

Warmer Test Lab

Use evidence to plan, evaluate, and improve a fair test.

PS.1 "The student will demonstrate an understanding of scientific and engineering practices by asking questions and defining problems ask questions that require empirical evidence to answer develop hypotheses indicating relationships between..."

NAME _____ DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline the research question and hypothesis. Circle the independent variable, dependent variable, constants, and control, then number the two limits on the conclusion.

Testing a Hand Warmer

- ① Engineers at Riverbend Middle School wanted to improve a hand warmer made from iron powder. They asked, "How does the amount of saltwater added affect the temperature increase?" This question needs measurements, not opinions. Their hypothesis stated that if more saltwater is added, then the warmer's temperature increase will rise. Saltwater volume was the independent variable, and temperature increase was the dependent variable. Each group wore goggles and used a digital thermometer carefully.
- ② To make a fair test, the groups kept the iron mass, cup size, starting temperature, and stirring time constant. They tested 5, 10, and 15 milliliters of saltwater three times each. A control cup received 0 milliliters. The table shows temperature increases after five minutes. Repeated trials helped reveal variation. The control let students compare the reaction with a cup that received no saltwater.

TEMPERATURE INCREASE AFTER FIVE MINUTES

Saltwater volume (mL)	Trial 1 (°C)	Trial 2 (°C)	Trial 3 (°C)	Mean (°C)
0	0.0	0.1	0.2	0.1
5	3.0	3.2	3.1	3.1
10	5.3	5.1	5.2	5.2
15	5.4	5.3	5.5	5.4

- ③ The 10 and 15 milliliter means were close, so more saltwater gave little extra heating. A graph would put volume on the horizontal axis and mean temperature increase on the vertical axis. Students should not claim 15 milliliters is always best. Only three trials were run, and room temperature may have changed. They recommended testing 10 milliliters again with more trials.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 What evidence would answer the engineers' research question?

2 Name the independent variable and dependent variable. Then name two constants in the test.

3 Which tested saltwater volume had the highest mean temperature increase? Why is that result not enough to prove it is always best?

4 How did the control cup help make the investigation stronger?

3 YOUR TURN _____ Your own words

Plan a fair test for a different safe classroom object or process. Write an empirical question, an if-then hypothesis that names the independent and dependent variables, and a brief method with one constant, a control or comparison condition, three trials, and one safety step.

PART 1 • READ AND MARK

Underline the research question and hypothesis. Circle the independent variable, dependent variable, constants, and control, then number the two limits on the conclusion. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	What evidence would answer the engineers' research question?	Measurements of temperature increase for hand warmers given different volumes of saltwater.
2	Name the independent variable and dependent variable. Then name two constants in the test.	Independent variable: saltwater volume. Dependent variable: temperature increase. Constants include iron mass, cup size, starting temperature, and stirring time.
3	Which tested saltwater volume had the highest mean temperature increase? Why is that result not enough to prove it is always best?	15 mL had the highest mean, 5.4 °C. Only three trials were run, and room temperature may have changed.
4	How did the control cup help make the investigation stronger?	It provided a comparison with a cup that received no saltwater.

PART 3 • YOUR TURN (SAMPLE ANSWER)

Question: How does wing length affect the flight distance of a paper airplane? Hypothesis: If wing length increases, then flight distance will increase because larger wings may provide more lift. I will fly airplanes with 6 cm, 8 cm, and 10 cm wings three times each and measure distance with a meterstick. I will keep the paper type, airplane design, thrower, and launch spot constant. The 8 cm standard-wing airplane is the comparison condition. I will clear the flight path before throwing.

Accept equivalent evidence-based descriptions of variables, constants, controls, repeated trials, and limitations. For the open response, accept any safe, testable plan that clearly identifies the required parts and uses a measurable dependent variable.