Earth's Energy Balance

Use energy-flow data to explain climate change

EN.ESS2.4 "Analyze and interpret data to explore how variations in the flow of energy into and out of Earth's systems cause changes to the atmosphere and climate."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the two changes that alter energy flows, then circle every table value that differs from the baseline. Use your marks to connect each change to its net energy gain.

Where Does Earth's Energy Go?

1. At the top of Earth's atmosphere, sunlight arrives, some is reflected to space, and the rest is absorbed by the surface and atmosphere. Earth also sends energy back to space as infrared heat. Scientists compare these flows in watts per square meter, written W/m². A positive net gain means Earth takes in more energy than it sends out.

2. The table shows four simplified snapshots of the same planet. Each number is an energy flow in W/m², averaged over the whole planet. In the darker-surface case, less sunlight reflects away. In the heat-trapping case, less infrared energy escapes because gases absorb and re-emit it. These snapshots hold other listed flows fixed to isolate each change.

SIMPLIFIED PLANETARY ENERGY FLOWS

Case	Incoming sunlight (W/m²)	Reflected sunlight (W/m²)	Outgoing infrared (W/m²)	Net gain (W/m²)
Baseline	340	100	240	0
Darker surface	340	98	240	2
Heat trapping	340	100	238	2
Combined	340	98	238	4

3. Compare the net gains, not just one column. The combined case adds the effects of a darker surface and stronger heat trapping. Extra energy warms mainly the oceans, while the land and air also warm; atmospheric temperature patterns can shift. Over time, a warmer Earth emits more infrared energy, reducing the imbalance unless the flows change again.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare the darker-surface case with the baseline. Which flow changes, and how does that change produce the net gain shown?

2. Compare the heat-trapping case with the baseline. Which flow changes, and what does its net gain indicate?

3. How does the combined case's net gain compare with either single-change case? What temperature trend would you expect while that gain continues?

4. All four cases receive the same amount of incoming sunlight. What does this rule out as the cause of their different net gains, and which flows do change?

3 YOUR TURN

Your own words

Choose an incoming sunlight value from 335 to 345 W/m^2, but not 340, and keep the baseline's other flows. In three or four sentences, calculate the net gain and predict the short-term temperature trend and how outgoing infrared might respond over time.

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PART 1 · READ AND MARK

Underline the two changes that alter energy flows, then circle every table value that differs from the baseline. Use your marks to connect each change to its net energy gain. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare the darker-surface case with the baseline. Which flow changes, and how does that change produce the net gain shown?	**Reflected sunlight falls from 100 to 98 W/m^2. With the other flows unchanged, Earth retains 2 W/m^2 more energy.**
2	Compare the heat-trapping case with the baseline. Which flow changes, and what does its net gain indicate?	**Outgoing infrared falls from 240 to 238 W/m^2. The 2 W/m^2 net gain indicates that Earth takes in more energy than it sends out.**
3	How does the combined case's net gain compare with either single-change case? What temperature trend would you expect while that gain continues?	**Its 4 W/m^2 gain is twice either single-change gain of 2 W/m^2. Earth would warm while the gain continues.**
4	All four cases receive the same amount of incoming sunlight. What does this rule out as the cause of their different net gains, and which flows do change?	**Changes in incoming sunlight cannot explain the different net gains. Reflected sunlight and outgoing infrared change.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

My new case has incoming sunlight of 344 W/m^2, reflected sunlight of 100 W/m^2, and outgoing infrared of 240 W/m^2. The net gain is 344 - 100 - 240 = 4 W/m^2. Earth would warm at first. As it warms, outgoing infrared would increase, reducing the gain.

Accept any allowed incoming value with a correctly calculated net gain. A positive gain should predict warming and eventually more outgoing infrared; a negative gain should predict cooling and eventually less outgoing infrared.