

Gravity, falling and air resistance: the spinner fair test

Lesson at a glance

Open by dropping a ready-made paper spinner beside a crumpled ball of the same paper so pupils see the slow, turning fall. Class plans a fair test on the fair-test-planner interactive: change wing length, measure fall time, keep drop height, paper and paperclip the same. Groups build short- and long-wing spinners, time drops from a marked height, record trials and simple averages in the Investigation Journal, then conclude that longer wings mean more 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

Put the spinner sizes on the board for pupils to rule (a 6 × 16 cm rectangle; wings trimmed to 4 cm or 8 cm). Pre-make one demo spinner and a same-paper ball. Mark matching drop heights (~1.5–2 m) at 2–3 stations with string if metre sticks are short. Scissors, paperclips, one timer per group, Investigation Journal pages stacked aside until planning.

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

Drop only from a safe steady height; steady any chair yourself, 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:** Stay on the floor. Drop the ready-made spinner once, then the crumpled ball from the same height: no air-resistance explanation yet. Hands-up: bigger wings slower, faster, or the same? Accept wind/spin/weight ideas; steer talk toward fall time, the thing they will measure.
- **Plan a fair test:** Board the three short definitions, then drive the fair-test-planner card sort on the IWB whole-class. Steer bins to Change = wing length, Measure = fall time, Keep the same = drop height, paper, paperclip. Leave bins up. Issue journals: question, prediction with reason, change/measure/same, short vs long, and one trust check each group writes themselves.
- **Make and drop the spinners:** Board the five making steps and model one short-wing cycle with a clear open-hand start and first-floor-touch stop. Groups build both spinners first (~6–8 min), then fan out to free stations. Circulate: only wing length differs; discard spoiled trials; raw times go straight onto the journal grid. Minimum is one clean pair; target two trials each.
- **Record and average:** Stopwatches away. Work the board example ($2.2 + 2.6 \rightarrow 2.4$) before pupils average. Spoiled unrepeated trials stay as a labelled single reading unless a free station allows one quick re-drop. Remind: the number is what we saw; meaning comes next.
- **What does the evidence show?:** Collect short vs long averages on the board. Draw out: longer wings $\rightarrow$ longer fall time $\rightarrow$ greater air resistance against gravity. Separate observation ("2.4 s") from inference. Name unfair-test pitfalls (different height, missing clip). Ask watching pupils whether they agree and what they would try next.
- **Reflect and tidy:** Partner sentence: air resistance slowed our spinner when the wings were... Two volunteers share. Celebrate careful timing, honest averages and used trust checks. Pack scissors, clips, timers and scrap; clear the floor.

What it should show

Long wings should give longer average fall times than short wings when the length gap is large: more wing area, more air resistance. Odd results usually mean unequal drop height, a pushed release, a missing paperclip, or reaction-time error on very short drops; re-check height and wing marks and re-run from a still open hand.

Misconceptions & interventions

- **Heavier things always fall faster, so the long-wing spinner should hit first because it has more paper.** Hold both spinners: same paper type and one paperclip each. The clip is most of the mass. The scrap trimmed off is tiny; wing size (air resistance) is what we are testing.
- **If we change drop height as well as wings, we still know the wings caused the time difference.** Point back at the Keep-the-same board bins. If two things change, you cannot tell which one mattered: re-drop from the marked height only.
- **A tenth of a second difference proves long wings are slower.** Fall times are only a couple of seconds, so reaction error is large. Treat tiny gaps as similar; re-check height and wing length before claiming a difference.

**Differentiation**

Emerging	Developing	Proficient
• Pre-cut rectangles and centre lines so the group only trims wing length, folds and clips; pair them at the teacher station for the first timed drop. • Accept one clean time per wing size and help them label it rather than forcing an average.	• Prompt a second trial and the halving average once two clean times exist. • Ask why their trust check matters after any spoiled drop.	• Critique another group's method: was height truly identical, and was the release from rest? • If time allows, add a medium-wing spinner and predict where its average should sit between short and long.

Cross-curricular hook

Maths measures and data: pupils add two trial times, halve for the mean, and compare short vs long averages.