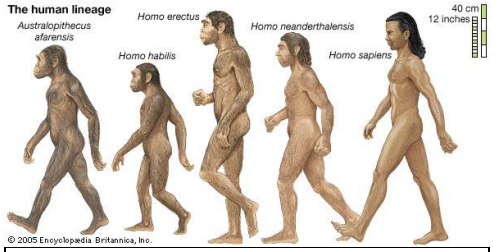
B4: Evolution Knowledge Organiser

Lesson sequence

1. Human evolution
2. The theory of evolution
3. Resistance
4. Classification
5. How to modify species
6. Problems with modifying species
7. Genetic engineering of bacteria (HT)

1. 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.
***8Homo 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. 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.

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.
***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)
****Carl Woese**	Developed the modern system of classification with three domains.
***Domains**	Modern idea of classifying living things into three main groups: 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. 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. 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.

7. 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.