CHURCH STRETTON SCHOOL

Triple Science - Biology

SB3 Knowledge organiser

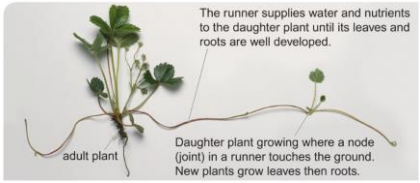
B3: Genetics

Lesson sequence

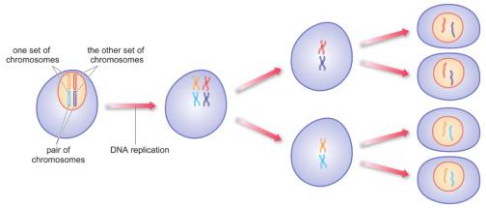
1. Sexual and asexual reproduction
2. Meiosis
3. DNA
4. DNA extraction
5. Protein synthesis
6. Genetic variants and phenotypes
7. Mendel
8. Alleles
9. Inheritance
10. Multiple and missing alleles
11. Gene mutation
12. Variation

1. Sexual and asexual reproduction	
Asexual reproduction	Reproduction which does not involve sex cells or fertilisation.
Sexual reproduction	The production of new living organisms by combining genetic information from two individuals of different types (sexes).
fertilisation	The fusion of male and female gametes to form a zygote.
Vertebrates	An animal that posses a backbone or spinal column.
Invertebrates	An animal lacking a backbone or spinal column.
Mitosis	When one cell divides into two genetically identical daughter cells.
Binary fission	A kind of asexual reproduction. A single organism becomes two independent organisms.
Clones	An organism or cell produced asexually that has the same genes as the original.

variation	Any difference between cells, individual organisms, or groups of organisms of any species.



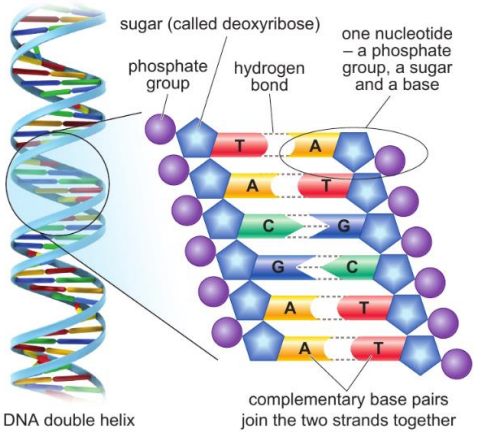
2. Meiosis	
Gametes	Egg cell and sperm cell.
Fertilisation	Sperm cell fuses with egg cell and nuclei combine.
Zygote	Single cell formed by fertilisation.
Gene	Length of DNA coding for a protein. Controls your characteristics.
Genome	All the DNA and genes in an organism.
Protein	Polymer made from amino acids.
Polymer	Long molecule made by chaining together many shorter ones.
Diploid	A cell with 23 pairs of chromosomes (46 in total).
Haploid	A cell with 23 single chromosomes.
Meiosis	Cell division that makes gametes.
Meiosis stages	DNA replicates, cell divides into 2 diploid cells, these divide into 4 haploid daughters.
Why gametes are different	Chromosomes in a pair are slightly different. Different gametes get different combinations of chromosomes.



Exam-style question

Compare and contrast mitosis and meiosis. *(3 marks)*

3. DNA	
Chromosome	Large DNA molecule made into a small package by tightly coiling DNA around a protein.
DNA structure	Two strands, double helix, complementary base pairs, sugar-phosphate backbone.
DNA bases	Adenine, A; thymine, T; cytosine, C; guanine, G
Complementary base pairs	A pairs with T C pairs with G
Hydrogen bonds	Weak force holding the two strands of DNA together.
DNA analysis	Uses small differences in DNA to determine family relationships or link people to crimes.



4. DNA extraction	
DNA extraction: Mix water, salt and detergent.	Salt makes DNA clump together, detergent breaks down cell membranes to release DNA
DNA extraction: Mash fruit/veg and add the solution	Increases the surface area
DNA extraction: Leave in water bath at 60°C	Heat makes it react quicker
DNA extraction: Filter the mixture and collect filtrate	To remove unwanted lumps
DNA extraction: Measure out 10 cm³ of filtrate	It's easier to work with a small amount
DNA extraction: Add two drops of protease solution	Protease breaks down proteins around the DNA
DNA extraction: Gently add ice-cold ethanol	DNA is insoluble in ethanol so precipitates
DNA extraction: Leave for several minutes	So white DNA layer forms

5. Protein synthesis	
Genetic code	The set of rules by which information encoded in genetic material.
Transcription	The process by which the information in a strand of DNA is copied into a new molecule of messenger RNA (mRNA).
RNA polymerase	An enzyme that is responsible for making RNA from a DNA template.

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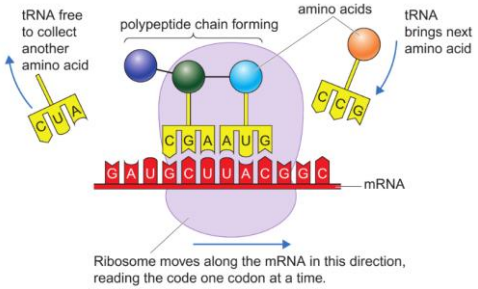
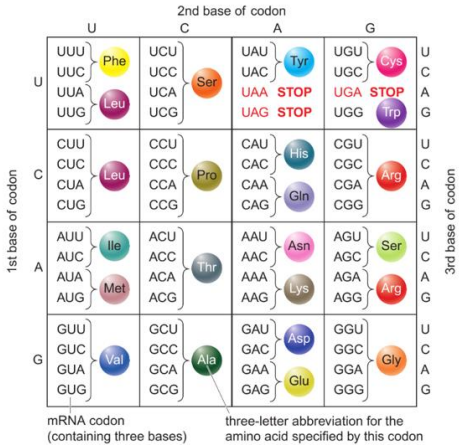
Messenger RNA (mRNA)	A single-stranded **RNA** molecule that corresponds to the genetic sequence of a gene
Uracil	In RNA, thymine is replaced by the base uracil.
Translation	The process in which ribosomes in the cytoplasm synthesize proteins after the process of transcription.
Nuclear pores	Regulates the transportation of molecules between the nucleus and the cytoplasm.
Ribosomes	A structure found in the cytoplasm which translates a genetic code into chains of amino acids.
Transfer RNA (tRNA)	A type of RNA molecule that helps decode a messenger RNA (mRNA) sequence into a protein.
Codon	A sequence of three bases that code for an amino acid.
Triplet code	Another name for a codon. A sequence of three bases.
Polypeptide	A chain of amino acids.
Protein	Made up of one or more polypeptide molecules.

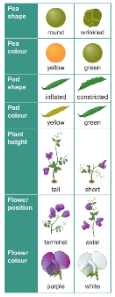


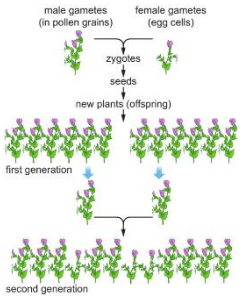
6. Genetic variants and phenotypes	
Mutation	A change to the bases in a gene.
Allele	Different version of the same gene. We have two alleles of each gene.
Phenotype	The characteristics produced by the alleles.

Genetic disorder	A health problem caused by one or more abnormalities in the genome.

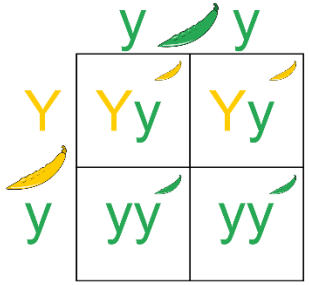


7. Mendel	
Inherited variation	Variation caused by genes.
Gregor Mendel	The ‘god father’ of genetics. He discovered the basics principles of heredity through experiments with garden peas.
Traits	A genetically determined characteristic.
Offspring	The young born of living organisms.
First generation	Subsequent sets of offspring from controlled or observed reproduction.
Second generation	The offspring from allowing the **F1** individuals to interbreed.



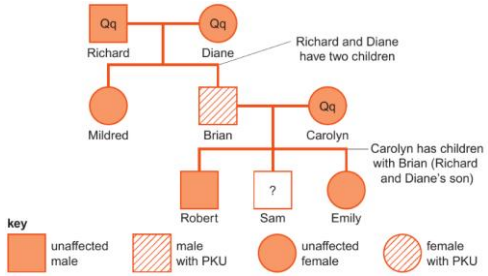


8. Alleles	
Homozygous	We have two copies of the same allele.
Heterozygous	We have two different copies of an allele.
Dominant allele	One copy needed for characteristic to show. Written as a capital.
Recessive allele	Two copies needed for the characteristic to show. Written as lowercase.
Genotype	The combination of alleles in an organism.
Punnet square	A graphical representation of the possible genotypes of an offspring arising from a particular cross or breeding event.
Genetic diagram	Shows the likelihood of offspring produced by parents with certain genotypes.

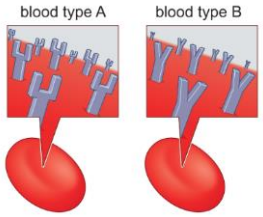


9. Inheritance	
Sex chromosomes	Female: XX Males: XY
Inheriting sex	All eggs are X, 50% of sperm are X and 50% are Y, so 50% of zygotes are XX and 50% are XY.
Punnett squares	Uses the genotypes of male and female gametes to predict the genotypes of the offspring.
Probability and Punnett squares	Punnett squares tell you the likelihood of certain offspring, not what will actually happen.

Cystic fibrosis	Illness caused by a inheriting two copies of a faulty recessive allele.
Family pedigree chart	Chart showing how genotypes are inherited down through a family.



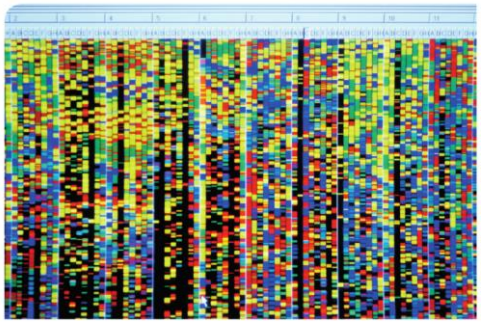
10. Multiple and missing alleles	
ABO Blood group	The classification of human blood (A, B, AB, O)
Codominant	Occurs when two versions, or “alleles,” of the same gene are present in a living thing, and both are expressed.
Sex-linked genetic disorders	A trait in which a gene is located on a **sex** chromosome. In humans, the term generally refers to traits that are influenced by genes on the X chromosome.
Haemophilia	A bleeding disorder that slows the blood clotting process.
Colour-blindness	The inability to perceive colours in a normal fashion. The most common forms of colour-blindness are inherited as sex-linked (X-linked) recessive traits.



Exam-style question

Explain how ABO blood group alleles illustrate dominance, recessiveness and codominance. *(3 marks)*

11. Gene mutation	
Mutation	A change to the bases in a gene.
Effect of mutations	Change the structure of a protein and how it works. Sometimes harmless, normally harmful, very rarely beneficial.
Cause of mutations	Mistakes copying DNA during cell division, DNA damage from chemicals or radiation.
Inheriting mutations	Only if they occur in gametes (egg and sperm).
Human Genome Project	(HGP) Project involving many scientists from many countries to find the order of bases in human DNA.
How is the HGP useful?	To tailor drugs to genes, to design better drugs.
Genetic differences	HGP found 99% of DNA in all people is identical.



12. Variation	
Variation	Natural differences between members of a species that affect the chance of survival.
Genetic variation	Variation caused by genes
Environmental variation	Caused by interaction with the surroundings - such as food, climate etc.
Causes of most variation	A combination of genes and the environment.
Acquired characteristics	Changes caused by the environment during your lifetime, such as losing a leg.
Continuous variation	Can be anywhere within a range, such as height, following a normal distribution.
Discontinuous variation	Can be only one of a few possibilities, such as blood type: A, B, AB, O.
Normal distribution	Bell-shaped curve with more in the middle and fewer either side.