

AS AQA Biology Unit 2

What is variation? Differences between organisms

Intraspecific vs Interspecific Variation? intraspecific = differences between organisms of the same species AND interspecific = difference between organisms of different species

Discontinuous vs Continuous Variation? discontinuous = characteristics fall into certain groups with no overlap (e.g. blood group) – determined by genetics only AND continuous = characteristics show a range (e.g. height) – determined by genetic and environmental factors

What is Standard Deviation? spread of data around the mean

Why is SD better than Range? range is largest minus the smallest, range is affected by outliers

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 influence of genetics and environment on characteristics

What do identical twins share? same alleles and same environment

What if non-identical twins are similar? due to similar environment

What if non-identical twins are different? due to different alleles

Building block of DNA? nucleotide (phosphate, deoxyribose sugar, nitrogenous base)

DNA structure? 2 polynucleotides joined by hydrogen bonds between the complementary bases (AT, CG) – coils to form a helix

Benefits of DNA as a double helix? more stable, beneficial in semi-conservative replication, more compact

What is a gene? a section of DNA that codes for a protein, made out of intron (non-coding dna) and exon (coding dna)

How does a gene/exon code for a protein?

- made out of a sequence of bases
- each 3 bases code for 1 amino acid (triplet code)
- therefore
- sequence of bases
- determines sequence of triplet codes
- which determine the sequence of AAs
- = 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 tertiary structure
- change in active site shape
- substrate no longer complementary
- can no longer form enzyme-substrate complex

What is a chromosome? formed during interphase - made of 2 identical 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

What does cell cycle (mitosis) produce? 2 genetically identical cells, diploid (full set of dna)

Benefit of Mitosis? growth and repair of tissues

Stages of Cell Cycle? Interphase/Mitosis/Cytokinesis

Interphase? G1: protein synthesis
S: dna replication
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 identical nuclei)

What happens to DNA mass in mitosis? halves

What happens to Chromosome number in mitosis? stays the same

What does Meiosis produce? produces gametes, 4 genetically different cells, haploid (half the dna)

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

Difference between Metaphase I and Metaphase II? Metaphase I = homologous pairs line up in centre of cell (23 pairs), Metaphase II = single chromosomes line up in middle of cell (23 chromosomes at this stage)

What happens to DNA mass in meiosis? quarters

What happens to Chromosome number in meiosis? halves

Describe Semi-Conservative Replication? produces 2 identical copies of the DNA – each has half the old 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 (A to T, C to G)
- DNA Polymerase joins the sugar-phosphate backbone of the new strand

Evidence for SCR? DNA made of ^{15}N (heavy nitrogen) is replicated in an environment of ^{14}N (light nitrogen) – produces DNA molecules with half ^{15}N , half ^{14}N – medium density

What is cancer? uncontrolled cell division (uncontrolled mitosis) leading to formation of a tumour

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

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. 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

Role of haemoglobin in oxygen transport? haemoglobin loads oxygen in the lungs – due to high partial pressure of oxygen and low partial pressure of carbon dioxide, haemoglobin has a high affinity and becomes saturated (full). the haemoglobin is transported in the blood in the red blood cell. at the respiring tissues, oxygen is unloaded – due to low partial pressure of oxygen and high partial pressure of carbon dioxide, haemoglobin has low affinity and becomes unsaturated.

What is affinity? how well haemoglobin carries oxygen, its level of attraction

Affects of high levels of carbon dioxide on affinity? high partial pressure of carbon dioxide lowers affinity – 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. this shifts the ODC to the right, called the bohr shift. Benefit = more oxygen delivered to respiring cells.

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

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 partial pressures

Affinity of active organisms? has a low affinity, curve to the right, therefore more oxygen can be unloaded to meet it cells demand for 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 respiration

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?

- Beta glucose arranged in a straight chain (each alternative beta 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 (fibres)
- forms structure of cell wall
- strong material (prevents plant cell from bursting or shrinking)

Why do large organisms need specialised exchange and transport systems?

- have a small surface area to volume ratio
- multicellular (high demand and large diffusion distance)
- impermeable surface (prevent pathogens entering and reduce water loss)

Structure of exchange system in insects? has openings on body called Spiracles – connects to the trachea which connects to tracheoles which connects directly to the cells

Adaptation of the 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), maintains concentration gradient

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?

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

Stomata? opening in the lower epidermis of the leaf formed when a pair of guard cells are turgid

Why is the transport system in mammals called a double circulatory system? the heart pumps twice, the blood goes thru 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

Role of Hepatic Artery, Hepatic Vein, Hepatic Portal Vein? hepatic artery = takes oxygenated blood to the liver, hepatic vein = takes deoxygenated blood from the liver back to the heart, hepatic portal vein = takes deoxygenated blood from the digestive system to the liver to be filtered

Structure of arteries?

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

Structure of veins?

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

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

How is tissue fluid formed and returned to circulatory system?

- at the arterial end of the capillary there is a build up hydrostatic pressure
- this pushes fluid out of the capillary thru the pores
- the fluid surrounds the cells, this is called tissue fluid
- at the venous end of the capillary 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

Why is there a large decrease in pressure in the arterioles? increase in total cross-sectional area

Describe the structure of the xylem?

- long continuous hollow tube
- wall contains pits/pores
- wall made out of lignin
- lignin: strong, waterproof, adhesive

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 thru the cells, passing thru the cell membrane
- apoplast is when the water moves between the cells or in the cell wall
- 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

What is root pressure? when the water is absorbed by the root and enters the xylem – this applies hydrostatic pressure to the column of water in the xylem, pushing the water up slightly

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 adhesion and root pressure
- (adhesion = water particles stick to lignin in wall of xylem)

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

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

Factors that increase rate of transpiration?

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

How to set up a potometer?

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

How to measure rate of transpiration? measure distance bubble moves in a certain time, measure cross-sectional area of tube for answer in volume

What does a potometer actually measure? measures rate of water uptake (due to: transpiration, photosynthesis, making cells turgid)

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

What is a species? a group of individuals with similar characteristics that can interbreed to produce fertile offspring

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 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 double strands can reform

look for hybrid dna (half one species, half other species)

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: compare for the same protein (e.g. haemoglobin)

results = more similar the AA sequence

more similar the species

more closely related

more recent a common ancestor

(comparing dna sequence better then comparing aa sequence: dna contains INTRONS and triplet code is DEGENERATE)

- Protein Shape: compare 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 rabbit

rabbit will make antibodies against albumin of species A

takes these antibodies and place in 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

Benefits of courtship behaviour?

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

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

How 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 resistant gene will survive and the others will die out (selection)
- the resistant ones that survive will pass on their 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)

What is species diversity? number of different species and the number of individuals for each species

Benefit of high species diversity? Stable ecosystem – each species is less likely to become extinct and if a species does it will not affect the food chain as there are other species available

How does deforestation lower species diversity?

- reduces variety of plants
- less habitat
- less variety of food sources
- lowers animal species diversity