disclaimer: this keyword bank is far from comprehensive since i started it really late lol

keywords

topic	stuff

cell structure	**NUCLEUS**
	- Protects DNA from **degradation**
	- presence of **studded nuclear pores (<u>transmembrane porin proteins</u>)** on nuclear envelope helps **regulate the movement of substances** into and out of the nucleus
	- nuclear envelope is a **double membrane**
	  - **2** phospholipid bilayers
	  - outer surface is **studded with ribosomes**
	  - outer membrane is **continuous** with that of the **endoplasmic reticulum**
	  - phosphate groups of outer membrane face the **cytoplasm**, those on the inner membrane face the **nucleoplasm**
	- phospholipid bilayer is held together by **weak hydrophobic interactions** between the **non-polar hydrocarbon tails** of phospholipids
	-

	CELL SURFACE MEMBRANE - phospholipid bilayer is held together by **weak hydrophobic interactions** between the **non-polar hydrocarbon tails** of phospholipids - cholesterol: **carbon skeleton** with **4 fused rings** and a **hydroxyl group** at the end
	MITOCHONDRIA - inner mitochondrial membrane is thrown into many **convoluted folds** called **cristae** - **high surface area to volume ratio** for **high rate** of **oxidative phosphorylation** - cristae: high surface area for attachment of electron carriers and ATP synthase

SER

- SER is made up of **interconnected network of membrane-bound tubules**
- carbohydrate metabolism
- Ca^{2+} store

GA

- GA is made up of **flattened sacs** called **cisternae**
-

RER

- **Ribosomes** on RER synthesise polypeptides via **translation**
- Polypeptides **fold** into **native 3D conformation** in the **RER lumen**
- made up of an **interconnected network** of **membrane-bound cisternae** which is **continuous** with the **outer membrane** of the **nuclear envelope**
- **Tagging** and **packing** of **products** for **distribution** to **other parts of the cell** such as the CSM and lysosomes via **secretory vesicles**
- **Carbohydrate metabolism**
- **Synthesis** of **cell wall components**
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LYSOSOMES

- autophagy
- fuse with endocytic vesicles to form secondary vesicles

TRANSPORT / MOVEMENT OF SUBSTANCES

- diffusion: from a region of **higher concentration** to a region of **lower concentration**
- **hydrophobic core** of the **phospholipid bilayered** cell surface membrane
- **Secretory** / **transport** vesicles are transported along **microtubules**
- **transmembrane** protein channels

ADVANTAGES OF COMPARTMENTALISATION

- Allows **chemically incompatible reactions** to be **separated physically**

	- Reactions can take place **simultaneously** - Allows for **accumulation of specific molecules** in a specific organelle - **Optimises** conditions such as pH - Ensures **high rate of reaction** -
	standard questions - Advantages of compartmentalisation - Structure / functions of organelles - transport of glucose - fluid mosaic model - why are viruses considered living / non-living
biomolecules	1. **condensation** reactions with the **loss of one water molecule** 2. glucose **concentration gradient** 3. glucose is **polar**, hence **hydrophilic** 4. **weak** hydrogen bonds / hydrophobic interactions / ionic bonds that **stabilise the structure** are broken
	SECONDARY STRUCTURE OF PROTEINS ALPHA-HELIX - formation of **hydrogen bonds** between the **O atom of the C=O group** with the **H atom of an -NH group** situated **4 amino acid residues ahead** in the polypeptide - one turn every **3.6 amino acid** residues BETA-PLEATED SHEETS - interchain or intrachain
	HAEMOGLOBIN - characteristics: 1) effective loading and unloading of oxygen, 2) soluble in aqueous blood, 3) maximized oxygen-carrying capacity, 4) cooperativity - each **globin** is folded into a **specific 3D conformation** with a **deep hydrophobic cleft** - **Globular**: amino acids with **hydrophobic R groups** are buried in the **interior** of the protein, those with **hydrophilic** R groups project **outwards** - each polypeptide has a **haem group** (**prosthetic** group, hydrophobic) with a **central Fe^{2+}** which can carry **O_2**

    - each molecule can carry **4 O_2**
- 4 subunits are **<u>loosely bound</u>** to each other
    - allows **cooperativity**
- Dimers are held together by **weak hydrogen bonds** = can **move with respect to each other** = cooperativity
- Mutation in sickle-cell anaemia:
    - **T** is replaced by **A** in the gene coding for the **<u>beta-globin chain</u>**
    - mRNA codon **GAA → GUA**
    - **Glutamate** (**hydrophilic** R group) → **valine** (**hydrophobic** R group)
    - **HbA → HbS**
    - At **<u>low oxygen concentrations</u>**, HbS molecules would **<u>clump together</u>** and **<u>polymerise to form fibres</u>** = circular biconcave shape → sickle shaped
    - Less flexible sickle shaped cells **block narrow blood capillaries** = **low blood flow** = **reduced oxygen supply to tissues** = **tissue damage**
    -

COLLAGEN

- characteristics: 1) large, long, fibrous, 2) insoluble, 3) stable triple helix, 4) high tensile strength
- **glycine** present in every third residue
- **multiple hydrogen bonds** form between the OH groups of hydroxylysine / hydroxyproline in the polypeptide chain
- 3 helices are **closely wound** around each other to form a **triple helix** (tropocollagen)
- **compact**
- **high tensile strength**
- tropocollagen molecules form **cross-links** via **covalent bonds** = **high tensile strength**
- **bundling** of tropocollagen to form **collagen fibril**s, which bundle to form **collagen fibres**

G PROTEIN LINKED RECEPTOR

- characteristics: 1) embedding of receptor in plasma membrane to receive extracellular signals, 2) allows transmission of signals into cell

	- **activated G-protein** binds to GPLR on the cytoplasmic side - **extracellular signal** binds to the receptor and **<u>triggers a change in the 3D conformation</u>** of the receptor - hydrophilic R groups of amino acids facing the **exterior of the alpha helices** interact with **charged phosphate heads** of the phospholipid bilayer by forming **hydrogen bonds** and **ionic bonds** -
	CELLULOSE - High tensile strength - Long straight chain - OH groups project outwards on both sides of the cellulose chain
	STARCH / GLYCOGEN - Starch is **helical** - **Amylopectin** is **branched** - Starch is **compact** = **energy store** -
	TRIGLYCERIDES - More **energy-rich C-H bonds** than an **equivalent mass of glycogen** = more **energy** can be **stored** and **released** in triglycerides - Solvent for fat-soluble vitamins - Long-term energy store - Heat insulator - Less dense than water = provides buoyancy
	PHOSPHOLIPIDS - **Degree of saturation** of fatty acid tails **regulates membrane fluidity** - Amphipathic
	standard questions - haemoglobin / cellulose / collagen / GPLR structure & function
enzymes	**ENZYME MODE OF ACTION** - **Globular** structure - **Highly specific biological catalysts** - Weak bonds such as hydrogen bonds and ionic bonds form

	between the substrate and catalytic residues and binding residues at the enzyme active site
	- at high [substrate]:
	  - **active sites are saturated** at any given moment in time
	  - maximum rate of reaction is reached
	- as temperature increases, the molecules gain **kinetic energy** and **vibrate faster**
	- **specific** 3D conformation
	- at temperatures **slightly** above the optimum, the enzyme **partially retains** its **specific** 3D conformation
	- Rate of reaction is **maximum** at **optimum** temperature / pH
	- Acid-base catalysis
	- Strain effect: temporary weak bonds form between amino acid residues at the active site
	- Proximity effect: bind substrates next to each other temporarily to increase chance of reaction
	- Microenvironment effect: provides hydrophobic environment for non-polar substrates to react more readily
	- Serve as **orientation surfaces** for substrates to expose them for reaction
	- **Lock and key** hypothesis: active site of enzyme and substrate are **exactly complementary**
	- **Induced fit** model: active site of enzyme & substrate do not fit together exactly. Upon substrate binding, the active site undergoes a change in the 3D conformation to improve fit between substrate and enzyme
	- binding residues at active site form temporary bonds with the substrates
	- catalytic residues catalyse the enzymatic reaction
	- structural residues: maintain the structure of the enzyme's active site

	DENATURATION - bonds **holding the 3D conformation of the enzyme together** such as hydrogen bonds, ionic bonds, and hydrophobic interactions **between the R groups** of **amino acids** in the enzymes are broken
	COMPETITIVE INHIBITION

	- At low substrate concentrations, competitive inhibitors bind to the active site of the enzymes **more readily** than the substrates - **Prevents** formation of **enzyme-substrate complexes** -
	NON-COMPETITIVE INHIBITION - **Prevents** formation of **enzyme-substrate complexes** -

	ALLOSTERIC
	- Graph is sigmoidal shaped
	- **3D conformation** of **active site** is changed
	- Allosteric activation: **activator** binds
	  - Stabilises **active** form of enzyme
	  - **Increases affinity** of enzyme for its substrate
	- Allosteric inhibition: **inhibitor** binds
	  - Stabilises **inactive** form of enzyme
	  - **Reduces affinity** of enzyme for its substrate

	standard questions - competitive inhibitor - non-competitive inhibitor - mode of action (induced fit, lock-and-key) - effect of temperature - effect of pH
dna & genomics	**DNA PACKING / STRUCTURE** - DNA is **wound around histones** to form **nucleosomes** - **hydrophobic interactions** between **stacked nitrogenous bases** -
	DNA REPLICATION - **template** DNA strand - **primer** binds to parental strand at the **replication fork**, extending the daughter strand in a **5' to 3' direction** towards the **origin of replication** to form the first Okazaki fragment - helicase **unwinds** DNA molecule further - **second** Okazaki fragment formed is **further** away from **origin** of replication

	- DNA ligase / DNA polymerase III catalyses the formation of phosphodiester bonds between the free 3′ -OH group and 5′ phosphate group - deoxyribonucleotides are **aligned** to **growing daughter strand** by **complementary base pairing**
	TRANSCRIPTION - RNA polymerase **reads** the **terminator sequence** - DNA double helix **unwinds** and **unzips** - template DNA strand - **free** ribonucleotides bind to the **template DNA strand** by **complementary base pairing** - RNA polymerase catalyses the formation of **phosphodiester bonds** between the free 3′ -OH end and 5′ phosphate group of **adjacent ribonucleotides** -
	TRANSLATION - **aminoacyl-tRNA** carrying **methionine** with **anticodon UAC** - Polypeptide **folds into its native 3D conformation** sometimes with the help of **chaperone proteins** -
	FUNCTIONAL RNA - rRNA has a **unique 3D conformation** with **many hairpin loops** - tRNA has a **clover leaf structure** with **3 loops**, one of which is the **anticodon loop** - **3′ CCA end** is the **site of attachment of amino acids** specific to the tRNA anticodon
	standard questions - describe the packing of DNA in eukaryotic chromosomes (2020 P2 Q5a) - DNA replication process - transcription process - translation process - post-transcriptional mRNA modifications
cell cycle	1. tight control of cell cycle nearest cell division occurs at the

	appropriate timing and rate 2. **centromeres divide** 3. meiosis forms **gametes** 4. mitosis forms **somatic cells** 5. meiosis has 2 rounds of **nuclear division** 6.
	MITOSIS - **shortening** spindle fibres pull sister chromatids **centromere-first** to **opposite** poles of the cell - centrioles **form the MTOC** in animal cells and are involved in the **organisation of the spindle fibres** -
	MEIOSIS - crossing over takes place when **non-sister chromatids of homologous chromosomes exchange alleles at corresponding gene loci** at points called **chiasmata** - **shortening** spindle fibres pull chromosomes **centromere-first** to **opposite** poles of the cell - **chiasmata break** -
	MUTATIONS / CHROMOSOMAL ABERRATIONS - gene mutation - **nucleotide insertion** / **deletion** / **substitution** - **truncated** polypeptide - **premature termination** of translation - change in **amino acid sequence** of polypeptide - **non-functional** protein - change in **number** or **structure** of chromosomes - chromosomal **translocation** / **duplication** / **deletion** - **chemical carcinogens**: **ethidium bromide**, **polycyclic aromatic hydrocarbons** - Chromosomal mutations result from **deletion** / **insertion** / **inversion** (R! translocation) -
	CANCER DEVELOPMENT - **loss of density-dependent inhibition**

	- **loss in DNA repair**
	- **loss** of **anchorage dependence**
	- **lose their ability to differentiate** into (specific cell type)
	- **uncontrolled cell division**
	- tumour suppressor genes (p53 gene) code for proteins involved in:
	  - **inhibition of cell cycle**
	  - **repairing damaged DNA**
	  - stimulation of **apoptosis** when **damaged DNA cannot be repaired**
	- **proto-oncogenes** undergo a **gain-in-function mutation** to form **oncogenes**
	- bypass cell cycle checkpoints

	standard questions - describe stages of mitosis / meiosis - how genetic variation occurs - differences between mitosis and meiosis - cancer development
genetic basis of variation	**LINKAGE** - **recombinant gametes** are formed only from **crossing over at a point between the 2 gene loci,** which occurs with **low probability** - two genes **do not undergo independent assortment**, resulting in a **greater proportion of gametes** with **parental combination of alleles** -
	CHI-SQUARED TEST - **Calculated** chi-squared value of _ is smaller / larger than **critical** chi-squared value of _ at **p=0.05** - Probability that any **difference between the expected and observed values** are due to **chance alone** is more / less than _ - **Significant** / no significant **difference** between **expected and observed data** - Expected ratio of ____ is **valid / invalid** - Conclude that the genes for __ and __ are **unlinked / linked** and **segregate / do not segregate independently**

	BEES - If **<u>larvae</u>** are fed **worker jelly**, they develop to form **worker bees** - If **<u>larvae</u>** are fed **royal jelly** that is **high in sugar content**, the **development of the female reproductive system** is stimulated = develop to form **queen bees** - **<u>Diet</u>** affects **<u>DNA methylation</u>** at **<u>CpG sites in DNA</u>** - Some genes are **<u>silenced</u>** = **<u>phenotype</u>** affected
	standard questions - chi-squared test - bees - himalayan rabbit - epistasis
genetics of bacteria & viruses	**GENERAL (VIRUSES)** - **depletion** of host cell resources may lead to **cell death** - acellular - can evolve and adapt to external conditions - Nucleocapsid -
	T4 PHAGE - phage **injects** viral genome into host cell, **leaving the capsid outside** - Phage **dsDNA** is used as a **<u>template</u>** by **phage-coded DNA polymerase** for **semi-conservative DNA replication** -
	LAMBDA PHAGE - phage **injects** viral genome into host cell, **leaving the capsid outside** - **prophage**
	INFLUENZA - Neuraminidase cleaves sialic acid residues from host cell receptors
	HIV - haemagglutinin has a 3D conformation complementary to that of sialic acid-containing receptors

- Other RNA molecules serve as **positive-sense viral RNA genomes**
- Translation of **gag** and **pol** genes form **polyproteins**
- Polyprotein synthesised from translation of gag mRNA is then cleaved by **viral proteases** to form proteins forming the nucleocapsid
- **viral envelope** of HIV fuses with **host cell surface membrane**, releasing the **nucleocapsid** into the cytoplasm

GENERAL (BACTERIA)

- divide by **binary fission**
-

BINARY FISSION

- As DNA replicates, **one origin** moves **rapidly** to the **opposite end of the cell**
- The cell also **elongates**
- When DNA replication is complete, the bacterium's **plasma membrane pinches inwards** to form a **double layer** along the **axis** of a cell

TRANSFORMATION

- **direct uptake** of **foreign DNA** by **competent bacteria** from the environment with the **expenditure of ATP**
- **DNA-binding protein**
- **competence-specific protein**
- **transforming DNA** replaces a **homologous region** on the **recipient chromosome** by **homologous recombination**

CONJUGATION

- **Direct contact** between the **F+ donor** and **F- recipient** bacterium through a **conjugation tube**, which is involved in transferring the F plasmid **unidirectionally**
- The F plasmid in the donor F+ cell **replicates semi-conservatively** by **rolling circle replication**
- An **endonuclease** cuts the F plasmid at the origin of replication
- **Intact parental circular DNA strand rolls** while serving as a **template** for the synthesis of a **complementary strand**
-

	standard questions - T4 phage reproductive cycle - lambda phage reproductive cycle - Influenza reproductive cycle - HIV reproductive cycle - process of binary fission - conjugation - generalized / specialized transduction - transformation

COPEG	**EUKARYOTES**
	- **methylated DNA recruits histone deacetylase enzymes**
	- methylation of **cytosine** in **CpG dinucleotides** in the **promoter** by **DNA methyltransferase**
	- spliceosomes **excise** intron
	- **Histone acetylation**:
	  - **Neutralises positively-charged R groups of lysine** in the histone tail
	  - **Reduces affinity** of **histone octamers** for negatively-charged DNA
	  - Chromatin becomes **less compact**
	  - Promoter becomes **more accessibl**e to RNA polymerase and GTFs
	- **Histone methylation**:
	  - Methylated histones **attract proteins** to **keep chromatin tightly packed**
	  - Chromatin becomes **more compact**
	  - Promoter is **less accessible** to RNA polymerase and GTFs
	- **DNA methylation**:
	  - **DNA methyltransferase** catalyses the **addition of methyl groups** to **cytosine** residues of **CpG dinucleotides** in the **promoter**
	  - Changes the **3D conformation** of the **promoter**, prevents binding of **RNA polymerase** and **GTFs**
	  - Methylated DNA **attracts other proteins** which **recruit histone deacetylase enzymes**
	  - **Increases affinity** of histone octamers for DNA
	  - Chromatin becomes more **compact**
	- Protein degradation

- Enzymes in the cytoplasm attach ubiquitin molecules to proteins to be targeted for degradation. ATP is expended.
- Ubiquitinated proteins are recognised by proteosomes
- Proteasomes degrade ubiquitinated proteins. ATP is expended
- Ubiquitin is released and can be recycled

TELOMERES

- telomeres **shorten** due to **end-replication problem**
    - Shortening act as **signals** for cells to enter **replicative senescence**
- **Tandem repeats** of **TTAGGG** in humans
- One strand of the telomere is longer than the other = formation of **3' overhang**
- **Telomerase**
    - RNA component: acts as a **template** for the enzyme to **guide the insertion** of **multiple repeats of TTAGGG** to **extend the 3' end of the telomere**
    - **Reverse transcriptase**
        - Binds to part of the DNA at its **3' overhang** at its **active site**
        - Catalyses the formation of **phosphodiester bonds** between **adjacent deoxyribonucleotides** at the **3' end** of the telomere
        - Synthesises tandem repeats of **TTAGGG** by **complementary base paring**
-

CENTROMERES

- **Repetitive DNA sequences** made up of **tandem repeats**
- **Genetically inert**
- **Never transcribed**
- **Heterochromatin**
- **Adhesion point** for sister chromatids in a chromosome
- **Site of assembly** of the **kinetochore**
- Essential for **equal segregation** of **sister chromatids** and **homologous chromosomes** to **opposite poles** of the cell

	- Organise chromatin within **interphase nucleus** -

	PROKARYOTES
	- allolactose is the **inducer** of the lac operon, which binds to an **allosteric site** on the **lac repressor** protein
	- bacterial DNA is associated with **non-histone proteins** to form a **super coiled** structure which is very compact
	- advantages of operons:
	  - allows bacteria to use a variety of substrates
	  - quickly respond to changes in external environment by transcribing genes
	  - conserve resources, reduce wastage
	- When **[glucose] is high**:
	  - **[cAMP] falls**, cAMP **does not bind to CAP** molecules
	  - CAP molecules remain **inactive**
	  - CAP does not bind to **CAP binding site**
	  - **RNA polymerase** has **lower affinity** for the **promoter**
	  - Basal rate of transcription

	standard questions - DNA modifications - histone modifications - transcriptional level - post-transcriptional level - translational level - post-translational level - lac operon - trp operon - advantages of operons - eukaryotes vs prokaryotes
stem cells	**TOTIPOTENCY** - can differentiate into any cell type including those of extra-embryonic membranes to **form a whole organism** -
	PLURIPOTENCY
	MULTIPOTENCY

	ETHICAL IMPLICATIONS - **intentional creation of embryos** for research and destroying them in the process is considered **<u>active killing</u>** and violates respect for **nascent** human life
	standard questions - Ethical implications of using embryonic stem cells - define characteristics - definitions of totipotency, pluripotency, multipotency - iPSCs
cell signaling	1. **3D conformation** of **intracellular binding sites** is **complementary** to that of **specific relay proteins** 2. **glycogenesis** 3. **gluconeogenesis** 4. **glycogenolysis** 5. **liver**, **fat**, and **muscle** cells 6. **phosphorylation** and **activation** of an **inactive** protein kinase
	GLUCAGON SIGNALING PATHWAY - **activated** G-protein **<u>binds</u>** to and **activates** adenyl cyclase - **gluconeogenesis**: **amino acids** and **triglycerides** are converted to **glucose** in the **liver** - inhibits glycogenesis
	INSULIN SIGNALING PATHWAY - Receptors **dimerise** - **Tyrosine kinase domain** of each receptor is **activated** - Cross-phosphorylation of **tyrosine residues** on **cytoplasmic tails** of each receptor
	standard questions - glucagon signalling pathway - insulin signalling pathway - advantages of cell signalling - signal amplification
molecular techniques	**POLYMERASE CHAIN REACTION (PCR)** - during PCR, **elongation of the primers** ensures that **only the sequences between** the forward and reverse primers are amplified

	- DNA is **extracted** from **cells** in blood - primers provide a **free 3' -OH end** for Taq polymerase to add deoxyribonucleotides to **elongate** the DNA strands - allows large numbers of copies of DNA for analysis to be amplified in a relatively short amount of time - cell-free method, no unwanted cellular debris to be cleaned up
	GEL ELECTROPHORESIS - separates DNA (charged macromolecules) by size and charge - DNA is negatively charged due to the negatively-charged sugar-phosphate backbone - the gel acts as a **molecular sieve**, slowing down the movement of larger macromolecules - band pattern indicates the **number** and **size** of DNA fragments within the mixture
	SOUTHERN BLOTTING - DNA bands are transferred to a nitrocellulose membrane - single-stranded radioactively-labeled DNA probes
	standard questions - PCR process - gel electrophoresis process - southern blotting process - nucleic acid hybridisation - why only target DNA is amplified in PCR
respiration	1. anaerobic respiration in the long term **depletes glucose / glycogen reserves more rapidly** 2. lactic acid accumulation changes **cell pH** 3. meet **energy demand** 4. glucose is **fully oxidized** in aerobic respiration 5. glucose is the **main respiratory substrate** 6.
	OXIDATIVE PHOSPHORYLATION - **chemiosmotic synthesis of ATP** in **oxidative phosphorylation** of **aerobic respiration** - protons are **charged** and are unable to pass through the

	hydrophobic core of the **phospholipid bilayered inner mitochondrial membrane**
	- Oxygen is the **<u>final electron and proton acceptor</u>**
	  - Allows **ETC** to **continue accepting electrons** from reduced NAD and reduced FAD
	  - **Regenerates FAD and NAD** to act as **hydrogen carriers** for **glycolysis, link pathway and Krebs Cycle** to continue

	ANAEROBIC RESPIRATION
	- In the absence of oxygen:
	  - Pyruvate **cannot be further oxidised** through link reaction and Krebs cycle
	  - Converted to **ethanol** during lactic acid fermentation
	-

	standard questions - stages of aerobic respiration - anaerobic respiration - why anaerobic respiration cannot be a long-term source of energy - difference in ATP produced from anaerobic vs aerobic respiration

photosynthesis	**PHOTOPHOSPHORYLATION**
	- **cyclic** / **non-cyclic** photophosphorylation
	- **light energy is converted to chemical energy** when chlorophyll traps light of particular wavelengths
	- **high energy electrons** are emitted from the **reaction centre** to the **primary electron acceptor**
	- **NADP** is the **final electron and proton acceptor** in non-cyclic photophosphorylation
	- light is used for the photolysis of water, **replacing electrons lost** from **chlorophyll a P680** in photosystem II
	- An electron in P680 chlorophyll a is excited and transferred to the primary electron acceptor
	  - Creates electron gap in P680 chlorophyll a
	  -

	CALVIN CYCLE

	- **carbon fixation** - GP is **phosphorylated by ATP** and **reduced** by **reduced NADP** to form TP - directly limited by **temperature** and **carbon dioxide concentration** - **Rubisco: RuBP carboxylase oxygenase** - **6 rounds** of Calvin cycle gives **2 molecules of GALP** to form **1 molecule of glucose** -
	standard questions - cyclic vs non-cyclic - calvin cycle
evolution	**DEFINITIONS** - BIOLOGICAL CLASSIFICATION: **organisation** of species according to **shared observable characteristics** into **taxonomic groups**, **may not take into account the evolutionary relationships** between organisms - ECOLOGICAL SPECIES CONCEPT: organisms that occupy the **same ecological niche** and have the **same unique and particular role** in an **ecosystem** are considered to be of the same species - MORPHOLOGICAL SPECIES CONCEPT: defines a species based on **anatomical resemblances** and **differences.** Organisms with **similar physical structures** are considered to be of the same species -
	MICROEVOLUTION - **heterozygote advantage** - **pass alleles on** to the next generation - **frequency** of allele in the gene pool **increases over generations** - **genetic drift** leads to **drastic reduction in population size** and **change in allele frequencies** - **genetic variation** leads to **inheritable phenotypic variation** - reproductive success - heterozygote superiority

	SPECIATION - bacteria are **difficult to culture** = difficult to gather **morphological evidence** - **genetic drift** — founder's effect - gene pools become **distinct** over time - **restricted gene flow** - **different geographical areas** exert **different selection pressures** which select for different advantageous phenotypes - **increased diversity of selection pressures** = higher probability of organisms **evolving divergently** & forming different species - different islands **exert different selection pressures** due to **unique environments** on each island - **mutations** are **random**, and are **unlikely to occur at the same region in the DNA of 2 different populations**, hence species formed on an island are different from species anywhere else
	MACROEVOLUTION - **divergent evolution**: species become **increasingly different** from **ancestral species** over time - **descent with modification: homologous structures** are adapted for different functions
	standard questions - natural selection - speciation - advantages of molecular methods
climate change	**OTHER TERMS** - Short wave radiation: from the sun - Longwave radiation: reflected shortwave radiation, often trapped in the atmosphere - Ice-albedo effect: ice melts = more dark surfaces exposed = more ice melts
	MANMADE CAUSES - increasing **energy usage** of electricity - Deforestation - Livestock farming
	CORAL REEFS

	- **Thermal stratification**: results in reduced upwelling, affecting nutrient fluxes, affecting coral reefs - Nurseries for fish fry -
	PLANTS / INSECTS - Geographical range - Vertical distribution shifting - Plant species represent a potential rich reservoir of biomedicines - Genetic diversity is important to maintain the resilience of crop species in the face of climate change
	MOSQUITOES - Eggs are resistant to dessication - Adults emerge from pupae by ingesting air to expand the abdomen → splits open the pupal case to emerge head first
	standard questions -
infectious diseases	**INNATE IMMUNITY** - phagocytes can form **pseudopodia** which can **extend** and **enclose** the microorganism to form a **phagocytic vesicle** - **recognition** / **binding** / **attachment** of macrophage to (pathogen) **antigen** on (pathogen)

	ADAPTIVE IMMUNITY
	- **naive / effector** B / T lymphocytes
	- **activated** helper T cells secrete **cytokines**
	- **clonal expansion**
	- **clonal selection**
	- B cells **differentiate** to form **plasma** cells
	- **somatic recombination**:
	  - **V(D)J recombinase** deletes the DNA between **randomly selected V(D)J segments**
	  - different **combinations** of V(D)J gene segments
	  - different **antigen-binding sites**
	  - variation in **antibodies** secreted
	- **somatic hypermutation**:

- **activation-induced cytidine deaminase** catalyses the **deamination** of **cytosine** to **uracil** in the gene segments coding for **V domains**
- **base mismatch**
- **error-prone DNA repair**
- **introduces more mutations**
- mutant antibodies synthesized and produced
- may lead to **affinity maturation**

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TUBERCULOSIS

- Granuloma ruptures → liquefaction
- Airborne disease transmitted via fine aerosol droplets
- Infectious dose of TB is very small
- Bacteria can become dormant
- Latent infection

ANTIBIOTICS

- penicillin interferes with the transpeptidation reaction of bacterial cell wall synthesis
- penicillin-binding protein (PBP) is an enzyme that catalyses the formation of peptide cross-links between adjacent peptides

VACCINATION

- herd immunity
- stimulates production of antibodies and memory B and memory T cells (immunological memory) with antigen-binding receptors with 3D conformations that are complementary to the antigens found on the virus

standard questions

-