

Impact Choices

Compare design solutions using criteria, constraints, and test evidence.

PS.1.d.iii "constructing and critiquing conclusions and explanations generate and compare multiple solutions to problems based on how well they meet the criteria and constraints"

NAME _____ DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline the two criteria, circle the three constraints, and number the two values in the Design B row that support the team's choice.

Protecting an Egg

- ① A team needed to protect a raw egg during a one-meter drop. Its criteria were an uncracked egg and a package light enough to carry easily. Its constraints were reused paper only, a cost of no more than one dollar, and twenty minutes for construction. Cushioning can lengthen stopping time during impact. Longer stopping time lowers average force on the egg.
- ② Design A used tightly rolled paper tubes around the egg. Design B used loose crumpled paper inside a paper cup. Design C used flat paper layers. Every package met the three constraints. The team dropped each package three times from the same height onto the same hard surface, using a new egg each time. They recorded uncracked eggs and package mass.

EGG PACKAGE TEST RESULTS

Design	Uncracked eggs, out of 3	Package mass, grams
A	3	42
B	3	28
C	1	18

- ③ Design B was the strongest choice because it protected all three eggs and had less mass than Design A. Design C was lightest, but it did not meet the protection criterion. The team linked loose crumpled paper to better impact absorption. That explanation is plausible, but more drops on different surfaces are needed before claiming paper shape caused the difference.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 List both criteria and all three constraints for the egg package.

2 Which design meets both criteria best? Use two values from the results to support your answer.

3 Compare Design B and Design C. What advantage does each design have based on the test results?

4 Why does the passage say the team needs more evidence before claiming that paper shape caused the difference?

3 YOUR TURN _____ Your own words

A lab needs a holder for a glass test tube that might be bumped or set down hard. Create two reused-paper holder designs that cost less than one dollar and take no more than twenty minutes to build. Compare the designs, choose one that best protects the tube and is easy to carry, and describe one fair test.

PART 1 • READ AND MARK

Underline the two criteria, circle the three constraints, and number the two values in the Design B row that support the team's choice. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	List both criteria and all three constraints for the egg package.	Criteria: keep the egg uncracked and make the package easy to carry. Constraints: use reused paper only, cost no more than \$1, and finish in 20 minutes.
2	Which design meets both criteria best? Use two values from the results to support your answer.	Design B. It kept 3 of 3 eggs uncracked and had a mass of 28 g, less than Design A, which also kept 3 of 3 eggs uncracked.
3	Compare Design B and Design C. What advantage does each design have based on the test results?	Design B has better protection, with 3 uncracked eggs compared with 1 for Design C. Design C is lighter, at 18 g compared with 28 g for Design B.
4	Why does the passage say the team needs more evidence before claiming that paper shape caused the difference?	The team tested only three drops for each package and used only one drop surface. More drops and different surfaces could show whether the result repeats.

PART 3 • YOUR TURN (SAMPLE ANSWER)

Solution 1 is a folded cardboard sleeve with a thick crumpled-paper base. Solution 2 is a paper cup holder with four rolled-paper side supports and a crumpled-paper base. Both use reused paper, cost less than one dollar, and can be built in twenty minutes. I would choose Solution 2 because its side supports can keep the test tube from striking the cup wall, while its base can lengthen stopping time if it is set down hard. I would carry identical test tubes in both holders along the same route ten times and record slips or cracks.

Accept accurate paraphrases of the criteria and constraints. For the open task, accept varied paper designs if students give two solutions, compare them using both criteria, follow all constraints, and describe a fair comparison test.