How did scientists calculate the age of the Earth?

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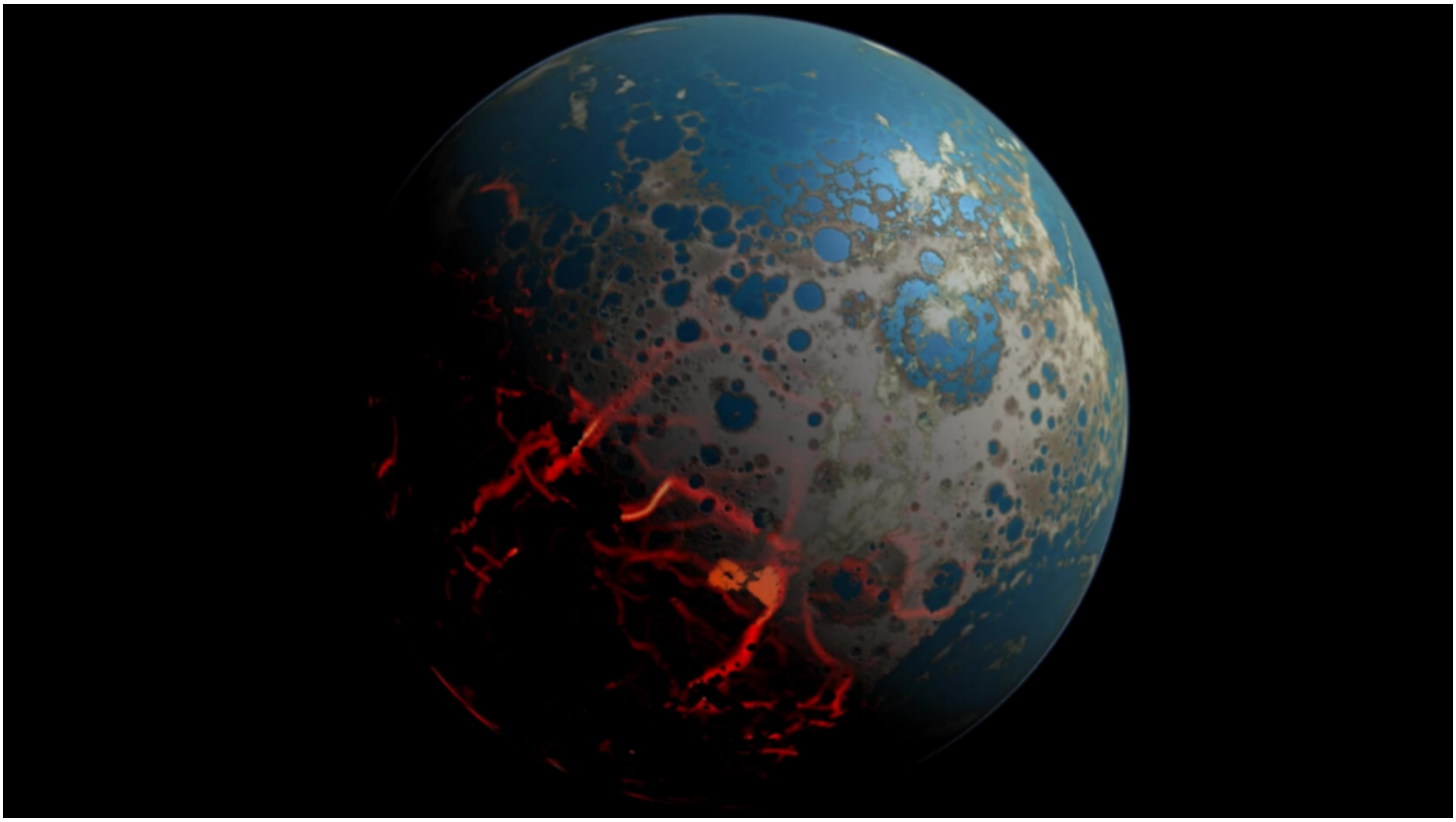


Image 1. An artistic conception of the early Earth, showing a surface pummeled by large impacts. Scientists used radiometric dating techniques to estimate the Earth's age at 4.5 billion years. Graphic: Simone Marchi/NASA Artistic rendering of early Earth

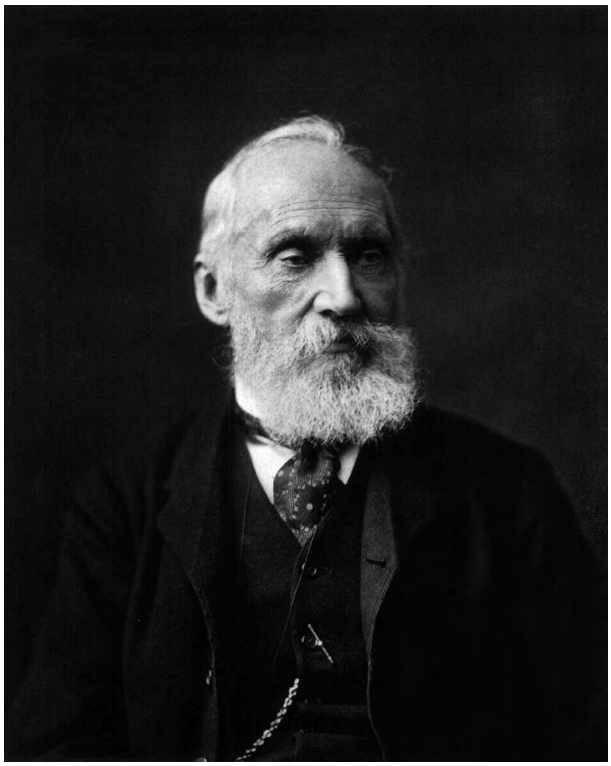
Take a look at a globe or a map of the world. You might see towering mountains, deep oceans and sprawling glaciers. All of these features make the Earth what it is today.

Even more interesting, by some people's standards, is how old the Earth is. Scientists have calculated the age of our planet to be about 4.5 billion years. But how did scientists determine that age? The answer is complicated: It involves everything from observation, to complicated mathematics, to understanding the elements that make up our planet.

From Hot To Cold Rocks

In the 1800s, scientists tried to determine the age of the Earth, but they made a few mistakes. In 1862, Lord Kelvin, a famous Irish scientist who studied physics and math, estimated that the Earth

was between 20 million years old and 400 million years old. Even an age of 400 million years would make the planet quite young in relation to the rest of the universe.



Lord Kelvin thought that if Earth had started as a mass of melted rock, it had to cool. He tried to calculate how long it would have taken to cool. His estimate was wrong, but his idea of drawing conclusions based on observations and calculations was an accurate scientific method.

Relative Dating Pushed Earth's Age Into Billions

Scientists also tried to use relative dating to determine the age of the Earth. This method compares layers of rock to determine how old each layer is in relation to one another. This method can show which layers are older or which events happened before others. However, it does not yield an actual date for those layers or events, so it does not provide an exact age.

Relative dating did not give scientists the exact number they were looking for. However, it did suggest that the Earth was most likely billions of years old, and not just millions as was previously thought.

Determining Absolute Age Of Rocks

Advances in chemistry, geology and physics continued, and in the early to mid-1900s, scientists found a method to determine the absolute age of a rock or mineral sample. The absolute age of a sample is its actual age in years. This method of determining absolute age is called radiometric dating, and it involves the decay, or breakdown, of radioactive elements. Using radiometric dating, scientists can determine the actual age of a rock.

Radiometric dating requires an understanding of isotopes. Isotopes are different forms of the same element, which have a different number of neutrons. Neutrons are tiny particles inside the nucleus, or core of an atom.

The isotopes of unstable radioactive elements are called parent isotopes. They decay, or break down, into other, more stable elements called daughter isotopes. They do this in a predictable way in a certain amount of time called a half-life. The half-life of an element is the amount of time required for exactly half of a quantity of that element to decay.

Scientists can measure the number of parent isotopes that are left in a sample. They compare this to the number of daughter isotopes that are in the sample. This comparison is called a ratio. Using the half-life, they can calculate how long it would take for that number of daughter isotope to form. Using the ratio and the half-life, they can determine the age of a rock sample.

Radiometric Dating Zeroes In On Earth's Age

One problem with this approach to dating rocks and minerals on Earth is the presence of the rock cycle. During the rock cycle, rocks are constantly changing forms. Old rocks are destroyed as they slide back into the Earth, and new rocks form when lava cools and solidifies.

The first rocks that formed on the Earth are no longer here, and this makes finding an exact age for the Earth difficult. The oldest rocks that have been found are about 3.8 billion years old, though some tiny minerals have been dated at 4.2 billion years.

To get around the difficulty presented by the rock cycle, scientists have looked elsewhere in the solar system for even older rock samples. They have examined rocks from the moon and from meteorites, neither of which have been changed by the rock cycle. Radiometric dating has also been used on those rocks. All of the data from this planet and beyond has led scientists to estimate Earth's age at 4.5 billion years.

Quiz

1 One of the article’s central ideas is that scientists have determined the Earth is 4.5 billion years old.

How does the author introduce this central idea?

(A) by explaining how Lord Kelvin came up with his estimate of Earth's age

(B) by giving a quick summary of how scientists tried to calculate Earth's age

(C) by describing how radiometric dating was used to estimate Earth's age

(D) by showing why rocks were so important for figuring out Earth's age

2 Which statement would be MOST important to include in a summary of the article?

(A) The Earth has features such as tall mountains and deep oceans that have taken many years to form.

(B) Relative dating was unable to give scientists the exact estimate of Earth's age, but it was helpful.

(C) Lord Kelvin is a famous Irish scientist who figured out that the Earth was at least 20 million years old.

(D) Scientists used radiometric dating of Earth's rocks and rocks from beyond Earth to calculate Earth's age.

3 What is the MAIN reason the author includes the section "Relative Dating Pushed Earth's Age Into Billions"?

(A) to highlight a method to calculate Earth's age that did not follow the scientific method

(B) to highlight a method to calculate Earth's age that is the most accurate way to date

(C) to highlight a method to calculate Earth's age that got closer to the latest estimate

(D) to highlight a method to calculate Earth's age that scientists prefer to use today

4 How would the article change if the section "From Hot To Cold Rocks" came before the introduction [paragraphs 1-2]?

(A) The readers would learn about the first estimate of Earth's age before learning the current estimate.

(B) The readers would learn about the current estimate of Earth's age before learning the first estimate.

(C) The readers would learn that the Earth is billions of years old before learning its exact age.

(D) The readers would learn the Earth's exact age before learning that it is billions of years old.