Geological Time Estimation
Teacher's Notes

An impression of the age of the Earth can be gained from unrolling a standard toilet roll. Life only begins halfway through the very last sheet.
Earth Scientists estimate the age of a rock in several ways:

The ***absolute age*** of rock strata is given in years, often with a plus or minus tolerance range.

- Radioactive materials decay at a known rate. The degree of loss of parent to daughter product is used to estimate the length of time since the molten rocks solidified and radioactive decomposition began. This method requires rocks to be igneous or found in close association with igneous rocks. The footsteps in volcanic tephra from Laetoli are a fine example of the latter when the geological age of the Australopithecine family can be dated at 3.7 million years before present (Reed et.al, 2019).

The ***relative age*** of rock strata is simply whether a rock is older than or younger than another and can be estimated by:

- The Principle of Superposition. In a group of undisturbed sedimentary rocks/sediments the younger rock overlies the older.
- The relative levels of mineralisation in fossils from the same location can also be used. Fluorine seeps into calcium rich bones and replaces it. However, since the amount of fluorine in groundwater varies from place to place, correlation cannot occur over distance.
- Changes in fossil structure in time can also provide an estimation of relative age of their enclosing strata.
- Index Beds are strata which can be correlated over geographic distances. Basalts in Sydney can be correlated with basalts in Tasmania because they are the same strata. (In some suburbs the age a house was built can be estimated by the colour of bricks and tiles on the roof). However, we cannot give the rocks below these the same age unless they also are the same strata. Erosion could have removed rock from one location resulting in the surfaces not being coeval.
- Index fossils are fossils which existed at a specific time period over a broad geographical area. They have wide distribution but limited vertical range. Glossopteris, an early tree which forms most of our coal measures in WA, can be used to correlate sediments between Collie and Moora in WA and across to South Africa. Ammonites, being marine, could travel all over the world's seas. Rocks of the Island of Skye in Scotland can be correlated with others in Switzerland. Organisms which do not change much over time make poor index fossils. Students may wish to add index fossils to their personal age scale worksheet.

Index fossils

Students discuss the criteria necessary for a good index fossil and attempt to insert good examples of this in the last column of their *Personal Time Scal*e worksheet (dummy/pacifier and hearing aid?) or students can sketch a cross section through a town rubbish tip and suggest good index fossils/rubbish for the last hundred years.

Correlate the Sediments

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References

Reed, D., Harrison, T. & Kwekason, A. Eyasi Plateau Paleontological Expedition, Laetoli, Tanzania, fossil specimen database 1998–2005. *Sci Data* **6,** 304 (2019). https://doi.org/10.1038/s41597-019-0304-2