
Symptoms	<ul style="list-style-type: none"> Recurrent episode of fever Fatal Shaking when protists burst out of blood cells Headaches, vomiting, diarrhoea
Treatment	<ul style="list-style-type: none"> Take antimalarial drugs - kill parasites in blood
Prevention	<ul style="list-style-type: none"> Use mosquito nets - avoid being bitten Insecticides - kill mosquitoes Remove standing water - prevent mosquitoes breeding

3.1.6 Human defence systems

Non-specific defence system

Skin	<ul style="list-style-type: none"> Acts as barrier Produces antimicrobial secretions - kill bacteria
Nose	<ul style="list-style-type: none"> Hair & mucus trap & prevent pathogens entering lungs
Trachea & bronchi	<ul style="list-style-type: none"> Has mucus - trap pathogens Cilia waft mucus upwards to throat - swallowed
Stomach	<ul style="list-style-type: none"> Produce HCl - kill pathogens in food

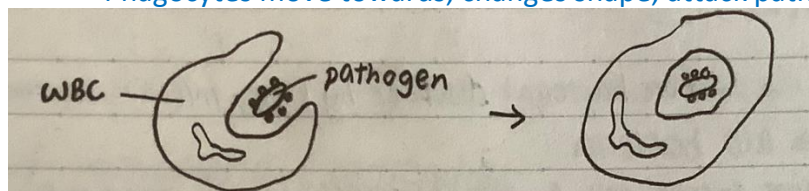
White blood cell

- Phagocytes (non-specific) & Lymphocytes (specific)

How?

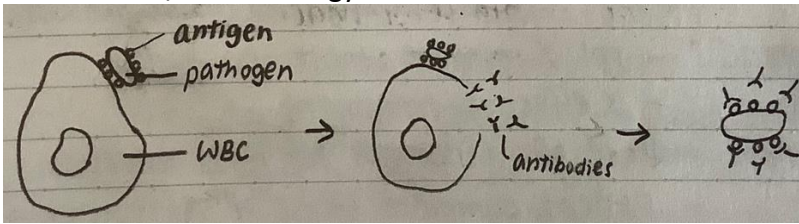
1. Ingest pathogens (phagocytes)

- Phagocytes move towards, changes shape, attack pathogen, engulfs & digest it with enzymes



2. Produce antibodies (protein) (made by lymphocytes)

- Have complementary shape - specific antibody for specific pathogen
- Allow binding with antigens (foreign microorganisms)
- If same pathogen re-enters body, WBC respond quickly, produce correct antibodies, prevent infection



3. Produce antitoxins - counteract toxins

In conclusion - lead to immunity from pathogens

3.1.7 Vaccination

How prevent?

- Contain small amount of dead or inactive forms of pathogen
- Stimulate WBC to respond & produce antibodies quickly specific to pathogen in large quantities to kill pathogen
- Reduce spread of infection - ppl immune
- Prevent illness in an individual

Herd immunity

- Immunising large proportion of population
- Reduce spread of infection / pathogens

MMR vaccine - protects against **measles, mumps & rubella**

3.1.8 Antibiotics and painkillers

Antibiotics eg penicillin

- Cure bacterial diseases by killing infective bacteria inside body
- Damage bacterial cells - kill bacteria

X kill virus - coz viruses live inside cells & are inaccessible to antibiotic

Overuse - speed up development of resistant strains of bacteria

How bacteria become resistant?

- Mutation
- Some resistant to antibiotics - survive
- Reproduce by binary fission
- Pass gene for resistance of offspring
- Increase population of resistant strain

Why resistant strain spread?

- Ppl not immune to it
- Treatment is not effective

How to reduce resistant strain?

- Reduce use of antibiotics for mild infection
- Patient complete course of antibiotics - kill all bacteria
- Restrict agricultural use of antibiotics

Painkillers eg aspirin, paracetamol

- Treat symptoms

For more help, please visit our website www.exampaperspractice.co.uk

- Don't kill pathogens

3.1.9 Discovery and development of drugs

Drugs - chemical that affect body chemistry

Discovery - traditionally drug extracted from plants & microorganisms

Plants	<ul style="list-style-type: none"> • Aspirin (painkiller) from willow • Digitalis (treat heart condition) from foxgloves
Microorganism	<ul style="list-style-type: none"> • Penicillin (antibiotic) • Discovered by Alexander Fleming from Penicillium mould

Now, most new drugs are synthesised by chemists in pharmaceutical industry. However, the starting point may still be a chemical extracted from a plant.

Development - testing new drugs

- 1. Pre-clinical trials** in lab of new drugs on cells, tissues & live animals
 - Test for toxicity, dosage & efficacy
- 2. Clinical trials** - test on healthy volunteers & patients at very low doses
 - Monitor for safety & side effects
 - If drug is found to be safe, further clinical trials are carried out to find the optimum dose for the drug
- 3. Double-blind trial**
 - Placebo & drug is randomly allocated to large no of patients in groups
 - Doctors & patients don't know who has new drug or placebo so
 - Data won't be affected by knowledge
 - To verify efficiency & determine correct dose
- 4. Peer review of data & analysis of result**
 - Prevent false claims
 - Check results are valid, avoid bias

Placebo

- Tablet with no drug / chemical & has no effect
- Used to compare & prove effectiveness of drugs

Placebo effect

- Ppl expect treatment to work so they feel better even though it doesn't do anything

Why trial is reliable? Large no of ppl

Why stopped early? Sufficient information gained

Why manufacturers don't take part? They could cheat

Repeat experiment - improve reliability

Why data is unreliable? Ppl lies

Factor similar in volunteers - age & sex

3.2 Monoclonal antibodies (biology only) (HT only)

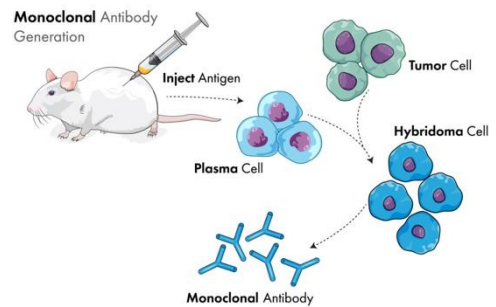
3.2.1 Producing monoclonal antibodies

Monoclonal antibodies

- Produced from single clone of cells
- Specific to one binding site on an antigen
- Target specific chemical / cell in body

Production of monoclonal antibodies

1. Vaccinate mouse to stimulate mouse lymphocytes to make a particular antibody
2. Combine lymphocytes with a particular type of tumour cell to make hybridoma cell
3. Hybridoma cell can both divide & make antibody
4. Single hybridoma cell cloned to produce many identical cells that produce same antibody
5. Large amount of antibody collected & purified



3.2.2 Uses of monoclonal antibodies

Pregnancy test	<ul style="list-style-type: none"> • Pregnancy testing stick • HCG (hormone) found in women urine only when pregnant • If pregnant - HCG in urine binds to monoclonal antibodies - change in colour
Diagnosis of disease eg cancer (Treat some disease)	<p>How?</p> <ul style="list-style-type: none"> • Monoclonal antibody bind to radioactive substance, a toxic drug / chemical - stop cell grow & divide • Trigger immune system to attack cancer cell directly • Deliver substance to cancer cells without harming other cells in body
Measuring & monitoring	<ul style="list-style-type: none"> • Measure & monitor level of hormones & other chemicals in blood to detect pathogens / drugs
Research	<ul style="list-style-type: none"> • Locate / identify specific molecules in cell / tissue <p>How?</p> <ul style="list-style-type: none"> • Monoclonal antibody bind to fluorescent dye • If molecules present - antibodies bind to molecules

But

- Create more side effects than expected eg fever
- Not as widely used

3.3 Plant disease (biology only)

3.3.1 Detection and identification of plant diseases

Plants infected by viral, bacterial, fungal & insects (eg aphids)

Aphids

- **Sharp mouthparts** – penetrate into phloem vessels for phloem sap
- **Attack in huge no.** – deprive plant cells – damage & weaken plant
- **Act as vectors** – transfer pathogens

Prevention – pesticides, enclosed spaces eg greenhouses, aphid-eating insects eg ladybirds

Mineral ion deficiency (non-communicable disease)

Nitrate deficiency - stunt growth

- Nitrate ions from soil needed for proteins synthesis for growth

Magnesium deficiency – yellow leaves (chlorosis)

- Magnesium ions from soil needed to make chlorophyll

Treatment – fertilizers (repair damage, plant recovers)

Symptoms of plant disease

- **Stunted growth** – coz nitrate deficiency
- **Spots on leaves** eg rose black spot (fungi)
- **Areas of decay / rotting** eg rose black spot / blights
- **Abnormal growths** eg crown galls (bacterial)
- **Malformed stems & leaves** – coz aphid infestation
- **Discoloration** eg chlorosis coz magnesium deficiency / mosaic patterns coz tobacco mosaic virus
- **Presence of visible pests** eg aphids

Treatment / Prevention – pesticides / antifungal treatments, remove diseased plants prevent spreading

Identifying diseases

- Using disease descriptions in gardening manual / online & compare them
- Taking infected plants to lab to identify pathogen using DNA analysis
- Use testing kits containing monoclonal antibodies to identify pathogens

3.3.2 Plant defence responses

Physical – act as barrier to prevent pathogens entering

1. Cellulose cell walls
2. Waxy cuticle on leaves
3. Layers of dead cells around stems – fall off with pathogens

Chemical

4. Antibacterial chemicals – kill bacteria eg mint
5. Poisons – deter predators / herbivores (organisms that eat plants) eg foxgloves

Mechanical

6. Thorns & hairs – difficult / painful for herbivores to eat eg roses
7. Leaves drop / curl when touched – knock insects off / frighten animals eg mimosa pudica
8. Mimicry – mimic unhealthy plants – deter herbivores, mimic butterfly eggs – butterflies don't lay eggs eg variegation