science biology

GCSE B3 – Infection and Response

1. Microorganisms and disease

Microorganism – bacteria, virus, fungus or protist
Pathogen – microorganism that causes a disease
Bacteria – microorganisms that reproduce inside the **host** and release **toxins** that cause illness
Virus – **invade host cells**, reproduce and burst cells causing **damage** to the cell and tissues
Communicable disease – caused by a pathogen and spread from person to person

2. Modes of transmission

Transmission	Examples
Direct contact	Sexual contact or shaking hands.
Water-borne	Dirty water can transmit disease eg. cholera
Air-borne	Coughing and sneezing can spray thousands of tiny droplets into the air
Food-borne	Undercooked or reheated food can cause bacterial diseases
Vector	Organisms can spread disease by biting

3. Human Diseases

Disease	Transmission	Symptoms	Treatment/ prevention
Salmonella (Bacterium)	Uncooked poultry, unhygienic	Sickness diarrhoea	Antibiotics Well cooked food
Gonorrhoea (Bacterium)	Unprotected sex	Discharge pain when urinating	Antibiotics Wear condoms
Malaria (Protist)	Mosquito bites	Fever fatigue headache vomiting	Mosquito nets repellent chloroquine
HIV (Virus)	Body fluids, sex, sharing needles	AIDS: damages immunity	Anti-viral drugs Condoms & don't do drugs!
Measles (Virus)	Airborne – coughs & sneezes	Red skin rash	Painkillers, MMR vaccine

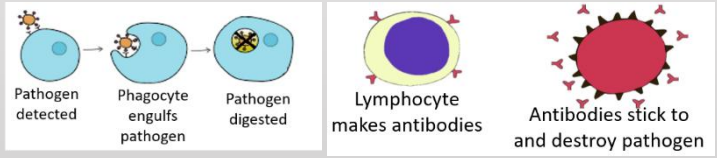
4. Plant Diseases

Disease	Transmission	Symptoms	Prevention/ Treatment
Tobacco Mosaic Virus	Direct contact with diseased plant material and by insects	Mosaic pattern damaged cells preventing photosynthesis	Field hygiene and pest control
Rose Black Spot Fungus	Spores carried by wind and spread by rain from leaf to leaf	Purple spots on leaves, dead leaves, poor flowers	Remove and burn affected leaves, fungicides

5. Defence mechanisms

First line of Defence stops pathogens from entering
•Skin: outer physical barrier that scabs when broken, skin oil is antiseptic
• Nose: goblet cells release **mucus** which traps pathogens
• Trachea and bronchi: ciliated cells move mucus up & out
• Stomach: hydrochloric acid destroys pathogens

Second line of defence the Immune system attacks invading pathogens. White blood cells can:
• **Engulf** and **digest** pathogens (phagocytosis)
• **Produce antibodies** that attach to the specific **antigens** on the pathogen and destroy it
• **Produce antitoxins** that destroy bacterial toxins



6. Vaccination

Vaccination will prevent illness
1. Inject a small quantity of dead or inactive pathogen
2. White blood cells produce antibodies specific to the antigens
3. Pathogen is destroyed
4. If the same pathogen re-enters the body the white blood cells respond **rapidly** to produce **massive** amounts of the **correct antibodies**, destroying the live pathogen and preventing infection.

MMR vaccine - protects against measles, mumps and rubella
Herd immunity - immunising a large proportion of the population will stop the spread of disease and protect those that can't be vaccinated.

7. Medicines

A **drug** is any substance that alters how the chemical reactions in the body work.
- **Antibiotics** - kill ONLY bacteria or prevent them from multiplying eg. **penicillin**
- **Painkillers** – relieve the symptoms only eg. **paracetamol**
- **Antivirals** – target specific viruses and slow down replication. Viruses are hard to destroy without damaging the cell they're in.

8. Antibiotic Resistance: e.g. MRSA

1. Mutation occurs when bacteria multiply
2. Mutation makes bacteria resistant to antibiotic
3. Antibiotic kills all the others
4. Less competition for food or space
5. New colony of resistant bacteria grows quickly

Causes: Incorrect/overuse of antibiotics, not completing the full course of antibiotics, over-sterile environments e.g. hospitals

9. Drugs

Drugs were traditionally extracted from plants and microorganisms
• **Digitalis** (heart drug) originates from Foxgloves.
• **Aspirin** (painkiller) originates from Willow.
• **Penicillin** (antibiotic) discovered by Alexander Fleming from Penicillium mould.

Drug trials

Stage 1 (Pre-clinical) Tested on human cells and tissues and then animals
Check for **toxicity**
Stage 2 (clinical): Low doses are tested on healthy human volunteers
Check for **side effects**
Stage 3 (clinical): Tested on patients
Check for **effectiveness** and **dosage**

Placebo – fake drug (looks same, taken same way) used as a control and allows the results from the real drug to be **compared**

Double blind – doctors and patients don't know who gets the real drug = no bias

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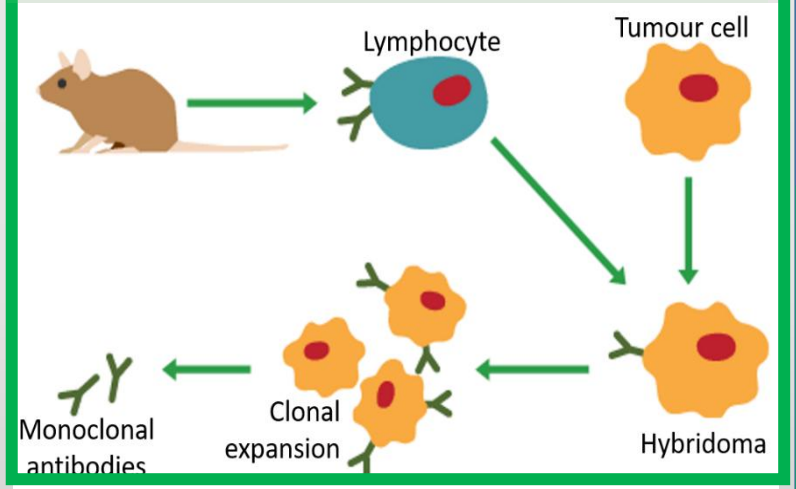
10. Monoclonal antibodies:

- Produced from a single clone of cells.
- The antibodies are specific to one binding site on one type of antigen
- Target a specific chemical or specific cells in the body.

They are made by:

1. injecting a mouse with a specific substance
2. mouse **lymphocytes** make the specific **antibody**
3. lymphocytes are combined with a **tumour** cell to make a **hybridoma** cell
4. hybridoma cells are **cloned** to produce many identical cells that all produce the same antibody
5. large amounts of antibody can be collected and purified



11. Advantages of monoclonal antibodies:

- Diagnosis such as in **pregnancy tests**
- Measuring the levels of hormones or to detect pathogens
- Locate or identify specific molecules in a cell or tissue by binding to them with a **fluorescent** dye
- **Cancer** treatments - 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.

Disadvantages of monoclonal antibodies:

Not yet as widely used as hoped, due to - **expensive** to produce, cause **side effects** and **ethical issues** of animal testing.

12. Plant diseases:

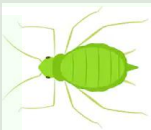
Detected by:

- stunted growth
- spots on leaves
- areas of decay (rot)
- lumps/growths
- malformed stems or leaves
- discolouration
- the presence of pests.

Identification of disease can be made by:

- reference to a gardening manual or website
- taking infected plants to a laboratory to identify the pathogen
- using testing kits that contain monoclonal antibodies

Aphids – penetrate phloem to feed and take products of photosynthesis. Also act as vectors transferring pathogens to the plants.



13. Plant deficiencies

Plants can be damaged by a range of **ion deficiency conditions**:

- **stunted growth** caused by nitrate deficiency - **Nitrates** are needed for **protein synthesis** and growth

- **chlorosis** (yellow leaves) caused by magnesium deficiency - **Magnesium** is needed to make **chlorophyll**

14.Plant defence mechanisms

Plants have defence mechanisms to avoid damage and disease.

Physical defence responses to resist invasion of microorganisms:

- **Cellulose** cell walls.
- Tough **waxy cuticle** on leaves.
- Layers of dead cells around stems (**bark** on trees) which fall off.

Chemical plant defence responses:

- Antibacterial chemicals.
- **Poisons** to deter herbivores.

Mechanical adaptations:

- **Thorns** and hairs deter animals.
- Leaves which droop or curl when touched.
- Mimicry to trick animals.