

The Oldest Rocks on Earth Did Not Form on Earth

Learning target: I can describe a puzzling pattern in the ages of the oldest rocks, connect it to what I already know about rock layers, and write a first explanation that I can test later in the chapter.

Phenomenon exploration

About 25 min

Pairs

MS-ESS1-4 · practice

MS-ESS2-2 · supports

discussion

writing

Name _____

Date _____

Period _____

Directions

Read the description of the phenomenon and study the table and the bar chart. Fill in the notice and wonder table on your own first. Then answer the questions with your partner, talking before you write. There are no wrong answers in q4 and q5; they are your first explanations, and you will come back to them at the end of the chapter to see what changed.

You will need: This worksheet, Pencil, A partner for q3 to q7

The phenomenon

Between 1969 and 1972, Apollo astronauts carried about 382 kilograms of moon rock back to Earth. When laboratories measured the ages of the oldest pieces, the answer was about 4.4 to 4.5 billion years. Meteorites, which are pieces of asteroids that fall to Earth, measure even older: about 4.56 billion years. Scientists use those numbers to say the solar system, and Earth with it, formed about 4.5 to 4.6 billion years ago.

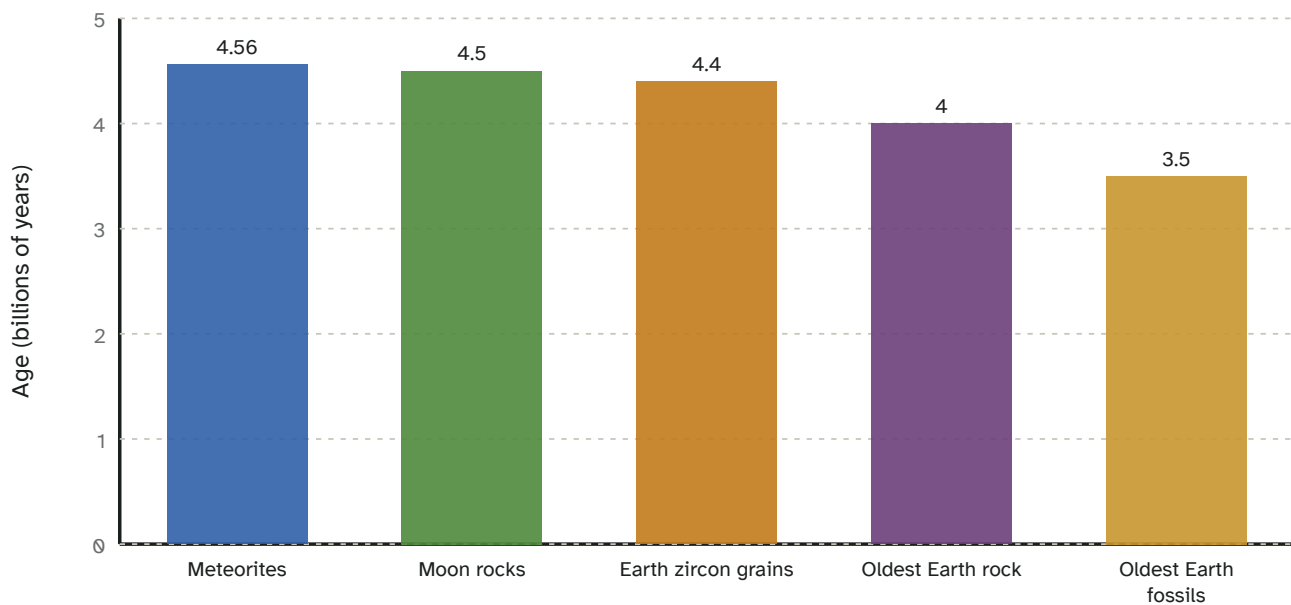
Here is the puzzle. Nobody has ever found a rock on Earth that old. The oldest known Earth rock, a gray banded rock from northern Canada called the Acasta Gneiss, is about 4.0 billion years old. The oldest known Earth *mineral grains*, tiny zircon crystals from the Jack Hills in Western Australia, are about 4.4 billion years old, but the sandstone they sit in is far younger: the grains were washed out of some older rock that no longer exists. The oldest widely accepted fossils, layered microbial mounds called stromatolites, are about 3.5 billion years old. If Earth, the moon and the asteroids formed at nearly the same time, why are Earth's oldest rocks the youngest of the group?

How an age in years is measured — Some minerals contain atoms that change into other kinds of atoms at a steady, known rate, like a clock that starts ticking when the mineral forms. Counting how far the change has gone gives an age in years. This is called **absolute dating**. It only works on certain minerals, usually ones that formed from cooling molten rock, and the clock resets if the rock melts again.

Oldest measured ages (real reference values, rounded)

Sample	Oldest measured age	Where it came from
Meteorites (pieces of asteroids)	about 4.56 billion years	Fell to Earth; the Canyon Diablo meteorite from Arizona is a famous example
Moon rocks (oldest Apollo samples)	about 4.4 to 4.5 billion years	Collected on the moon's surface by astronauts
Zircon mineral grains (Jack Hills, Australia)	about 4.4 billion years	Single grains inside a much younger sandstone
Acasta Gneiss (northern Canada)	about 4.0 billion years	The oldest known whole rock on Earth
Stromatolite fossils (Western Australia)	about 3.5 billion years	The oldest widely accepted evidence of life
Earth itself (accepted age)	about 4.54 billion years	Worked out from meteorites and moon rocks, not from any Earth rock

How far back each kind of sample reaches



Real rounded ages from the table. Notice the staircase: the bars get shorter as you move from space rocks to Earth rocks to Earth fossils.

Notice and wonder (on your own)

1. Record three things you notice and three things you wonder. A notice must be something you can point to in the table or chart; a wonder must end with a question mark.

I notice (something I can see in the text, table or chart)	I wonder (a question it makes me ask)
1	
2	
3	

2. How much older are the oldest meteorites than the oldest known Earth rock? Show the subtraction, in billions of years and then in millions of years.

What you already know (with your partner)

3. In the last lesson you learned ways to tell which rock layer is older. Write two rules or clues you already know for putting rocks in order, and say whether each one gives an age in years or only an order (older than, younger than).

4. First explanation: Earth formed about 4.54 billion years ago, yet no Earth rock older than about 4.0 billion years has been found. Write your best explanation for where the first half-billion years of Earth rock went. Use at least one of these words: *melted, recycled, worn away, buried*.

5. If Earth's own rocks cannot give Earth's age directly, why might scientists trust the ages of meteorites to stand in for the age of Earth? Write your best idea, even if you are not sure.

6. The zircon grains are 4.4 billion years old, but the sandstone they sit in is much younger. Explain how a single grain can be older than the rock around it. (Think about where sand comes from.)

7. Write two questions you would need answered to test your explanation in q4. Each question should name something a scientist could actually look for or measure.

Sentence frames for the first explanation

If q4 feels hard, start with one of these: 'The oldest Earth rocks are gone because ___, which could not happen on the moon because ___.' Or: 'The moon and the meteorites kept their old rocks because nothing ___ them, but on Earth ___ keeps changing the surface.' You may also draw a quick sketch of what Earth's surface does over millions of years and label it instead of writing a full paragraph.

Why the moon is a better time capsule

The moon has no oceans, no rain, almost no air and no moving plates, and its surface is covered with craters that are billions of years old. Earth has only about 200 confirmed impact craters, most of them young. Predict which body has more very old rock exposed at its surface today and explain why, then suggest what that means for a scientist who wants to study the first 500 million years of the solar system. Write a short paragraph with at least two reasons.