Pocket Heat Test

Design and test a chemical hand warmer

8.7.a "Design and test a device that can release or absorb thermal energy by chemical reactions."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the design goal, circle what changes between the two devices, and number the steps used to test them. Use your marks to decide which design meets the goal.

A Warmer That Works

1. At a winter bus stop, a hand warmer can help keep fingers comfortable. An air-activated warmer contains iron powder. When oxygen in the air reacts with the iron, the reaction releases thermal energy. A class wants to place a sealed warmer in a fabric sleeve so it does not touch skin directly. Their goal is for the outside of the device to stay between 32°C and 38°C at both 10 minutes and 40 minutes after activation. A temperature outside that range means the design misses the goal.

2. The class tests two devices. Each has an identical iron packet inside an identical fabric sleeve. One sleeve has an extra thin, breathable wrap around it; the other has no extra wrap. The wrap leaves the sleeves' air vents uncovered so both packets can get oxygen. Students activate the packets at the same time and place the devices side by side in the same room. At each reading, they measure the center of the outside face of each complete device, directly over its packet.

3. The room is 21°C. After 10 minutes, the device without the extra wrap measures 42°C, while the wrapped device measures 36°C. After 40 minutes, the unwrapped device measures 30°C, while the wrapped device measures 33°C. The class checks both readings against its goal instead of choosing the device with the highest temperature. These measurements show how each complete device performed in this room. A test outdoors would help the class learn whether its chosen design also works at a cold bus stop.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why must both packets be able to get oxygen during the test?

2. Why do students measure the same place on the outside of each complete device?

3. Which device meets the temperature goal at both times? Use both of its readings to support your choice.

4. What should the class keep the same when it tests its chosen device outdoors, and what question would that test answer?

3 YOUR TURN

Your own words

Design a device that uses a sealed air-activated iron warmer to help keep a small water bottle warm on a winter walk. Describe how you would build it and compare it with a bottle without a warmer in a fair test; name what you would measure and a result that would show your device works.

ANSWER KEY

Pocket Heat Test

GRADE 8 · 8.7.a

PART 1 · READ AND MARK

Underline the design goal, circle what changes between the two devices, and number the steps used to test them. Use your marks to decide which design meets the goal. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why must both packets be able to get oxygen during the test?	**Oxygen reacts with the iron to release thermal energy. Blocking oxygen could change the reaction rather than test the effect of the wrap.**
2	Why do students measure the same place on the outside of each complete device?	**Measuring at matching points makes the temperatures comparable and tests what a hand would feel on each device's outer surface.**
3	Which device meets the temperature goal at both times? Use both of its readings to support your choice.	**The wrapped device meets the goal. Its outside measures 36°C at 10 minutes and 33°C at 40 minutes, both within 32°C to 38°C.**
4	What should the class keep the same when it tests its chosen device outdoors, and what question would that test answer?	**Keep the packet, sleeve, wrap, measurement point, and reading times the same. The test would show whether the device also stays within the goal range outdoors.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would attach a sealed iron warmer to the outside of a small water bottle with a breathable holder that leaves the warmer exposed to air. I would place an identical bottle beside it, with the same amount of water at the same starting temperature but no warmer. Both bottles would stay outdoors together. I would measure the water temperature in each bottle at the start and after 30 minutes. My device works if its water is warmer after 30 minutes.

For Part 3, accept designs that allow oxygen to reach a sealed iron warmer and compare water temperatures under the same conditions. The student's stated result must use those measurements to judge whether the device works.