

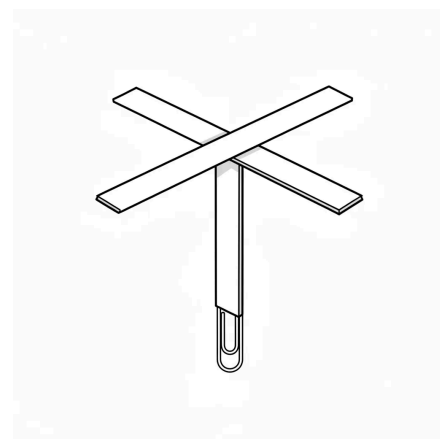
Identifying Variables & Planning a Fair Test: Paper Helicopters

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Answers and suggested responses

Introduction: The Paper Helicopter

When you drop a paper helicopter, gravity pulls it down while air resistance pushes up against the wings, causing it to spin and slow its fall. To understand how different designs affect flight, scientists must identify variables and plan a fair test. A **fair test** is an experiment where only one variable is changed at a time, while all other conditions are kept the same.



Part 1: Identifying Variables

Scenario A: Maya's Wing Length Experiment (Fictional Practice Example)

(Fictional Practice Example) Maya wants to find out if changing the wing length of a paper helicopter affects how long it stays in the air. She makes three paper helicopters with wing lengths of 4 cm, 6 cm, and 8 cm. She drops each helicopter from a height of 2.0 meters and uses a stopwatch to measure the time it takes to hit the ground. She uses the same type of paper and the same size paperclip for all three helicopters.

1. What is the independent variable in Maya's experiment?

- ☐ **A** The height from which the helicopter is dropped (2.0 meters)
- ☐ **B** The wing length of the paper helicopter (4 cm, 6 cm, 8 cm)
- ☐ **C** The time it takes for the helicopter to hit the ground
- ☐ **D** The type of paper used to make the helicopter

Answer: B. The wing length of the paper helicopter (4 cm, 6 cm, 8 cm)

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2. What is the dependent variable in Maya's experiment?

- ☐ A The wing length of the paper helicopter
- ☐ B The size of the paperclip used
- ☐ C The flight time (time to hit the ground)
- ☐ D The height of the drop

Answer: C. The flight time (time to hit the ground)

3. Identify two variables that Maya controlled (kept the same) in her experiment to ensure it was a fair test. (2 pts)

Answer: Maya controlled the drop height (2.0 meters) and the type of paper (as well as the size of the paperclip) for all three helicopters.

Part 2: Interpreting Experimental Data

Scenario B: Leo's Weight Experiment (Fictional Practice Example)

(Fictional Practice Example) Leo is testing how the number of paperclips attached to the bottom of a paper helicopter affects its flight time. To ensure a fair test, he uses identical helicopter designs, the same paperclip type and release method, and conducts his trials in the same indoor location. He drops each helicopter three times from a height of 2.5 meters and records the flight times in the table below.

Leo's Flight Time Data (Fictional Practice Example)

Number of Paperclips	Trial 1 (s)	Trial 2 (s)	Trial 3 (s)	Average Flight Time (s)
1 paperclip	2.4	2.5	2.3	2.4
2 paperclips	1.8	1.9	1.7	1.8
3 paperclips	1.2	1.3	1.1	1.2

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4. Based on Leo's data, describe the relationship between the number of paperclips and the average flight time. (2 pts)

Answer: As the number of paperclips increases, the average flight time decreases (the helicopter falls faster).

5. Why did Leo drop each helicopter three times and calculate an average instead of dropping it only once? (2 pts)

Answer: Leo did multiple trials to improve the reliability of his results and reduce the effect of random errors (like timing delays or drafts).

6. In Leo's experiment, what was the independent variable and what was the dependent variable? (2 pts)

Answer: The independent variable was the number of paperclips (weight). The dependent variable was the flight time.

Part 3: Design Your Own Fair Test

Scenario C: Paper Type Investigation (Fictional Practice Example)

(Fictional Practice Example) Now it's your turn to plan an experiment. You want to investigate how the **type of paper** (e.g., printer paper, construction paper, tissue paper) affects the flight time of a paper helicopter. Note: No practical flight test is required for this planning task. If your teacher chooses to conduct a physical test, always use a safe, reachable drop height while standing on the floor—never stand on chairs or desks.

7. Write a hypothesis for this experiment. (Use the 'If... then...' format). (2 pts)

Answer: If we use lighter paper (like tissue paper), then the helicopter will have a longer flight time because it is lighter and experiences more relative air resistance.

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8. Describe the step-by-step procedure you would follow to conduct this experiment. Explain how you will measure the dependent variable. (4 pts)

Answer: 1. Construct three helicopters of identical size, each using a different paper type (printer, construction, tissue).

2. Attach one paperclip to each.

3. Drop the first helicopter from a safe, reachable height while standing on the floor (e.g., 1.5 to 2.0 meters, never standing on chairs or desks) and time its fall with a stopwatch.

4. Repeat the drop 3 times and record the times.

5. Repeat steps 3-4 for the other two helicopters and calculate the average flight time for each.

9. Identify three variables you must control (keep the same) in this experiment to ensure a fair test. (3 pts)

Answer: 1. The dimensions/size of the helicopter.

2. The drop height.

3. The number of paperclips attached (weight).

4. The release method (dropping without pushing).