SCIENCE FOUNDATIONS

Experimental design

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you run a fair test, like checking whether a new plant food really helps tomatoes grow, by changing only one thing and repeating the test enough times to trust the result. A company testing a new shampoo gives it to one group and the old one to another, with neither group knowing which they got. A cook testing two baking times tries each one several times before deciding which is better. Knowing experimental design tells you whether a result is real or just luck, and how to set up a test that actually answers your question.



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Worked examples

EXAMPLE 1

Q How would you design a fair test of whether bigger paper airplane wings fly farther, with each plane flown three times?

Wing size	Trial 1	Trial 2	Trial 3	Average

SOLUTION

Write the question and hypothesis: bigger wings will fly farther.

Plan: build planes that differ only in wing size, fly each one three times.

The wing size is the one thing you change. That one thing is called the independent variable.

Record each distance in a table, then average each wing size.

The result is a fair design with repeats and a table of distances.

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EXAMPLE 2

Q How would you design a fair test of whether soil type affects how many seeds sprout?

Soil type	Seeds planted	Seeds sprouted

SOLUTION

Write the question and hypothesis: richer soil will sprout more seeds.

Plan: plant the same number of seeds in each soil, same water and light.

Count sprouted seeds each day and record in a table.

The result is a fair design comparing soils with equal seed numbers.

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Practice questions

1 **Design a test of whether a new plant food helps tomato plants grow taller. State the question and hypothesis, what you change, what you measure, and how you record results.**

- **A** Plant food makes tomatoes taller: change only the plant food, measure height each week, record in a table and average each group
- **B** Change the plant food, water and light all at once, then guess which mattered
- **C** Give plant food to one plant, measure it once, and record nothing
- **D** Change the plant food each week and compare with last year plants

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2

A student tests whether the amount of sunlight affects plant growth. She gives one group 2 hours of sun and another group 6 hours, keeping water and soil the same. What is the independent variable?

A Plant height

B Amount of sunlight

C Amount of water

D Type of soil

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3

A student tests whether fertilizer helps tomatoes grow. She gives fertilizer to plants in a sunny window and gives no fertilizer to plants in a dark cupboard. What is wrong with this test?

A She used too many plants

B She should have measured every day

C Nothing is wrong

D Two things changed at once: fertilizer and light

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4 A student tests whether the amount of water affects how tall bean plants grow. She gives one group 100 mL of water a day and another group 200 mL a day, and she records the height of each plant every week. Which of these is the thing she measures to judge the result?

- **A** Height of the plants
- **B** Amount of water
- **C** Amount of sunlight
- **D** Type of soil

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5 What comes first in a design?

- **A** A question and a hypothesis
- **B** A table of results
- **C** A conclusion
- **D** A repeat of the test

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6 Why repeat each trial?

A To check the result is reliable

B To use up more materials

C To make the test longer

D To change the hypothesis

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7 Why use a table?

A To organise results clearly

B To hide the results

C To make the test fair

D To choose the hypothesis

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8 How many factors should change at once?

- A One
- B Two
- C None
- D As many as possible

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9 What is a fair test?

- A Only the independent variable changes
- B Every variable changes at once
- C No variable changes at all
- D The results are always the same

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10

Why write the hypothesis before testing?

A. So the test is planned to check that prediction

B. So the results cannot surprise you

C. So you can change the hypothesis after seeing the results

D. So the test needs no repeats

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ANSWER KEY

1. Plant food makes tomatoes taller: change only the plant food, measure height each week, record in a table and average each group

2. Amount of sunlight

3. Two things changed at once: fertilizer and light

4. Height of the plants

5. A question and a hypothesis

6. To check the result is reliable

7. To organise results clearly

8. One

9. Only the independent variable changes

10. So the test is planned to check that prediction

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