Roots to Runoff

Test a plant-inspired barrier for muddy water

BOT.4.6 "Enrichment: Use an engineering design process to design and conduct an investigation that uses biomimicry to provide a plant-based solution to an environmental challenge.*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the mangrove feature that inspires the design, circle the two success criteria, and number the steps used to test the barrier. Use your marks to trace how the team moves from a plant observation to evidence.

Can Coconut Fibers Slow Muddy Runoff?

1. After heavy rain, muddy runoff can carry soil into a stream, where excess sediment clouds water and covers habitat. Mangroves offer a design clue: their aboveground roots interrupt moving water and can help sediment settle. A student team wants a small, plant-based barrier for a school garden drain. They choose coconut coir, fibers from coconut husks, and tie loose bundles across a shallow model channel. The coir is not a mangrove root. Its spacing imitates how many roots leave paths for water while slowing the flow. The team defines success as less sediment leaving the channel without a major slowdown.

2. Before building, the team sets two measurable criteria: at least 30% less dry sediment collected at the outlet than with no barrier, and no more than 60 seconds to collect the first 200 milliliters of runoff. They test two setups, an empty channel and a channel with coir bundles. For each trial, they mix 10 grams of dry soil into 300 milliliters of water, stir, then pour over the same amount of time down the same sloped channel. A preweighed filter at the outlet catches escaping soil. After the filters dry completely, the team weighs them again to find the captured sediment mass.

3. Across three trials, the average outlet sediment masses are 8.0 grams without coir and 5.0 grams with coir. The coir reduces escaped sediment by 3.0 grams, or 37.5% of the control value. Average times to collect 200 milliliters are 25 seconds without coir and 52 seconds with coir. Both criteria are met in this model, but that does not prove the design will work in a real storm. The team plans another test with faster flow and a thinner bundle. They will check whether it still captures sediment while allowing water through, then revise the barrier if either criterion fails.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does the coir barrier use biomimicry to address muddy runoff?

2. Name the variable the team changes and two conditions it keeps the same. Why keep those conditions the same?

3. Does the coir barrier meet both success criteria? Show the sediment calculation and cite the flow-time result.

4. What trade-off could a thinner bundle reveal in the next test? Name both results the team must measure.

3 YOUR TURN

Your own words

Choose an environmental challenge other than muddy runoff. In five or six sentences, propose a plant-based design inspired by a plant structure, describe a comparison test and two conditions you would keep the same, set two measurable success criteria, and explain one possible revision.

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PART 1 · READ AND MARK

Underline the mangrove feature that inspires the design, circle the two success criteria, and number the steps used to test the barrier. Use your marks to trace how the team moves from a plant observation to evidence. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does the coir barrier use biomimicry to address muddy runoff?	**Its spaced bundles imitate mangrove roots, which interrupt moving water and help sediment settle while leaving paths for water.**
2	Name the variable the team changes and two conditions it keeps the same. Why keep those conditions the same?	**The team changes whether coir bundles are present. It keeps the soil mass and water volume the same so differences in results can be linked more fairly to the barrier.**
3	Does the coir barrier meet both success criteria? Show the sediment calculation and cite the flow-time result.	**Yes. (8.0 − 5.0) ÷ 8.0 × 100 = 37.5% less sediment, which exceeds 30%. The 200-milliliter collection time is 52 seconds, below 60 seconds.**
4	What trade-off could a thinner bundle reveal in the next test? Name both results the team must measure.	**A thinner bundle may let water pass faster but trap less sediment. The team must measure outlet sediment mass and the time to collect 200 milliliters.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

To save water in a school garden, I would make a rain collector from bamboo slats arranged like the inward-sloping leaves of a bromeliad. The slats would guide water into a jar. I would pour 500 milliliters of water over the collector and over a flat bamboo sheet, then measure how much each catches. I would keep the pour rate and the area of bamboo the same. Success would mean catching at least 100 milliliters more than the flat sheet and losing no more than 50 milliliters through gaps between slats. If too much leaks through the gaps, I would fit the slats closer together and test again.

Accept other accurate plant-inspired designs with a comparison test, controlled conditions, two measurable criteria, and a revision linked to test results. For question 2, other valid controlled conditions include channel slope and pour duration.