

B4: Natural selection and genetic modification Knowledge Organiser

- Lesson sequence**
- Human evolution
 - The theory of evolution
 - Resistance
 - Classification
 - Modifying life
 - Problems with modifying life

1. Human evolution	
Binomial naming	Two-part names, first part = genus, second part = species, written in italics.
<i>Homo sapiens</i>	Our species. Evolved about 200,000 years ago. Skull volume 1450 cm ³ .
<i>Ardipithecus ramidus</i>	Aka 'Ardi'. 4.4 million years ago, walked upright and climbed trees, 350 cm ³ skull volume.
<i>Australopithecus afarensis</i>	Aka Lucy. 3.2 million years ago, walked upright, skull volume 400 cm ³ .
<i>Homo habilis</i>	2.4-1.4 million years ago, walked upright, skull volume 5-600 cm ³ .
<i>Homo erectus</i>	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 <i>Homo habilis</i> , their son Richard worked on <i>Homo erectus</i> .

2. 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	Changes in DNA that 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.

3. Resistance	
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.

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.
Linnaeus' classification system	Kingdom → phylum → class → order → family → genus → species
Problems with classification	Sometimes organisms that look similar are not actually related.
Carl Woese	Developed the modern system of classification with three domains.
Domains	The three main groups of life: bacteria, Archae, Eukarya.
Bacteria	Single-celled organisms with no nucleus and no unused sections of DNA.
Archae	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.

5. Modifying Life	
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 <i>Bacillus thuringiensis</i> 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. Problems with modifying life	
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.