

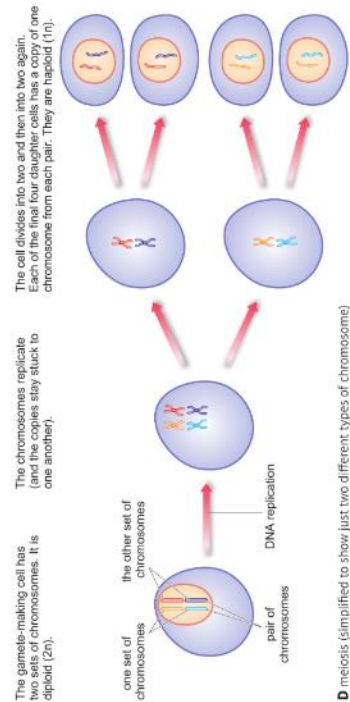
### B3: Genetics

#### Lesson sequence

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

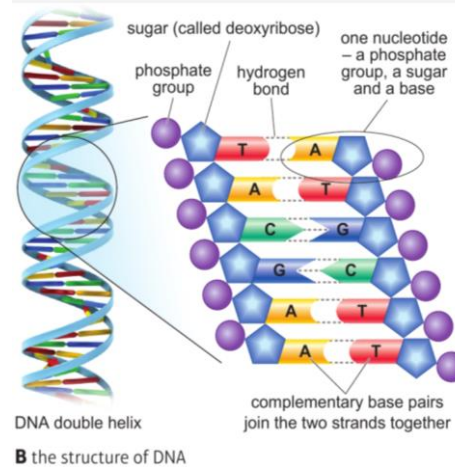
#### 1. Meiosis

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



#### 2. DNA

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



#### 3. DNA extraction

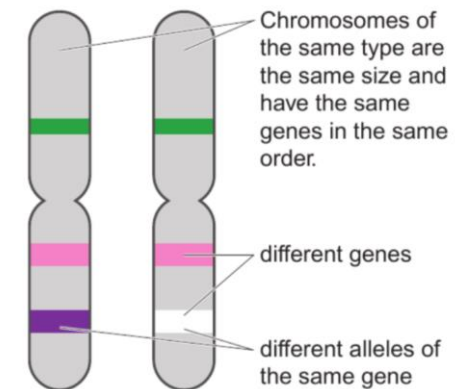
<b>DNA extraction: Mix water, salt and detergent.</b>	Salt makes DNA clump together, detergent breaks down cell membranes to release DNA
<b>DNA extraction: Mash fruit/veg and add the solution</b>	Increases the surface area
<b>DNA extraction: Leave in water bath at 60°C</b>	Heat makes it react quicker
<b>DNA extraction: Filter the mixture and collect filtrate</b>	To remove unwanted lumps
<b>DNA extraction: Measure out 10 cm<sup>3</sup> of filtrate</b>	It's easier to work with a small amount
<b>DNA extraction: Add two drops of protease solution</b>	Protease breaks down proteins around the DNA
<b>DNA extraction: Gently add ice-cold ethanol</b>	DNA is insoluble in ethanol so precipitates
<b>DNA extraction: Leave for several minutes</b>	So white DNA layer forms

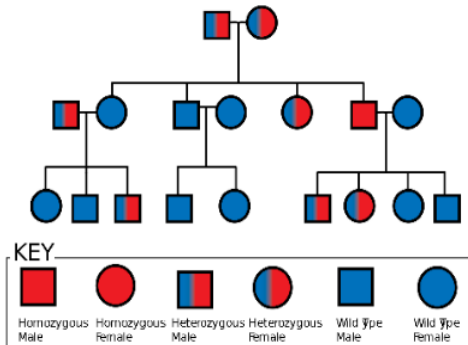


Ethanol causes DNA to precipitate, so you can see it.

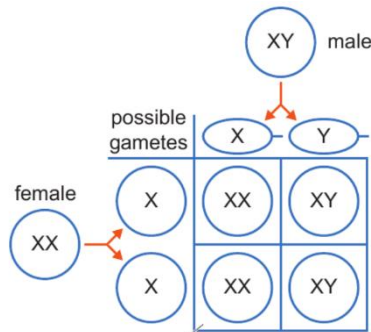
#### 4. Alleles

<b>Allele</b>	Different version of the same gene. We have two alleles of each gene.
<b>Homozygous</b>	We have two copies of the same allele
<b>Heterozygous</b>	We have two different copies of an allele
<b>Dominant allele</b>	One copy needed for characteristic to show. Written as a capital.
<b>Recessive allele</b>	Two copies for the characteristic to show. Written as lowercase.
<b>Genotype</b>	The combination of alleles in an organism.
<b>Phenotype</b>	The characteristics produced by the alleles.
<b>Genetic diagram</b>	Shows the likelihood of offspring produced by parents with certain genotypes

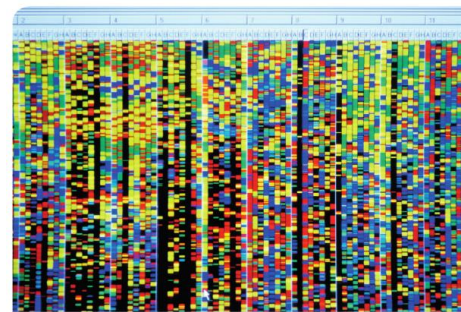




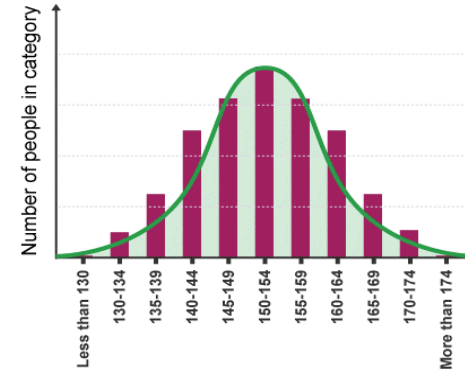
5. Inheritance	
<b>Sex chromosomes</b>	Female: XX Males: XY
<b>Inheriting sex</b>	All eggs are X, 50% of sperm are X and 50% are Y, so 50% of zygotes are XX and 50% are XY
<b>Punnett squares</b>	Uses the genotypes of male and female gametes to predict the genotypes of the offspring.
<b>Probability and Punnett squares</b>	Punnett squares tell you the likelihood of certain offspring, not what will actually happen.
<b>Cystic fibrosis</b>	Illness caused by inheriting two copies of a faulty recessive allele.
<b>Family pedigree chart</b>	Chart showing how genotypes are inherited down through a family.



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



C A map of part of one human genome. Each coloured band represents a different base in the DNA sequence. Some of the bases in this part of the genome will be different in different people.



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