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Subject: Biology	Topic: Cells (1)	Year Group: 12

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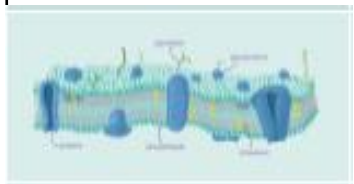
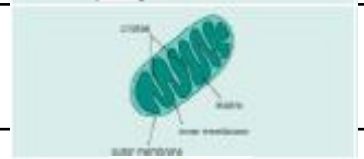
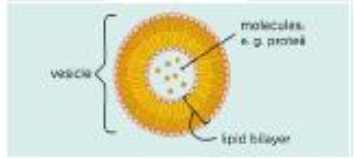
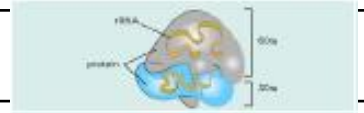
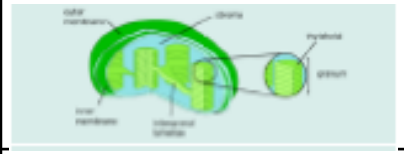
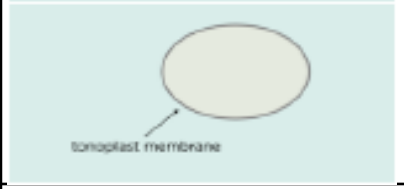
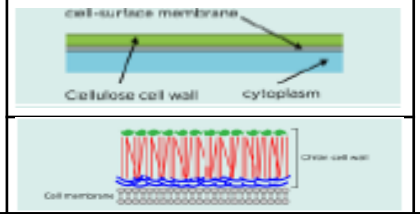
Eukaryotic cells- Animal (1)

	Organelle	Structure	Function
1	Cell surface membrane		1-Controls passage of entry of substance into the cell 2-Site of cell communication via receptors
2	Nucleus		1-Stores DNA 2-Nuclear pores allow mRNA & ribosomes to pass through
3	Mitochondria		1-Carries out aerobic respiration to produce ATP
4	Lysosomes		1-Contains digestive enzymes to break down pathogens, old organelles, cells & food molecules
5	Ribosomes		1-Site of protein synthesis
6	Rough endoplasmic reticulum		1-Provide large surface area for protein synthesis
7	Smooth endoplasmic reticulum		1-Synthesise, store and transport lipids & carbohydrates
8	Golgi apparatus		1-Modifies proteins 2- Sort, package and transport molecules around the cell

Eukaryotic cells- Plant (2)

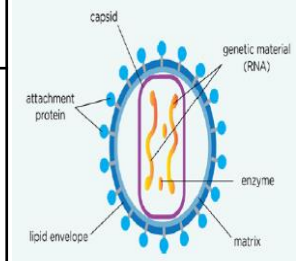
These are the additional organelles in plants, algae and fungi

	Organelle	Structure	Function	Which organism?
1	Chloroplasts		1-Site of photosynthesis	Plants & algae
2	Cell vacuole		1-Maintains cell structure 2-Acts as a temporary energy store	Plants
3	Cell wall		1-Provides support & mechanical strength	Plants & algae Fungi

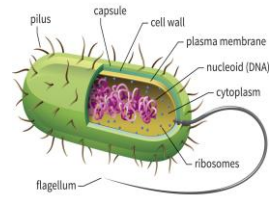
Key Vocabulary

1	Eukaryotic cells	A cell that has a membrane-bound nucleus and chromosomes. The cell also possesses a variety of other membrane-bound organelles, such as mitochondria and endoplasmic reticulum.
2	Prokaryotic cells	A cell of an organism belonging to the kingdom Prokaryote that is characterized by lacking a nucleus and membrane-bound organelles. E.g. bacteria
3	Bacteria	A prokaryote containing a plasmid (loop of DNA) and flagellum for movement
4	Virus	Acellular, non-living particles that are smaller than bacteria. They contain DNA or RNA but can only multiply inside living host cells.

Viruses (1)

	Structure	Function	5	Structure
1	Capsid	A protein coat which encloses the nucleic acid in a virus.		
2	Attachment protein	The capsid can have these which are essential to allow the virus to identify and attach to a host cell.		
3	Lipid envelope	Outermost layer of viruses that's protects genetic material when traveling between host cells. Not all viruses have envelopes. Typically derived from portions of the host cell membranes, but include some viral glycoproteins.		

Prokaryotic cells- Bacteria (1)

	Structure	Function	5	Structure
1	Flagellum	Part of a bacterial cell which helps the bacteria to move.		
2	Plasmid	Small circular loops of DNA which contain genes that bacteria can have.		
3	Pilus	Hair-like appendage found on the surface of many bacteria		
4	Capsule	A polysaccharide layer that lies outside the cell envelope		

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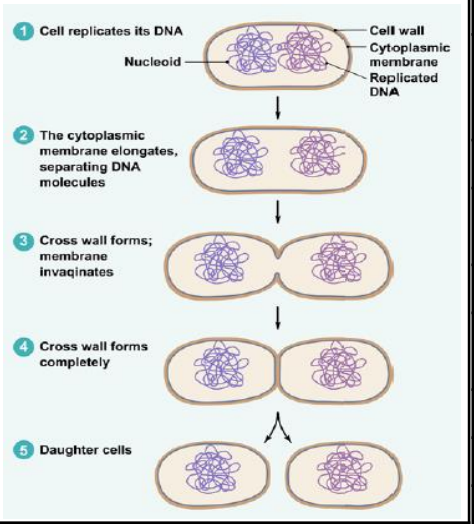
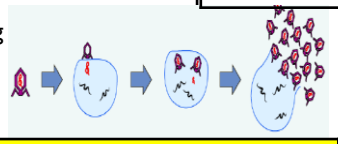
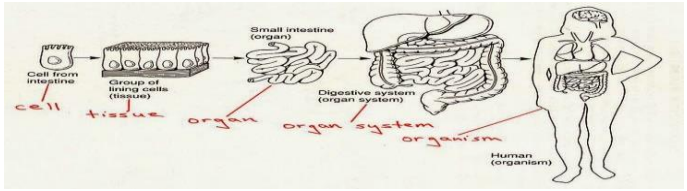
Bacteria and virus replication (2)

1	Bacteria	Bacteria replicate by binary fission 
2	Virus	Viruses replicate by binding to the host cell, injecting their genetic material into the cell, using the hosts machinery to replicate and burst out of the host cell 

Specialised cells

1	In complex multicellular organisms, eukaryotic cells become specialised for specific functions. Eg: Red blood cell- no nucleus for more space to bind oxygen, muscle cell- more mitochondria for respiration, palisade cell- lots of chloroplasts for photosynthesis
2	Specialised cells are organised into: (See key vocab table) 

Eukaryotic Vs Prokaryotic cells

	Feature	Eukaryotic cell	Prokaryotic cell
1	**Nucleus**	Present	Absent
2	**DNA**	Linear & packaged into chromosomes in the nucleus	Circular & freely floating in the cytoplasm
3	**Cell membrane**	Present	Present
4	**Membrane bound organelles**	Present	Absent
5	**Ribosomes**	Present (80s)	Present (70s)
6	**Cell wall**	Sometimes (cellulose or chitin- plants)	Present (peptidoglycan)
7	**Chloroplast**	Sometimes	Absent
8	**Flagellum**	Absent	Sometimes
9	**Capsule**	Absent	Sometimes
10	**Plasmid**	Absent	Sometimes

Methods for studying cells

	Microscopes	Light Microscope	Scanning Electron Microscope	Transmission Electron Microscope
1	Medium	Light Beam	Electron Beam	Electron Beam
2	Dimensions	2D	3D	2D
3	Max Magnification	X1,500	X200,000	X2,000,000
4	Max Resolution	200 nm	20 nm	0.1 nm

5	Magnification calculation	Magnification = image size / actual size
6	Cell fractionation a) Homogenisation- 1st stage of cell fractionation, cells broken up by a homogeniser (blender) & organelles released from cell. b) Filtration- Separates organelles & debris c) Ultracentrifugation- 2nd stage of cell fractionation, fragments in filtered homogenate are separated in a centrifuge.	

Keywords

1	Light microscope	A type of microscope which has a condenser, objective lens and eyepiece lens and light is passed through the thin specimen an up through the objective and eyepiece lenses to the eye.
2	Electron microscope	Beams of electrons are used to visualize structures in a vacuum. Electrons have a smaller wavelength than light so electron microscopes have a higher resolution than light microscopes.
3	Scanning electron microscope (SEM)	A type of electron microscope which bounces beams of electrons off the surface of an object to develop a 3D image of the specimen (no need therefore for thin sections).
4	Transmission electron microscope (TEM)	A type of electron microscope which asses a beam of electrons through a very thin section of specimen (which often has been stained with heavy metals to show up the fine internal structures).
5	Graticule	A series of lines on a microscope which can be used to calculate the size of objects.
6	Resolution	The minimum distance needed to differentiate between 2 adjacent objects/ points that are close together
7	Magnification	The number of times bigger the image/drawing is compared to the object/real size
8	Cell fractionation	The process where cells are broken up and the different organelles they contain are separated out.
9	Cell	The basic structural, functional, and biological unit of all known organisms.
10	Tissue	A collection of similar cells that perform a specific function.
11	Organ	A combination of different tissues that are coordinated to perform a variety of functions.
12	Organ system	Many organs work together in an organ system to perform a particular function.
13	Organism	A group of organ systems working together. Any individual entity eg: animal, plant or single celled life form
14	Micrometre Nanometre	1x10-6 m 1x10-9 m

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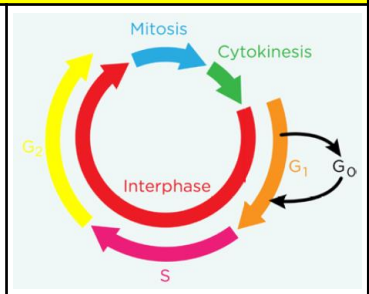
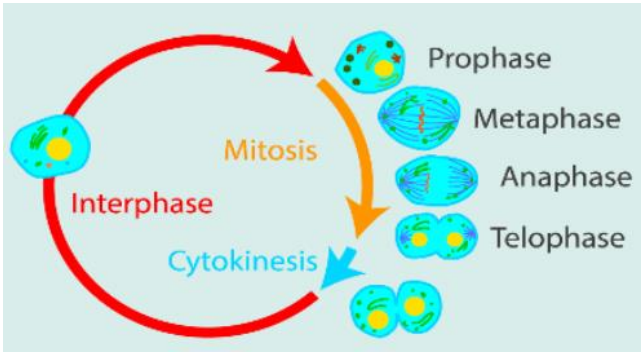
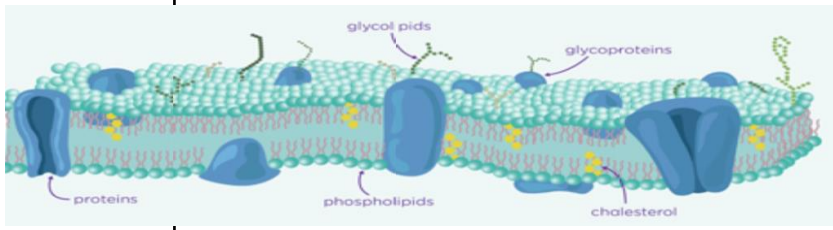
Cell division

1	Within multicellular organisms, not all cells retain the ability to divide. The eukaryotic cell cycle has three main stages; interphase, Mitosis and cytokinesis (see key vocab) The stages of mitosis are below	

2	Stage	Description
	Prophase	DNA condenses & coils, nuclear envelop breaks down, centrioles move to opposite poles of the cell
	Metaphase	Spindle fibres attach to centromeres & chromosomes line at the equator
	Anaphase	Centromeres divide, chromatids move to opposite poles
	Telophase	Chromosomes uncoil, nuclear envelope reforms

3		
4	Problems with cell division (cancers)	Cancerous cells have uncontrolled cell division and a modified cell cycle (repeats too quickly). Treatments involve disrupting the cell cycle (chemotherapy) by stopping DNA synthesis or by changing the cytoskeleton in mitosis.

Cell membranes

1	Structure	Composed of phospholipids, proteins, glycoproteins, glycolipids and cholesterol. Cholesterol- has a hydrophilic end and hydrophobic end- regulates membrane fluidity by intercalating between the phospholipids. 
2	Function	Act as barriers and control what passes into and out of the cells and organelles
	Structure	Function
3	Phospholipid	Triglyceride in which one of the three fatty acid molecules is replaced by a phosphate molecule. Phospholipids are important in the structure an functioning of plasma membranes.
4	Bilayer	A membrane consisting of two layers of phospholipids.
5	Protein channel	A protein completely spanning the phospholipid bilayer which form water-filled tubes to allow water-soluble ions to diffuse across the membrane.
6	Carrier protein	Carbohydrate chains attached to a protein (often extrinsic) which are part of the cell surface membrane. They act as recognition sites, help cells to attach to one another and allows cells to recognise one another.
7	Glycoprotein	Carbohydrate chains attached to a protein (often extrinsic) which are part of the cell surface membrane. They act as recognition sites, help cells to attach to one another and allows cells to recognise one another.
8	Glycolipid	A carbohydrate covalently bonded with a lipid. They act as recognition sites, help maintain stability of the membrane and help cells attach to one another.
9	Cholesterol	Lipid that is an important component of cell-surface membranes because it adds strength. Excess in the blood can lead to atheroma.

Key Vocabulary

1	Cell cycle	The series of events that take place in a cell that cause it to divide into two daughter cells.
2	Interphase	Stage of the cell cycle consisting of 2 growth phases (G1&G2) and a DNA synthesis stage (S). The cell may exit the cycle at G0.
3	Mitosis	Stage of the cell cycle, which is a type of nuclear division resulting in 2 identical; daughter cells been made.
4	Cytokinesis	Stage of the cell cycle when cell splits in 2, forming 2 identical daughter cells.
5	Daughter cell	The cells that are produced by cell division.
6	Chromatid	One of the two strands of a chromosome that are joined together by a single centromere prior to cell division.
7	Centromere	The place where the two copies of DNA after replication are joined together.
8	Spindle fibres	These form the spindle apparatus which are responsible for pulling the chromatids to separate ends of the cell.
9	Centrioles	Where the spindle fibres develop from in animal cells.
10	Equator	Where the chromosomes arrange themselves during metaphase.
11	Cancer	A group of diseases caused by a growth disorder of cells as a result of damage to the genes that regulate mitosis and the cell cycle which results in uncontrolled growth and division of cells.
12	Tumour	A group of abnormal cells which develops and constantly expands in size.
13	Plasma membrane	Membranes consisting of a phospholipid bilayer found around and within all cells. The cell-surface membrane is the plasma membrane that surrounds cells.
14	Permeability	Ability to pass liquids/gases. Depends on the size, polarity and charge of the molecule. If it is small, non-polar and fat soluble it is very permeable and can pass through the cell membrane.
15	Fluid mosaic model	Arrangement of molecules in the cell-surface membrane. Fluid- individual phospholipid molecules can move relative to each other. Mosaic- proteins vary in shape, size and pattern.

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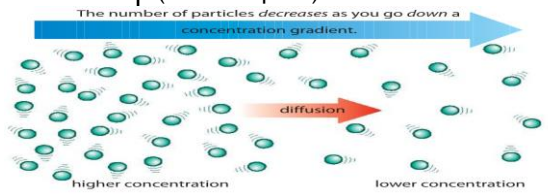
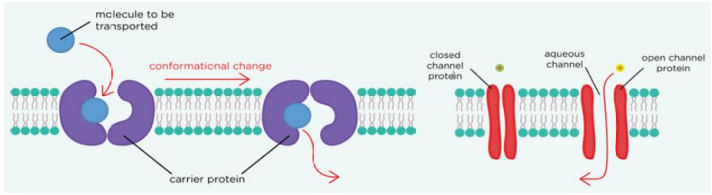
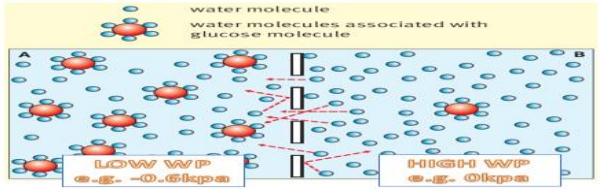
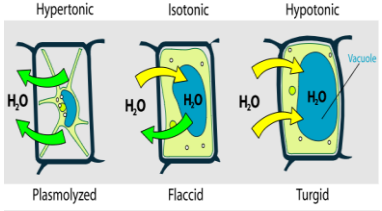
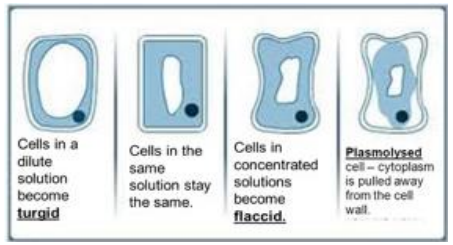
Passive transport

1	Passive transport- involves exchange of substances without requiring metabolic energy from the cell. There are 3 types: Diffusion, facilitated diffusion, osmosis (see key vocab)		
2	Diffusion	Eg: oxygen (non-polar), CO_2, Water (small and polar) 	Factors effecting rate of diffusion: 1- No of channel & carrier proteins 2- surface area of cell membrane 3- diffusion distance 4- concentration gradient 5- Type of molecule/ion diffusing 6- Temperature
3	Facilitated diffusion	Specific to one particular ion, will only open when ion is present. 	
4	Osmosis		

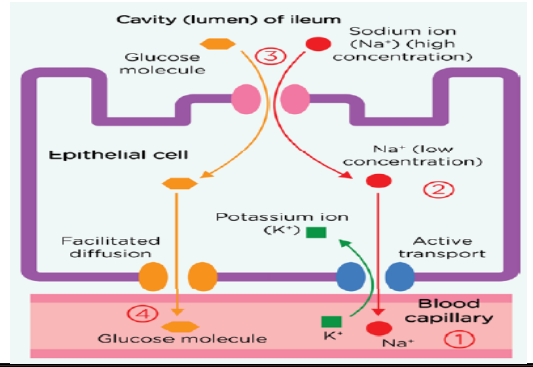
a) Effects on animal cells
Animal cells expand when placed in a solution of higher water potential. As animal cells don't have cell walls, the cell will burst open and become Haemolysed.
If water leaves an animal cell by Osmosis, it will shrink and appear 'wrinkled'.
It will become Crenated.

b) Effects on plant cells

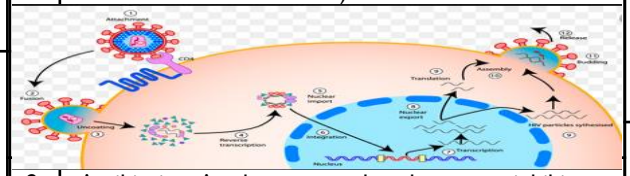




Active transport

1	The movement of particles from an area of low to high concentration, against a concentration gradient. It uses ATP energy.	
2	Co-transport	Occurs when transport of one substance is coupled with transport of another substance across a membrane. Eg: Glucose & sodium co transport in the ileum
3		

Human immunodeficiency virus (HIV)

1	**HIV**- Replicates in T-helper cells causing AIDs due to decreased cell count. The compromised immune system leads to risk of serious infections. It is a retrovirus (group that have reverse transcriptase so can make DNA from RNA).
	
2	Antibiotics- A substance used to destroy or inhibit the growth of bacteria by targeting specific enzymes & organelles. They are ineffective against viruses as the virus uses the host's machinery.

Key Vocabulary

1	Diffusion	The net movement of molecules (or ions) from a region of high concentration to a region of low concentration. It is passive so does not require energy.
2	Facilitated diffusion	Diffusion involving the presence of protein carrier molecules to allow the passive movement of substances (normally large, polar or charged molecules) across plasma membrane.
3	Osmosis	The movement of water from a region where there is a higher water potential to a region where there is a lower water potential through a partially permeable membrane. It is passive.
4	Water potential	The pressure created by water molecules. It is the measure of the extent to which a solution gives out water. The greater the number of water molecules present, the higher (less negative) the water potential. Pure water has a water potential of zero.
5	Isotonic	A solution which has the same water potential as the cell within it.
6	Active transport	Movement of a substance from a region where it is in a low concentration to a region where it is in a high concentration. The process requires the expenditure of metabolic energy in the form of ATP as substance are moved against the concentration gradient.
7	Co-transport	The transport of one substance coupled with the transport of another substance across a plasma membrane in the same direction through the same protein carrier.

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Components of the immune system

1	Antibodies		Proteins produced by lymphocytes in response to the presence of the corresponding antigen. They agglutinate pathogens by forming antigen-antibody complexes, leading to phagocytosis and neutralisation of toxins.
2	Antigens		A molecule that is recognized as foreign by the immune system and triggers an immune response by lymphocytes.
	Component		Function
3	Phagocytes	Macrophages	Engulfs & digests pathogens by fusion of the phagosome & lysosomes and process of phagocytosis. Carry out non-specific immune response.
		Neutrophils	
4	T cells (Cells which mature in the thymus and are associated with cell-mediated immunity)	T helper cells	Stimulates B cells to divide & secrete antibodies. Many different types of them with receptors that respond to a single antigen.
		Cytotoxic T cells	Kill abnormal cells and body cells that are infected by pathogens by producing a protein called perforin which makes holes in the cell-surface membrane.
		T memory cells	Remain in the blood for years & provide long term protection
5	B cells (Each type of B cell produces a specific antibody that responds to one specific antigen)	Plasma cells	When the B cell is activated to divide by mitosis it gives a clone of plasma cells which produce & secrete the specific antibody complementary to the antigen on the pathogen's surface.
		B memory cells	Remain in the blood for years & provide long term protection

Using monoclonal antibodies

1	Attached to drugs to deliver them to specific cell types eg: cytotoxic drug to cancel cell
2	Disease diagnosis- testing for presence of specific pathogen antibodies in the blood
3	Used in pregnancy tests (refer to ELIZA test key vocab)
4	Ethical considerations: high risk (treatment may cause death), use of animals for production may cause harm, human trials

Cell mediated immunity

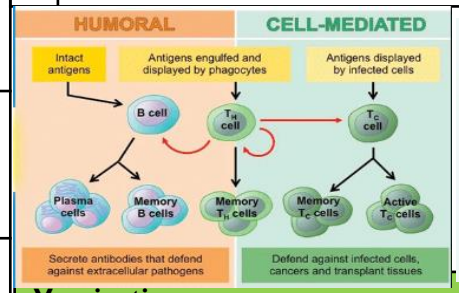
1	Antigen(pathogen) displayed on cell surface(body cells or phagocytes) after phagocytosis.
2	T cells with the specific receptor bind with the antigen & are activated.
3	They divide by mitosis (clonal expansion) & differentiate into T helper, cytotoxic and memory cells.

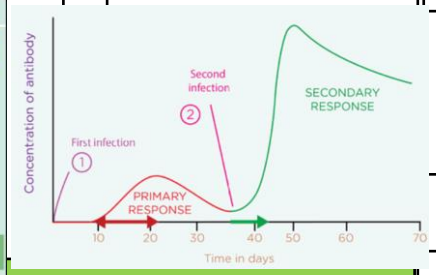
Humoral immunity

1	This response is best at fighting pathogens that are free in bodily fluids. 1- Free antigen binds to complementary B cell receptor, activating B cell (clonal selection) 2- Pathogen is endocytosed & antigen presents on plasma membrane 3- T helper cell binds to presented antigen & stimulates B cell to divide by mitosis (clonal expansion) 4- B cell differentiates to plasma & memory cells

Primary & secondary response

1	Primary immune response- When a pathogen infects the body for the first time the initial response is slow.
2	Secondary immune response- When there is a 2nd/subsequent infection with the same pathogen, memory cells divide rapidly and develop into plasma cells that produce antibodies.





Vaccination

Refer to key vocab for herd immunity, natural & artificial immunity

1	Vaccination	Introduction into the body of a vaccine containing disease antigens, by injection or mouth, to induce artificial immunity
2	Vaccine	Work by injecting weakened/dead pathogens into the body to stimulate an immune response, to form memory cells against the specific antigen, which destroy the pathogen quickly upon infection
3	Ethical issues	Side effects, financial costs, right to choose, animal testing of vaccines before use on humans, human trials before scaled use
4	Active immunity	Occurs when specific antibodies produced by own immune system
5	Passive immunity	When specific antibodies introduced to individual from an outside source

	Immunity	Example
7	Natural Active	Direct contact with pathogen
8	Natural Passive	Antibodies through breastmilk
9	Artificial Active	Vaccination
10	Artificial Passive	Injection of antibodies

Key Vocabulary

1	Pathogen	A microorganism that causes disease.
2	Self	The body's own cells and molecules.
3	Foreign	(Non-self) Not your own body's cells and molecules. Eg: pathogens- viruses, bacteria
4	Lymphocyte	Type of white blood cell responsible for the immune response. They become activated in the presence of antigens. There are two types: B lymphocytes and T lymphocytes.
5	Phagocytosis	Mechanism by which phagocytes engulf particles to form a vesicle or a vacuole.
6	Lysosome	Contain enzymes called lysozymes which they release into the phagosome which hydrolyse the bacterium.
7	Phagosome	A vesicle formed as the bacterium is engulfed by the phagocyte. The lysosome release their lysozymes into the phagosome.
8	Clonal selection	As the receptor on a helper T cell attaches to the antigen this activates the T cell to divide rapidly by mitosis and form a clone of genetically identical cells. These cloned T cells stimulate B cells to divide and form a clone of identical B cells all of which produce the antibody that is specific to the foreign antigen.
9	Antigen presentation	When an antigen-presenting cell e.g. phagocyte displays foreign antigens on their own cell-surface membrane.
10	Monoclonal antibodies	Antibodies produced by a single clone of cells.
11	Natural immunity	A type of active immunity resulting from an individual becoming infected with a disease under normal circumstances.
12	Artificial immunity	A type of active immunity resulting from vaccination. It involves inducing an immune response in an individual without them suffering symptoms of the disease.
13	Herd immunity	Arises when a sufficiently large proportion of the population has been vaccinated which makes it difficult for a pathogen to spread within that population.
14	Antigenic variability	Pathogen may mutate frequently so that its antigens change suddenly rather than gradually which means vaccines become ineffective because the new antigens on the pathogen are no longer recognized by the immune system.
15	ELISA test	Enzyme linked immunosorbent assay which uses antibodies to detect the presence and quantity of a protein in a sample. A colour change is seen dependent on antigen amount in sample.