7.4 Scientific techniques

When archaeologists and historians find objects from the past, they often need help from scientists who use the latest techniques and machinery to gather more information. Many of these techniques – known as scientific techniques – are used to assess the likely age of sources. They can tell us, for example, the ages of the skulls in Source 2. Scientific techniques like the ones described below need to be used in combination with other historical techniques and evidence to provide a complete explanation of the past.

Scientific dating techniques

Many scientific dating techniques are used to investigate the past. Some are absolute dating techniques, which allow the age of an object to be stated as precisely as possible (in years). Others are relative dating techniques, which can only determine whether an object is of an earlier or more recent date relative to (compared with) another object.

Some scientific techniques used to analyse historical sources

- Stratigraphy (analysis of soil or rock layers)
- Fluorine dating (analysis of the age of bones)
- Radiocarbon dating
- Dendrochronology (analysis of tree rings)
- DNA analysis
- Ice-core sampling
- Palynology (analysis of microscopic organic compounds)

Source 1 Some scientific techniques used to investigate the past

Source 2 Three skulls – front: *Homo habilis* (Kenya, 1.88 million years old); centre: *Homo erectus* (Kow Swamp, Victoria, 13000 years old); back: *Homo sapiens* (Keilor, Victoria, 13000 years old)

Stratigraphy

Stratigraphy involves analysing sources found in the different strata of earth. Strata are layers marking different geological time periods. Since the layers of rocks are generally youngest on top and oldest on the bottom, items found in the lowest strata will usually be the oldest (see Source 3). In an archaeological dig, scientists may know that a particular stratum (the singular form of strata) is 1000 years old. This means that the items excavated from that stratum will probably be of a similar age.

Natural disasters and geological events can change the way strata are arranged, so it is not an exact science. Stratigraphy is a relative dating technique.

Fluorine dating

Bones can be dated using fluorine dating. Bones absorb the chemical element fluorine from the soil in which they are immersed. The longer they are there, the more fluorine they absorb. Like stratigraphy, this is a relative dating technique.

Source 3 Different artefacts are found in different strata (or layers). These are generally positioned according to their age. Artefacts found in stratum A will be more recent than those found in stratum E.

Radiocarbon dating

Radiocarbon dating is a complex technology that is more accurate than stratigraphy and fluorine dating. It is an absolute dating technique. All living things contain a particular type of carbon called C14, which is why we are called carbon-based life forms. This carbon is continuously renewed while an organism is alive. Living things stop absorbing C14 when they die. C14 is radioactive, which means that, over time, it breaks down at a known rate into a different type of carbon. Scientists use special equipment to work out how much C14 is still present in once-living organisms. Using that information, they can work out how long ago the organism died, and therefore how old it is.

Dendrochronology

Dendrochronology refers to tree-ring dating. Scientists can date a tree by studying the growth rings in a cross-section of its trunk (see Source 5). Each year in a tree's life, a new ring forms. It varies in shape and width according to the conditions that year. It has two parts: a light part (spring growth) and a dark part (summer/autumn growth). Scientists can study these rings and can compare rings between trees to determine their age.

Sometimes experts can calculate the relative age of wooden artefacts, such as bowls or floorboards. This is possible if they can match the ring patterns in the wood with those of local trees of the same species.

Source 5 Trees grow a new ring every year.

Source 4 Radiocarbon dating would determine the likely age of mummified human remains such as these. This corpse was found in central Asia.

Other scientific techniques

DNA analysis

All living organisms (except some viruses) contain deoxyribonucleic acid, or DNA. DNA holds the genetic code that determines how a living thing develops and operates. It is comparable to the ones and zeros that make up computer code and tell your software what to do. DNA is sometimes preserved in the remains of once-living organisms. Scientists can learn a lot from studying DNA. They can tell what type of organism it is. They can also tell how closely related it is to other species and to other individuals of the same species. For example, they can study the DNA of ancient remains and determine how closely related they are to modern humans.

Ice-core sampling

This technique works in a similar way to stratigraphy. Ice-core samples are long cylinders of ice that have been drilled from thick ice sheets. These samples are most commonly taken in the polar ice caps of Antarctica and Greenland, or from high mountain glaciers all over the world. As ice forms in the gradually increasing build-up of annual layers of snow, lower layers are older than upper layers. This means that an ice core contains ice formed over many years. Air trapped at various sections along an ice core, such as the one shown in Source 6, provides evidence of what the atmosphere was like at different periods in the past. Scientists can then form conclusions about the climate at a particular time.

Source 6 Scientists collecting ice-core samples in Antarctica

Source 7 Analysis of the fossilised pollen in this soil core allows researchers to find out how plant life in a particular area changed over thousands of years.

Palynology

Palynology is the study of microscopic organic compounds (such as pollen) that are found in soil. Taking soil cores enables scientists to analyse fossilised pollen and find out how plant life in a particular area has changed over thousands of years (see Source 7).

Check your learning 7.4

Remember and understand

1 In your own words, describe each of the scientific techniques covered in this section.
2 Describe how DNA analysis can help historians to better understand a source.

Apply and analyse

3 Explain why it is important to be able to date sources.
4 Imagine you found human remains at an archaeological dig. Which methods would be best suited to dating these remains and why?

Evaluate and create

5 Explain which dating technique you think is the most accurate or the most reliable. Justify your answer.
6 Study the evidence about the age of the Sphinx in the following Key concept section. Determine how old you think the Sphinx is. Make sure you support your decision with evidence.