Meiosis

Used for sexual reproduction, combines genetic material from two parents to produce genetically unique offspring.

Halves the number of chromosomes in gamete, occurs in germline cells.

2 sets of division - Meiosis I and Meiosis II

Prophase I	Chromosomes condense Homologs pair up Crossing over occurs
Metaphase I	Homologous pairs line up along metaphase plate
Anaphase I	Homologous pairs are separated Sister chromatids stay together

Telophase and cytokinesis follow same steps as Mitosis

Genetic variation in meiosis

Crossing over	Occurs in Prophase I Homologous pairs come together Internal chromatids cross at chiasma Genetic info is swapped
Independent assortment	Occurs in Metaphase I Homologous pairs line up randomly Gametes do not receive just paternal or maternal information More than 8 million combinations

There is not further duplication of DNA between meiosis I and meiosis II, meiosis II is the same as mitosis except 4 daughter cells are produced.

Mitosis

Mitosis is the process used for growth and repair of cells as well as reproduction of unicellular organisms.

It comes after interphase and before cytokinesis, order can be remembered using Isaac please make another two cells.

Prophase	Replicated DNA condenses into chromosomes wrapped around histones Centrioles produce spindle fibres and migrate to poles Nuclear membrane breaks down Nucleolus disappears Spindle fibres attach to chromosomes at centromere
Metaphase	Spindle fibres line the chromosome up on the metaphase plate
Anaphase	Spindle fibres contract Sister chromatids are pulled to the poles
Telophase	Chromosomes reach the poles New nuclear membrane forms Spindle fibres break down Chromosomes condense

Cells

Smallest unit of life. Contains organelles.

If if metabolic rate is greater than material exchange rate then the cell will die.

Prokaryotes	No nucleus No membrane bound organelles 1 circular chromosome Commonly contains cytoplasm, nucleoid, plasmids, ribosomes, cell wall, slime capsule, flagella and pili

Cells (cont)

Eukaryotes	All multicellular organisms Membrane bound organelles. Shares plasma membrane, cytoplasm, DNA and ribosome features with prokaryotes.

Mechanisms of change

Change in allele frequency in an gene pool

Mutation	Random change in DNA sequence
Sexual reproduction	New gene combinations and alter allele frequency
Gene flow	Immigration or emigration of alleles in a gene pool
Genetic drift	Random event changes composition, larger effects in smaller populations Bottleneck effect- dramatic decrease in population, unique alleles are lost Founder effect- small portion of population move, smaller gene pool
Natural selection	Selection pressures leave fittest phenotypes

Mutation alone does not have a large effect when combined meaningful changes can be made.

Evolution types

Evolution type:

Divergent	New species result from the same ancestral species, allopatric speciation results in homologous structures.
Convergent	Opposite of divergent, similar selection pressures cause similar adaptations. Result in analogous features

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Evolution types (cont)

Evidence of evolution can include a variety of different studies about an animal

Fossil record	Order of species in time scale
Biogeography	Study of historical distribution of species past and present. Geographically closer together means it is more likely they are similar.
Morphology	Analysis of features to see if they are homologous
Biochemistry	Studying the similarities between the base pairs. DNA hybridisation can be used.

Cell cycle

Process of growth and division to form new cells

3 stages - interphase, meiosis/mitosis, cytokinesis

Interphase	G1- cell growth; cytosol, proteins and organelles
	G0- arrest of cell cycle, dying or damages cells
	Synthesis- replication of DNA
	G2- continuation of growth and preparation

Mitosis or meiosis see respective sections

Cytokinesis	Differs from animal to plant Divison of cytoplasm and organelles before splitting of cells Animals have cleavage furrow pinching the cells apart Plants have a cell plate that turns into the cell wall

Simple inheritance

Complete dominance	Dominant allele masks the recessive allele Recessive allele only has an effect when homozygous Dominant is capital letter, recessive lowercase.
Incomplete dominance	Neither allele is wholly dominant Heterozygous individual will show a blending Writing alleles- common base used superscript capitals used for allele.
Co-dominance	Both alleles are dominant only one expressed in each cell

Inheritance patterns:

Autosomal dominant	Find two parents with trait having child without
Autosomal recessive	Check for two parents without having a child with
X-linked dominant	Occurs in every generation of family, all daughters have the trait when father has and mother doesn't.
X-linked recessive	Does not occur in every generation of family, do all females with trait have father with.
Y-linked	Occurs in every generation of family, only in males, passing from father to son.

Some genetic disorders include Down's syndrome which is trisomy for chromosome 21, Turner - monosomy for X without Y. Klinefelter two X chromosomes and a Y

Transport across the membrane

The membrane is a phospholipid bilayer enclosing the cell. Made of phospholipids, proteins and cholesterol.

The phospholipid bilayer has outwards facing negatively hydrophilic phosphate heads and inwards facing lipid tails that are hydrophobic.

Types of transport:

Simple diffusion	Down the concentration gradient, occurs do to the random movement overtime, passive. Can transport gases and small lipophilic molecules
Facilitated diffusion	Down the concentration gradient through transport proteins, passive. Channels transport small charged ions Carrier proteins transport small uncharged molecules like glucose
Osmosis	Net movement of water across a semipermeable membrane. Water moves from low solute concentration to high. Membrane must be permeable to water but not solute. Dilates solution. Hypo to hyper
Active transport	Requires ATP uses carrier proteins as pumps. Against the gradient. Sodium potassium pump for muscle and nerves.

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Transport across the membrane (cont)

Bulk transport	Substances to large to pass through proteins. ATP used to form vesicles which move between membrane and golgi.

Speciation

The evolution of two or more species from a single species to the point the viable offspring cannot be produced.

Isolating mechanisms prevent gene flow

Prezygotic	Ecological- different areas Temporal- breeding season differs Behavioural- different mating behaviours Mechanical- physical characteristics are incompatible Gamete isolation- female reproductive tract is fatal to sperm
Postzygotic	Zygote mortality- fertilisation occurs but zygote doesn't develop Inviability of zygote- develops to embryo but not further Sterile- offspring cannot reproduce

Types of speciation:

Allopatric	Occurs due to a geographical barrier and assumes no gene flow between populations
Sympatric	Same geographic areas habitat preferences differ. Gene flow can occur.

DNA stucture

Double stranded double helix shape composed of nucleotides. Strands run from 5' to 3' and are antiparallel.

3 main components in a nucleotide. The nitrogenous bases hold strands together

Nitrogenous bases	Adenine, thymine, cytosine, guanine. Form weak hydrogen bonds with complementary base. Chargaff's rule states A goes with T and C with G. A and G are purine with1 ring. C and T are pyrimidines with 2 rings. A and T, 2 H bonds, C and G, 3 H bonds
Phosphate group	Forms strong backbone with sugar molecules
Sugar group	Deoxyribose sugar bound to phosphate at 5', nitrogenous base at 1' and previous nucleotide at 3'.

Semi-conservative replication as one strand from every new helix is from parent strand.

Protein synthesis

DNA to protein - 3 stages; Transcription, mRNA processing, Translation

Transcription	RNA polymerase unwinds dsDNA Adds RNA nucleotides complementary to template strand in 5' to 3' direction. Stops when polymerase reaches stop. dsDNA reanneals and primary RNA peals off

Protein synthesis (cont)

mRNA processing	Primary RNA transcript transformed into a form that can exit nucleus Leaves through a pore interacting with ribosome either in cytoplasm or on RER
Translation	Small ribosomal subunit bonds to mRNA at 5' tRNA bonds to mRNA, the anticodon is complementary to codon. Large ribosomal unit attaches Next tRNA molecule enters the ribsosome Complementary amino acids form polypeptide chain at opposite end Translation stops when a STOP is reached.

Proteins are large biological macromolecules, made up of amino acids, 3D shaped vital for correct functioning.

RNA

Differs from DNA as it has a ribose sugar rather than deoxyribose, and uracil instead of thymine. It is also single stranded

Types of RNA:

mRNA	DNA is copied to RNA so it can be translated
tRNA	Clover leaf shaped adapter molecule carrying amino acid
rRNA	Important part of ribosome

Mutations

Changes to DNA base sequence. Can be induced from exposure to mutagens or spontaneous.

Point mutations can be substitution insertion or deletion

Silent mutations	Have no effect, base is changed but codon does not
Missense	Can be minor- only one codon is altered, Major - frameshift where every acid past point is altered. Sickle cell anaemia
Nonsense	Premature stop is created can result in cystic fibrosis.

Mutation can only be inherited if it occurs in a germline cell and is passed on.

Natural selection

Mechanism by which evolution occurs

Removes less fit genes from gene pool, increasing allele frequency of fitter phenotypes.

Better phenotype means increased chance for reproduction thus higher allele frequency.

Can result in co-evolution if two species provide the selection pressure for each other.

Fossils

Trace fossils are not the body but can be excrements or similar. Body fossils are bones or parts of the body preserved.

The process of fossilisation starts with organism death, the soft tissue decays and buried under sediment. The sediment solidifies and is exposed.

The process requires hard parts, quick burial, low oxygen environments.

Types of fossils:

Mineralised	Organic matter is turned into minerals

Fossils (cont)

Mould	Organism completely decomposes and leaves and empty space
Cast fossil	An empty space filled with rocks

Dating of fossils:

Relative dating	Looks at the rock layer the fossil was found in and surrounding fossils with known age ranges
Absolute dating	Uses radioisotopes which decay over time and measuring the level of different elements and the isotopes.

Transitional fossils are highly sought after as they can show traits from both the ancestral and modern forms of the organism.