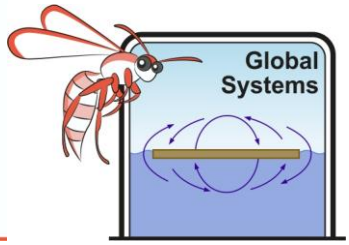

Radiocarbon – Teacher Notes

Dealing with data

Researchers need to collect data that is both accurate and precise. However, as Clifford Stroll famously said:

"Data is not information
Information is not understanding
Understanding is not wisdom" *Garbage in = Garbage out*

Researchers into climate change cannot directly use temperature measurements before three hundred years ago. Daniel Gabriel Fahrenheit only built the first accurate thermometer in 1709. It used a standard scale named after him. Prior to that instruments could only indicate if substances were cooler than or hotter than others.
To assess if changes in temperature are atypical or lie within the normal range of variation, researchers need information that stretches beyond a few hundreds of years. They need information that ranges over geological time. Milankovic cycles are variations in Earth's average temperature from 12°C to 22°C. Data suggest that they repeat over 100,000 year cycles.

Scientific data must be observable, measurable and repeatable.

Primary data is data collected by a scientist or group of scientists for a specific purpose

Secondary data is data collected by other scientists for another similar purpose but which can be used to support an hypothesis

Proxy data is data that can be used to infer information to support an hypothesis

Example
An Australian scientist observes and measures the length of year 10 students left arm. Which kind of data are they collecting? Primary data
The scientist then compares their data with that collected by a Japanese scientist. What kind of data are they using now? Secondary data
To get a word wide perspective, the scientist uses the sleeve length of uniforms given to fifteen years old Swedish maritime students during the 1914 to 1916 period.
What kind of data are they using now? Proxy data

To support the concept of Milankovic Cycles, scientists have drilled deep into the Antarctic Ice Cap. From ice core they have collected air bubbles trapped. From the volume carbon dioxide they can estimate the percentage of carbon dioxide in the atmosphere at that time. By using the carbon-14 to carbon 12 ratio in trapped carbon dioxide they can also estimate the age of the specimen. From this they can infer the ambient global temperature changes over a long period of time. Ice at the base of the cap in East Antarctica is estimated to be 1.5 million years old.

From the paragraphs above:
Give two examples of primary data collected and explain your choices. Temperature readings collected by Fahrenheit. (He collected them himself). Percentage of carbon dioxide in the air bubbles collected by the scientists themselves.
Give two examples of proxy data and explain your choice. Estimations of the temperature based on carbon dioxide levels and estimation of age based on carbon – 12 to carbon – 14 ratios.

Radiocarbon – Teacher Notes

Interesting fact Although the incidence of radiocarbon in the atmosphere has remained fairly constant at 1.2 parts per trillion to carbon-12 over the last few thousand years, above ground atomic bomb testing in the 1950s and 1960s caused a doubling of concentration. This spike was absorbed into tooth enamel and can be used as a marker to accurately estimate a person's age. CSIs can also measure the time of burial of bodies more that 400 years ago. At lesser time the readings can be inaccurate.