Runoff Redesign

Use test evidence to improve a plan for protecting a creek.

ENV.4.5 "Enrichment: Use an engineering design process to define a problem, design, construct, evaluate, and improve a device or method to reduce or prevent human impact on a natural resource (e.g., build a water filter, design an air purifier..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the problem and design criteria, circle what the team measured, and number the steps they took to design, build, test, and improve their solution.

A Strip That Slows the Mud

1 After a heavy rain, Maya noticed brown water leaving the bare slope beside her school's bus loop. The water crossed pavement, entered a storm drain, and eventually reached a creek. Loose soil can cloud creek water and cover habitat used by aquatic organisms. Maya defined the problem as reducing the soil washed from this slope before runoff reached the drain. Her team set two criteria: their solution should lower both the amount of runoff and the mass of soil it carried. It also had to keep the walkway clear and use materials the school could maintain.

2 The team designed a planted strip to slow water moving down the slope. They built two equal trays with the same slope and mass of soil. One tray stayed bare. Across the lower edge of the other, they installed a narrow strip of native grass plugs and mulch, leaving an outlet to collect water. They poured 500 milliliters of water onto each tray at the same rate and collected the runoff. After drying the soil carried by the runoff, they measured its mass. In one trial, the bare tray produced 350 milliliters of runoff and 8 grams of soil; the planted tray produced 190 milliliters and 3 grams.

3 In a second trial, the bare tray released 330 milliliters of runoff with 7 grams of soil; the planted tray released 200 milliliters with 3 grams. The team judged the strip promising because both criteria improved in each trial. However, a strip wide enough to catch more runoff might block the walkway, and a tray cannot show how plants survive a whole season. They revised the design by moving the strip farther up the slope and adding a second, short planted strip. Their next test would use the same pour and measure runoff and soil again before proposing installation.

2 ANSWER WITH EVIDENCE

Use the passage

1. State the problem Maya's team defined. What two results did their design need to improve?

2. Why did the team use equal trays, the same soil mass and slope, and the same amount and rate of poured water?

3. Use results from both trials to judge whether the first design met the team's two criteria.

4. How did the revision address a design constraint, and what would the team measure to evaluate it?

3 YOUR TURN

Your own words

Litter from a school parking lot reaches a pond through a storm drain. In one paragraph, propose a method to catch the litter without blocking the drain. Explain how you would build and fairly test a model, what you would measure, and one change you might make based on the results.

ANSWER KEY

Runoff Redesign

HIGH SCHOOL · ENV.4.5

PART 1 · READ AND MARK

Underline the problem and design criteria, circle what the team measured, and number the steps they took to design, build, test, and improve their solution. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	State the problem Maya's team defined. What two results did their design need to improve?	**The team wanted to reduce soil washed toward the creek. Their design needed to lower runoff volume and the mass of soil in that runoff.**
2	Why did the team use equal trays, the same soil mass and slope, and the same amount and rate of poured water?	**Keeping those conditions the same made the planted strip the main difference between the trays, so the results could be compared fairly.**
3	Use results from both trials to judge whether the first design met the team's two criteria.	**Yes. The planted tray had less runoff in both trials, 190 versus 350 milliliters and 200 versus 330 milliliters. It also carried less soil, 3 versus 8 grams and 3 versus 7 grams.**
4	How did the revision address a design constraint, and what would the team measure to evaluate it?	**Moving the strips farther up the slope could help keep the walkway clear. The team would repeat the pour and measure runoff volume and soil mass.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would place a removable mesh basket beside the drain opening to catch litter before it enters, while leaving the opening clear for water. To model it, I would build two sloped trays with matching outlets and place a basket beside one outlet. I would add the same number of paper scraps and pour the same amount of water onto each tray at the same rate. I would count the scraps that leave each tray and measure how long the water takes to drain. If the basket catches few scraps, I would use a finer mesh and repeat the test to check that water can still drain.

Accept different evidence-based judgments in Question 3 if students cite both runoff and soil results. For Your Turn, accept other workable litter-catching methods that include a fair comparison, a measure of effectiveness, and a way to check that drainage remains open.