Inside a Layered Earth

Use density data and heat sources to explain Earth's internal structure.

ESS.2A.1 "Analyze and interpret data to explain and communicate the differentiation of Earth's internal chemical structure (e.g., core, mantle, and crust) using the production of internal heat from the radioactive decay of unstable isotopes and..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline one sentence about each heat source, then circle the density ranges in the table that help explain the order of Earth's layers.

How Earth Became Layered

1. Earth did not begin as three tidy layers. As the young planet pulled in debris, collisions and compression released energy. Dense material sinking toward the center released more gravitational energy. Together, these processes heated young Earth enough for much of its interior to separate by density. The table compares today's layers, from the surface inward.

EARTH'S LAYERS: TYPICAL MATERIALS AND APPROXIMATE DENSITIES

Layer	Typical materials	Density (g/cm^3)
Crust	Silicate rock, relatively rich in silicon	2.7–3.0
Mantle	Silicate rock rich in magnesium and iron	3.3–5.7
Core	Mostly iron and nickel	9.9–13.1

2. The numbers provide evidence, not just labels. The iron-rich core is far denser than the rocky mantle or crust. When early Earth was partly molten, iron-rich material could sink, while less dense rocky material remained above it. Later, partial melting of mantle rock produced some of the melts that formed Earth's crust.

3. Heat did not vanish when the layers formed. Unstable isotopes in rocky materials decay, releasing energy mainly within the mantle and crust. This ongoing heat helps keep the mantle hot and slowly moving, though most mantle rock remains solid. Radioactive decay sustains internal heat; gravitational energy played a major role in the earlier separation.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the core's materials and density range help explain why it lies below the mantle?

2. Compare the crust and mantle in the table. How does their density pattern fit the passage's explanation of where crust formed?

3. Why does radioactive decay still matter after Earth's layers formed? Identify where most of this heat is released.

4. A student says, "Radioactive decay first sorted Earth into layers." Evaluate the claim using the passage and one density comparison from the table.

3 YOUR TURN

Your own words

Imagine two young rocky planets containing metal and silicate rock. Planet A becomes partly molten, but Planet B stays mostly solid. Predict which is more likely to form a dense metal center, and support your prediction with Earth's density data, a source of early heat, and the later role of radioactive decay.

ANSWER KEY

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PART 1 · READ AND MARK

Underline one sentence about each heat source, then circle the density ranges in the table that help explain the order of Earth's layers. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the core's materials and density range help explain why it lies below the mantle?	**The mostly iron-and-nickel core is much denser than the rocky mantle. When early Earth was partly molten, dense metal could sink below mantle rock.**
2	Compare the crust and mantle in the table. How does their density pattern fit the passage's explanation of where crust formed?	**The crust is less dense than the mantle and lies above it. Melts derived from mantle rock helped form that outer layer.**
3	Why does radioactive decay still matter after Earth's layers formed? Identify where most of this heat is released.	**Decay of unstable isotopes releases heat mainly in the rocky mantle and crust. It helps keep the mantle hot and slowly moving.**
4	A student says, "Radioactive decay first sorted Earth into layers." Evaluate the claim using the passage and one density comparison from the table.	**The claim is not supported. Early heating, including gravitational energy, allowed dense material to sink; the core's density of 9.9–13.1 g/cm^3 exceeds the mantle's 3.3–5.7 g/cm^3. Radioactive decay helps sustain heat after layering.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Planet A is more likely to form a dense metal center because melting lets metal sink. Earth's core has a density of about 9.9–13.1 g/cm^3, compared with 3.3–5.7 g/cm^3 for its mantle. Collisions and sinking metal could supply early heat, while radioactive decay in rocky layers could help keep Planet A's interior hot later.

Accept explanations that distinguish early heat and density-driven separation from the continuing heat produced by radioactive decay. Students may cite either density ranges or a correct comparison between them.