Runoff Under Review

Test scientific questions and claims against an experimental design

FSL.3C.2 "Determine the validity of scientific questions (e.g., hypothesis) and variables for complex experimental designs."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the two quoted scientific questions, circle the two factors deliberately changed in the first experiment, and number three details in the final paragraph that weaken the second team's claim.

What Leaves the Garden Soil?

1. A school science club wants to find out what carries nitrate from garden soil into drainage water. The club prepares 16 trays with the same soil mass and one basil seedling each. Four trays receive fertilizer and straw mulch, four receive fertilizer only, four receive mulch only, and four receive neither. The trays stay under the same lamps for four weeks and get equal amounts of water on the same days. After each watering, students collect all drainage. They measure its nitrate concentration and volume, then use both measurements to calculate the total nitrate mass released by each tray.

2. Maya asks, "Under these conditions, does adding fertilizer increase the total nitrate mass in drainage over four weeks?" She predicts that fertilized trays will release more nitrate than unfertilized trays when mulch use is the same. Leo asks, "Does fertilizer make gardens healthier everywhere?" He suggests judging health by whether the basil looks good, without deciding what to measure. Another student wonders whether mulch changes the effect of fertilizer, not just the amount released from any one tray. The club records a total for every tray rather than combining all drainage before measuring it.

3. A second team tries to study fertilizer using eight new trays. All four fertilized trays sit by a south window and are watered twice as often as the four unfertilized trays by a north window. The south window gets more hours of sunlight. Both groups use mulch, and the team measures nitrate concentration in each tray's drainage after four weeks. It does not record how much drainage each tray produces. Its report states that fertilizer alone caused the difference in total nitrate mass. The team plans to repeat its setup with more trays next month.

2 ANSWER WITH EVIDENCE

Use the passage

1. Which of Maya's and Leo's questions can the first experiment answer? Explain why the other question is not valid for this experiment.

2. Is Maya's prediction testable in the first experiment? Name the changed factor, the measured outcome, and one factor that must match between groups being compared.

3. Which two tray groups could you compare to test whether mulch changes nitrate release without mixing in fertilizer's effect? Explain your choice.

4. Give two reasons the second team's claim about fertilizer alone causing a difference in total nitrate mass is not supported.

3 YOUR TURN

Your own words

Design a new tray experiment to test how watering frequency and seedling type (basil or kale) affect nitrate mass in drainage over four weeks. Write a testable question, describe a comparison that isolates watering frequency, and name two conditions you would keep the same.

ANSWER KEY

Runoff Under Review

HIGH SCHOOL · FSL.3C.2

PART 1 · READ AND MARK

Underline the two quoted scientific questions, circle the two factors deliberately changed in the first experiment, and number three details in the final paragraph that weaken the second team's claim. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Which of Maya's and Leo's questions can the first experiment answer? Explain why the other question is not valid for this experiment.	**Maya's question is answerable because the experiment compares fertilizer treatments and measures nitrate mass over four weeks. Leo's question has no defined measure of health, and one experiment with basil cannot answer a claim about gardens everywhere.**
2	Is Maya's prediction testable in the first experiment? Name the changed factor, the measured outcome, and one factor that must match between groups being compared.	**Yes. The changed factor is fertilizer use, and the measured outcome is total nitrate mass in drainage. Mulch use must match between the groups being compared.**
3	Which two tray groups could you compare to test whether mulch changes nitrate release without mixing in fertilizer's effect? Explain your choice.	**Compare the fertilizer-and-mulch group with the fertilizer-only group. Both receive fertilizer, so mulch use is the difference being tested. Comparing mulch-only trays with trays receiving neither also works.**
4	Give two reasons the second team's claim about fertilizer alone causing a difference in total nitrate mass is not supported.	**The groups differ in watering frequency and sunlight as well as fertilizer use, so fertilizer's effect cannot be isolated. The team also measured concentration without drainage volume, so it cannot determine total nitrate mass.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Over four weeks, do watering frequency (daily or every other day) and seedling type (basil or kale) change the total nitrate mass in tray drainage? I would compare daily and every-other-day trays growing basil, and I would test both schedules with kale. All trays would receive the same total amount of water, soil mass, fertilizer amount, and light exposure. I would measure drainage nitrate concentration and volume to calculate total nitrate mass.

For the mulch comparison, accept either pair of groups with the same fertilizer treatment. For the open task, accept other specified watering schedules if seedling type is held constant in the comparison and the question names a measurable outcome.