

## Friction fair test: which surface slows a car most?

### Lesson at a glance

Open by holding up a toy car and asking which classroom floor would slow it more. Pupils predict which of sandpaper, carpet or smooth wood will give the shortest roll, then place Change/Measure/Keep-the-same cards on the fair-test-planner interactive. Groups rotate three shared stations with a fixed ramp height, release the same car three times per surface, and record middle values on the Investigation Journal page. Class middle distances feed the data-recorder bar chart before a short talk on friction and fairness.

### 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

Before the bell, open three long shared stations (sandpaper, carpet, smooth wood/laminate), each with one metre stick and one pair of identical books already in place. Have one ramp, one toy car and tape per group ready to hand out — nothing is built once the lesson starts.

**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                                                                                                     |
| shared long run-out surface stations (sandpaper, carpet, smooth wood or laminate), each long enough that the car stops on that surface (about 1 m or more) | 1   | class | classroom          | a sandpaper sheet taped into a long grit-up strip, a marked classroom carpet patch, and a long wooden table top or a smooth floor tile run |
| metre stick (one at each station, stays at that station)                                                                                                   | 3   | class | classroom          | a long tape measure or a metre of marked ribbon at each station                                                                            |
| masking tape                                                                                                                                               | 1   | group | classroom          | a chalk mark or sticky note as the start line                                                                                              |
| Investigation Journal pages                                                                                                                                | 1   | pupil | provided printable | plain paper ruled into a planner box and a four-row results table                                                                          |
| two identical books or blocks at each station, to prop every ramp to the same height                                                                       | 6   | class | classroom          | six identical readers from a class set, or six identical wooden blocks                                                                     |

**Safety watch-point**

Keep cars on marked strips — no aiming at people. Handle sandpaper carefully, bin loose grit, and clear run-outs so nobody trips on samples or tape.

### Teaching moves

- **Our question and predictions:** Write the question exactly: Which surface slows a toy car the most? Name sandpaper, carpet and smooth wood. Take three or four partner predictions aloud and push for a reason linked to how rough or smooth the surface feels, not a favourite guess.
- **Plan a fair test:** Drive the fair-test-planner interactive on the IWB. Read all five cards first, then agree Change = surface, Measure = roll distance, Keep the same = ramp height, car, start point. Keep pupil writing to the three quick Investigation Journal boxes only — extra keep-the-same, station order, one-line prediction — so planning stays inside seven minutes.
- **Run the fair test:** Model one smooth-station run live: release without a push, measure start tape to front bumper in cm, order three distances and write the middle value. Then circulate while groups rotate stations. Watch for shoves, moving start lines, or skipping the middle number before they leave a station.
- **Check your results:** Two to three minutes only — neaten what is already on the Investigation Journal page. Check three numbers per surface, correct order for the middle value, and cm units. A group short one fair trial runs it now; do not send tables home.
- **What does the class data show?:** Open the data-recorder interactive, collect each group's middle values, agree a sensible class figure per surface, and show the bar chart. Prompt: shortest bar means most friction; was your prediction supported; what would have made the test unfair?
- **What we learnt:** Use two stems only: Our test was fair because... and The evidence shows... slowed the car most. Invite one school example of grip or slipping, revisit opening predictions without shame, then collect cars, shake grit into the bin and clear tape.

### What it should show

Expect shortest rolls on sandpaper, then carpet, longest on smooth wood/laminate — rougher surface, more friction, shorter distance. Exact cm vary with car and ramp, but the order should be clear. Oddly similar distances across all three usually mean the ramp is too steep or groups are pushing; lower the books and re-model a still release.

### 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. Point at the wheels on the sandpaper as they roll.
- **A shorter roll means the car was weaker or the ramp gave less push.** — Remind them the same car and ramp height were kept every time — only the surface changed — so a short bar on the class chart means more friction, not a weaker car.
- **One trial is enough; the middle value is just extra writing.** — Show three sample distances with one odd outlier and ask which single number would mislead. Order them together and circle the middle so the class sees why three tries protect the claim.

**Differentiation**

| Emerging                                                                                                                                                                                                                   | Developing                                                                                                                                                                               | Proficient                                                                                                                                                                                              |
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| <ul style="list-style-type: none"><li>• Offer the stem I think ... will slow it most because ... and mixed roles so a less confident child holds the metre stick on the start line while a partner reads the cm.</li></ul> | <ul style="list-style-type: none"><li>• After three surfaces, ask what would make this test unfair, or have the pair name which extra keep-the-same they checked on every run.</li></ul> | <ul style="list-style-type: none"><li>• Early finishers watch another group's keep-the-sames and report one fair-test strength or risk, still using only the class stations and journal page.</li></ul> |

**Cross-curricular hook**

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