

Lesson 17 • energy-forces

Friction fair test: which surface slows a car most?

Lesson at a glance

Open by asking which of four floors — carpet, wood, sandpaper or tile — would stop a toy car soonest. Pupils whisper predictions, then sort Change / Measure / Keep-the-same cards on the fair-test-planner interactive and note one extra keep-the-same on the Investigation Journal page. Groups rotate through shared surface stations, releasing the same car three times per surface and recording middle distances in cm. Class middle values pool on the data-recorder interactive into a bar chart; close with display-only talk on which surface showed most friction.

Learning objectives

- Plan and run a fair test of friction with one change, one measure and clear keep-the-sames
- Measure roll distance with care using the same method, units, repeats and a sensible middle value

Before the bell – prep

Day before: gather carpet, wood, sandpaper and tile/laminate patches long enough for a full stop (~1 m), plus one ramp, toy car, metre stick and two identical books per group. Before the practical, set all ramps to the same two-book height, tape start lines, and open four shared stations so groups begin trials, not setup.

Materials

Item	Qty	Per	Source	Low-cost substitute
toy car	1	group	school kit	another similar toy car first; if cars still run short, use the same type of roller for every group (a marble only as last resort)
ramp board (about 50–80 cm)	1	group	classroom	a stiff piece of card or a shelf board propped on two identical books
shared long run-out surface stations (carpet, wood, sandpaper, tile/laminate), each long enough that the car stops on that surface (about 1 m or more)	1	class	classroom	marked classroom carpet patch, a long wooden table top, a sandpaper sheet taped into a long grit-up strip, and a smooth floor tile or laminate run
metre stick	1	group	classroom	a 30 cm ruler used end to end with care, always recording in cm
masking tape	1	group	classroom	a chalk mark or sticky note as the start line
Investigation Journal pages	1	pupil	classroom	plain paper ruled into a planner box and a four-row results table

Safety watch-point

Cars stay on tables or marked floor strips — no aiming at people. Sandpaper rough-side up; mind fingers on grit. Keep run-outs clear so nobody trips on samples or bags.

Teaching moves

- **Getting Started:** Keep it light — hold up one toy car and point at two real classroom floors if you can. Take a quick show of hands on which would slow it more, then ask how we could find out fairly. Do not lay out the full ramp kit yet.
- **Our question and predictions:** Write the question exactly: Which surface slows a toy car the most? Name the four surfaces so every group uses the same list. Take three or four spoken predictions and push for a reason linked to rough or smooth feel. Use partner talk time for helpers to open stations.
- **Plan a fair test:** Drive the fair-test-planner interactive; read all five cards before anyone places them. Agree Change = surface, Measure = distance, Keep the same = ramp height, car, starting point. Name fair test and friction as cards land; hold middle value for the next step. Pupils write only three quick boxes on the Investigation Journal page — extra keep-the-same, station order, one-line prediction.
- **Run the fair test:** Model one live run on wood first (2–3 min): same two-book ramp, no-push release, measure start line to front bumper in cm, order three distances and take the middle. Then send groups to rotate stations. Circulate for shove-free releases, straight metre sticks, and three trials written before they move on. If time slips after ~18 min, finish three fair surfaces rather than rush a fourth.
- **Check your results:** This is check-and-complete only — no second write-up and no homework table. Look for three numbers per surface, correct order before the middle value, units in cm, and no invented readings. A group short one fair trial runs it now.
- **What does the class data show?:** Open the data-recorder interactive; pool group middle values into one sensible class figure per surface, then show the bar chart. Display-only prompts: shortest bar = most friction; was your prediction supported; what would have made the test unfair; why three tries and a middle value. Never invent missing numbers — blank a row or re-run one shared surface at the front.
- **What we learnt:** Two spoken stems only: Our test was fair because... and The evidence shows... slowed the car most. Bridge once to everyday grip (trainers on the yard vs a smooth hall). Revisit opening predictions without shame. Collect cars and ramps; shake sandpaper grit into the bin; clear tape and floor run-outs.

What it should show

Expect shorter rolls on sandpaper and carpet, longer on smooth wood and tile — more friction, shorter distance. Exact cm vary with car and ramp, but the pattern should be clear. If all four surfaces look alike, the ramp is probably too steep or groups are pushing; lower the ramp and remodel a gentle release. A car that veers off does not count — reset and repeat.



Misconceptions & interventions

- **Pupils say a rough surface 'pulls the car back' from underneath.** — Have them rub two surfaces together and revoice friction as rubbing between wheels and floor, not a pull from below. Point at the wheels on the carpet station as they roll.
- **Pupils think a short roll means the car was weaker, not that the surface had more friction.** — Point at the class chart and restate: same car, same ramp — only the surface changed. Shortest bar means that surface slowed the car most.
- **Pupils shove the car or change ramp height between surfaces, treating each run as a race rather than a fair test.** — Stop the class and re-voice ready, steady, release. Ask what must stay the same, then remodel one no-push release from the taped start line.



Differentiation

Emerging	Developing	Proficient
• Offer the stem I think ... will slow it most because ... and mixed roles so a less confident pupil holds the metre stick on the start line while a partner reads cm. • Pair at the teacher table for the first surface to lock in no-push release and start-line-to-bumper measuring before they rotate alone.	• Confident pairs also predict which surface will let the car roll furthest and name the extra keep-the-same they will check every run. • If a trial leaves the surface, they reset and complete three fair tries before choosing the middle value.	• Early finishers stay with the science: what would make this test unfair? or watch another group and check their keep-the-sames. • In the class-chart talk, explain why three tries and a middle value beat trusting one roll, linking shorter distance to more friction.



Cross-curricular hook

Tie to Maths Data — pool middle values, build the class bar chart, and read which surface is shortest.