

Variation

- Genetic** - inherited e.g. eye colour, hair colour
- Environmental** - scars, tattoos, piercings
- Both** - skin colour (tan), hair style (naturally curly but straightened)

Chromosome - long strands of DNA (23 pairs in normal cells, 23 in sex cells (gametes))
DNA - double helix, all info to make an organism

Sexual Reproduction

- Fertilisation
- Gametes
- Genetic variation in offspring

Asexual Reproduction

- No fertilisation
- No gametes
- Identical clones are made
- E.g. runners in plants

Gender Determination

XX = female
 XY = male

	X	Y
X	XX	XY
X	XX	XY

During meiosis, 1 sex chromosome goes into one gamete, and the other goes into a second gamete.

The **punnet square** shows there is a **50% chance** of having a boy or a girl every time.

DNA - Instructions to make an organism.

- Double helix polymer
- Sugar phosphate backbone
- Nucleotides made up of 4 bases that pair up A-T and G-C.
- Every 3 base pairs is the instructions given to a ribosome to make an **amino acid**. These are combined to make **proteins**.

Sections of coding parts of DNA are called **genes**. Non-coding sections of DNA can turn on and off different genes to make different proteins.

Mutation == change (mistake) in DNA
 Mutations in coding = change to characteristic
 Mutations in non-coding = bigger changes to the organism

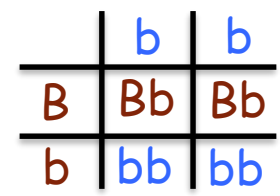
Genome- All genes of an organism
 Human Genome Project - map out all 21000 genes

Advantages of HGP	Issues and Concerns with HGP
<ul style="list-style-type: none"> Cancer diagnosis Forensics Evidence for evolution 	<ul style="list-style-type: none"> Genetic discrimination Re-engineer human species Very expensive

Genetic Crosses

e.g. A heterozygous brown eyed dog mates with a homozygous blue eyed dog. Brown eyes is dominant.

- Write genotype of parents
 $Bb \times bb$
- Draw punnet square, write parents on top and side and fill in the boxes



- Write out the possible phenotypes of the offspring

50% chance heterozygous brown eyed
50% chance homozygous blue eyed
 or a 1:1 chance of brown : blue

Gene - a section of DNA that codes for 1 characteristic

Allele - different forms of a gene

Genotype - Symbols used to show genes for 1 characteristic e.g. Bb

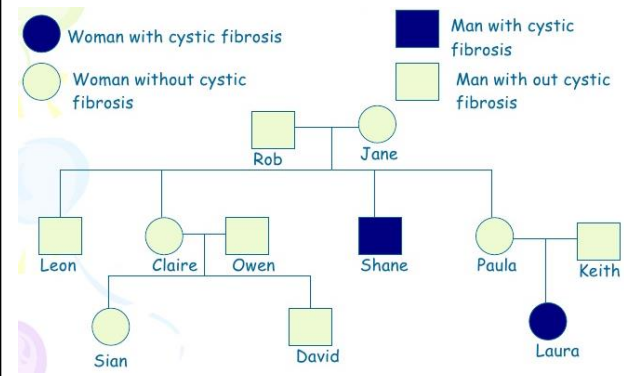
Phenotype - Description of genes e.g. Brown eyes

Homozygous - Both genes are the same i.e. BB or bb

Heterozygous - Both genes are different i.e. Bb

Genetic Diseases

- Polydactyly - **dominant** allele - extra finger or toe
- Cystic Fibrosis - **recessive** allele - excess mucus



Rob and Jane must be Ff (where f means has CF)

Ff x Ff

	F	f
F	FF	Ff
f	Ff	ff

25% chance of CF

Genetic Engineering - adding wanted characteristics to organisms.

e.g. **Making Insulin**

- Remove wanted insulin gene using enzymes
- Take a plasmid from a bacteria (vector)
- Open plasmid and insert insulin gene with DNA ligase
- Put plasmid back in bacteria
- Incubate to allow bacteria to grow and make insulin.

GM Crops

- + Resistant to insects, viruses, fungi
 - + Grow bigger, taste better, more nutritious
 - + Crops can be grown all over the World
 - + Increased crop yield
- Worries over long term effects
 - Reduced biodiversity
 - Could develop allergies to the food
 - Herbicide resistant gene could spread to weeds making superweeds!

Natural Selection

- Variation occurs naturally within a species due to mutations
- Some organisms have adaptations increasing their chances of survival
- These organisms are more likely to reproduce
- The genes responsible for the adaptation are passed on to their offspring.

Reasons why people didn't believe Darwin at first:

- Against religious beliefs
- They didn't know about genes or mutations at the time so Darwin couldn't explain why some organisms had more useful characteristics
- Not enough evidence

Selective Breeding

Humans breed animals/plants to gain desirable characteristics in offspring (takes many generations).
 e.g. disease resistance, increased milk production, behaviour, scented flowers etc.

Downsides - Reduces variation limiting success of survival if conditions change, new diseases might wipe out every member of the same species, inbreeding in animals leads to defects.

Fossils

These can be made from:

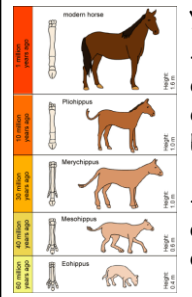
- Bones and teeth
- Minerals that have replaced bone and tissue
- Organisms trapped in amber or ice
- Burrows, tracks, where organisms have laid

Softer body parts such as tissue, muscle etc. **decay** if conditions are suitable.

Fossil record - collection of fossils that show evolution of an organism over many years.

- Usually incomplete as most organisms don't become fossils, softer bodies decay, fossils melt underground due to Earth movement, not been found yet,

- Usually need to comment on changes over time e.g. shape, length or number of bones.



Extinction - Living things become extinct because:

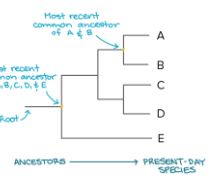
- Habitat changes - not adapted to survive
- New predator - not adapted to get away or hide
- Disease - lack of immunity
- New, more successful competitor - better adapted species will get food, space, water etc.

Classification

Carl Linnaeus	Carl Woese
<ul style="list-style-type: none"> • Grouped according to characteristics and structures that make up organisms. • Kingdom, Phylum, Class, Order, Family, Genus, Species 	<ul style="list-style-type: none"> • Three-domain system • Based on new chemical analysis techniques that prove some species aren't as closely related as once thought. <ul style="list-style-type: none"> • Archaea - primitive bacteria • Bacteria - true bacteria • Eukaryota - fungi, animals, plants, protists • These are sub-divided into K,P,C,O,F,G and S.

Organisms are named using **binomial system** (genus and species in latin) . It is used worldwide regardless of language.

Evolutionary trees show common ancestors . The more recent the common ancestor, the more closely related they are.



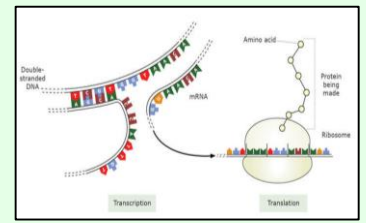
History of Genetics

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- **Mendel** studied pea plants and discovered that characteristics are controlled by 2 'units' that can be dominant or recessive.
- In the late 19th century behaviour of chromosomes during cell division was observed.
- In the early 20th century it was observed that chromosomes and Mendel's factors behaved in similar ways, leading to the idea that the factors (genes) were located on chromosomes.
- In the mid-20th century the structure of DNA was determined and the mechanism of gene function worked out.

Protein Synthesis

1. DNA strands unwind.
2. A corresponding template of ATGC is made called mRNA.
3. This leaves the nucleus and binds to a ribosome.
4. With the help of tRNA, amino acids are made.
5. The protein is then released from the ribosome.



Animal Cloning

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Adult Cell Cloning - makes copy of adult

1. Take nucleus from an adult cell
2. Take nucleus out of an egg cell
3. Put adult nucleus into empty egg cell
4. Electric shock
5. When it becomes an embryo, insert into uterus

Embryo Transplant - makes cloned offspring

1. Sperm and egg mixed in petri dish
2. Grow into an embryo
3. Split the embryo into cells
4. Each cell develops into an identical embryo
5. Insert into host uteruses

Plant Cloning

Cuttings - Cut a bit off and plant it.
- Cheap and quick

Tissue Culture - Cells put in growth medium with hormones. Grown all year, can make lots, more expensive.

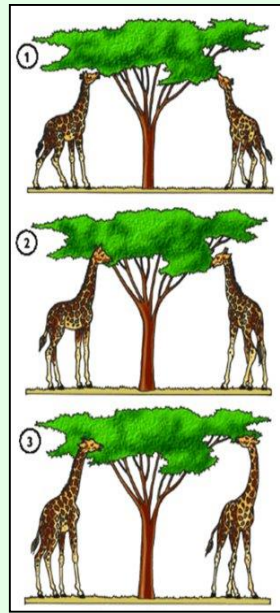
Evolution Theories

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Lamarck - the more a characteristic is used the more developed it becomes and is then passed on to offspring. *(which is nonsense!)*

E.g. Giraffes stretched their necks to reach higher food and passed on the characteristic to their offspring.

Darwin proposed that a daratation made some giraffes have longer necks so they would be more likely to eat, survive and reproduce.



Speciation - making a new species

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A new species is made by:

Alfred Wallace wanted to publish his findings on natural selection before Darwin which prompted the Origin of the Species.

1. Geographical **isolation** (species split by water or mountains)
2. Genetic variation in both groups means some are more adapted to survive in their own conditions
3. Natural selection - best breed and pass on desirable genes
4. Speciation - new species can't interbreed with the other species

