

B3: Genetics Knowledge Organiser

Lesson sequence

1. Meiosis
2. DNA
3. DNA extraction
4. Alleles
5. Inheritance
6. Gene mutation
7. Variation

1. 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.

2. 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.

3. 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

4. Alleles

*Allele	Different version of the same gene. We have two alleles of each gene.
**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 for the characteristic to show. Written as lowercase.
*Genotype	The combination of alleles in an organism.
*Phenotype	The characteristics produced by the alleles.
**Genetic diagram	Shows the likelihood of offspring produced by parents with certain genotypes

5. 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 inheriting two copies of a faulty recessive allele.
**Family pedigree chart	Chart showing how genotypes are inherited down through a family.

6. 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.

7. 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.

