

Lesson 18 • energy-forces

Simple machines: levers and ramps

Lesson at a glance

Open with the heavy-box dilemma: lift straight up or roll up a long slope? Model a see-saw lever with a ruler, pencil pivot and coin bag, naming effort and load as you slide the pivot. Groups build their own lever, try three pivot places, then prop a plank on books as a ramp and compare straight lift versus ramp and steeper versus gentler angles. Jots land on the Investigation Journal before packing: easiest set-ups and the effort-for-distance bargain.

Learning objectives

- Build a lever and a ramp and use each to move a load
- Describe how levers and ramps let you move a load with a smaller push, if you push further or travel a longer path

Before the bell – prep

Per group: one 30 cm ruler, one pivot (pencil, triangular block or thick eraser), one small load (coin bag, washers or 100 g mass), and a plank or stiff board. Stack ordinary classroom books as the raised surface. Keep sticky tack and scrap card trays handy. Set aside one demo lever kit for the worked model.

Materials

Item	Qty	Per	Source	Low-cost substitute
30 cm ruler or stiff card strip	1	group	classroom	a sturdy wooden paint-stirrer or a flat stick from a hardware shop
pencil, triangular block or thick eraser (pivot)	1	group	classroom	a marker pen or a rolled piece of card taped into a firm tube
small load (cloth bag of coins, metal washers or 100 g mass)	1	group	school kit	a small sealed bag of rice or a filled film canister / mini food tin
plank or stiff board for ramp (about 40–60 cm)	1	group	classroom	a sturdy cardboard folder or a shelf offcut
classroom books or blocks (to raise one end of the plank and set platform height)	6	group	classroom	stacked copy books already on desks, or a desk edge as the raised surface
sticky tack (optional, to seat the pivot)	1	group	classroom	a shallow groove between two books to cradle the pivot
scrap of card or small tray so the load can slide on the ramp	1	group	classroom	a plastic lid from a tub
Investigation Journal page	1	pupil	classroom	plain A4 paper with the same recording prompts written on the board

Safety watch-point

Fingers out from under raised loads; lower gently, no hard flicks. One pupil holds the plank steady. Mind toes if a load slides; never stand heavy loads on desk edges.

Teaching moves

- **Levers and ramps: the big idea:** Project only the short board text. Run the full worked model live: load near one end, pivot middle then closer to the load, think aloud through wonder–predict–test–observe–think. Point and say ‘this push is the effort; the bag is the load.’ Head off free-force talk: name the trade-off every time — less effort, longer push.
- **Build a lever:** Hand out ruler, pivot and load. Circulate for a stable pivot and a load that sits without rolling. If the ruler slips, seat the pivot in sticky tack or a shallow groove of two books. Ask: which end is the load, where is the pivot, which end will you push?
- **Investigate: where should the pivot go?:** Say the fair-test aloud: change only pivot position; same load, ruler and hand. Groups try nearer the load, middle, nearer the hand. Before any kit is moved aside, stop them to jot easiest place, hardest place, and whether the hand moved further when the push felt easier. If every position feels the same, add coins or washers.
- **Build and test a ramp:** Clear lever kit aside. Groups prop the plank on a book stack to a low height. Protect the two comparisons: straight lift versus ramp push first, then one steeper and one gentler angle to that same height. Cue the card tray if the load scrapes. If a group is slow, set their raised surface yourself so they still reach lift-versus-ramp.
- **Record what we found:** Keep the Investigation Journal beat inside the hour. Capture lever easiest/hardest pivot, ramp lift-versus-ramp and steeper-versus-gentler, plus one plain conclusion sentence. Sentence starter if needed: ‘The load felt easiest to move when... because...’ If a desk missed the ramp, run a quick whole-class ramp at the front so every page can note it.
- **Make sense and tidy:** Take three quick shares. Revoice with effort/load language: pivot closer to the load felt smaller but the hand moved further; the ramp did not make the load lighter — it spread the work. Lower loads before moving planks; collect masses into one tub; count rulers back in.

What it should show

Lever: pivot nearer the load feels easiest and the hand travels further; pivot nearer the hand feels hardest. Ramp: less push than a straight lift to the same height, longer path; a gentler angle feels easier still. If every lever position feels the same, the load is too light — add washers. If the ramp feels harder, friction is winning; use the card tray.

Misconceptions & interventions

- **Pupils say simple machines ‘give free force’ or make work cost nothing.** — Revoice the bargain on the demo lever: ‘Nothing is free — you give a longer push for a smaller force.’ Have them watch how far their hand travels when the push feels light.
- **Pupils say ‘the ramp makes the load lighter.’** — Hold the same load and say: ‘Its weight has not changed.’ Ask which path was longer — the ramp spreads the same work over more distance.

**Differentiation**

Emerging	Developing	Proficient
• Pre-place a centre sticker on the ruler as a starting pivot mark; teacher sets the book stack so the group still reaches lift-versus-ramp. • Offer the sentence starter on the journal page: 'The load felt easiest to move when... because...'	• After three pivot places, ask why the easier push made the hand travel further — point at effort and load on their set-up. • If the load scrapes, cue the card tray and re-run gentler versus steeper so they feel slope, not friction.	• Stabilise the load with a small piece of tape and rate easier/harder by hand-travel as well as feel. • Challenge: explain to another group why a steeper ramp to the same height needs more push — without using the word 'lighter'.

Cross-curricular hook

Link to Maths measures: compare hand-travel and path length in centimetres when the push feels easier.