Shade for Trout

Use test results to improve a design for a warming creek.

BIO.5.8 "Enrichment: Use an engineering design process to create a solution that addresses changing ecological conditions (e.g., climate change, invasive species, loss of biodiversity, human population growth, habitat destruction, biomagnification..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the team's success criterion and circle its design constraints. Number the first test, the redesign, and the planned follow-up test to track how evidence shapes the solution.

Cooling a Creek Side Channel

1. After several hotter summers, a shallow, slow-moving side channel of a neighborhood creek reaches 27°C on some afternoons. Young trout need cooler, oxygen-rich water, so long warm spells can shrink the habitat they can use. A student design team wants to cool a sunny 12-meter stretch without placing anything in the water. They define success as lowering afternoon water temperature by at least 2°C compared with a similar unshaded channel. The design must also leave a walking path open, cost under $400, and avoid harming streamside plants. These criteria and constraints guide what the team builds and measures.

2. The team builds two small, removable shade panels from recycled fabric and wooden frames. One panel covers half the channel's width; the other covers nearly all of it. During three short, supervised trials, they record water temperatures just downstream of each panel and in a similar unshaded channel at the same time. The half-width panel averages 1°C cooler than the unshaded channel; the wider panel averages 2.5°C cooler. However, the wider frame reaches across the walking path. The team keeps the wider shade area as its target but must change the supports before installing anything permanently.

3. The team redraws the wider panel with supports on bare ground away from the path. Their materials estimate is $310, within the budget, but a drawing cannot prove that the revised panel will cool the water. They plan a two-week trial, measuring afternoon temperatures in the shaded channel and a comparable unshaded channel at the same times. They will also check whether the panel blocks drifting leaves or bends during high water. If the temperature difference stays below 2°C, they will change the panel's angle and test again. Any permanent installation needs the land manager's approval.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the team's temperature goal and walking-path constraint address the needs of both trout and people?

2. Which tested panel should guide the next design? Use the temperature results to explain your choice.

3. Why can't the team install the tested wider panel as it is? What change do they plan?

4. What results from the two-week trial would show that the revised design meets the temperature goal without creating a new problem?

3 YOUR TURN

Your own words

A school pollinator garden now faces longer summer dry spells. Propose a design that helps its native flowering plants survive without a permanent hose. Give one measurable success goal, one constraint, a comparison test, and a change you would try if your design fails.

ANSWER KEY

Shade for Trout

HIGH SCHOOL · BIO.5.8

PART 1 · READ AND MARK

Underline the team's success criterion and circle its design constraints. Number the first test, the redesign, and the planned follow-up test to track how evidence shapes the solution. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the team's temperature goal and walking-path constraint address the needs of both trout and people?	**The goal is to make the channel at least 2°C cooler than an unshaded channel for the trout, while the design must keep the path open for people.**
2	Which tested panel should guide the next design? Use the temperature results to explain your choice.	**The wider panel should guide it because its average temperature difference was 2.5°C, meeting the 2°C goal; the half-width panel reached only 1°C.**
3	Why can't the team install the tested wider panel as it is? What change do they plan?	**Its frame reaches across the walking path. The team plans to move its supports to bare ground away from the path.**
4	What results from the two-week trial would show that the revised design meets the temperature goal without creating a new problem?	**The shaded channel would be at least 2°C cooler than the unshaded channel, and the panel would not block drifting leaves or bend during high water.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would place a layer of wood chips around the plants to slow water loss from the soil. My goal is for at least 8 of 10 plants to survive six weeks of dry weather. The chips must stay off the stems to avoid trapping moisture against them. I would compare two groups of 10 similar plants, one with chips and one without, and give both the same water. If fewer than 8 plants in the chipped group survive, I would try a thicker layer and test again.

Accept designs that address dry conditions with a measurable goal, a relevant constraint, a fair comparison, and a revision linked to a possible test result. Students need not propose wood chips.