

Heat Does Not Float: Fixing Mateo's Quiz

Learning target: I can find the errors in a classmate's explanations of convection, Earth's layers, energy sources and the biosphere, explain why each idea is wrong, and rewrite it correctly.

Error analysis

About 40 min

Individual

MS-ESS2-1 · practice

MS-LS2-3 · supports

writing

independent practice

Name _____

Date _____

Period _____

Directions

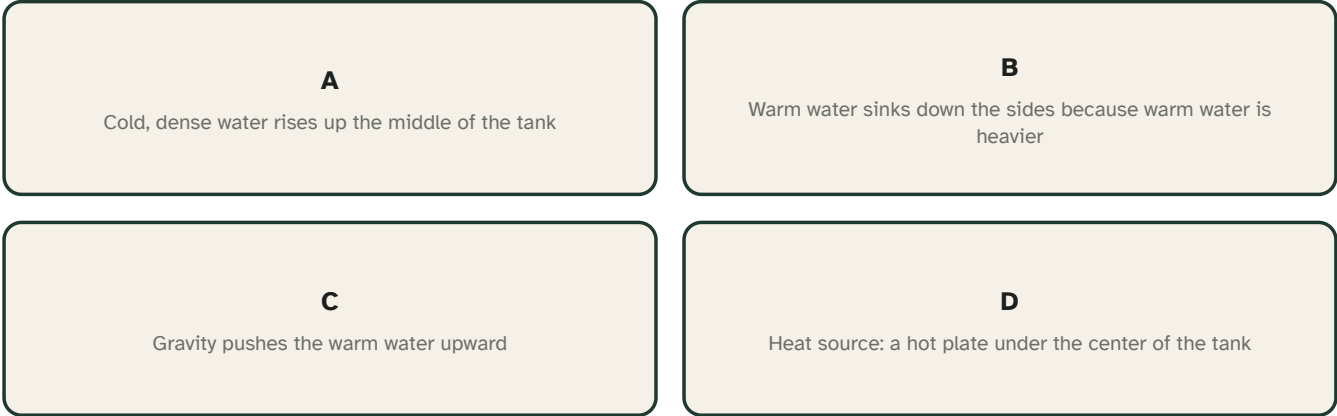
Mateo took the lesson quiz and wrote the eight answers below, then drew the convection diagram. Some answers have a serious error, and one is correct. For every item, decide whether it is right or wrong, explain exactly what went wrong, and rewrite the wrong answers so that they are scientifically accurate. Be specific: 'it is wrong' earns nothing; 'it says heat moves up on its own, but it is the less dense water that is pushed up' earns full credit.

You will need: This worksheet, Pencil, W2 word bank (optional)

Mateo's quiz answers

#	Quiz question	Mateo's answer
1	Why does warm water rise in a tank heated from below?	Heat rises. Heat always goes up, so the hot water floats to the top and the cold water just stays where it is.
2	Describe the mantle.	The mantle is a sea of liquid magma under the crust. That is why it flows and why volcanoes have lava.
3	How does the sun's energy reach Earth?	By convection. The hot air from the sun rises and travels through space until it reaches Earth.
4	Why is Earth's core so hot?	Because the layers above squeeze it. Pressure makes heat, like a bike pump getting warm when you use it.
5	What happens to energy in a food chain?	Energy cycles. Decomposers break down dead plants and send the energy back into the soil so new plants can use it, so energy goes around and around.
6	Which Earth system or systems does a rain cloud belong to?	Only the atmosphere, because it is up in the air. Water in the sky is not part of the hydrosphere until it lands.
7	Biosphere 2 was a closed system. What does that mean?	Nothing at all could get in or out, not even sunlight. That is why the oxygen ran low: there was no light for the plants.
8	Why does warm ocean water near the equator stay at the surface?	The sun warms the surface water, which makes it less dense than the colder water below it, so it stays on top instead of sinking.

Mateo's convection tank



Mateo's diagram of a tank heated from below. Four labels, A to D, describe what he thinks is happening. Check each one.

Part A: Diagnose

1. For each of Mateo's eight answers, write 'correct' or 'error' and one sentence naming the exact mistake (or, for the correct one, the idea that makes it right).

Correct or error?	What exactly is wrong (or why it is right)
Answer 1	
Answer 2	
Answer 3	
Answer 4	
Answer 5	
Answer 6	
Answer 7	
Answer 8	

2. Which of the diagram labels A to D are wrong? For each wrong label, name the mistake in a few words.

Part B: Rewrite

- 3.** Rewrite answer 1 correctly. Your version must explain what actually rises, why it rises, and what gravity does. Do not use the phrase 'heat rises.'

- 4.** Rewrite answer 2 correctly. Include what state the mantle rock is in, how it can still move, and where the liquid rock in a volcano comes from.

- 5.** Rewrite answer 3 correctly. Name the right transfer method and explain why Mateo's method is impossible between the sun and Earth.

- 6.** Rewrite answer 4 correctly, naming the two main sources of the interior's heat. (The textbook also mentions pressure; say what pressure actually does to the inner core.)

- 7.** Rewrite answer 5 correctly. Your version must say what cycles and what does not, what decomposers really return to the soil, and where the energy ends up.

8. Rewrite answers 6 and 7 correctly, in one or two sentences each.

9. Rewrite the wrong labels on the diagram (A, B and C) so that the diagram is correct. Keep label D.

10. Mateo's errors in answers 1, 3 and 5 and in label C share one underlying confusion. Name it in one sentence, and suggest one habit that would help him avoid it.

Two test questions for every answer

For each of Mateo's answers, ask: (1) Is he talking about energy or about matter? Energy is carried, matter moves; if a sentence has heat doing the moving on its own, something is off. (2) What is the force? In this lesson the only force that makes things rise or sink is gravity acting on denser and less dense material, so any answer that gives gravity a different job needs rewriting. Check the word bank from W2 for the exact meaning of each term before you rewrite.

Write the next quiz

Write three new quiz questions about this lesson that would catch a student who still believes 'heat rises,' 'the mantle is liquid' or 'energy cycles.' For each question, write a wrong answer such a student would give, the correct answer, and one sentence explaining why the wrong answer is tempting. The best questions describe a new situation (a swimming pool, a greenhouse, a volcano on another planet) rather than repeating the textbook's examples.