Brighter or Better?

Refine a photosynthesis test using evidence

BOT.1.8 "Enrichment: Use an engineering design process to manipulate a variable of choice to refine a protocol to optimize output of photosynthesis or cellular respiration.*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the factor the team changes, circle two conditions it keeps constant, and number the sentences that describe the first test and the refined test.

Finding the Best Light Setting

1 A school greenhouse team wants to improve photosynthesis in pondweed without adding more equipment. They use a dissolved oxygen probe to estimate photosynthesis: oxygen in the water rises when the plant produces more than it consumes. Their design goal is the largest oxygen increase in ten minutes. They can adjust one factor, the brightness of a dimmable LED.

2 The team tests four LED settings while keeping the same plant mass, water volume, LED distance, dissolved carbon supply, and trial length. They also monitor water temperature so heating cannot quietly change the results. Each setting is tested three times, and the table reports the mean increase in dissolved oxygen, not the starting oxygen level.

PONDWEED LIGHT TEST

LED brightness	Mean oxygen increase in 10 minutes
25%	0.3 mg/L
50%	0.7 mg/L
75%	1.0 mg/L
100%	0.9 mg/L

3 The first test identifies a promising setting, not a final answer. The team plans to test 65% and 85% brightness alongside 75% to search near the highest result. They will repeat each setting three times under the same conditions. If a new setting gives a larger mean oxygen gain, they will adopt it and test again.

2 ANSWER WITH EVIDENCE

Use the passage

1. What factor does the team change, and what are two conditions it keeps constant to make the comparison fair?

2. Which tested brightness best meets the team's goal? Compare its result with the result at 100%.

3. Why will the team test 65% and 85% brightness alongside 75%?

4. Suppose 85% brightness produces a mean oxygen increase of 1.1 mg/L under the same conditions. Should the team adopt it for the next protocol? Explain.

3 YOUR TURN

Your own words

Design a test to optimize cellular respiration in germinating pea seeds. Choose one factor other than LED brightness, give two settings to compare, name a measurable output and two conditions to keep constant, and explain what result would make you revise the protocol.

Brighter or Better?

PART 1 · READ AND MARK

Underline the factor the team changes, circle two conditions it keeps constant, and number the sentences that describe the first test and the refined test. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What factor does the team change, and what are two conditions it keeps constant to make the comparison fair?	**The team changes LED brightness. It keeps conditions such as plant mass and water volume constant.**
2	Which tested brightness best meets the team's goal? Compare its result with the result at 100%.	**At 75% brightness, the mean oxygen increase is 1.0 mg/L, compared with 0.9 mg/L at 100%.**
3	Why will the team test 65% and 85% brightness alongside 75%?	**Those settings let the team search near the best result so far and compare them with 75%.**
4	Suppose 85% brightness produces a mean oxygen increase of 1.1 mg/L under the same conditions. Should the team adopt it for the next protocol? Explain.	**Yes. Its mean increase of 1.1 mg/L exceeds the 1.0 mg/L at 75%, so it better meets the team's goal.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would compare germinating pea seeds at 18 °C and 25 °C. I would use a sensor to measure the rise in CO_2 concentration over 20 minutes. Each trial would use the same mass of seeds and the same container volume. I would repeat each setting three times. If 25 °C produces a higher mean CO_2 rise, I would use 25 °C in the revised protocol.

Accept other controlled conditions named in the passage for question 1. For the open task, accept any testable factor and respiration output if the two settings, controls, and rule for revision form a fair comparison.