AQA AS Level Biology Unit 1

Why do we calculate ratios or percentages with data? for easier comparison, because different groups have different starting numbers/masses

Why do we take a large sample size? more representative, findings not due to chance

Why do we take random samples? avoid bias

Why do we take repeats? identify anomalous results and calculate a reliable mean

Why do we have controls? to see that what we are testing (e.g. drug) is causing the effect

How do we treat control groups? treat exactly the same but do not give the drug, give a placebo

Evaluate the conclusion?

- compare the conclusion wording to the data wording
- correlation does not mean causation, other factors may been involved
- sample size unknown
- no repeats
- no controls
- length of study unknown
- then answers specific to the data (use common sense)

What are biological molecules? molecules made and used by living organisms e.g. Carbohydrates, Proteins, Lipids

What are the functions of carbohydrates?

- energy source (glucose in respiration)
- energy store (starch in plants, glycogen in animals)
- structure (cellulose in cell wall of plants)

What are the building blocks for carbohydrates called? monosaccharides

Example of monosaccharides? glucose (alpha and beta), galactose, fructose

Formula for monosaccharides? $C_6H_{12}O_6$ (isomers = same formula but different arrangement)

Difference between alpha and beta glucose? on Carbon 1, alpha glucose has a OH group on the bottom and beta glucose has a OH group on the top

How are monosaccharides joined together? condensation reaction (removing water) – between 2 OH groups

Bond in carbohydrate? glycosidic bond

Example of disaccharides? glucose + glucose = maltose, glucose + galactose = lactose, glucose + fructose = sucrose

Formula for disaccharides? $C_{12}H_{22}O_{11}$

How are polymers separated? hydrolysis (add water)

What is a polysaccharide? many monosacharrides joined by condensation reaction/glycosidic bonds

Example of polysaccharides?

- Amylose (long chain of alpha glucose) which makes starch/glycogen
- Cellulose (long chain of beta glucose) which makes cell wall in plants

Test for starch? add iodine, turns blue/black

Test for reducing sugar? heat with benedicts, turns brick red

Test for non-reducing sugar?

- heat with benedicts – no change
- therefore, add dilute hydrochloric acid (hydrolyses glycosidic bond)
- then add sodium hydrogencarbonate (neutralises solution)
- heat with benedict - turns brick red

How is starch digested?

- Salivary Amylase in the mouth and Pancreatic Amylase in the SI breaks the starch into maltose
- Maltase on the lining of the SI breaksdown the maltose into glucose

How is sucrose digested? sucrase on the lining of the SI breaks it down into glucose and fructose

How is lactose digested? lactase on lining of the SI breaks it down into glucose and galactose

What is lactose intolerance? person does not have the lactase enzyme

Symptoms of lactose intolerance?

- Diarrhoea and Flatulence
- <u>diarrhoea</u> – undigested lactose lowers water potential of the lumen of the SI, so water enters the lumen by osmosis, = watery faeces
- <u>flatulence</u> – undigested lactose enters the LI, broken down by micro-organisms, releasing gas

What are 2 types of proteins? Globular and Fibrous

What are globular proteins? soluble proteins with a specific 3D shape e.g. enzymes, hormones, antibodies, haemoglobin

What are fibrous proteins? strong/insoluble/inflexible material e.g. collagen and keratin

What are the building blocks for proteins? amino acids

Structure of amino acid? central carbon, carboxyl group to the right (COOH), amine group to the left (NH2), hydrogen above and R group below

How do amino acids differ? have different R groups e.g. glycine has a hydrogen in its R group – simplest amino acid

How are amino acids joined together? by condensation reaction between the carboxyl group of one and amine group of another, leaves a bond between carbon & nitrogen (called a peptide bond) forming a dipeptide

Define primary, secondary, tertiary, quaternary structure?

- Primary = sequence of AA, polypeptide chain (held by peptide bonds)
- Secondary = the primary structure (polypeptide chain) coils to form a helix, held by hydrogen bonds
- Tertiary = secondary structure folds again to form final 3d shape, held together by hydrogen/ionic/disulfide bonds
- Quaternary = made of more then one polypeptide chain

Examples of quaternary structure proteins? collagen (3 chains), antibodies (3 chains), haemoglobin (4 chains)

Structure of collagen?

- strong material, used to build tendons/ligaments/connective tissues
- primary structure mainly made up of glycine (simplest amino acid)
- secondary structure forms a tight coil (not much branching due to glycine)
- tertiary structure coils again
- quaternary structure made from 3 tertiary structures wrapped around each other like rope
- = a collagen molecule
- many of these collagen molecules make the tendons/ligaments/connective tissues

Test for protein? add biuret, turns purple

What is an enzyme? a biological catalyst (substance that speeds up the rate of reaction without being used up – lowers activation energy)

What makes an enzyme specific? has a specific active site shape, only complementary substrates can bind to the active site to form enzyme-substrate complexes

Lock and Key Model vs Induced Fit Model?

- LK = active site shape is rigid, only exactly complementary substrates can bind to form ES complexes
- IF = active site changes shape, the substrate binds to the active site – the active site changes shape so the substrate fits exactly forming an ES complex

Affect of substrate concentration on enzyme activity?

- increase substrate concentration, increases chance of successful collisions, increase chance of forming an ES complex, increase rate of reaction
- this continues until all the enzyme's active sites are full/saturated = maximum rate of reaction

Affect of temperature on enzyme activity?

- as temperature increases
- the kinetic energy increases
- the molecules move faster
- increase chance of successful collisions
- increase chance of forming ES complex
- increase rate of reaction
- carries on till optimum
- after optimum
- bonds in tertiary structure break
- lose active site shape
- substrate no longer complementary
- cant form ES complexes
- enzyme denatured

Affect of pH on enzyme activity? if change pH away from optimum, bonds in tertiary structure break, lose active site shape, no longer form ES complex, enzyme denatured

Competitive vs Non-Competitive Inhibitors?

- Competitive = a substance with a similar shape to the substrate and a complementary shape to the enzyme's active site, binds to the active site, blocking it, preventing ES complexes from forming
- Non-Competitive = a substance that binds to another site on the enzyme other then the active site, causes the active site to change shape, so less ES complexes can form

Competitive vs Non-Competitive Inhibitors? increase substrate concentration to excess (very high concentration) – with competitive inhibitor maximum rate of reaction will be reached, with non-competitive inhibitor maximum rate of reaction cannot be reached

2 types of microscopes? Light and Electron (transmission and scanning)

How to judge a microscope? by Magnification and Resolution

Magnification? how much larger the image size is compared to the actual size

Which has higher magnification? TEM > SEM > LM

Formula for magnification? magnification = image size/actual size

Conversion? 1 mm = 1000 micrometre. 1 mm = 1,000,000 nanometre

Why can organelles appear different in images? viewed from different angles and at different levels/depth

Resolution? minimum distance at which 2 very close objects can be distinguished

Which has higher resolution? TEM > SEM > LM

Why does electron microscopes have a higher resolution? Electron microscope uses electrons which have a shorter wavelength (light microscope uses light which has a large wavelength)

Difference between TEM and SEM? in Transmission the electrons pass through the specimen, in Scanning the electrons bounce off the specimen's surface

Advantage and Disadvantage of TEM?

- Advantage = highest magnification and highest resolution
- Disadvantage = works in a vacuum so can only observe dead specimens, specimen needs to be thin, black and white image, 2D image, artefacts

Advantage and Disadvantage of SEM?

- Advantage = produces 3D image
- Disadvantage = works in a vacuum so can only observe dead specimens, black and white image, artefacts

Cell Fractionation?

- Breakdown tissue into cells (cut, pestle & mortar)
- add cold/isotonic/buffer solution (*cold = reduce enzyme activity, isotonic = same water potential so organelle does not shrink or burst, buffer = maintains constant pH*)
- homogenate – breaks open cells releasing organelles
- filter = removes large debris and intact cells
- centrifuge – spin at low speed, largest organelle builds at bottom (nucleus), leaves supernatant, spin at higher speed, next heaviest organelle forms at bottom (chloroplast or mitochondria)
- (*organelle by size: nucleus, chloroplast, mitochondria, endoplasmic reticulum/golgi body/lysosomes, ribosomes*)

Eukaryotic vs Prokaryotic?

- Eukaryotic = animal/plant cell, has membrane bound organelles (nucleus, endoplasmic reticulum, golgi body, lysosome, mitochondra)
- Prokaryotic = bacteria, has no membrane bound organelles

What is an Animal Cell made of?

- Organelles (nucleus, endoplasmic reticulum, golgi body, lysosomes, mitochondria, ribosomes) – all have membrane except the ribosomes
- Cytoplasm (site of chemical reaction)
- Cell Membrane (holds cell contents together, controls what enters/leaves cell, cell signalling)

Structure of Nucleus?

- contains DNA (made of genes, genes code for making proteins)
- DNA wrapped around histones to form Chromatin
- nucleus has a double membrane, called Nuclear Envelope, which contains pores
- at centre of nucleus is Nucleolus – produces mRNA (copy of a gene)
- rest of nucleus made of Nucleoplasm (contains the dna/chromatin)

Endoplasmic Reticulum?

- 2 types = Rough and Smooth
- Rough Endoplasmic Reticulum has ribosomes on it, makes proteins
- Smooth Endoplasmic Reticulum has no ribosomes on it, makes lipids/carbohydrates

Golgi body?

- modifies and packages proteins
- packages them into vesicles for transport
- digestive enzymes are placed into lysosomes (vesicles with membranes around them)

Mitochondria?

- site of respiration, releases energy, produces ATP (energy carrier molecule)
- has a double membrane, inner membrane folded into Cristae (increases surface area for enzymes of respiration)
- middle portion called Matrix

Ribosomes?

- attached to RER
- site of protein synthesis

What are the 3 types of Lipids?

- Triglycerides (fat for energy store, insulation, protection of organs)
- Phopholipids (to make membranes)
- Cholesterol (for membrane stability and make hormones)

Structure of triglyceride?

- made of 1 glycerol and 3 fatty acids
- joined by condensation reaction, ester bonds
- bond is COOC
- there are 2 types of triglycerides: saturated fat and unsaturated fat

Saturated vs Unsaturated Fat?

- Saturated = has no carbon double bonds in the R group of the fatty acid
- Unsaturated = has carbon double bonds in the R group of the fatty acid

Structure of phospholipid?

- made of 1 glycerol, 2 fatty acids and 1 phosphate
- phosphate forms a hydrophillic head, fatty acids form hydrophobic tails
- forms a phospholipid bilayer, basic structure of membranes

Where are Membranes found?

- around organelles (membrane bound organelles) = to hold organelles contents together, control what enter/leaves organelles
- around cells (cell surface membranes) = to hold cell contents together, control what enters/leaves cell, cell signalling

Basic structure of a membrane?

- made of a phospholipid bilayer (a double layer of phospholipids)
- hydrophilic heads face water/fluid
- hydrophobic tails face towards each other, protected from water/fluid

Additional structures in membranes? Proteins, Carbohydrates, Cholesterol

Role of proteins in the membrane?

- Extrinsic and Intrinsic
- extrinsic = found in one layer
- intrinsic = found in both layers – forms transport proteins (carrier and channel)

Role of carbohydrates in the membrane? form Glycoprotein and Glycolipid (if carbohydrate attaches to protein or lipid) – acts as receptors to hormones in cell signalling

Role of cholesterol in the membrane? sits between the phospholipids in the bilayer, provides membrane stability

Why are membranes defined as having a Fluid-Mosaic Model? fluid = describes the phospholipids in the bilayer – flexible, mosaic = describes the appearance of the proteins

Define Diffusion? net movement of molecules from an area of high concentration to an area of low concentration until equilibrium is reached (down the concentration gradient)

Simple vs Facilitated Diffusion?

- Simple = molecules move directly through the phospholipid bilayer
- Facilitated = molecules pass through transport proteins (large use carrier, charged use channel)

Factors that affect rate of diffusion?

- surface area (increase = increase rate of diffusion)
- concentration gradient (increase = increase rate of diffusion)
- thickness (decrease = decrease diffusion distance = increase rate of diffusion)
- temperature (increase = increase kinetic energy = molecules move faster = increase rate of diffusion)
- size of molecules (smaller molecules = increase rate of diffusion)

What is Ficks Law? (Surface Area x Concentration Gradient)/Thickness

Define Osmosis? movement of water molecules from an area of high water potential to an area of low water potential through a partially permeable membrane

Which liquid has the highest water potential?

- distilled/pure water
- has a value of 0kPa
- lower water potential by adding solutes (makes water potential negative)
- water moves from less negative water potential (e.g. -35 kPa) to more negative water potential (e.g. -75 kPa)

Surround animal cell with pure water? swells and burst (water enters by osmosis)

Surround plant cell with pure water?

- swells but does not burst
- cell wall prevents it from bursting
- made of cellulose – strong material
- the cell is <u>Turgid</u>

Surround animal cell with concentrated sugar/salt solution? shrinks (water leaves by osmosis)

Surround plant cell with concentrated sugar/salt solution?

- water leaves by osmosis
- cell wall prevents cell from shrinking, keeps it rigid
- the protoplast (cell membrane plus contents) shrink
- the cell is <u>Plasmolysed</u>

Define Active Transport? movement of molecules from an area of low concentration to an area of high concentration using ATP and carrier proteins (against concentration gradient)

Describe the process of active transport?

- molecules (in area of low concentration) bind to carrier protein
- ATP breaksdown to ADP, Pi and Energy
- the Pi and Energy cause the carrier protein to change shape
- carrier protein releases molecules on opposite side (in area of high concentration)
- the carrier protein releases the attached Pi to return to its original shape

Adaptations of SI?

- folded to form Villus (large surface area)
- cells lining SI have Microvilli (large surface area)
- wall of SI is thin (short diffusion distance)
- rich blood supply (maintains concentration gradient)
- cells lining SI have transport proteins and mitochondria

Active Transport of Glucose in SI?

- sodium ions are actively transported from the cells lining the SI into the blood
- lowers the sodium ion concentration in the cell
- therefore sodium ions move from the lumen of the SI into the cell
- this pulls in glucose via a cotransport protein
- therefore glucose builds up in the cell and moves into the blood by diffusion

Structure of Bacteria?

- No nucleus – loose DNA in the form of a single loop and plasmid
- No membrane bound organelles: smaller ribosomes, mesosomes – infolding of cell membrane for respiration
- Cytoplasm
- Cell Membrane & Cell Wall (made of peptidoglycan)
- some have a Capsule (reduce water loss, protect from phagocytosis) and Flagella (movement)

Cause of Cholera?

- involves a bacteria called Vibrio Cholerae entering the SI
- the bacteria produces toxins which cause the cells lining the SI to release Chloride ions into the lumen of the SI
- this lowers the water potential of the lumen
- so water enters the lumen by osmosis leading to diarrhoea (watery faeces)

Treatment for Cholera?

- ORT (Oral Rehydration Therapy)
- contains Sodium ions – absorbed by cells lining the SI lowering the water potential of the cells so they absorb water by osmosis
- contains Glucose – provides energy (given in the form of starch, as starch is insoluble)
- contains Potassium ions – increases appetite

Function of Lungs? site of gas exchange (oxygen into blood – used in cells for respiration, carbon dioxide out of the blood – toxic waste product of respiration)

What is Lungs made up of? Trachea, Bronchi, Bronchioles, Alveoli (+ capillaries)

Function of trachea, bronchi, bronchioles? transport of air and filter air, (bronchioles also controls amount of air reaching alveoli)

Structure of trachea/bronchi?

- wall made of c-shaped cartilage
- cartilage is strong so trachea/bronchi do not collapse
- cartilage is c-shaped to give flexibility
- lining made of goblet cells and ciliated epithelial cells
- goblet cells make mucus, which traps pathogens/particles
- ciliated epithelial cells have cilia, which pushes mucus up and out of lungs

Structure of bronchioles?

- wall made of smooth muscle
- smooth muscle contracts, lumen narrows, bronchiole constricts
- (occurs when surrounded by noxious gases – reduces amount reaching alveoli)
- lining made of goblet cells and ciliated epithelial cells

Adaptation of alveoli?

- millions of tiny alveoli that are folded (large surface area)
- thin wall/one cell thick/squamous epithelial cells (short diffusion distance)
- elastic tissue in wall (stretches when breathing in to increase surface area, recoils when breathing out to push the air out)
- ventilation maintains concentration gradient (high oxygen, low carbon dioxide)

Adaptation of capillaries?

- millions of tiny capillaries (large surface area)
- thin wall/one cell thick/squamous epithelial cells (short diffusion distance)
- narrow lumen (increases diffusion time, decreases diffusion distance)
- circulation maintains concentration gradient (low oxygen, high carbon dioxide)

How O_2 moves from the alveoli to the capillaries? by simple diffusion passing thru the alveolar epithelium and capillary epithelium

How CO_2 moves from capillaries to the alveoli? by simple diffusion passing thru the capillary epithelium and alveoli epithelium

Describe the process of Breathing/Ventilation?

- Breathing In/Inhalation = external intercostal muscles contract (rib cage moves up and out) & diaphragm contracts (flattens), therefore increase in volume in chest and decrease in pressure, so air moves in
- Breathing Out/Exhalation = external intercostal muscle relax (rib cage moves down and in) & diaphragm relaxes (back to dome shape), therefore decrease in volume in chest and increase in pressure, so air pushed out (aided by elastic recoil in the alveoli)

Formula for Pulmonary Ventilation?

- PV = tidal volume x ventilation rate
- tidal volume = volume of air breathed in/out in one breath
- ventilation rate = number of breaths per minute
- Pulmonary Ventilation = volume of air breathed in/out per minute

Pulmonary Tuberculosis?

- infectious disease
- caused by a bacterial pathogen called Mycobacteria Tuberculosis
- spread in air droplets
- infected person coughs/sneezes, releases air droplets containing pathogen
- requires prolonged exposure
- pathogen enters lungs
- pathogen becomes trapped by white blood cells (primary infection)
- if person's immune system weakens (old age, hiv, medical conditions, malnourished, immunosuppressant drugs) the pathogen may escape causing disease (post primary infection)
- causes damage to lung tissue
- symptoms = fever, cough up blood, night sweats, severe weight loss
- treatment = long course of antibiotics (6-9 months)

Pulmonary Fibrosis?

- formation of scar tissue (in alveoli)
- increases diffusion distance (so less gas exchange)
- reduces elasticity (so less air pushed out of lungs)
- reduces surface area (so less gas exchange)
- symptoms:
- shortness of breath (rapid breathing but shallow breaths)
- chronic dry cough (due to presence of scar tissue)
- discomfort in chest

- fatigue/tiredness

Emphysema?

- caused by smoking
- alveoli becomes permanently stretched (shortness of breath)
- alveoli walls breakdown (reduced surface area)
- alveoli burst (reduced surface area)
- symptoms = shortness of breath, chronic cough (more mucus), bluish skin colouration

Asthma?

- localised (lungs) allergic reaction
- main allergens = pollen, animal fur, dust
- other factors = air pollution, stress, cold air, exercise
- allergens/factors cause white blood cells to release histamine, histamine causes inflammation, so bronchioles constrict & goblet cells release more mucus (airways narrow)
- symptoms = difficulty breathing, wheezing (whistling sound), tight feeling in chest, cough

Heart?

- job is to pump blood around the body (delivers nutrients to cells and remove waste)
- made of 4 muscular chambers (2 atria, 2 ventricles)
- atria pumps blood to ventricles, ventricles pump blood out of heart (R to lungs, L to body)
- ventricles thicker then atria (has to pump blood further)
- left ventricle has a thicker muscular wall then right ventricle, therefore has stronger contractions, so can generate higher pressure and pump the blood further around the body

Blood vessels of the heart?

- artery takes blood away from the heart, vein returns blood to the heart
- Vena Cava supplies R atrium (with deoxygenated blood from body)
- Pulmonary Vein supplies L atrium (with oxygenated blood from lungs)
- R ventricle supplies Pulmonary Artery (deoxygenated blood to lungs)
- L ventricle supplies Aorta (oxygenated blood to body)

Job of valves in heart?

- Ensure one way flow of blood, no backflow
- (blood flows from atria to ventricles to arteries)
- 2 sets of valves: Atrio-ventricular Valve & Semi-lunar Valve
- AV valve = between atria and ventricles
- SL valve = between ventricles and arteries

When are AV valves open or closed? Open = pressure in atria greater then pressure in ventricles, Closed = pressure in ventricles greater then pressure in atria

When are SL valves open or closed? Open = pressure in ventricles greater then pressure in arteries, Closed = pressure in arteries greater then pressure in ventricles

Describe the processes of the cardiac cycle?

- Filling Stage = atria relaxed, ventricles relaxed, AV valve open, SL valve closed
- Atria Contracts = the SAN located in the R atrium initiates the heart beat and sends the impulse across both atria making them contract, this pushes all the remaining blood into the ventricles so it becomes full
- Ventricles Contract = the AVN picks up the impulse, delays it (*stops the atria and ventricles contracting at the same time, so the atria empties and the ventricles fill*), sends the impulse down the septum in the Bundle of His, then at the apex the impulse goes up both walls of the ventricles in the purkine fibres, *so the ventricles contract from the base upwards, pushing the blood up thru the arteries*, when the ventricles start to contract the AV valve closes then the SL valve opens and blood leaves the heart
- Ventricles Relax = the SL valve closes then the AV valve opens and filling starts again

What causes the Heart Sounds?

- when the valves close
- 1st = AV closes
- 2nd = SL closes

Formula for Cardiac Output?

- CO = Stroke Volume x Heart Rate
- stroke volume = volume of blood pumped out of the heart in one beat
- heart rate = number of beats per minuted
- Cardiac Output = volume of blood pumped out of the heart in one minute

Coronary Heart Disease and Myocardial Infarction?

- high blood pressure damages lining of coronary artery
- fatty deposits/cholesterol builds up beneath the lining, in the wall = Atheroma
- the atheroma breaks thru the lining forming a Atheromatous Plaque on the lining, in the lumen
- this causes turbulent blood flow
- a blood clot (thrombus) forms
- this block the coronary artery
- therefore less blood flow to the heart muscle
- less glucose and oxygen delivered
- the heart muscle cannot respire
- so it dies (myocardial infarction)

Risk Factors of CHD?

- Age, gender, ethnicity
- Saturated fats (increases LDL, LDL deposits cholesterol in the arteries to form atheroma)
- Salts (increases blood pressure – lowers water potential of the blood so it holds the water)
- Smoking (nicotine = increase HR and makes platelets more sticky – blood clot, carbon monoxide = permanently blocks haemoglobin)
- Obesity and Lack of Exercise

Atheroma & Aneurysm? atheroma weakens wall of artery, blood builds up in the wall, the wall swells then bursts = aneurysm

What is a pathogen?

- a disease causing micro-organism
- e.g. bacteria, virus, fungi
- bacteria cause disease by producing toxins
- virus cause disease by dividing in cells causing them to burst

Body's defence against pathogens?

- I, Barriers (prevents pathogens entering the body)
- II, Phagocytes (perform phagocytosis and stimulate specific response)
- III, Specific Response (uses lymphocytes to produce memory cells and antibodies)

What are the Barriers (I)?

- Skin, an impermeable barrier made of keratin
- Cilia & Mucus in Lungs
- Stomach Acid (denatures/breaksdown pathogens)

Describe the process of Phagocytosis (II)?

- pathogen releases chemicals
- this attracts the phagocyte
- the phagocyte binds to the pathogen
- the phagocyte engulfs the pathogen
- forms a phagosome around the pathogen
- lysosomes inside the phagocyte release digestive enzymes into the phagosome
- breaking down the pathogen

Describe the Specific Response (III)?

- phagocytes perform phagocytosis (engulf and destroy pathogen) without destroying the antigen, they place antigens on their surface, they present antigens
- t lymphocytes (t cells) bind to the antigen and become stimulated
- they divide by mitosis to form 3 types of cells: *t helper, t killer, t memory*
- t helper cells stimulate b lymphocytes (b cells)

- t killer cells kill infected cells (infected by virus)
- t memory cells provide long term immunity
- b lymphocytes (b cells) engulf and present antigens on their surface, the t helper cells bind to this
- the b cells become stimulated and divide by mitosis to make 2 types of cells: *Plasma Cells & B Memory Cells*
- Plasma cells make antibodies
- B memory cells provide long term immunity

What is a antigen? a protein on the surface of a pathogen that stimulates an immune response

How does the immune response lead to production of antibodies? the phagocytes stimulate the t cells, the t cells form t helper cells, the t helper cells stimulate the b cells, the b cells form plasma cells, the plasma cells make antibodies

What is an antibody?

- a globular protein
- made by plasma cells
- has 3 regions: variable region, hinge region, constant region
- variable region has a different shape in each antibody, contains the antigen binding sites, these bind to complementary antigens (on a pathogen) to form an antigen-antibody complex, destroying the pathogen
- hinge region gives the antibody flexibility
- constant region the same shape in all antibodies, binds to phagocytes to help with phagocytosis

How do Memory cells (B/T) work?

- made during the specific immune response after a new infection by a pathogen (called a primary infection)
- B and T memory cells remain in the blood
- if person is reinfected by the same pathogen (called a secondary infection) the memory cells will recognise the pathogen and produce antibodies RAPIDLY and to a LARGE amount
- therefore the pathogen is killed before it can cause harm = immunity

How does a vaccine produce immunity? involves giving an injection that contains dead/weakened pathogens that carry antigens which stimulates the immune response leading to production of antibodies & memory cells

Active vs Passive immunity?

- Active = individual has memory cells – can make their own antibodies & provides long term immunity
- Passive = person given antibodies, these work then die, no long term immunity, no memory cells.

How does activity immunity occur? naturally = by primary infection, artificially = by vaccination

How does passive immunity occur? naturally = from mother to baby (placenta or breast milk), artificially = by injection

Successful Vaccination Programme?

- produce suitable vaccine (effective – make memory cells, does not cause disease, no major side effects, low cost, easily produced/transported/stored/administered)
- herd immunity

What is herd immunity? when a large proportion of the population is vaccinated, therefore most people will be immune, only a few will not be a immune, increases chance of non-immune person coming into contact with immune person, so the pathogen has no where to go, so it dies out

Problems with Vaccination Programmes?

- vaccine does not work (dead form ineffective, pathogen hides from immune system)
- vaccine not safe (no weak/inactive form, causes major side effects)
- many strains of pathogen
- cannot achieve herd immunity (logistic of vaccinating large proportion)
- antigenic variability

What is antigenic variability? the pathogen mutates, the antigen changes shape, so the memory cells no longer complementary – do not recognise the pathogen, therefore the pathogen can reharm

What is a monoclonal antibody? one type of antibody, complementary to one type of antigen, made by one type of plasma cell

What are monoclonal antibodies used for? identify specific antigens or antibodies in person's blood

How do monoclonal antibodies identify specific <u>antigens</u> in the blood?

- e.g. identify PSA antigen made by prostate cancer
- place monoclonal antibodies complementary to PSA antigen on test plate
- add person's blood to test plate
- if PSA antigen is present in the blood, it will bind to the monoclonal antibodies
- then a 2nd set of monoclonal antibodies with an enzyme attached is added
- if the PSA antigen is present, this 2nd set will bind to it
- if the PSA antigen is not present, this 2nd set will not bind
- the test plate is then washed
- if PSA antigen is present, 2nd set of monoclonal antibodies will attach, this will not be washed away, so the enzyme will be present
- if PSA antigen not present, 2nd set of monoclonal antibodies will not attach, this will be washed away, so enzyme also washed away
- a colourless substrate is then added, if the enzyme is present it will breakdown the substrate causing a colour change, if the enzyme is not present there will be no colour change

- therefore: colour change occurs = enzyme present/PSA antigen is present, no colour change = no enzyme present/no PSA antigen is present

How do monoclonal antibodies identify specific <u>antibodies</u> in the blood?

- e.g. identify TB antibodies in the blood
- place antigen complementary to TB antibodies on test plate
- add person's blood to test plate
- if TB antibodies are present in blood, they will bind to the antigen
- then a set of monoclonal antibodies (with an enzyme attached) complementary to the TB antibodies are added
- if the TB antibodies are present, the monoclonal antibodies will attach
- if the TB antibodies are not present, the monoclonal antibodies will not attach
- the test plate is then washed
- if the TB antibodies are present, the monoclonal antibodies will attach, this will not be washed away, so the enzyme will be present
- if the TB antibodies are not present, the monoclonal antibodies will not attach, this will be washed away, so the enzyme will be washed away
- a colourless substrate is then added, if the enzyme is present it will breakdown the substrate causing a colour change, if the enzyme is not present there will be no colour change
- therefore: colour change occurs = enzyme present/TB antibody is present, no colour change = no enzyme present/no TB antibody is present