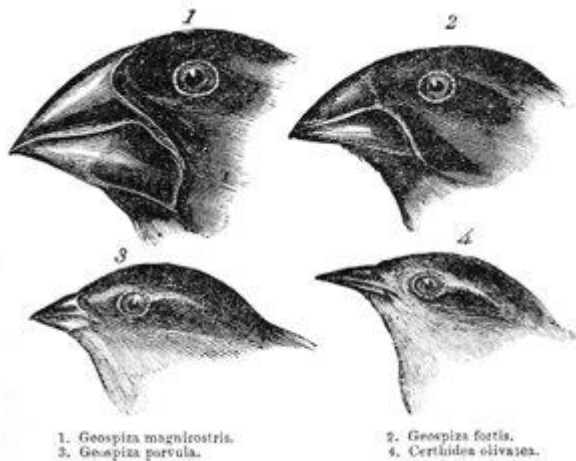


Natural Selection

1. Charles Darwin, as a result of observations on a round the world expedition, backed by years of experimentation and discussion and linked to developing knowledge of geology and fossils, proposed the theory of evolution by natural selection.

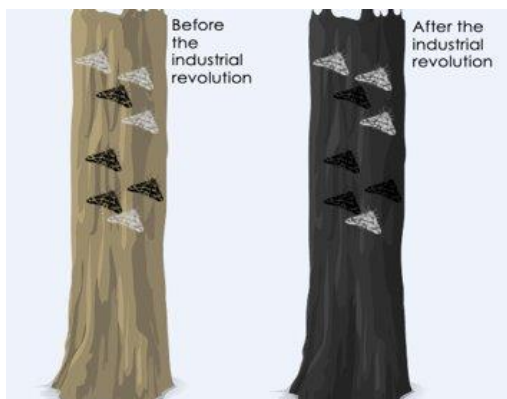


2. The Theory of Evolution by Natural Selection says that Individual organisms within a particular species show a wide range of variation for a characteristic.
3. Individuals with characteristics most suited to the environment are more likely to survive to breed successfully.
4. The characteristics that have enabled these individuals to survive are then passed on to the next generation.

5. Evolution is a change in the inherited characteristics of a population over time through a process of natural selection which may result in the formation of a new species.
6. The theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago.
7. Evolution occurs through natural selection of variants that give rise to phenotypes best suited to their environment.
8. If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.
9. The theory of evolution by natural selection is now widely accepted.
10. Evidence for Darwin's theory is now available as it has been shown that characteristics are passed on to offspring in genes.
11. There is further evidence in the fossil record and the knowledge of how resistance to antibiotics evolves in bacteria.
12. The theory of evolution by natural selection has had wide reaching implications for our understanding of Biology and the natural world.

Fossils and Extinction

13. Extinctions occur when there are no remaining individuals of a species still alive.
14. Several factors can cause a species to become extinct. They include:
 - new diseases
 - new predators
 - new, more successful competitors
 - changes to the environment over geological time, such as climate change
 - a single catastrophic event, such as a massive volcanic eruption or a collision between an asteroid and the Earth



Evolution



15. A species may also become extinct through speciation.
16. Fossils are the 'remains' of organisms from millions of years ago, which are found in rocks.
17. Fossils may be formed from parts of organisms that have not decayed because one or more of the conditions needed for decay are absent.
18. They can be formed when parts of the organism are replaced by minerals as they decay, and as preserved traces of organisms, such as footprints, burrows and rootlet traces.
19. Many early forms of life were soft-bodied, which means that they have left few traces behind.
20. What traces there were have been mainly destroyed by geological activity. This is why scientists cannot be certain about how life began on Earth.
21. We can learn from fossils how much or how little different organisms have changed as life developed on Earth.

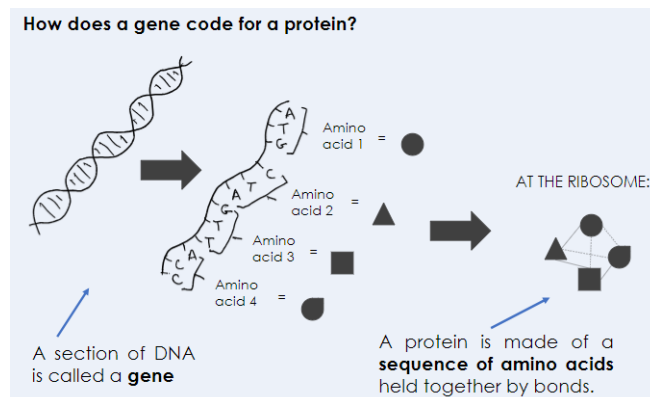
Classification

22. Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus. Linnaeus classified living things into kingdom, phylum, class, order, family, genus and species.
23. As evidence of internal structures became more developed due to improvements in microscopes, and the understanding of biochemical processes progressed, new models of classification were proposed.
24. Due to evidence available from chemical analysis there is now a 'three-domain system' developed by Carl Woese.
25. In this system organisms are divided into:
 26. - Archaea (primitive bacteria usually living in extreme environments)
 27. - Bacteria (true bacteria)

28. - Eukaryota (which includes protists, fungi, plants and animals).
29. Evolutionary trees are a method used by scientists to show how they believe organisms are related.
30. They use current classification data for living organisms and fossil data for extinct organisms.

DNA and Proteins (SS Only)

31. DNA is a polymer made from four different nucleotides.
32. Each nucleotide consists of a common sugar and phosphate group with one of four different bases attached to the sugar.
33. DNA contains four bases, A, C, G and T.
34. (HT only) In the complementary strands a C is always linked to a G on the opposite strand and a T to an A.
35. A sequence of three bases is the code for a particular amino acid.
36. The order of bases controls the order in which amino acids are assembled to produce a particular protein.



37. Not all parts of DNA code for proteins.
38. The long strands of DNA consist of alternating sugar and phosphate sections.
39. Attached to each sugar is one of the four bases.
40. The DNA polymer is made up of repeating nucleotide units.
41. (HT only) Proteins are synthesised on ribosomes, according to a template.





- 42. Carrier molecules bring specific amino acids to add to the growing protein chain in the correct order.
- 43. (HT only) When the protein chain is complete it folds up to form a unique shape. This unique shape enables the proteins to do their job as enzymes, hormones or forming structures in the body such as collagen.

Mutation (HT SS Only)

- 44. Mutations occur continuously.
- 45. Most mutations do not alter the protein, or only alter it slightly so that its appearance or function is not changed.
- 46. A few mutations code for an altered protein with a different shape. An enzyme may no longer fit the substrate binding site or a structural protein may lose its strength.
- 47. Non-coding parts of DNA can switch genes on and off, so variations in these areas of DNA may affect how genes are expressed.
- 48. The structure of DNA and genetic variation affects the protein made in coding DNA by altering the activity of a protein and in non-coding DNA by altering how genes are expressed.
- 49. A change in DNA structure may result in a change in the protein synthesised by a gene.

The Theory of Evolution (SS Only)

- 50. Charles Darwin, as a result of observations on a round the world expedition, backed by years of experimentation and discussion and linked to developing knowledge of geology and fossils, proposed the theory of evolution by natural selection.
- 51. Darwin published his ideas in *On the Origin of Species* (1859).
- 52. There was much controversy surrounding these revolutionary new ideas. The theory of evolution by natural selection was only gradually accepted because:

- 53. - the theory challenged the idea that God made all the animals and plants that live on Earth
- 54. - there was insufficient evidence at the time the theory was published to convince many scientists the mechanism of inheritance and variation was not known until 50 years after the theory was published.
- 55. Other theories, including that of Jean-Baptiste Lamarck, are based mainly on the idea that changes that occur in an organism during its lifetime can be inherited.
- 56. We now know that in the vast majority of cases this type of inheritance cannot occur.

Speciation (SS Only)

- 57. Alfred Russel Wallace independently proposed the theory of evolution by natural selection. He published joint writings with Darwin in 1858 which prompted Darwin to publish *On the Origin of Species* (1859) the following year.
- 58. Wallace worked worldwide gathering evidence for evolutionary theory.
- 59. He is best known for his work on warning colouration in animals and his theory of speciation.
- 60. Alfred Wallace did much pioneering work on speciation but more evidence over time has led to our current understanding of the theory of speciation.
- 61. If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.

