AQA A2 Level Biology Unit 4

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

What is null hypothesis? expect no difference, any difference is due to chance (not significant) e.g. no difference between the mean values of different groups

What is p-value?

- probability that findings are due to chance
- if $p>0.05$, probability findings are due to chance is more than 5%, therefore, findings are due to chance, not significant
- if $p<0.05$, probability findings are due to chance is less than 5%, therefore, findings are not due to chance, they are significant

What is standard deviation? spread of data around the mean

How do we use standard deviation?

- shows reliability of a mean in repeat experiments (larger SD, less reliable the mean)
- used to calculate standard error/confidence limits

How to calculate standard error? SD divided by $\sqrt{n}$

How to calculate confidence limits? 2 x standard error

If the CL of 2 different means overlap, what does it imply? the probability that the difference between 2 means is due to chance is more than 5% ($p>0.05$), therefore it is due to chance, it is not significant, we accept null hypothesis

If the CL of 2 different means do not overlap, what does it imply? the probability that the difference between 2 means is due to chance is less than 5% ($p<0.05$), therefore it is not due to chance, it is significant, we reject null hypothesis

What is Chi-Squared test?

- tests whether the difference between observed and expected values is significant or due to chance
- compare calculated chi-square value to a standard critical value

- if the CSV is above the CV, $p<0.05$, probability that difference is due to chance is less than 5%, it is not due to chance, it is significant, we reject the null hypothesis
- if the CSV is below the CV, $p>0.05$, probability that difference is due to chance is more than 5%, it is due to chance, it is not significant, we accept the null hypothesis

What does Spearman Rank Correlation Coefficient measure?

- measures the nature and size of the correlation between 2 variables
- values range from -1 to +1
- positive value = positive correlation
- negative value = negative correlation
- zero = no correlation
- +0.9/-0.9 = strong correlation
- +0.1/-0.1 = weak correlation

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

What is a population? all the individuals of a particular species in a particular place

What is a community? all the different population of species in a particular place

What is a habitat? the place where an organism lives

What is an ecosystem? a mix of different communities and habitats and how they interact based on abiotic and biotic factors

What is ecological niche? an organisms role/position in an ecosystem – in terms of its interaction with abiotic and biotic factors

Why can 2 different species not occupy the same ecological niche? interspecific competition will take place for the limiting factors/resources (abiotic & biotic factors) – better adapted species will out compete the other = competitive exclusion principle

How to sample plants over a large area?

- obtain a map of the area
- divide the map into grids
- select a large number of coordinates using a running mean
- select a random set of coordinates using a random number chart
- in each coordinate place a quadrat
- measure abundance of the plant species = frequency or percentage cover
- calculate average for the whole area

How to sample plants along a path?

- use a transect
- place a tape along the path, count number of plants touching tape (Line Transect)
- or

- place a tape along the path, at regular intervals along the tape place a quadrat, measure abundance within the quadrat (Belt Transect)

How to sample animals in an area?

- mark-release-recapture technique
- set a trap
- capture the animal species [Sample 1]
- mark them (tag or fluorescent marker – ensure its non-toxic and not harmful)
- release them
- after some time (sufficient time for them to mix with the whole population), replace the trap
- count number in 2nd set [Sample 2] and count the number marked
- estimate population size by: $\frac{\text{number in sample 1 x number in sample 2}}{\text{marked in sample 2}}$

Assumptions of Mark-release-recapture technique?

- no births or deaths
- no immigration or emigration
- marked animals mix evenly with population
- mark is not toxic
- mark does not come off
- large population

What are the 3 stages of population growth?

- slow/lag phase: species becomes adapted to new environment
- rapid/log phase: species adapted, abundant resources, doubling with reproduction, birth rate>death rate
- stationary phase: resources become limited, intraspecific competition occurs, birth rate = death rate

How are resources/limiting factors grouped?

- abiotic (non-living): light, temperature, water, O_2/CO_2, minerals, pH, living space
- biotic (living): predator, prey, mates, competition, disease

What is competition? when organisms compete for resources (abiotic and biotic)

What are the 2 types of competition?

- intraspecific: occurs between organisms of the same species, only occurs when resources become limited, leads to natural selection and adaptation
- interspecific: occurs between organisms of different species, can happen at any time even if resources are not limited, leads to formation of climax communities

Describe the predator/prey relationship?

- prey increases in number
- more food available for predator
- predator increases in number (more energy available for reproduction & growth)
- predator eats more of the prey
- prey decreases in number
- less food available for predator
- predator decreases in number
- less of the prey are eaten
- prey increases in number [cycle repeats]

How to calculate population growth for a country?

= (births + immigration) – (deaths + emigration)

How to calculate percentage population change for a country? (change/original) x 100

What is birth rate? number of births per thousand in a year

How to calculate birth rate? (no. of births/population size) x 1000

What factors affect birth rate?

- economic = availability of contraceptives
- education on family planning
- societal/cultural/governmental influence on family size recommendation

What is death rate? number of deaths per thousand in a year

How to calculate death rate? (no. of deaths/population size) x 1000

What factors affect death rate?

- age profile of population
- amount of food available
- water and sanitation
- availability of medical care
- natural disasters
- disease
- war

What does a survival curve show? percentage of population still alive at each age

How to calculate life expectancy from a survival care? measure the age at which 50% of the individuals are still alive

Demographic Transition Model?

- graph to represent how countries change with development
- stage 1 = underdeveloped country, high birth rate, high death rate
- stage 2 = developing country, high birth rate, falling death rate, increasing population
- stage 3 = further developing country, falling birth rate, further falling death rate, increasing population (but slower)
- stage 4 = developed country, low birth, low death rate, stable population
- stage 5 = overdeveloped country, very low birth rate, low death rate, falling population & elderly

Interpreting population pyramids?

- wide base, narrow top = developing country, high birth rate, increasing population size, young population
- narrow base, wide middle portion = developed country, very low birth rate, decreasing population, ageing population

Structure of ATP?

- Adenosine Triphosphate
- made from 1 adenosine and 3 phosphates
- formation: ADP + Pi (+ energy used) = ATP
- carries energy in its bonds
- breakdown: ATP = ADP + Pi (+ energy released)
- energy carrier molecule

How can ATP be formed?

- photophosphorylation (light dependent stage of photosynthesis)
- substrate-level phosphorylation (glycolysis and krebs cycle of respiration)
- oxidative phosphorylation (electron transport chain of respiration)

What makes ATP (from respiration) a good source of energy?

- immediate source = need to only break one bond (plus bond is weak)
- manageable source = releases small amount of energy

Uses of ATP (made by respiration) in organisms?

- protein synthesis
- organelle synthesis
- dna replication
- cell division (mitosis)
- active transport
- metabolic reactions
- movement
- maintaining body temperature

What is photosynthesis?

- using light energy to make glucose (and other biological molecules)
- occurs in plants (plants will use the glucose in respiration & other organisms will obtain the glucose for respiration)

Adaptation of plant for photosynthesis?

- leaf located near top of plant = closer to light
- leaf is thin and wide = large surface area for light, short diffusion distance for CO_2
- has many veins = connect to xylem to bring in water
- has stomata for gas-exchange (CO_2/O_2)
- has air spaces to support ease of gas-exchange
- palisade cells located near top of leaf close to the light
- palisade cells are large = large surface area for light
- palisade cells have a thin cell wall = short diffusion distance for CO_2
- palisade cells contain many chloroplasts (site of photosynthesis)
- palisade cells have a large vacuole = pushes chloroplast to edge of cell closer to light

Structure of chloroplast?

- site of photosynthesis
- contains discs called thylakoids (contain chlorophyll)
- a stack of thylakoids = granum
- thylakoids are surrounded by a fluid material called stroma

How does photosynthesis take place?

- In 2 stages
- <u>light dependent stage</u> = on thylakoids, makes ATP and reduced NADP
- <u>light independent stage</u> = in stroma, uses the ATP and reduced NADP to make <u>glucose</u>

Describe the light dependent stage?

- <u>light hits chlorophyll</u>
- chlorophyll absorbs the light
- electrons become excited and are lost from the chlorophyll
- electrons enter an electron carrier system
- electrons move down the chain releasing energy
- this energy is used to join ADP and Pi to make **ATP** (photophosphorylation)
- the electron ends up by joining with NADP to form reduced NADP
- <u>light also hits water</u>
- causes photolysis (breakdown of water due to light)
- forms: H+, e-, O_2
- the H+ joins with the **reduced NADP** (now carries a hydrogen atom: H+ and e-)
- the e- replaces electrons lost from chlorophyll
- O_2 given off as waste

Describe the light independent stage?

- involves the calvin cycle
- RuBP (5 carbon) joins with CO_2 to make 2 lots of GP (3 carbon)
- the GP is converted/reduced into TP (3 carbon)
- this uses energy from ATP and hydrogen atom from reduced NADP
- the TP can be used to reform RuBP (uses energy from ATP)
- the TP can also be used to form glucose (carbohydrate)
- GP can also be used to form amino acids (proteins) and fatty acids
- TP can also be used to form glycerol
- fatty acids and glycerol will form a lipid
- photosynthesis/calvin cycle = produces all the main biological molecules

What are the limiting factors for photosynthesis? factors that limit the rate of photosynthesis, when these factors are increased – the rate of photosynthesis increases, these are light/temperature/CO_2/water

Effect of limiting Light on the calvin cycle?

- RuBP decreases – being converted into GP but not being reformed from TP (no ATP)
- GP increases – not converted into TP (no ATP/reduced NADP) but is being formed from RuBP

Effect of limiting CO_2 on the calvin cycle?

- RuBP increases – not converted into GP (no CO_2) but is being reformed from TP
- GP decreases – not being formed from RuBP (no CO_2) but being converted into TP

What is the compensation point in plants?

- the point in the day (light intensity) when the CO_2 taken in by photosynthesis equals the amount given out by respiration = no net gas exchange
- at low light intensity: rate of respiration > rate of photosynthesis [CO_2 absorbed]
- at high light intensity: rate of photosynthesis > rate of respiration [CO_2 released]

How to measure rate of photosynthesis?

- measure amount of CO_2 used or measure amount of O_2 produced, in a certain time
- one method = photosynthometer

How does photosynthometer work?

- measures amount of O_2 produced
- uses aquatic plants (e.g. elodea), as the O_2 produced can be observed and collected
- the plant is surrounded in sodium hydrogencarbonate solution (CO_2 source)
- the plant is kept in darkness before experiment runs (uses up all the O_2 in the plant)
- as the experiment runs, O_2 will be produced, this will be collected in a capillary tube
- the amount collected can be measured, this will be converted into a volume using πr^2

- volume can then be divided by time to calculate rate

What is respiration?

- releasing energy from glucose to make ATP
- ATP will provide energy for life processes
- ATP can be made by substrate-level phosphorylation (glycolysis & krebs cycle) and oxidative phosphorylation (electron transport chain)

What are the 2 types of respiration? aerobic (with oxygen) and anaerobic (without oxygen)

Describe Aerobic Respiration?

- occurs in 4 stages: Glycolysis, Link Reaction, Krebs Cycle, Electron Transport Chain
- glycolysis takes place in cytoplasm of the cell
- link reaction and krebs cycle take place in matrix of mitochondria
- electron transport chain takes place on inner membrane of mitochondria (cristae)
- the main job of the first 3 stages are to provide reduced NAD and reduced FAD for the last stage, this is where most of the ATP is made by oxidative phosohorylation

- glycolysis
- uses glucose to produce 2x pyruvate, 2x ATP, 2x reduced NAD
- pyruvate enters link reaction
- ATP made by substrate-level phosphorylation
- reduced NAD used in ETC

- link reaction
- uses pyruvate to produce acetylcoenzyme A, reduced NAD, CO_2
- pyruvate + coenzyme A + NAD = acetylcoenzyme A + reduced NAD + CO_2
- acetylcoenzyme A used in krebs cycle
- reduced NAD used in ETC
- CO_2 given off as waste

- krebs cycle
- uses acetylcoenzyme A to produce reduced NAD, reduced FAD, ATP, CO_2
- reduced NAD and reduced FAD used in ETC
- ATP made by substrate-level phosphorylation
- CO_2 given off as waste

- electron transport chain
- reduced NAD and reduced FAD release the hydrogen atom (H+/e-) they are carrying
- the H+ build up in the matrix of the mitochondria
- the e- enter the ETC
- the electron (e-) moves along the chain releasing energy, this pumps the protons (H+) from the matrix into the intermembranal space
- the H+ build up in the intermembranal space, then diffuse back into the matrix via a transport protein called ATP Synthase
- this leads to the production of ATP = oxidative phosphorylation

- oxygen is used as a final electron acceptor and proton acceptor
- it removes the electron from the end of the ETC, so the ETC can continue
- it removes the proton from the matrix, hence maintaining concentration gradient
- it becomes water

Describe anaerobic respiration?

- no oxygen present, so no final electron acceptor and proton acceptor
- ETC stops, also krebs cycle and link reaction stop
- the only way of making ATP is by substrate-level phosphorylation in Glycolysis
- for this to continue, NAD is required
- NAD is reformed from reduced NAD made in glycolysis
- the reduced NAD donates its hydrogen atom (H+/e-) to pyruvate to reform NAD
- in animals the pyruvate becomes lactate (lactic acid)
- in plants/yeast the pyruvate becomes ethanol and CO_2

What is the source of energy for an ecosystem? sunlight

What is the role of producers, consumers, decomposers in an ecosystem?

- producers = perform photosynthesis, use light energy to make glucose (will be used in respiration)
- consumers = cannot make their own glucose, need to eat plants (primary consumers) or other animals (secondary/tertiary consumers) to obtain glucose
- decomposers = bacteria and fungi, perform saprobiotic decomposition, release enzymes onto dead plants/dead animals/animal waste breaking them down to obtain glucose

How does energy move through an ecosystem? by the food chain, begin with producer and then moves onto primary consumer, then secondary consumer, then tertiary consumer – with decomposers occurring at each stage (trophic level)

Why is all the light energy not utilised by plants in photosynthesis? only 2% is used in photosynthesis – of the rest, a certain part misses the chloroplast, the other parts would be reflected or the wrong wavelength

Why is energy lost along a food chain?

- not all the glucose made by producers is stored as starch or used to form biomass, as a certain part is lost in respiration
- Net Productivity = Gross Productivity – Respiratory Losses
- net productivity = amount stored in starch
- not all the energy in the plant is transferred to primary consumers as certain parts of the plant are inedible and indigestible
- of the energy the primary consumer obtains, a certain amount is used in respiration, the rest is stored as glycogen and used to build biomass
- not all this stored energy is transferred to secondary consumers due to inedible parts and indigestible parts
- only 10% of energy is transferred from producer to primary consumer
- only 20% of energy is transferred from consumer to consumer

- the losses are due to respiration, inedible parts, indigestible parts
- higher proportion is transferred from consumer to consumer because consumers are more edible and digestible, producers are made up of cellulose
- the higher consumers have the highest respiratory losses as they have increased movement (hunt for food)

Effect of energy loss on a food chain? places a limit on the length of a food chain, those at the higher trophic levels (just quaternary consumers) would not obtain enough energy from the food it consumes

What does a Pyramid of Number represent?

- number of each type of organism at each trophic level – the numbers decrease as we move up trophic levels due to the loss of energy (not as many individuals can be supported)
- can look inverted when it does not take into account mass (e.g. 1 oak tree or millions of fleas)

What does a Pyramid of Biomass represent?

- biomass of each type of organism at each trophic level
- biomass = mass of living tissue (based on dry mass, water excluded)
- units for biomass (g per m^2 for land based animals, g per m^3 for water based animals)
- not normally inverted, exception: *food chain of phytoplankton to zooplankton (in certain months because the zooplankton have a high rate of reproduction they consume large amounts of phytoplankton, therefore, they have a larger biomass then the producer phytoplankton)*

What does a Pyramid of Energy represent?

- amount of energy found at each trophic level
- as before, loss of energy occurs along a food chain (respiration, inedible parts, indigestible parts)

What are the units for energy? kJ/m^2 /year

Agricultural ecosystem?

- description for farming ecosystems
- aim of farms is to grow crops and raise animals
- grow crops to sell & feed farm animals
- raise animals to sell meat & other resources (e.g. wool, eggs, milk, leather)

How are crops intensively farmed for high yield?

- select suitable location (sunlight, water, minerals)
- clear area of plants and animals (deforestation – removes competition/pest)
- selectively breed crop
- use greenhouse to provide high levels of light, CO_2, temperature

- provide water by irrigation
- add fertilisers (provides minerals = nitrate, phosphate, magnesium)
- control pests

What are pests? organisms that harm plants/crops – other plants (weeds) acts as competitors, insects eat the plant, fungi cause disease

How can pests be controlled? pesticides or biological control

What are pesticides? chemical sprays that kill the pest, for weeds = herbicide, insects = insecticide, fungi = fungicide

Advantages and Disadvantages of using pesticides?

- <u>advantages</u>
- fast acting
- can control area covered
- <u>disadvantages</u>
- non-specific
- non-biodegradable leading to bioaccumulation and toxicity in the higher trophic levels
- pest may be resistant
- needs to be reapplied

What are biological control? using predators or parasites to the pest

Advantages and Disadvantages of using biological control?

- <u>advantages</u>
- specific
- does not cause bioaccumulation
- no issues of resistance
- does not need to be reapplied
- <u>disadvantages</u>
- slow acting
- cannot control area covered
- may become a pest itself

What is an integrated pest control system?

- makes use of both pesticides and biological control – the aim is to reduced the amount of pesticide used, as the pesticide harms food chains and ecosystems
- <u>process:</u>
- keep some native trees (will act as natural habitats to natural biological controls)
- monitor area for pests
- mechanically remove pests if present
- initial dose of pesticide – fast acting
- then apply biological control – will increase in number over time and provide long term control
- reapply pesticides whenever there is an uncontrollable outbreak

Environmental impact of Crop Farming?

- Deforestation = reduces species diversity, reduces plant species diversity, less habitats and food sources, reduces animal species diversity
- Monoculture = one type of plant/crop grown, depletes certain nutrients in the soil (no time provided for nutrient levels to recover)
- Selective Breeding = reduces genetic diversity of crop (reduces variation, reduces ability to adapt to changes in the environment)
- Pollution = bioaccumulation of pesticides, eutrophication from chemical fertilisers

Reducing Environmental impact of Crop Farming?

- keep some native trees (helps to maintain species diversity)
- keep hedgerows (help to maintain species diversity + absorb chemical fertilisers reducing eutrophication)
- polyculture (grow different crops at different times of the year, allows depleted nutrients to recover in the soil)
- keep seeds of wild crop (maintain genetic diversity, use if environment changes)
- use biological control for pests & natural fertiliser for minerals

How are animals intensively reared in farming?

- selectively bred
- given predigested food, with high protein and high energy levels
- given antibiotics and vaccinations
- given steroid hormones
- restricted movement and kept warm (reduce energy loss)

Natural Ecosystem vs Agricultural Ecosystem (farms)?

- natural = light energy source, agricultural = light + food for farmer + fossil fuel for machines
- natural = high biodiversity, agricultural = low
- natural = high species diversity, agricultural = low
- natural = high genetic diversity, agricultural = low
- natural = low productivity, agricultural = high
- natural = nutrients recycled, agricultural = nutrients added (fertiliser)
- natural = competition/predators control pests, agricultural = pesticides/biological control
- natural = reaches climax community, agricultural = prevent climax from being reached

What is biodiversity? the variety in an ecosystem (species diversity, genetic diversity and habitat diversity)

What is species diversity?

- number of different species & number for each species in an area
- benefit = stable ecosystem, each species less likely to become extinct, if they do, it has a smaller knock on effect on food chains

What is genetic diversity?

- variety of alleles for a species
- benefit = more variation, species able to adapt to changes in the environment (e.g. increase temperature, new disease)

What lowers biodiversity?

- <u>deforestation</u>
- remove trees to make space for housing and farms
- reduces plant species diversity
- reduces habitats
- reduces variety of food sources
- reduces animal species diversity
- <u>farming</u>
- deforestation occurs
- only a few plants and animals kept
- selective breeding occurs (lowers genetic diversity)
- pesticides used

What is the value of Carbon to organisms? acts as the main chemical group in most biological molecules (carbohydrates, amino acid, fatty acid & glycerol)

Describe the carbon cycle?

- Carbon Dioxide removed from atmosphere by plants/producers by photosynthesis (produces glucose)
- Carbon Dioxide removed from atmosphere by ocean (CO_2 dissolves in ocean)
- Plants respire returning CO_2 to the atmosphere
- Animals respire returning CO_2 to the atmosphere
- Decomposers respire returning CO_2 to the atmosphere
- Combustion of fossil fuels returns CO_2 to the atmosphere
- Evaporation of the ocean returns CO_2 to the atmosphere

What is the greenhouse effect? the atmosphere reflects light, traps in the light beneath the atmosphere, this traps in heat, warming up the earth's surface

What causes the greenhouse effect? the atmosphere is made up of greenhouse gases – Carbon Dioxide and Methane

How has greenhouse effect led to global warming? there has been increased release of greenhouse gases (*CO_2 - deforestation and burning fossil fuels, Methane - excavating fossil fuels, burning fossil fuels, released by farm animals*) which has led to an exacerbated greenhouse effect leading to an increase of the earth's temperature

What are the effects of global warming?

- melting of polar ice cap (loss of habitats & flooding of low lying lands)
- drought and famine occurs (reduced biodiversity/species diversity/genetic diversity)
- extreme weather conditions (storms, hurricanes, tornadoes)
- reduces life cycle of insects (rapid rate of reproduction – high temperature, high kinetic energy, increased rate of reaction, increased enzyme activity, increased rate of respiration)
- reduces yield of crop plants (increase temperature will increase rate of photosynthesis but increases rate of respiration more greatly – this uses up the glucose/energy, so less is available for growth)

What is the value of Nitrogen to organisms? used to make amino acids & proteins and used to make nitrogenous bases in DNA

Describe the nitrogen cycle?

- nitrogen present in the atmosphere as nitrogen gas (N_2)
- N_2 cannot be absorbed by plants, they can only absorb Nitrate ions (NO_3-)
- N_2 converted into Ammonium Ions (NH_4+) by <u>nitrogen fixation</u> by nitrogen-fixing bacteria
- there are 2 types of NFB: mutualistic and free-living
- *mutualistic NFB* are found in the root nodules of leguminous plants, they place the NH_4+ ions directly in the roots – these plants can use this to make AA
- *free-living NFB* are found in the soil – they place NH_4+ ions in the soil
- NH_4+ ions cannot be absorbed by plants therefore is converted into NO_3- by <u>nitrification</u> by nitrifying bacteria
- Ammonia ions (NH_4+) into Nitrite ions (NO2-) into Nitrate ions (NO_3-)
- the NO_3- ions will be absorbed by plants to make AA/proteins
- consumers can eat the plant to obtain the AA
- dead plants, dead animals, animal waste are broken down by saprobiotic decomposers, this releases Ammonia ions (NH_4+) back into the soil by a process called <u>ammonification</u>
- Nitrate ions (NO_3-) can be converted back into Nitrogen gas (N_2) by <u>denitrification</u> by denitrifying bacteria – they work in anaerobic conditions (when the field is waterlogged and all the air spaces in the soil are filled with water)

What minerals do fertilisers provide?

- nitrate = make AA, make nitrogenous bases
- phosphate = make ATP, DNA, phospholipids
- magnesium = make chlorophyll

What are the 2 types of fertilisers?

- natural/organic = applying dead plants, dead animals, animal waste (decomposed leading to ammonification, followed by nitrification to provide source of NO_3-)
- artificial/chemical = spraying on concentrated solutions of the minerals (fast acting and

higher concentration but increase risk of leaching/eutrophication)

How can application of high concentration of fertilisers affect plant growth?

- will lower water potential of soil
- so less water is absorbed by osmosis

What is the benefit of ploughing? increases amount of air spaces in the soil, supports aerobic respiration of decomposers and bacteria involved in nitrogen cycles (nitrogen fixing bacteria & nitrifying bacteria preveting denitrifying bacteria)

What is eutrophication?

- if large amounts of chemical fertilisers are sprayed onto fields and heavy rainfall occurs, the fertiliser may leach into local water sources
- the fertiliser will travel and build up in ponds or lakes
- the mineral (e.g. nitrates to make AA) will be absorbed and used by Algae
- this will lead to an increase growth of algae = algal bloom
- the algae grows on the upper surface of the water, this prevents light reaching the plants at the bottom of the water
- these plants cannot photosynthesise, so die
- these provide more nutrients to saprobitoic decomposers, so these increase in number
- the decomposers will aerobically respire, using up the oxygen in the water
- therefore fish die as less oxygen is available

What is succession? how an ecosystem changes over time (change in species diversity and habitat diversity)

What are the 2 types of succession? primary (occurs on new land) and secondary (occurs on previously colonised land that has become bare e.g. after a forest fire)

Describe Primary Succession?

- new land appears (glacier retreats exposing rock, lava cools, sand dunes)
- pioneer species settle
- <u>pioneer species are:</u>
- producers
- have mutualistic NFB
- asexually reproduce (same characteristics, larger number, faster rate of reproduction)
- xerophytes
- handle extreme conditions (extreme wind & extreme temperatures on bare land)
- have wind dispersed seeds (spread wide – reduce competition, find favourable environments)
- can anchor to land
- <u>over time</u> – the land erodes and soil forms, pioneer species die and decompose adding humus & nutrients to the soil
- small plants can now grow
- they out compete the pioneer species
- <u>over time</u> – more soil forms, small plants die and decompose adding more humus &

nutrients to the soil
- large plants can now grow, they out compete the small plants
- this process continues until the climax community is reached
- the climax community contains the best adapted species to the environment

Properties of Succession?

- species diversity increases (peaks just before climax – species in climax will out compete others)
- habitat diversity increases
- environment becomes less hostile
- food chains become more complex & biomass increases
-

Primary succession vs Secondary succession? secondary succession starts from small plants not pioneer species (soil and nutrients present) and secondary succession is faster (soil, nutrients and seeds already present)

How can conservation be used to prevent succession?

- used to prevent formation of woody forests – either on hill sides (for tourism) and farms (space for crops)
- involves: deforestation, burning trees, grazing, using pesticides

What is inheritance? offspring inheriting a combination of alleles (2 types) for each gene which will help determine characteristics

What is a gene? a section of dna that codes for a protein

What is an allele? a type/form of a gene

What is a dominant allele? an allele that is always expressed if present

What is a recessive allele? an allele that is only expressed if 2 are present

What is genotype? combination of alleles for a particular gene

What is phenotype? expressed/observed characteristic (if discontinuous – only determined by genotype, if continuous – determined by genotype and environment)

What is homozygous? having 2 of the same alleles (homozygous dominant – 2 of the same dominant alleles, homozygous recessive – 2 of the same recessive alleles)

What is heterozygous? having 2 different alleles

How can 2 parents with a dominant characteristic give birth to a child with a recessive characteristic? if both parents are Heterozygotes (carriers for recessive allele) they have a 25% chance of giving birth to a child who is Homozygous Recessive (has the recessive characteristic)

What is the probability of a child having a recessive characteristic if both parents are recessive? 100%

What is co-dominance? when 2 different dominant alleles are inherited, both are equally dominant, both will be expressed in the phenotype

What are multiple alleles? when the gene has more than 2 alleles (e.g. blood group)

Alleles for blood group?

- I^A, I^B, I^O
- I^A gives A antigen on RBC
- I^B gives B antigen on RBC
- I^O gives no antigen on RBC
- I^A, I^B are codominant
- I^O is recessive

Genotypes/Phenotype for blood group?

- A = I^AI^A, I^AI^O
- B = $I^B I^B$, I^BI^O
- AB = $I^A I^B$
- O = I^OI^O

Can receive blood from whom?

- A = from A & O
- B = from B & O
- AB = from A, B, AB, O
- O = only from O

What is a sex-linked gene? a gene carried on one of the sex chromosomes, normally the X chromosome

What is an inherited disease? inheriting a mutated allele that leads to production of a faulty protein, normally a recessive allele (dominant allele will decrease in frequency by natural selection, recessive allele can be carried by heterozygotes)

What is a sex-linked disease? inheriting a mutated allele carried on one of the sex chromosomes, normally a recessive allele & normally carried on X chromosome

Why do males have increased chance of inheriting a sex linked disease rather than females? males only have 1 X chromosome, females have 2 X chromosomes, females can be carriers, males cannot be carriers

What is the evidence that an allele is sex-linked? condition more common in males – (evidence from family tree can be shown by inheritance of X chromosome by son from mother)

Why are observed ratios normally different from expected ratios in inheritance?

- random fusion of gametes
- small sample size

- selection takes place
- mutation takes place

What does Hardy-Weinberg Principle calculate? frequency of an allele in a population

What does the HWP assume? that the frequency will not change over time, based on:

- isolated population
- large population
- random mating
- no mutation
- no selection

What is the HWP?

- p = frequency of dominant allele
- q = frequency of recessive allele
- p + q = 1 (100%, all the population)
- p^2 = frequency of homozygous dominant
- 2pq = frequency of heterozygous
- p^2 + 2pq = frequency of the dominant condition
- q^2 = frequency of homozygous recessive (of recessive condition)
- $p^2 + 2pq + q^2 = 1$

What is natural selection and adaptation?

- variation in population of species (genetic diversity/variety in gene pool)
- new alleles arise by random mutation
- environment applies a selection pressure on the population
- those with favourable characteristics/favourable alleles/selection advantage/better adapted survive, the others die [natural selection]
- the ones that survive will reproduce, passing on their favourable alleles
- if this happens for many generations, then that characteristic will become most common – the allele will become more frequent [adaptation]

What are the 2 types of selection? stabilising and directional

What is stabilising selection?

- when the environment favours those with the most common characteristic – those on the extreme dies out
- the common characteristic increases in proportion
- the range (standard deviation) will reduce

What is directional selection?

- when the environment favours those individuals with characteristics on one of the extremes
- over time this will become the most common characteristic

- normal distribution will shift to that extreme

What is speciation? how a species changes into a new species

Describe speciation?

- start with a population of species
- variation in the population
- population separated into different groups by geographical isolation
- each group is exposed to different environments/selection pressures
- each group undergoes different directional selections
- therefore each group changes so much that they can no longer interbreed with each other to produce fertile offspring
- changes include different courtship behaviour or incompatible gametes