

AQA AS Biology Unit 2 Revision Notes

What is Variation? difference in characteristics between organisms

Types of Variation?

intraspecific = differences between organisms of the same species

interspecific = differences between organisms of different species

Causes of Intraspecific Variation?

Genetic Factors = same genes but different alleles (allele are different type/forms of genes)

Environmental Factors

Causes of Interspecific Variation?

Genetic Factors = different genes and different alleles

Environmental Factors

Types of Characteristics? Discontinuous and Continuous

Properties of Discontinuous Characteristics?

characteristics fall into certain groups with no overlap (e.g. blood group) – determined by genetics only (a single gene)

Properties of Continuous Characteristics?

characteristics show a range (e.g. height) – determined by genetics (a few genes, polygenes) and environment

What is Standard Deviation? spread of data around the mean (variation of data)

Why is SD better than Range for describing Variation?

(range is largest value minus the smallest value), SD not affected by outliers but range is affected by outliers

Uses of SD?

- describe reliability of a mean value calculated using repeat values (e.g. mean value calculated from experiment using 5 repeats/trials)
- compare 2 different mean values

Using SD to test reliability of a mean value?

- large SD value = unreliable mean (large variation in repeats)
- small SD value = reliable mean (small variation in repeats)

Using SD to compare 2 different mean values? test whether the SD of the mean values overlap or not

If the SD of 2 different means overlap, what does it imply?

the difference between the 2 means is not significant but is due to chance

If the SD of 2 different means do not overlap, what does it imply?

the difference between the 2 means is significant, it is not due to chance

What do Twin Studies test? the level of influence of genetics and environment on characteristics

What do identical twins share? same alleles and same environment

What do non-identical twins share? different alleles but same environment

What if identical twins are similar? characteristic may be influenced by genetics (alleles) or environment

What if identical twins are different? characteristic not influenced by genetics or environment, influence on characteristic is random

What if non-identical twins are similar? due to similar environment, therefore, characteristic influenced more by environment

What if non-identical twins are different? due to different alleles, therefore, characteristic influenced more by genetics

What is DNA?

- DeoxyriboNucleic Acid
- found in all organisms (animals, plants, microorganisms)
- carries genes
- genes = section of DNA that codes for a protein
- all organisms are built of proteins

Building block of DNA?

- nucleotide (made of phosphate, deoxyribose sugar, nitrogenous base)
- 4 types of nucleotides (each has a different base, either Adenine/Thymine/Cytosine/Guanine)

DNA structure?

- DNA Double Helix
- join nucleotides by condensation reaction between nucleotides to form a polynucleotide
- join 2 polynucleotides by hydrogen bond between the bases
- A joins with T, C joins with G (complementary base pairing)
- produces double strand

- then coil double strand into Double Helix

Properties of DNA Structure?

- Double Stranded = makes DNA more stable & 2 strands act as templates in semi-conservative replication
- Coil into Helix = more compact
- Sugar-phosphate backbone = protects bases (bases code for protein)
- Hydrogen bonds between bases = weak, so double strand separates more easily for semi-conservative replication

What is a Gene?

- a section of DNA that codes for a protein
- made out of intron and exon
- intron = non-coding DNA (function e.g. turns gene on or off)
- exon = coding DNA (codes for protein)

How does a Gene/Exon code for a Protein?

- made out of a sequence of bases
- each 3 bases code for 1 amino acid (called triplet code)
- therefore,
- sequence of bases
- determines sequence of triplet codes
- which determine the sequence of AAs
- = polypeptide chain/primary structure (folds to secondary, then to tertiary/quaternary)

Properties of triplet code?

- degenerate = each AA has more than one triplet code
- non-overlapping = each base is read only once
- stop codes = occur at end of sequence – do not code for an AA

How does a mutation lead to a non-functional enzyme?

- change in base sequence
- change in sequence of triplet codes
- change in sequence of AAs
- change in primary structure
- change in hydrogen/ionic/disulfide bonds
- change in tertiary structure (3D shape)
- change in active site shape
- substrate no longer complementary
- can no longer form enzyme-substrate complex

What is a Chromosome?

- DNA in coiled form
- formed during interphase of cell division (mitosis/meiosis)
- made of 2 identical/sister chromatids joined by a centromere
- carries 2 copies of the same DNA molecule

What is a homologous pair of chromosomes?

a pair of chromosomes: 1 from mother/1 from father
carries same genes but different alleles – there are 23 pairs in humans

What is Cell Division?

- formation of new cells in multicellular organisms (animals & plants)
- 2 methods = mitosis & meiosis
- mitosis = produces genetically identical cells for growth & repair of tissues
- meiosis = produces genetically different haploid cells as gametes for sexual reproduction

What does Mitosis (cell cycle) produce?

2 genetically identical cells, diploid (have full set of chromosomes/DNA)

Benefit of Mitosis? growth and repair of tissues

Stages of Mitosis? Interphase/Mitosis/Cytokinesis

Interphase? G1: protein synthesis
S: DNA replication (doubles set of DNA)
G2: organelle synthesis

Mitosis?

Prophase: DNA coils to form chromosomes, nucleus breakdown, spindle fibres form

Metaphase: chromosomes line up in middle of cell and attach to spindle fibre via centromere

Anaphase: spindle fibres pull, centromere splits, sister chromatids move to opposite sides

Telophase: chromatids uncoil, nucleus reforms (left with 2 genetically identical nuclei)

Cytokinesis? separating cell into 2 (each receives a nucleus and organelles/cytoplasm)

What happens to DNA mass in mitosis? halves

What happens to Chromosome number in mitosis? stays the same (diploid)

What does Meiosis produce?

4 genetically different cells, haploid (half the amount of chromosome/DNA)

Benefits of Meiosis?

produces gametes which will be used in sexual reproduction in animals & plants
(2 gametes fuse to form a zygote, zygote develops into organisms)

Stages of Meiosis? Interphase/Meiosis I/Meiosis II/Cytokinesis

Interphase? G1: protein synthesis
S: DNA replication (doubles set of DNA)
G2: organelle synthesis

Meiosis I?

Prophase I: DNA coils to form chromosomes, nucleus breaks down, spindle fibres form, crossing over occurs

Metaphase I: homologous pair of chromosomes line up in middle of cell and attach to spindle fibre via centromere

Anaphase I: spindle fibres pull, homologous pair of chromosomes separate to opposite sides by independent assortment

Telophase I: chromosomes uncoil, nucleus reforms (left with 2 nuclei)

Meiosis II?

Prophase II: DNA coils to form chromosomes, nucleus breaks down, spindle fibres form

Metaphase II: chromosomes line up in middle of cell and attach to spindle fibre via centromere

Anaphase II: spindle fibres pull, centromere splits, sister chromatids move to opposite sides by independent assortment

Telophase II: chromatids uncoil, nucleus reforms (left with 4 genetically different nuclei)

Cytokinesis? separating cell into 4 (each receives a nucleus and organelles/cytoplasm)

How does Meiosis produce Variation? Crossing Over and Independent Assortment

What is crossing over?

occurs in Prophase I of Meiosis I

homologous pairs of chromosomes wrap around each other and swap equivalent sections of chromatids – produces new combination of alleles

What is independent assortment?

- in Anaphase I of Meiosis I – the homologous pairs of chromosomes separate
- in Anaphase II of Meiosis II – the chromatids separate
- independent assortment produces a mix of alleles from paternal and maternal chromosomes in gamete

What happens to DNA mass in meiosis? quarters

What happens to Chromosome number in meiosis? halves (haploid)

DNA Replication?

occurs in interphase before mitosis & meiosis
occurs by semi-conservative replication

Describe Semi-Conservative Replication?

DNA double strand separate and act as templates, producing 2 identical copies of the DNA, each has half the original strand and half the new strand

process:

- DNA Helicase breaks hydrogen bonds between the complementary bases
- double strand separates, leaves 2 template strands
- free complementary nucleotides bind to exposed bases on template strands (A to T, C to G)
- DNA Polymerase joins the sugar-phosphate backbone of the new strand

Evidence for SCR?

- Replicating Bacterial DNA in 2 types of Nitrogen Isotopes, ^{15}N and ^{14}N
- ^{15}N = heavy isotope
- ^{14}N = light isotope
- Nitrogen found in nitrogenous bases of DNA
- Bacterial DNA made from ^{15}N will have a Heavy Density
- Bacterial DNA made from ^{14}N will have a Light Density
- Experiment = Bacterial DNA made of ^{15}N is replicated in an environment of ^{14}N – produces DNA molecules with half ^{15}N /half ^{14}N (semi-conservative replication, original strand = ^{15}N & new strand = ^{14}N), therefore, DNA molecule has medium density

What is Cancer? formation of a tumour due to uncontrolled cell division (uncontrolled mitosis)

How does uncontrolled cell division occur?

- due to mutation of DNA/cells forming cancer cells
- mutation can occur randomly or due to mutagens (chemicals/radiation)
- cancer cells are rapidly dividing cells (like hair cells, skin cells, red blood cells), they spend less time in interphase and more time in the other stages (mitosis)

Treatment for Cancer?

Surgery = aim is to remove tumour

Chemotherapy = - using drugs that inhibit mitosis in rapidly dividing cancer cells
- problem, also affect normal healthy cells (hair cell, skin cells, rbc) causing side effects (hair loss, dry skin, tiredness)
- treatment given as regular doses to allow time for normal healthy cells to recover in number

Radiotherapy = radiation used to destroy cancer cells

What are the 2 forms of Reproduction?

- Sexual & Asexual
- Sexual Reproduction in Animals & Some Plants
- Asexual Reproduction in Microorganisms & Some Plants
- Sexual Reproduction uses 2 parents (each provides a gamete which fuse to form a zygote, zygote develops into organism)
- Asexual Reproduction uses 1 parent to produce genetically identical offspring

How does a Zygote develop into an Organism?

- Zygote is a stem cell
- stem cell = undifferentiated/unspecialised cell, can form any type of cell
- zygote divides by mitosis to make many stem cells
- each stem cell differentiates into specialised cell
- each specialised cell divides by mitosis to make many copies and form a tissue
- different tissues join to form an organ
- different organs join to form an organ system
- this is surrounded by the Body

Define a tissue, organ and organ system?

tissue = a group of specialised cells

organ = made of different tissues

organ system = different organs working together

What is Genetic Diversity? the variety of alleles within a population of a species

Benefit of high genetic diversity? species able to adapt with changes in the environment
e.g. if a new disease arises, some individuals will have characteristics to survive, and will reproduce passing on their alleles, so the species does not become extinct

What is selective breeding? interbreeding males and females with desired characteristics to produce offspring with the desired characteristics (inherit alleles) – lowers genetic diversity as all other alleles are excluded

What is founder effect?

- small group from the main population becomes isolated
- small number of individuals = low variety of alleles = low genetic diversity
- if this group interbreeds and repopulates – all the individuals will have alleles from this limited range
- plus, if a mutated allele is present, individuals would be more likely to inherit the allele

What is genetic bottleneck? large reduction in population size due to a natural disaster (or hunting), low number of individuals = low variety of alleles = low genetic diversity

Job of Red Blood Cells?

- found in humans/mammals (animals)
- carries haemoglobin
- haemoglobin carries oxygen

Structure of Haemoglobin?

- globular protein (soluble & specific 3d shape)
- quaternary structure made of 4 polypeptide chains (2 α , 2 β)
- each chain carries a haem group
- each haem group carries Fe²⁺
- each Fe²⁺ carries an O₂
- therefore, each haemoglobin carries 4 lots of O₂

Job of Haemoglobin? load oxygen in the lungs and deliver it to the respiring tissues

What is Affinity?

the level of attraction haemoglobin has to oxygen
(high affinity = strong attraction, low affinity = weak attraction)

Role of haemoglobin in oxygen transport?

- haemoglobin has High Affinity in the lungs – due to high partial pressure of oxygen and low partial pressure of carbon dioxide, so haemoglobin loads/associates oxygen in the lungs and becomes saturated (full)
- the haemoglobin is transported in the blood in the red blood cell
- at the respiring tissues, haemoglobin has Low Affinity – due to low partial pressure of oxygen and high partial pressure of carbon dioxide, so oxygen is unloaded/dissociated/delivered and haemoglobin becomes unsaturated

Relationship between O₂ Partial Pressure & Affinity/Saturation of Haemoglobin?

- positive correlation
- as O₂ partial pressure increases, affinity/saturation of haemoglobin increases
- the correlation is not linear but is curved (produces a s-shaped, sigmoid curve called Oxygen Dissociation Curve)
- middle portion of ODC has a steep gradient so when respiring tissues change from resting to active and partial pressure of O₂ falls, there is a large drop in affinity, so more O₂ would be delivered to the respiring tissues

Relationship between CO₂ Partial Pressure & Affinity/Saturation of Haemoglobin?

- negative correlation
- as CO₂ partial pressure increases, affinity/saturation of haemoglobin decreases
- this occurs at the site of respiring tissues = the carbon dioxide lowers the pH of the blood, makes the haemoglobin change shape, so oxygen is released, lowering affinity. this shifts the ODC to the right, called the bohr shift. benefit = more oxygen delivered to respiring cells

How does a Fetus receive oxygen? from mother's blood, oxygen dissociates from mother's haemoglobin and associates with fetal haemoglobin in the placenta – fetal haemoglobin has a higher affinity compared to mother's haemoglobin

Benefit of fetal haemoglobin having high affinity? fetal haemoglobin's ODC will be to the left, it has high affinity – so the oxygen will dissociate from the mother's haemoglobin and associate with the fetal haemoglobin at the low partial pressures of oxygen in the placenta, so it has enough oxygen for its needs

Why do adults not keep with fetal haemoglobin? the high affinity will mean less oxygen will be unloaded at the respiring tissues

Affinity of Organisms in a Low Oxygen Environment?

has a high affinity, curve to the left, therefore it can readily associate oxygen at the low oxygen partial pressures

Affinity of Active Organisms?

has a low affinity, curve to the right, therefore more oxygen can be unloaded to meet the cell's demand for more respiration

Affinity of Small Organisms?

have a large surface area to volume ratio, lose a lot of heat, needs to respire to generate heat, therefore has a low affinity, curve to the right, so unloads enough oxygen for the cells demand of more respiration

What are Polysaccharides?

- carbohydrates
- made of a long chain of monosaccharides joined by condensation reaction/glycosidic bonds
- 3 examples: Starch, Glycogen, Cellulose
- Starch & Glycogen used as Energy Stores (starch in plants, glycogen in animals), they are made out of many alpha glucose which are used for respiration
- Cellulose used to form Cell Wall in Plants, made out of many beta glucose

Properties of Starch and Glycogen as energy stores?

- Insoluble = do not affect water potential of the cell, do not diffuse out of the cell
- Coiled/Branched = compact, more can fit into a cell
- Branched/Chained = glucose removed from the end

Structure of Cellulose?

- β -glucose arranged in a straight chain (each alternative β -glucose is rotated 180 degrees) = cellulose straight chain
- many cellulose chains are cross linked by hydrogen bonds to form microfibrils
- many microfibrils are cross linked to form macrofibrils
- forms structure of cell wall

- strong material (prevents plant cell from bursting or shrinking)

How do Microorganisms Obtain Nutrients & Remove Waste?

- by exchange via their surface
- nutrients (e.g. glucose, oxygen) move in by diffusion via their surface
- waste (e.g. carbon dioxide) move out by diffusion via their surface

Why are Microorganisms able to perform exchange via their surface?

- have a large surface area to volume ratio
- have a short diffusion distance
- have low demand

Why can't Animals/Plants perform exchange via their surface?

- have a small surface area to volume ratio
- multicellular (large diffusion distance and high demand)
- impermeable surface (prevent pathogens entering and reduce water loss)
- therefore, require specialised Exchange & Transport systems
- exchange system = increases rate of diffusion of nutrients in and wastes out
- transport system = deliver nutrients and remove waste from all cells

Why do Insects have Specialised Gas Exchange Systems?

- multicellular organism so has a small surface area to volume ratio, large diffusion distance, high demand & body surface made of exoskeleton (impermeable barrier to reduce water loss)
- therefore, cannot perform gas exchange (O_2 in/ CO_2 out) via their surface, they require a specialised gas exchange system called Tracheal System

Structure of Tracheal System in Insects?

- starts with openings on body surface called Spiracles
- spiracles contain valves, open = gas exchange, closed = prevent water loss
- spiracles connect to Trachea
- trachea connect to Tracheoles
- tracheoles connect directly to Respiring Cells (delivering oxygen, removing carbon dioxide)

How does Gas Exchange occur in Tracheal System of Insects?

- at rest = down a concentration gradient, oxygen moves in & carbon dioxide moves out by simple diffusion
- when active = by ventilation, air inhaled for mass flow of O_2 in & air exhaled for mass flow of CO_2 out

Why do Fish have Specialised Gas Exchange Systems?

- multicellular organism so has a small surface area to volume ratio, large diffusion distance, high demand & body surface impermeable
- therefore, cannot perform gas exchange (O_2 in/ CO_2 out) via their surface, they require a specialised gas exchange system called Gills

Structure of Gills in Fish?

- many gill filaments and gill lamellae = large surface area
- gill lamellae have a thin wall (short diffusion distance) and are permeable
- ventilation brings in pure water (high oxygen, low carbon dioxide) and circulation brings in deoxygenated blood (low oxygen, high carbon dioxide), the water and blood pass over in opposite directions (countercurrent flow), which maintains concentration gradient all the way along the gill lamellae

Why do Humans/Mammals require a Specialised Transport System?

- multicellular organisms therefore have large diffusion distances and high demand
 - need a transport system to deliver nutrients and remove waste from all cells
 - transport system in humans/mammals called Circulatory System
 - Circulatory System made of heart, blood vessels, blood
- (heart pumps blood, blood vessels carry blood, blood carries nutrients/waste)

Why is the transport system in mammals called a double circulatory system?

the heart pumps twice, the blood goes through the heart twice – generates enough pressure to supply all body cells

Why is the transport system in mammals called a closed circulatory system?

blood is transported in blood vessels – helps to maintain pressure and redirect blood flow

Layout of Circulatory System?

- heart pumps blood which is carried in arteries which flow into arterioles which flow into capillaries which then are carried in venules then veins back to the heart
 - Artery to Arterioles to Capillaries to Venules to Veins
 - Artery/Arterioles carry blood away from the heart
- (arterioles are small arteries)
- Capillaries are the site of exchange (nutrients out, waste in)
 - Veins/Venules return blood back to the heart
- (venules are small veins)

Role of Arteries/Arterioles?

- generally carry oxygenated blood away from the heart
- for example, Coronary Artery to heart muscle
Hepatic Artery to liver
Renal Artery to kidneys

- exception = Pulmonary Artery carries deoxygenated blood to lungs

Role of Veins/Venules?

- generally carry deoxygenated blood back to the heart
- for example, Coronary Vein from heart muscle
Hepatic Vein from liver
Renal Vein from kidneys
- exception 1 = Pulmonary Vein carries oxygenated blood back to the heart
- exception 2 = Hepatic Portal Vein carries deoxygenated blood from digestive system to liver (for filtering)

Function of Arteries/Arterioles?

carry blood away from the heart so should be able to withstand high blood pressures & maintain high blood pressures

Structure of Arteries/Arterioles?

- narrow lumen = maintains pressure
- lining made of squamous epithelial cells = smooth lining to reduce friction
- thick wall = withstand pressure
- elastic tissue in wall,
ventricles contract – elastic tissue stretches to withstand pressure
ventricles relax – elastic tissue recoils to maintain pressure and smooth out flow
- smooth muscle in wall (particularly in arterioles),
smooth muscle contracts – lumen narrows and arteriole constricts
smooth muscle relaxes – lumen widens and arteriole dilates
- collagen in wall
prevents artery from tearing

Function of Veins/Venules? return blood back to the heart, the blood is under low pressure

Structure of Veins/Venules?

- wide lumen = ease of blood flow
- lining made of squamous epithelial cells = smooth lining to reduce friction
- thin wall = vein can be squashed by skeletal muscle pushing blood back to the heart
- valves in lumen = prevents backflow of blood

Function of Capillaries?

- site of exchange
- 3 locations,

With Alveoli, takes in O₂ and removes CO₂

With Microvilli, takes in glucose/amino acids/fatty acids & glycerol/vitamins/minerals

With All Cells, deliver nutrients and remove waste

Adaptation of Capillaries?

- many small capillaries = large surface area
- thin wall, one cell thick, squamous epithelial cells = short diffusion distance
- pores between cells = allows fluid to move in and out
- narrow lumen = increase diffusion time and decrease diffusion distance

Content of Blood?

- main component = Plasma (fluid)
- *plasma carries,*
- Cells = red blood cells, white blood cells, platelets
- Solutes = nutrients, waste, protein

How does exchange occur between Capillaries & All Cells?

- by mass flow
- fluid moves out of the blood in the capillaries carrying the nutrients
- fluid moves back into blood in the capillaries carrying the waste
- (fluid in the blood called plasma, fluid surrounding cells called tissue fluid, fluid in lymph system called lymph)

How is tissue fluid formed and returned to circulatory system?

- at the start of the capillary (arterial end) there is a build up hydrostatic pressure
- this pushes fluid out of the capillary via the pores
- the fluid carries the nutrients with it
- the fluid surrounds the cells, this is called tissue fluid
- at the finish of the capillary (venous end) the fluid moves back in by osmosis
- the capillary has low water potential due to the presence of proteins (too large to move out of capillaries)
- any excess tissue fluid is picked up by the lymph system and deposited in the vena cava

Why does high blood pressure cause accumulation of tissue fluid?

increases hydrostatic pressure, so more tissue fluid is formed – not as much can be returned to the circulatory system

Why does diet low in protein cause accumulation of tissue fluid?

the water potential in the capillary is not as low as normal, so not as much fluid can move back into the capillary by osmosis

Blood Pressure changes along the Circulatory System?

- Arteries =
- highest pressure (connects directly with heart/ventricles)
 - pressure fluctuates (increases when ventricles contract which causes the elastic tissue to stretch, decreases when ventricles relax which causes the elastic tissue to recoil)
 - overall decrease in pressure due to friction
- Arterioles = large decrease in pressure due to increase in total cross-sectional area (ensures pressure is not too high to damage capillaries)
- Capillaries = pressure here is called hydrostatic pressure (decreases due to a loss in fluid)
- Venules/Veins = blood under low pressure

What are the Exchange & Transport Systems in Plants?

- exchange systems = leaf and root
- leaf to absorb light and CO₂ for photosynthesis
- roots to absorb water and minerals
- transport systems = xylem and phloem
- xylem transports water and minerals
- phloem transports glucose/sugars
- xylem transports in one direction from roots to leaves, phloem transports in both directions

Job of the Roots?

- absorb water and minerals
- absorbs water by osmosis
- absorbs minerals by active transport
- plants need water for photosynthesis, cytoplasm hydration, turgidity of cells
- plants need magnesium, nitrate, phosphate (magnesium to make chlorophyll, nitrate to make amino acids, phosphate to make phospholipids/ATP/DNA)

Structure of the Roots?

- outer layer called Epidermis
- middle layer called Cortex
- inner layer called Endodermis
- xylem and phloem in the centre of root
- epidermis contain root hair cells, cortex contain cortex cells, endodermis contain endodermis cells

[root hair cells has a large surface area, large vacuole (store water/minerals), many mitochondria (provide ATP for active transport)]

How is water absorbed at the roots?

- mineral ions are actively transported from the soil into the roots
- from the soil into root hair cells into cortex cells into endodermis cells into the xylem
- this lowers water potential
- so water follows by osmosis
- water can move by symplast or apoplast
- symplast is when the water moves directly through the cells, passing through the cell membrane (supported by gaps between the cells called plasmodesmata)
- apoplast is when the water moves between the cells or in the cell wall, it doesn't pass across cell membrane
- apoplast continues until the endodermis cells – these cells have a casparin strip around them (a waterproof, impermeable barrier), so water enters the cell by symplast and then the xylem

Function of the Xylem? transport water and minerals from roots, up the plant, to the leaves

Structure of the xylem?

- long continuous hollow tube (no resistance to water flow)
- narrow lumen
- wall made out of lignin
- lignin: strong, waterproof, adhesive
- wall contains pits/pores (water and minerals can leave)

How does water move up the xylem?

- loss of water at the leaves (transpiration)
- water moves from the top of the xylem into the leaf by osmosis (transpirational pull)
- this applies TENSION to the column of water in the xylem
- the column of water moves up as one as the water particles stick together, COHESION
- this is the cohesion-tension theory
- it is supported by capillary action, adhesion and root pressure
- (capillary action = water automatically moves up narrow lumen of xylem)
- (adhesion = water particles stick to lignin in wall of xylem)
- (root pressure = water absorbed at the roots pushes the column of water up slightly by hydrostatic pressure)

Why does the diameter of a tree decrease during the day?

- more light and higher temperature
- increase rate of transpiration
- increase transpirational pull
- water pulled up xylem by cohesion-tension
- because the water particles stick to the wall of the xylem (adhesion)
- the walls of the xylem are pulled inwards

Structure of Leaves?

- upper layer called Upper Epidermis
- waxy cuticle on upper epidermis (barrier to reduce water loss)
- beneath the upper epidermis are Palisade Cells
- palisade cells are where photosynthesis takes place
- beneath palisade cells are Spongy Mesophyll Cells
- are loosely packed leaving air spaces to allow ease of gas exchange
- lower layer called Lower Epidermis

Adaptation of palisade cells for photosynthesis?

- located near top of leaf, closer to light
- large size, large surface area for light
- thin cell wall, short diffusion distance for carbon dioxide
- contains many chloroplasts, site of photosynthesis
- large vacuole, pushes chloroplast to the edge of the cell closer to light

Structure of chloroplast?

- organelle for photosynthesis
- has double membrane
- contains discs called thylakoids
- thylakoids contain chlorophyll
- stack of thylakoids called granum
- thylakoids surrounded by a fluid called stroma

How does Exchange occur in Leaves?

- lower epidermis of leaf contains pairs of cells called Guard Cells
- when turgid, guard cells form an opening called Stomata
- gas exchange occurs via the stomata
- In Day, plant photosynthesises and respire, CO₂ moves in for photosynthesis and O₂ moves out (some is used in respiration)
- At Night, plant only respire, O₂ moves in for respiration and CO₂ moves out

What is Transpiration? loss of water vapour from the leaf via the stomata

How does Transpiration occur?

- moist lining of spongy mesophyll cells evaporate forming water vapour
- water vapour builds up in air spaces
- if water vapour concentration is high enough & stomata is open, water vapour diffuses out

Factors that increase rate of transpiration?

- light = more light, more stomata open, increase surface area for transpiration
- temperature = more temperature, more evaporation (increase water vapour concentration) & more kinetic energy
- wind = more wind, maintains concentration gradient
- humidity = less humidity, less water vapour in the surrounding air, increase in water vapour concentration gradient

What is a Potometer? apparatus used to measure rate of transpiration

Principle of potometer?

- as transpiration occurs from the leaves, the plant will pull up more water from the potometer by cohesion-tension causing the bubble to move towards the plant
- the more water lost by transpiration, the more water taken up, the further the bubble moves

Measuring Rate of Transpiration?

- rate of transpiration = volume of transpiration *divided by* time
- for volume of transpiration, distance bubble moved x cross-sectional area of tube (πr^2)

How to set up a potometer?

- choose healthy leaf and shoot
- cut shoot underwater and connect to potometer underwater (prevents air bubbles entering/blocking xylem)
- ensure potometer is air tight and water tight

What does a potometer actually measure?

measures rate of water uptake as a result of water loss from plant
(water loss can be due to: transpiration, photosynthesis, making cells turgid, loss from potometer)

What is a Xerophyte? a plant adapted to reduce water loss (reduce transpiration)

Adaptations of Xerophyte?

- spiky, needle like leaves = reduced surface area
- thick waxy cuticle = waterproof, impermeable barrier
- densely packed spongy mesophyll = less air spaces, less water vapour build up
- sunken stomata/hairy leaves/rolled up leaves = traps moist layer of air, reduces concentration gradient

What is Classification? placing organisms into groups

What is Hierarchical Classification?

- large groups divided into smaller groups with no overlap
- kingdom, phylum, class, order, family, genus, species

What is Binomial Naming System?

- using Genus name and Species name to name organism
- Genus name first in capital, Species name second in lower case
- e.g. tiger = *Felis tigris*

What is a Species?

a group of individuals with similar characteristics that can interbreed to produce fertile offspring

Why are the offspring from 2 different species mating infertile?

- offspring will have a odd number of chromosomes
- therefore, cannot perform meiosis, cannot produce gametes
- example: horse + donkey = mule,
mule is infertile,
horse has 64 chromosomes/donkey has 62 chromosomes,
horse gamete has 32 chromosomes/donkey gamete has 31 chromosomes,
therefore, mule has 63 chromosomes

What is Phylogenetic Classification?

based on evolutionary relationships – how closely related different species are and how recent a common ancestor they have

3 ways of comparing relationship between different species?

DNA Hybridisation: comparing DNA base sequence

- take DNA from 2 species to be compared
- radioactively label one of the DNA
- heat both sets so double strand separates
- cool so single strands join together
- look for Hybrid DNA (one strand from species A, one strand from species B)
- identify Hybrid DNA by 50% radioactivity
- heat Hybrid DNA to measure similarity

results = higher temperature required
more hydrogen bonds present
more complementary base pairing
more similar the base sequence
more similar the species
more closely related

more recent a common ancestor

AA Sequence: comparing AA sequence for the same protein (e.g. haemoglobin in mammals)

results = more similar the AA sequence
more similar the DNA base sequence
more similar the species
more closely related
more recent a common ancestor

*(comparing DNA sequence better than comparing AA sequence:
DNA sequence provides information on INTRONS and triplet code is DEGENERATE)*

Protein Shape: comparing shape of the same protein (e.g. albumin) using immunological technique

- comparing species A and species B
- take albumin from species A
- place in a blood of rabbit
- rabbit will make antibodies against albumin of species A
- takes these antibodies and place in blood from species B
- if the albumin in species B has a similar shape to species A,
the antibodies will bind to form antigen-antibody complexes,
this will then form a precipitate

results = more precipitate
more complexes
more similar shape
more similar the species
more closely related
more common recent ancestor

What is Courtship Behaviour?

- Behaviour (actions/sounds) used by animals to identify when individuals are ready for mating
- courtship behaviour is specific/unique to each species
- closely related species will have a more similar courtship behaviour
- involves a stimulus-response chain, were all steps must be completed before successful mating can occur

Benefits of courtship behaviour?

- identify same species
- identify opposite gender
- identify when individual is ready for mating
- form a pair bond

What is a Bacteria?

- Microorganism
- Prokaryotic
- has no nucleus
- DNA is loose in 2 forms (single loop and plasmids)
- single loop carries most of the genes
- plasmids carry a few extra genes (e.g. antibiotic resistance gene)

What is a Antibiotic?

- substance made by Fungi
- destroys bacteria

5 ways an Antibiotic can destroy a Bacteria?

- prevent cell wall from forming, water enters bacteria by osmosis – it swells and bursts (osmotic lysis)
- increase membrane permeability
- inhibit DNA replication
- inhibit protein synthesis
- inhibit respiration

What is Antibiotic Resistance in Bacteria?

- when the bacteria is not affected by the antibiotic
- the bacteria has a Antibiotic Resistance Gene on its plasmid
- the gene produces a protein that protects it from the antibiotic
- 2 ways,
- produces an enzyme that destroys the antibiotic
- or
- changes protein shape on bacteria surface so antibiotic cannot bind

How does an Antibiotic Resistance Gene appear? by random mutation

How can Bacteria pass on the Antibiotic Resistance Gene?

- 2 ways,

Asexual Reproduction, bacteria produce genetically identical offspring, so offspring inherits antibiotic resistance gene, *called Vertical Gene Transmission*

Conjugation, bacteria copies its plasmid (with antibiotic resistance gene) and passes onto other bacteria, *called Horizontal Gene Transmission*

process: - conjugation tube forms between donor and recipient bacteria

- donor bacteria copies the plasmid and it passes through the tube in linear fashion

- once in recipient bacteria, the plasmid becomes circular and the recipient antibiotic resistance because it has antibiotic resistance gene

bacteria has

How can a Population of Bacteria may become resistant to an antibiotic?

- variation in the population
- some of the bacteria are resistant to the antibiotic – have an antibiotic resistant gene (carried on plasmid, appeared by random mutation)
- if antibiotic is used – the ones with the antibiotic resistant gene will survive and the others will die (selection)
- the resistant ones that survive will pass on their antibiotic resistant gene by vertical gene transmission (asexual reproduction) and horizontal gene transmission (conjugation)
- if this occurs for many generations, then most of the bacteria will be resistant to the antibiotic (adaptation)

Example of Antibiotic Resistance in Tuberculosis?

- tuberculosis caused by a bacterial pathogen called Mycobacterium Tuberculosis
- treatment involves a long course of antibiotics, 6-9 months
- often people do not complete the full course of antibiotics so the antibiotic resistant mycobacterium tuberculosis survive
- the antibiotic resistance ones will increase in proportion by selection/adaptation
- *therefore,*
- tuberculosis treatment requires a mix of antibiotics for effectiveness

Example of Antibiotic Resistance in MRSA?

- MRSA is a hospital superbug
- its a bacterial pathogen with resistance to many antibiotics
- its developed this due to,
- bacterial pathogens in hospital sharing antibiotic resistance genes by conjugation
- & overuse of antibiotics leading to selection/adaptation

What causes an increase in Antibiotic Resistance in Bacteria?

- overuse of antibiotics (for minor illnesses or viral infections)
- not completing full course of antibiotics

What is Biodiversity?

- variety in an ecosystem
- variety of habitats and variety of species

What is species diversity?

- number of different species
- number of individuals for each species

What is Genetic Diversity?

- variety of alleles in a species population
- the larger number of individuals in a species, the larger the genetic diversity

Benefit of high species diversity?

- Stable ecosystem
- each species is less likely to become extinct (due to high genetic diversity)
- & if a species does become extinct it will not affect the food chain as there are other species available

How to measure Species Diversity for an area?

- Species Diversity Index
- takes into account the number of different species and how many individuals there are for each species
- the larger the species diversity index, the larger the species diversity

How does deforestation lower species diversity?

- (deforestation is the removal of trees for wood & space)
- reduces variety of plants
- less habitat
- less variety of food sources
- lowers animal species diversity

How does agriculture/farming lower species diversity?

- deforestation to make space for farm
- only grow a few plants & keep a few animal species
- selectively breed plants & animals
- use pesticides to kill other species