energy-forces

Gravity, falling and air resistance: the spinner fair test

Lesson at a glance

Demo a ready-made paper spinner versus a crumpled ball of the same paper so pupils notice the slow fall, then run a whole-class fair-test-planner sort on the IWB (change wing length, measure fall time, keep height, paper and paperclip the same). Groups build short- and long-wing spinners from the template, time drops in fixed roles, and record trials on the Investigation Journal. They average the times and conclude that longer wings mean greater air resistance.

Learning objectives

- Plan and run a fair test of wing size and fall time for paper spinners
- Measure fall time with care, repeat trials and find a simple average
- Conclude how air resistance affects a falling object using the evidence

Before the bell — prep

Print two spinner templates per group (6×16 cm outline with short/medium/long marks) the day before, or mark the same sizes on A5. Gather scissors, one paperclip per spinner, stopwatches/phone timers, and mark one shared drop height (about 1.5–2 m) at every station. Pre-make one demo spinner and a same-paper crumpled ball.

Lesson 16

Materials

Item	Qty	Per	Source	Low-cost substitute
plain A4 paper for spinners (pupils rule and cut their own)	2	group	classroom	A5 plain paper with wing lengths marked in cm for pupils to cut, following the five fold steps authored in the lesson notes
round-tip scissors	1	group	classroom	teacher pre-cuts wings; pupils only fold
metal paperclip	2	group	classroom	same small blob of modelling clay on each stem
metre stick or wall height mark	1	station	school kit	a piece of string of fixed length held to the drop point at each station
stopwatch or phone timer	1	group	classroom	one shared classroom timer per station with a clear rotation order
ready-made paper spinner and matching crumpled paper ball (teacher demo)	1	class	classroom	any two same-paper shapes, one flat-winged and one crumpled
Investigation Journal page	1	pupil	provided printable	ruled paper with handwritten headings for question, prediction, change/measure/keep same, wing sizes, trust check, trials and average

Safety watch-point

Safe steady drop height only; adult steadies any chair — never windows or climbing furniture. Round-tip scissors walked closed; clear feet and bags from the drop zone; paperclips are not for mouths.

Teaching moves

- **Getting Started:** From standing height only, drop the ready-made spinner once, then the crumpled ball from the same height. Ask what is pulling both down and why the spinner takes longer — accept wind, spin, weight and paperclip ideas without naming air resistance yet. Keep kits and journals stacked.
- **Plan a fair test:** Board the three short definitions, then drive the fair-test-planner interactive so the class bins wing length (Change), fall time (Measure), and drop height/paper/paperclip (Keep the same). Only then issue Investigation Journal pages: prediction with reason, the three bins, short vs long default, and one group trust check.
- **Make and drop the spinners:** Model the five fold steps and one timed drop with clear open-hand start and first-touch stop. Groups make short and long only, then share stations. Fix roles (dropper, floor-spotter, timer, recorder) and insist times go straight onto the trials grid. Discard spoiled trials; walk the room for mismatched wings or changing height.
- **Record and average:** No more planned drops. Write the board example (2.2 + 2.6 → 2.4 s) and coach add-then-halve. One clean time is fine if labelled "one trial"; only send a group back if a reading is missing and a station is free.
- **What does the evidence show?:** Pool a few short vs long averages on the board. Draw out longer wings → longer fall time → more air resistance against gravity. Separate observation ("2.4 s") from inference. Name unfair moves (different height, missing clip, crumpled spinner) and link briefly to sycamore keys or parachutes.
- **Reflect and tidy:** "Air resistance slowed our spinner when the wings were ..." Take two volunteers, praise honest averages and trust checks, then pack scissors, clips, timers and scrap and clear the floor.

What it should show

Longer wings should give longer average fall times when short and long differ clearly — more air resistance opposing gravity. Mass stays roughly equal (same paper and paperclip). Odd results usually mean a push instead of a still release, a late stopwatch stop, a hit on a chair, or wings that were not actually different lengths; re-run one clean pair from the marked height.

Misconceptions & interventions

- **"Heavier things always fall faster, so the long-wing spinner should hit first."** — Hold up both spinners and point to the same paperclip on each: mass is roughly the same; only wing size changed. Ask which force from the air would grow with bigger wings.
- **"It falls slower because it spins" (treating spin as the cause instead of air resistance).** — Accept spin as something they noticed, then steer back to the measure: which wing size took longer, and what was pushing up against the larger wings?
- **Pupils change drop height or forget the paperclip between trials and still call it a fair test.** — Point at the Keep-the-same bin left on the board and re-voice the group trust check. Discard the messy trial and repeat from the wall mark with the clip fixed.

Lesson 16

Differentiation

Emerging	Developing	Proficient
• Pre-cut templates and support folding so the group only trims short vs long and runs the timed drops with an adult on the timer cue. • Accept one clean time per wing size labelled "one trial" instead of forcing an average.	• Prompt a second trial when the first release was messy, and ask them to say why the long-wing average should be larger before they share.	• Critique another group's method against the Keep-the-same list, or explain one change that would make the test unfair and how their trust check would catch it.

Cross-curricular hook

Maths link: add two trial times and halve to find a simple average, then compare short vs long.