From fossils to DNA

Fossils are old news! The famous scientist, astronomer and artist, Leonardo da Vinci, recognised **fossils** as remnants of ancient life, back in the late 1400s when he discovered the remains of sea life in the mountains of Italy.

The evidence for evolution

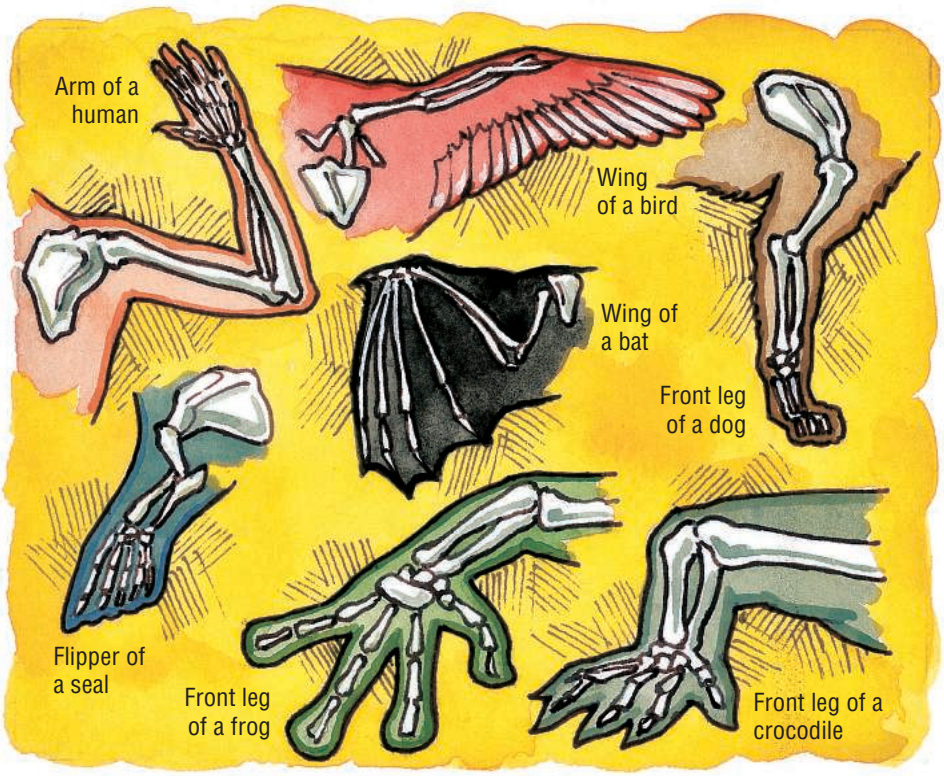
Darwin and Wallace developed their theories based on their biogeographical observations (see page 189). Early scientists also compared the anatomy and embryology of related **species** to glean evidence for **evolution**. In the last 30 years, analysis of **DNA** has provided a powerful new tool for evolutionary studies.

What can fossils tell us?

Fossils are the preserved remains of plants and animals. **Palaeontologists** study this physical evidence, which shows that a wide variety of different, and now **extinct** creatures, once roamed the Earth. Piecing together the fossil puzzle is tricky because fossilisation is a rare event, even for those animals that have hard body parts. The fossil record is often described as incomplete; there are gaps in the information fossils provide. However, scientists have been able to discover a great deal about the relationships of early life forms from fossils. They can gauge the age of the fossil by using radioactive dating techniques. Being able to date fossils means that the order in which different life forms appeared can be established.

Comparative anatomy

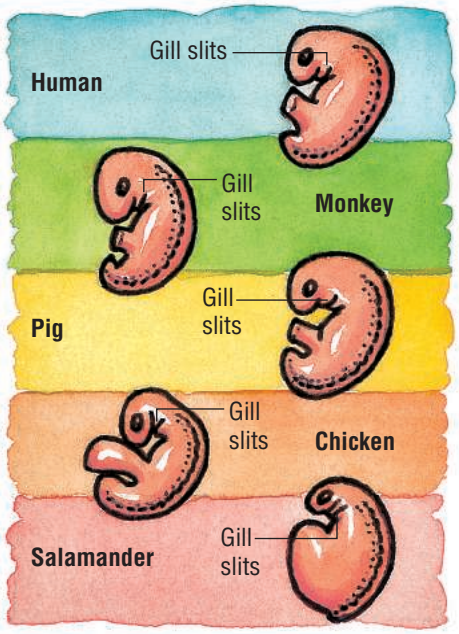
If you look at the structure of the limbs of birds, reptiles, mammals and amphibians, you can see similarities, although each is used for a different function. These are examples of **homologous structures**, where the similar structures present in different species are the result of common ancestry. The forearm of each species pictured is related to the fin of a fossilised fish, from which scientists believe amphibians evolved. DNA studies have confirmed the relationships between structures that were recognised as similar through comparative anatomy.



These limbs are all **adaptations** of a common underlying set of structures.

Comparative embryology

In the earliest stage of their development as embryos, birds, mammals, fish and reptiles all have gills. These similarities during the embryonic stage among closely related organisms are evidence of a common developmental pattern, the result of being related back to a **common ancestor**. The gills remain and develop in fish, but in humans they develop into Eustachian tubes that connect the throat and provide air to the middle ear.



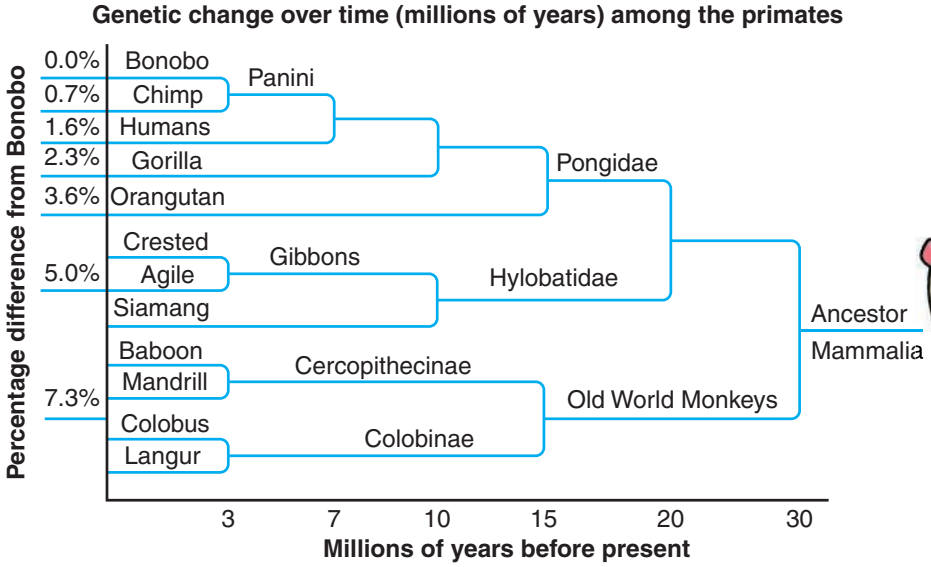
The embryos of very different species share many common features.

Comparing DNA

The strongest evidence for evolution is written in one of the world's tiniest codes. Since discovering the structure of DNA, and how it encodes genetic information, scientists have found that for humans, plants and most living things, the code is the same — only the order of the information is different. This suggests that life evolved only once on Earth, and that all species originated from one organism.

Evolutionary geneticists study how closely different species are related by comparing the similarities in their DNA. One method of measuring similarities between two species is DNA sequencing, in which the exact order of the DNA code is determined and compared to other, related species.

DNA studies generally confirm the evolutionary relationships that had been deduced from **biogeography** and comparative embryology, and anatomy.



Differences in DNA sequence can give an idea of how long two species have been separated.

Dragon's teeth

In China, dinosaur teeth were thought to be dragons' teeth! It was only after geologists, such as Charles Lyell, developed the idea that the Earth had formed over a much longer period than was previously believed (today's scientists estimate it is 4.5 billion years old) that fossils began to be widely recognised as the remains of ancient, extinct life forms.

Activities

REMEMBER

1. What type of scientist specialises in the study of fossils?
2. What are *homologous structures*?
3. Name and briefly describe two of the methods used to look at evolutionary relationships using DNA.

THINK

4. How are *comparative embryology* and *comparative anatomy* similar, and how do they differ?
5. Morphological studies are those that involve observing the structures and appearance of organisms. Which of the different types of evidence for evolution are morphological?
6. Why can't scientists design an experiment to test how a species has evolved?
7. If your school has access to a set of fossils, work through the following questions:
   (a) What information is provided about each fossil?
   (b) What parts of each have been preserved? What is missing?
   (c) Refer to a table of geographical eras. Draw up your own table and place each fossil in the era that it dates from. Can you make any generalisations based on this grouping?

BRAINSTORM

8. As a class, brainstorm the following: imagine a new species of animal is discovered in the depths of a Borneo jungle. It has fur, a long, muscular tail and lives in the canopy of the rainforest. How would you find out how it relates to other species?

ICT

9. Use Inspiration software to design a concept map showing ideas about the primate family.

learning

I CAN:

- ☐ explain what fossils tell us about evolution
- ☐ describe how comparative embryology, comparative anatomy and DNA studies provide evidence of evolution.