

## Background Information Sheet for Teachers

### Using clues from the past to learn about the climate

#### Ice cores

By analysing the gases trapped in the air bubbles in the ice, scientists can determine the concentration of gasses present in the air at the time of freezing.

To determine the temperature that the air was trapped they use isotope ratio  $^{18}\text{O} : ^{16}\text{O}$  and  $^2\text{H} : ^1\text{H}$ , in the air. When ratios are low, there is a low temperature. At higher temperatures more of the lighter molecules escape into the atmosphere, giving a higher ratio. This process occurs when water condenses to form snow.

#### Sediment cores

Sediment cores may contain fossilised pollen, midges, insects, flowers etc. which lived at different temperatures. So scientists can roughly work out the temperature from the species present.

Fossil shells are made up of calcium carbonate. During its lifetime, the creatures that inhabited the shells slowly extracted oxygen from the water to build up its shell. Experiments have shown that the proportion of oxygen-18, ( $^{18}\text{O}$ ) and oxygen-16 ( $^{16}\text{O}$ ) in the shell is sensitive to temperature. This is the temperature of the water that the creature lived in. So scientists can estimate ocean temperature using the oxygen isotope ratios in the shell. Both surface and seabed temperatures can be determined by analysis of the fossils of creatures that lived near the surface and on the bottom of the sea.

#### Fossilised tree rings

In areas of the world where there are large variations between summer and winter climate, many trees form clear, annual growth rings around their circumference. The thickness of these rings depends on many things including temperature, water availability, light levels, which insects were around and how long the growing season was. The rings can also be affected by variation in the concentration of gases in the atmosphere. By studying these tree rings, scientists have access to a year-by-year record of the climate stretching back hundreds, and sometimes thousands, of years. Fossilised trees can also be used, providing data which goes back even further.

#### Leaves

Leaf margin and features of the cuticle can provide estimations about the mean annual temperature range, water availability etc. Observations have shown that smooth leaves prefer warmer climates and jagged leaves prefer cooler climates.

Leaves that live in shaded, humid conditions are thin and long. If they are exposed to high levels of light it evolves to become small and the cuticle thickens. The conflicting demands of water conservation, gas exchange and light capture are governed by the laws of physics (evaporation and gas diffusion). Plants solve these problems by adapting to their conditions. Scientists have found a strong correlation between leaf margin and temperature. Mathematical models have been derived. It is not totally clear why there is such a strong correlation between leaf margin and temperature but it has been suggested that the teeth may help to increase sap flow in plants which may be a benefit in cooler climates.