Infection and response – Knowledge organiser

Topic 1 – Pathogens: How do they make us ill?		
1	**Pathogens**	**Microorganisms** that cause **infectious disease**. Include **bacteria, viruses, fungi** and **protists**. They can infect plants and animals and are spread by direct contact, by water or by air. **Bacteria** and **viruses** reproduce rapidly (multiply) inside our bodies.
2	**Bacteria**	**Bacteria** produce **toxins** (poisons) which make us ill. Examples include - **Salmonella**- food poisoning is spread by eating contaminated food and unhygienic conditions. We **vaccinate** poultry (chickens) against salmonella to reduce the spread of the disease. **Symptoms:** stomach cramps, fever, vomiting and diarrhoea. - **Gonorrhoea**- is a STD (sexually transmitted disease) which is spread through sexual contact. It can be easily treated with **antibiotics** and the spread can be reduced by using condoms. **Symptoms:** thick yellow/green discharge from the vagina or penis and pain when urinating.
3	**Viruses**	**Viruses** live and reproduce inside cells, causing **damage to the cells**. Examples include - **Measles**- it is serious illness which can be fatal. Most young children are vaccinated against the disease. It is spread by inhaling droplets from sneezes and coughs. **Symptoms:** fever and a red skin rash. - **HIV-** the virus attacks the body's immune cells, initially causing a flu-like illness. It can be controlled by antiretroviral drugs. In AIDS (late stages of the infection), the immune system is badly damaged. HIV is spread through sexual contact or exchange of bodily fluids. - **TMV** (Tobacco mosaic virus)- plant pathogen, causes a 'mosaic' pattern of discolouration on the leaves. This affects the plants ability to photosynthesise and therefore grow.
4	**Fungus**	- **Rose black spot-** purple or black spots develop on leaves. It affects the growth of the plant as photosynthesis is reduced. It is spread in the environment by water or wind. It can be treated by using **fungicides.**
4	**Protists**	- **Malaria-** is caused by a **protist** that has a life cycle that includes the mosquito. The spread of malaria is controlled by preventing mosquitos from breeding and by using mosquito nets to avoid being bitten. **Symptoms:** reoccurring fever and can be fatal.

Topic 2 – Human defence systems		
1	**Non specific human defence**	The human body defends itself against pathogens. This includes • A waterproof **skin** barrier that prevents their entry • Hairs in the **nose** to trap pathogens • Small hair-like cilia and mucus in the lining of the **trachea** (throat) and **chest** to sweep out pathogens • **Stomach** acid to destroy pathogens that are ingested
2	**White Blood Cells**	Important cells in our **immune system** that defend against pathogens by: – **<u>ingesting/engulfing</u>** pathogens (**phagocytosis**) – producing **<u>antibodies</u>** which kill specific pathogens – producing **<u>antitoxins</u>** which counteract toxins released by pathogens
3	**Immunity**	When white blood cells produce specific antibodies **(memory cells)** for a particular pathogen. This means you are **immune** to it (can't be made ill by that pathogen)

4	**Vaccinations**	Vaccinations (also known as immunisation) help to prevent illness. Spread of disease by pathogens can be reduced by immunising a large part of the population Contain small amounts of **inactive/dead** forms of a pathogen • **Stimulates** your **white blood cells** to **produce antibodies** • Antibodies kills pathogen • **Same pathogen re-enters** the body. The white blood cells **quickly** produce the **correct antibodies,** preventing infection.
5	**Antibiotics**	These are medicines that **kill bacteria only**. Cannot kill viruses because they (viruses) live i**nside** cells. So antibiotics are **unable to reach viruses**.
6	**Antibiotic resistance**	• Overuse of antibiotics has increased **antibiotic resistant strains of bacteria** (which have **mutated**). Individual resistant pathogens **survive** and **reproduce**, so the population of the resistant strain increases. Often called **superbugs**. Examples are MRSA, *C.Difficile.*
7	**Penicillin**	First **antibiotic** discovered by Alexander Fleming. Penicillin is extracted from the **fungus penicillium**. He found that it **killed bacteria** in patients with wounds. Penicillin works by **disrupting** the bacteria's cell wall.
8	**Painkillers**	Paracetamol and ibuprofen are examples of painkillers. These **treat the symptoms** like headache and fever) but **do not kill** pathogens.

Topic 3 – Drug discovery and development

1	**Drug**	A chemical that **changes the chemical processes** in the body.
2	**Drug discovery**	Most drugs are made in the pharmaceutical industry (drug company) Drugs were traditionally extracted from microorganisms and plants • The heart drug digitalis originates from foxgloves • Aspirin comes from willow • Penicillin from penicillium
3	**Drug tests**	New medical drugs are first tested and trialled to check that they are safe and effective. They are extensively tested for **toxicity, efficacy and dose.**
2	**Drug trials**	**Pre-clinical trials:** 1. Tested in the lab on **cell/tissues** 2. **Animal tests**, to check for safety/side effects and effectiveness in animals Clinical (human) trials: **Phase I: Healthy volunteers**: Small group (20-100) given a **very low dose** (amount) to check for safety/side effects **Phase II: Volunteers who have illness:** If found safe (no side effects), tested on larger group (200-400) to check **effectiveness** of drug (and see if it works). **Phase III: Volunteers who have the illness**: Larger scale of patients (over 3000) to test for the effectiveness of the drug and to find the safest dose (amount). (**Mostly double blind).** Larger scale studies provide more **reliable** results**.**
8	**Placebo**	A **fake drug** that does not actually contain the drug being tested
9	**Blind trials**	The patients do not know if they are given the drug or the placebo
10	**Double blind trials**	Neither the patients nor the doctors know who has been given the drug or placebo

Topic 4 – Monoclonal antibodies (HT)

1	**Monoclonal antibodies**	Produced from a **single clone of cells** The antibodies are **specific** to **one binding site** on **one protein antigen**. This helps to **target** specific cells or specific chemicals in the body.

2	**Lymphocytes**	White blood cells that make antibodies but do not divide
3	**Tumour cells**	These divide rapidly but are unable to make antibodies
4	**Monoclonal antibody production**	**Lymphocytes** in *mice* are <u>stimulated</u> to make a particular antibody The lymphocytes are **combined** with a particular **tumour cell**. The combined cell is called a **hybridoma** cell. The hybridoma cell **can both divide and make antibodies**. **Single** hybridoma cells are **cloned** to make more identical cells that all produce the same antibody. These are called monoclonal antibodies. A large amount of the antibody can be collected and purified.
2	**Uses of monoclonal antibodies**	**Diagnosis: In pregnancy test kits** **In laboratories:** to measure levels of hormones, other chemicals in blood and pathogens **In research:** to identify specific molecules in a cell or tissue by binding the antibodies to a fluorescent dye **Treat diseases such as cancer:** The monoclonal antibody can be bound to a radioactive substance, a toxic drug or a chemical that stop cells from dividing. It can also deliver drugs to the cells.
8	**Disadvantages**	Not yet as widely used because they have more side effects than expected

Topic 5 – Plant diseases: Detection and identification (HT)		
1	**Plant disease detection (HT)**	<u>Signs of plant disease:</u> spots on leaves, stunted plant growth, there are areas of decay, malformed (deformed) stems or leaves, extra growths or discolouration.
2	**Plant disease identification (HT)**	The type of plant disease can be identified by referring to a **gardening manual or website**, taking infected plants to the **laboratory** to identify pathogen, using **monoclonal antibody testing kits**.
3	**Causes of plant disease**	• **Infection** by insects (aphids) or **viral** (tobacco mosaic virus, eg), **bacterial**, **fungal** (black spot, eg) pathogens • Ion deficiency conditions: Nitrate ions needed for protein synthesis and their deficiency can lead to stunted growth. **Magnesium** ions needed for **chlorophyll** and their deficiency can cause **chlorosis** (yellowing of leaf).

Topic 6 – Plant defence response (HT)		
1	**Plant defence**	Needed to resist the invasion of microorganisms
2	**Physical response**	**Strong cellulose** cell walls, **tough** waxy cuticle on leaves, layers of **dead cells around** barks and stems which fall off
3	**Chemical response**	**Antibacterial** chemicals **Poisons** to deter herbivores
4	**Mechanical adaptations**	**Thorns and hairs** to deter animals Leaves that **droop or curl** on **touch** **Mimicry** to trick animals