CHURCH STRETTON SCHOOL

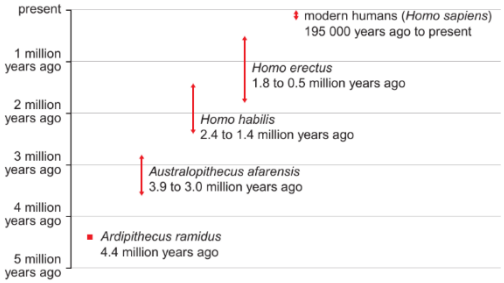
Triple Science - Biology

SB4 Knowledge organiser

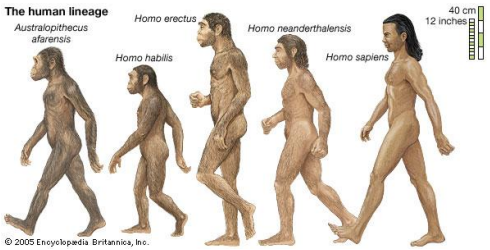
B4: Natural Selection and Genetic Modification

Lesson sequence

1. Evidence of human evolution
2. Darwin's theory (the theory of evolution)
3. Development of Darwin's theory
4. Classification
5. Breeds and varieties (How to modify species)
6. Tissue cultures
7. Genes in agriculture and medicine (Problems with modifying species)
8. GM and agriculture
9. Fertilisers and biological control



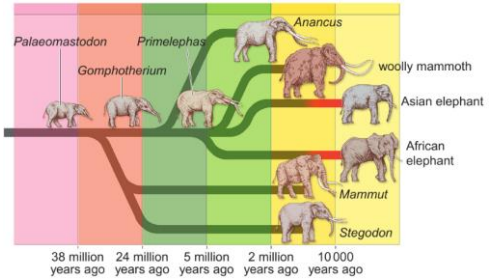
1. Evidence of human evolution	
Binomial naming	Two-part names, first part = genus, second part = species. Written in italics.
Homo sapiens	Our species. Evolved about 200,000 years ago. Skull volume 1450 cm^3.
Ardipithecus ramidus	Aka 'Ardi'. 4.4 million years ago, walked upright and climbed trees, 350 cm^3 skull volume.
Australopithecus afarensis	Aka Lucy. 3.2 million years ago, walked upright, skull volume 400 cm^3.
Homo habilis	2.4-1.4 million years ago, walked upright, skull volume 5-600 cm^3.
Homo erectus	1.8 to 0.5 million years ago, walked upright, skull volume 850 cm^3.



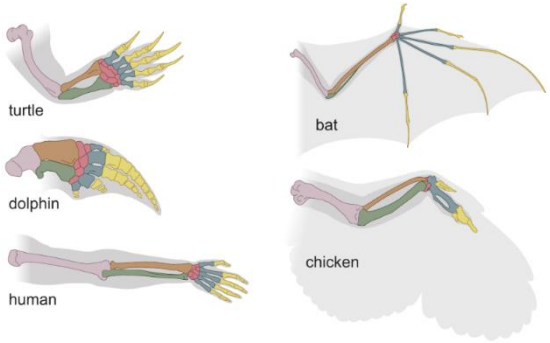
Fossil evidence	Many fossils have been found showing a gradual transition from 'ape-like' to 'human-like'.
Stone tool evidence	Older stone tools are simpler requiring less intelligence to make, younger stone tools are more complex requiring more intelligence to make.
The Leakeys	Mary and Louis discovered *Homo habilis*, their son Richard worked on *Homo erectus*.

2. Darwin's theory (The theory of evolution)	
Charles Darwin	Develop the theory of evolution.
Evolution	The way that species develop by gradual changes over many generations due to natural selection.
Variation	Natural differences between members of a species that affect the chance of survival.

Mutations and evolution	Changes in DNA cause variation.
Environmental change	Change to factors such as food supply, climate or predators.
Competition	The fight to eat, survive and breed.
Natural selection	Organisms with the best genes and characteristics are more likely to survive, breed and pass on their better genes.
Inheritance	Gaining your genes from your parents.
Well adapted	An organism has features that make it better able to survive and breed.
Evolution and the individual	An individual does not evolve during its lifetime, populations of organisms evolve over many lifetimes.
Human evolution	Humans did not evolve from chimpanzees, we both evolved from a common ancestor.



Resistance	The natural ability of some members of a species to survive poisons that would kill the other members.
Evolution of resistance	Evolution of organisms that stops them from being affected by poisons.
Rats and warfarin resistance	Warfarin is used to kill rats. Some rats were naturally resistant, survived the warfarin, bred and passed on their resistance genes.
Antibiotic resistance	Antibiotics are used to kill bacteria. Some bacteria were naturally resistant, survived the antibiotics, bred and passed on their resistance genes.
The problems of resistance	Antibiotic resistance means that many infections that used to be simple to treat may become too resistant to treat, causing major health problems.



3. Development of Darwin's' theory	
Galapagos Islands	Charles Darwin spent a couple of years in Galapagos. He observed unique animal behaviour that helped him assemble his theory.
Alfred Wallace	Came up with the same idea about evolution as Charles Darwin.
The origin of species	The book Charles Darwin published with his findings.
Pentadactyl limb	A **limb** with five digits, characteristic of tetrapod vertebrates (amphibians, reptiles, birds, and mammals).
Common ancestor	An ancestor that two or more descendants have in common.

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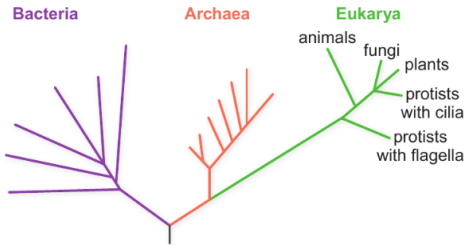
4. Classification	
Carl Linnaeus	Developed the modern system of classification.
How to classify	Based on similarities, group things into smaller and smaller groups with fewer and fewer similarities.
Problems with classification	Sometimes organisms that look similar are not actually related.
Kingdoms	Old idea, classifying living things into five kingdoms (including plants, animals and fungi).
Species	a group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding.
Carl Woese	Developed the modern system of classification with three domains.
Domains	Modern idea of classifying living things into three main groups: bacteria, Archaea, Eukarya.
Bacteria	Single-celled organisms with no nucleus and no unused sections of DNA.
Archaea	Single-celled organisms with no nucleus but with unused sections of DNA.
Eukarya	(Often) multi-cellular organisms with a nucleus and unused sections of DNA. Includes plants, animals, fungi and protists.

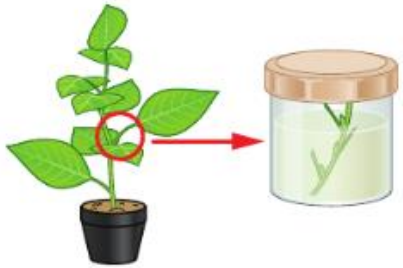


Kingdom	Main charateristics
animals 	multicellular (with cells arranged as tissues and organs), cells have nuclei, no cell walls
plants 	multicellular (with cells arranged as tissues and organs), have chloroplasts for photosynthesis, cells have nuclei, cellulose cell walls
fungi 	multicellular (apart from yeasts), live in or on the dead matter on which they feed, cells have nuclei, cell walls contain chitin (not cellulose)
protists 	mostly unicellular (a few are multicellular), cells have nuclei, some have cell walls (made of different substances but not chitin)
prokaryotes 	unicellular, cells do not have nuclei, flexible cell walls

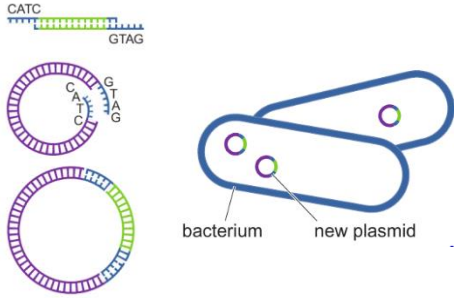
5. Breed and varieties (how to modify species)	
Artificial selection	When humans (normally farmers) select the animals/plants to breed with the best characteristics.
Selective breeding	Developing new breeds of plants or animals with better characteristics by selective breeding over many generations.
Selective breeding in practice	Choose parents with the best characteristics, breed them together, choose from their offspring with the best characteristics, breed them together, repeat for many generations.
Genetic engineering	Changing the characteristics of organisms by giving them genes from another organism.
GMO	Genetically modified organism: an organism that has had its genes changed.

Bt corn	Corn containing a gene from *Bacillus thuringiensis* that makes it produce a substance called Bt which kills insects.
Medical GMOs	GM bacteria are used to make insulin (for diabetes) and some antibiotics.
Pros and cons of GM	Quicker than selective breeding and can introduce more different characteristics but is expensive.

6. Tissue culture	
Stem cells	an undifferentiated cell of a multicellular organism and has the ability to develop into many different cell types.
Tissue culture	the growth of **tissues** or cells in an artificial medium separate from the organism.
Differentiate	The process by which a **cell** becomes specialized in order to perform a specific function.
Extinction	the termination of a kind of organism or of a group of kinds (taxon), usually a species.
Clone	an identical genetic copy of either a piece of deoxyribonucleic acid (DNA), a cell, or a whole organism.
Viruses	A microorganism that is smaller than a bacterium that cannot grow or reproduce apart from a living cell.

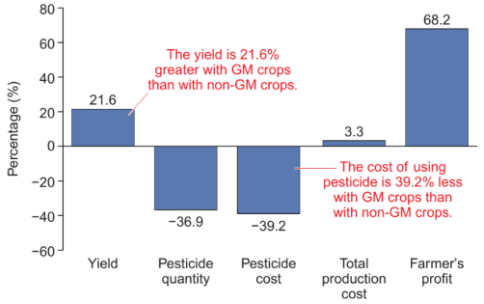


7. Genes in agriculture and medicine (problems with modifying species)	
Over-selection	Farmers focussing too much on breeding for one characteristic (such as chicken breast size), don't spot problems with other characteristics (such as weak leg bones) causing suffering.
Gene leakage	The concern GMOs could breed with wild relatives, enabling the modified genes to escape into the wild. This could have ecological impacts.
Resistance	The concern that in areas growing Bt corn, insects simply evolve resistance to Bt.
Insulin	Insulin made by GM bacteria is not identical to human insulin, and some people suffer bad reactions to it.



Genetic engineering of bacteria (HT)	
Plasmid DNA	Small loops of DNA containing a few genes.
Restriction enzyme	Enzymes that cut DNA, leaving sticky ends at each end of the piece of DNA.
Sticky end	A short sequence of unpaired bases at the end of a piece of DNA.
Ligase	An enzyme that joins two pieces of DNA by matching up the bases on their sticky ends.

Recombinant DNA	DNA produced by combining together two of more pieces of DNA.
How to genetically engineer bacteria	Cut out gene using restriction enzymes, remove plasmids from bacteria and open with restriction enzymes, use ligase to join gene and plasmid together, return plasmids to bacteria.



8. GM and agriculture	
Yield	The amount of product obtained.
Pests	Any animal or plant which has a harmful effect on humans, their food or their living conditions.
Insecticides	Are substances used to kill insects
Bt toxin	A naturally occurring bacteria that produces a protein toxic to certain types of insects.
Resistance	Ability of an organism to avoid or repel attack by biotic agents (pathogens, pests, parasites, etc.) or to withstand the effects of abiotic agents (chemicals, pesticides, salt, wind, heavy metals, etc).
Strains	A genetic variant or subtype of a microorganism.

Exam-style question

Describe one advantage and one disadvantage of using fertilisers on crops. *(2 marks)*

9. Fertilisers and biological control	
Biological control	A method of controlling pests such as insects, mites, weeds and plant diseases using other organisms.
Weeds	A plant considered undesirable in a particular situation.
Fertilisers	Are chemicals that are added to soil to supply nutrients to make it more fertile. The chemicals in fertilisers contain essential elements required for plant growth.
Pollution	Something introduced into the environment that is dirty, unclean or has a harmful effect.

Did you know?

Some attempts at biological control turn out to be disasters. The Asian harlequin ladybird was introduced to orchards in the USA to eat aphid pests. The ladybirds were so good at this that the native predators of aphids soon had no food. Even worse, the ladybirds also ate other native insects.