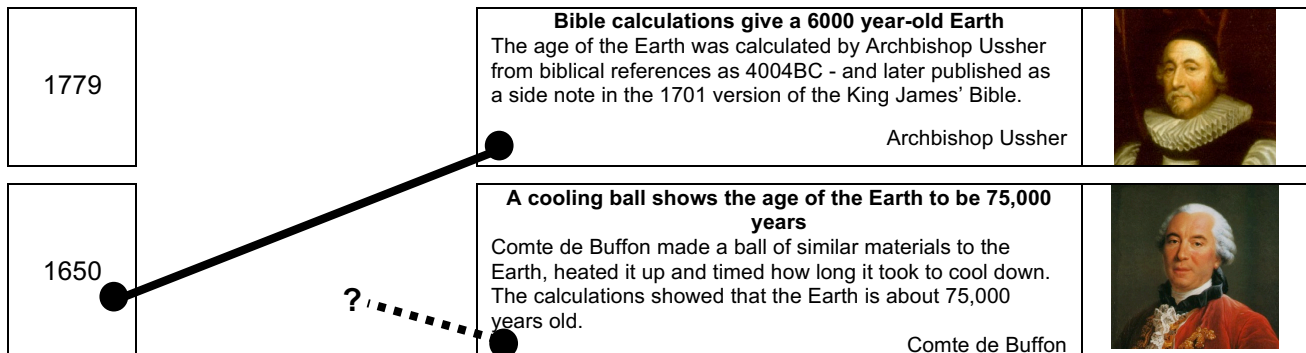


Working out the age of the Earth – moving backwards as time moved forwards

Link up your own timeline of how scientists worked out the age of the Earth

Link up the 'headlines' about calculating the age of the Earth (on page 3) like the example below, to show how ideas about the age of the Earth changed over time.

The first line has been drawn to show you what to do.



The back up

Title: Working out the age of the Earth – moving backwards as time moved forwards

Subtitle: Link up your own timeline of how scientists worked out the age of the Earth

Topic: This linking activity encourages pupils to think about how ideas of the age of the Earth changed over time.

Age range of pupils: 11 – 18 years

Time needed to complete activity: 15 mins




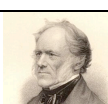



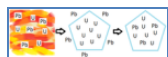
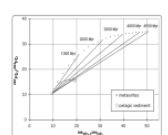
Pupil learning outcomes: Pupils can:

- describe how scientists' ideas of the age of the Earth have changed over time;
- describe some of the creative methods scientists have used to tackle the 'age of the Earth' problem.

Context:

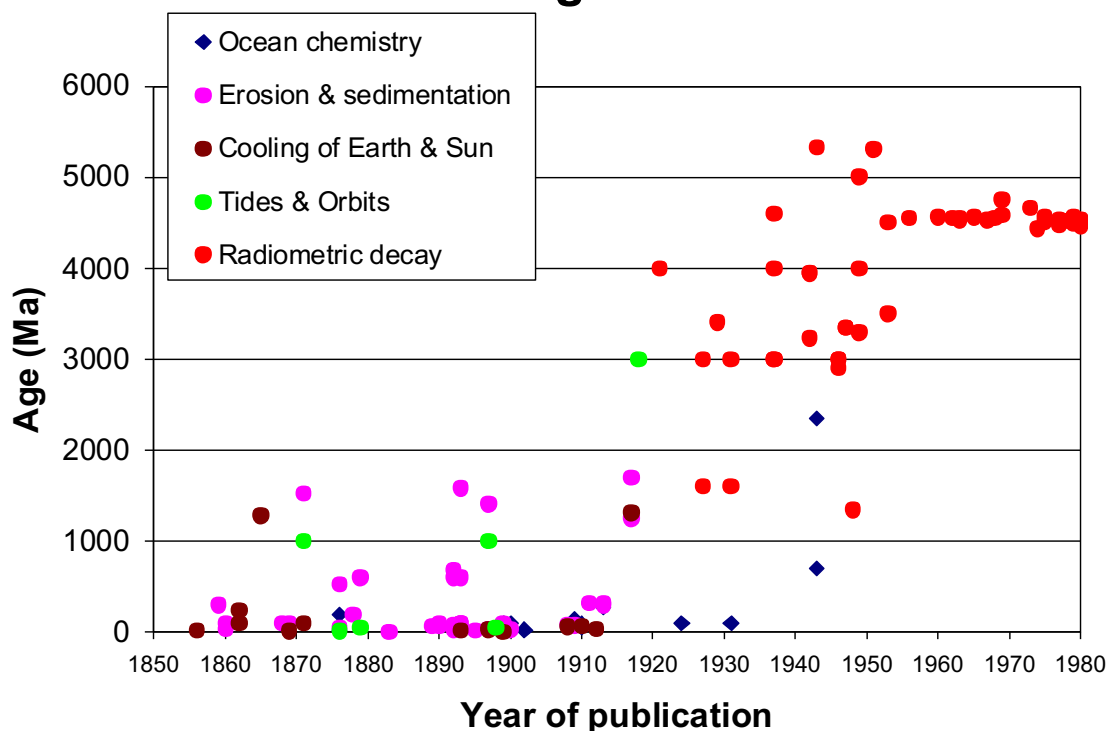
The ages linked up correctly will give the matching shown opposite. The linking lines should produce a 'star' of links.

Note that some of the calculations were accurate, but gave the wrong date because not all the data were known at the time. For example, Lord Kelvin's calculation that a molten Earth would take 24 million years to cool was correct; what he didn't know was that the Earth is being continually heated by radioactive decay and so is much older than this.

1650	Bible calculations give a 6000 year-old Earth Archbishop Ussher		<i>These images are in the public domain because their copyright has expired.</i>
1779	A cooling ball shows the age of the Earth to be 75,000 years Comte de Buffon		
1788	The Earth is so old that 'there is no vestige of a beginning ...' James Hutton		
1830	Since volcanoes have modern fossils beneath them, the Earth must be old Charles Lyell		
1860	Ganges sediment shows the Earth is 96 million years old John Phillips		
1897	Lord Kelvin calculates: a 24 million year old Earth Lord Kelvin		
1899	The salt in the sea gives an 80-90 million year date John Joly		
1931	Radioactive decay shows the Earth is 1.4 to 3.8 billion years old Zircon crystal trapping uranium		<i>I, KelvinW 344, the copyright holder of this work, release this work into the public domain. This applies worldwide.</i>
1956	Dating of meteorites shows that the Earth is 4.55 ± 1.5% billion years old The age of meteorites		<i>I, Jmpalin the copyright holder of this work, release this work into the public domain. This applies worldwide.</i>

A graph of Age of the Earth calculations compiled by Bob White is shown below, indicating how many attempts have been made to calculate the age of the Earth and how the age has become older over time, to the present general agreement.

Age of Earth



Following up the activity:

You could discuss (with care) how some religious texts have been interpreted to show that the Earth is very much younger than all the scientists' calculations – as the bible was in 1701 and still is by some people today

Underlying principles:

- A number of different and innovative ways have been used to calculate the age of the Earth since the first scientific estimation in 1779.
- Calculations of the age of the Earth from radiometric dating have given the most reliable figures, and in recent years have all clustered around 4.6 billion years, more easily remembered as near 4567 million years.

Thinking skill development:

Pupils will soon see that a pattern emerges (construction), as the age of the Earth calculations, in general, give older dates over time. Cognitive conflict is generated by Hutton and Lyell who made no calculations, apart from to say that the Earth was very old.

Resource list:

- copies of the sheet on page 3
- pencils and rulers to draw in the links

Useful links:

Able pupils will find Bob White's description of the debate about the Age of the Earth useful. It can be found in Faraday Paper No. 8 at: http://www.st-edmunds.cam.ac.uk/faraday/resources/Faraday%20Papers/Faraday%20Paper%208%20White_EN.pdf

Source: Devised by Chris King of the Earthlearningidea Team. The 'Age of the Earth' graph above was kindly provided by Professor Robert (Bob) White (rwhite@esc.cam.ac.uk) and is used with permission.

♥ **Earthlearningidea team.** The Earthlearningidea team seeks to produce a teaching idea regularly, at minimal cost, with minimal resources, for teacher educators and teachers of Earth science through school-level geography or science, with an online discussion around every idea in order to develop a global support network. 'Earthlearningidea' has little funding and is produced largely by voluntary effort.




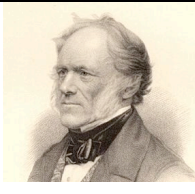

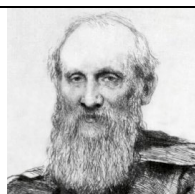
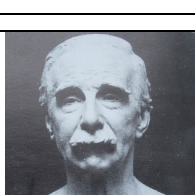
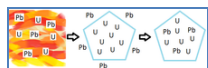
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Link up your own timeline of how scientists worked out the age of the Earth

1956	<p>Bible calculations give a 6000 year-old Earth The age of the Earth was calculated by Archbishop Ussher from biblical references as 4004BC – and later published as a side note in the 1701 version of the King James' Bible.</p> <p>Archbishop Ussher</p> 
1931	<p>A cooling ball shows the age of the Earth to be 75,000 years Comte de Buffon made a ball of similar materials to the Earth, heated it up and timed how long it took to cool down. The calculations showed that the Earth is about 75,000 years old.</p> <p>Comte de Buffon</p> 
1899	<p>The Earth is so old that 'there is no vestige of a beginning ...' James Hutton found rock sequences showing cycles of erosion, deposition and uplift over a great deal of time. When asked 'How much time?' he wrote – 'We find no vestige of a beginning ...' So he had no idea of how old the Earth was – but knew it was very old.</p> <p>James Hutton</p> 
1897	<p>Since volcanoes have modern fossils beneath them, the Earth must be very old Charles Lyell investigated how much lava volcanic Mount Etna in Italy was producing, and worked out its age as several hundred thousand years old. Since the fossils in the rocks beneath the volcano were identical to modern shellfish in the area – he showed that the Earth must be very old indeed.</p> <p>Charles Lyell</p> 
1860	<p>Ganges sediment show the Earth is 96 million years old John Phillips calculated, from how fast sediment was being laid down in the Ganges river basin, that the Earth must be nearly 96 million years old.</p> <p>John Phillips</p> 
1830	<p>Lord Kelvin calculates: a 24 million year old Earth William Thompson (Lord Kelvin) worked out that if the Earth had once been completely molten, it must have taken 24 million years to cool to its temperature today.</p> <p>Lord Kelvin (William Thompson)</p> 
1788	<p>The salt in the sea gives an 80-90 million year date John Joly worked out how much sodium was being carried to the sea by today's rivers and, from the saltiness of the ocean, calculated that the Earth was 80 – 90 million years old.</p> <p>John Joly</p> 
1779	<p>Radioactive decay shows the Earth is 1.4 to 3.8 billion years old Arthur Holmes calculated, from the decay of radioactive minerals in rocks, that the Earth was more than a billion years old.</p> <p>How a zircon crystal traps uranium as it forms, which then slowly decays to lead</p> 
1650	<p>Radioactive uranium/lead dating of meteorites shows that the Earth is $4.55 \pm 1.5\%$ billion years old Clair Patterson used radiometric dating to show that meteorites are $4.55 \pm 1.5\%$ billion years old – and the solar system and the Earth are likely to be the same age.</p> <p>The curves used to calculate the age of meteorites from U/Pb decay</p> 