

Briefing Sheet Session 2: Evidence for evolution

This sheet outlines in brief some of the clearest and most compelling evidence for evolution. Some of these examples are referred to in the *Test of FAITH* documentary (Part 2).

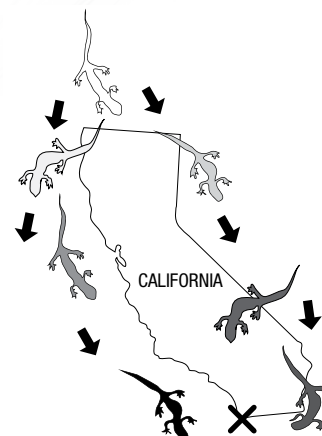
DNA	The molecule inside every cell of every living thing that carries the instructions for its growth and development.
Gene	A section of DNA that contains the instructions for making a single component (e.g., a protein) of an organism.
Chromosome	Each DNA strand in a living cell is wound up tightly into a chromosome. Apart from bacteria and the single-celled 'archaea', most living things have two copies of each chromosome. In sexually reproducing organisms, the offspring inherit one copy of each chromosome from each parent.
Species	A set of organisms that can interbreed (there are some exceptions to this rule).

Ring Species

One of the most important events in evolution is the formation of a new species, which is called 'speciation'. This happens when a group of organisms becomes isolated in some way from a population of the same species and the genetic make-up of each group changes independently, with the result that members of the sub-population can no longer successfully reproduce with members of the original population. To test whether this has occurred, a biologist must normally bring organisms from the two populations together.

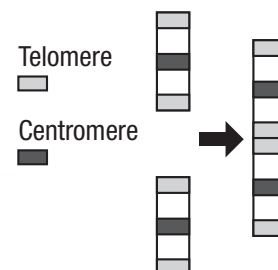
One of the more dramatic examples of speciation can occur when a series of populations, all from the same species, are naturally distributed over a large area. In rare cases, what is known as a 'ring species' is formed. If the populations adapt to a gradually changing environment as they spread out over an area, then when the populations meet again, completing the ring, they can no longer interbreed.

An example of this is found in the salamander population in California that spread down from the north, both along the coast and further inland. When the coastal and inland arms of the population met again in San Diego County, they could not interbreed (Mark Ridley, *Evolution* (Blackwell, 2004)).

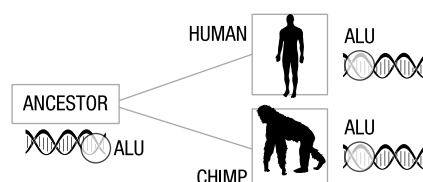


DNA Fossils

There are many indicators of common ancestry hidden in the DNA of every organism. These are 'DNA fossils', or mutations that do not affect the organism's health, and so are preserved in the DNA from generation to generation. Some of these mutations are so rare that any organisms that share them are likely to be descended from a common ancestor in which the mutation first occurred. By analysing thousands of such mutations evolutionary biologists can map out the evidence for relationships between organisms. Two examples are given below.



Humans have 23 different chromosomes, while chimpanzees have 24. Every chromosome has a sequence at each end called a 'telomere' and one in the middle called a 'centromere'. Twenty-two of the chromosomes from chimps and humans are very similar and, when you put the two non-matching chromosomes from a chimp end to end, they look very much like the remaining human chromosome: chromosome 2. Human chromosome 2 has the remnants of an extra centromere, and in the middle of the chromosome there are two telomeres stuck together. From this you could conclude that chromosome 2 in humans is a fusion of two chromosomes, and that an ancestor of humans had 24 different chromosomes. Evolutionary biologists use this as part of the evidence to show that chimpanzees and humans share a common ancestor.



About 50% of human DNA is made up of repetitive sequences, most of which are 'jumping genes' that contain just enough genetic information to copy and paste themselves anywhere within a chromosome. 'Alu' sequences comprise one of the largest groups of jumping genes. Most Alu sequences are now inactive. The individual carrying them suffers no harmful effects and is able to produce offspring, so the Alu sequence is passed from generation to generation. Nearly all Alu sequences are in exactly the same position in all humans, showing that we all have a common ancestor.

Nearly all of these are also shared by all humans and great apes (including chimpanzees and bonobos), and for evolutionary biologists this is compelling evidence that the three species share a common ancestor.

Further reading

Deborah B. Haarsma and Loren D. Haarsma, 'Origins', <http://67.199.69.61/origins>.

Darrel Falk, *Coming to Peace with Science* (IVP, 2004).

Graeme Finlay, 'Human Genomics and the Image of God', <http://graphite.st-edmunds.cam.ac.uk/faraday/Papers.php>.