

Simple machines do work: levers and pulleys

Lesson at a glance

Open by asking how to get a heavy bag onto a high shelf without a struggle. Model a lever with a ruler on a pencil pivot and a small book, then name the effort-distance trade-off in spoken language only. Groups build levers at tables, then rotate to 2–3 shared pulley stations (metre stick, cotton reel, string). They agree an oral claim, record on the ExperimentRecord Investigation Journal page, and check the pattern on the simple-machines interactive before linking to school tools and Dublin Port cranes.

Learning objectives

- Build and test a lever and a pulley and describe how each changes the size or direction of a force
- Explain the trade-off that when effort falls, distance rises
- Link simple machines to everyday school examples and to cranes, lifts and old mills in Ireland

Before the bell – prep

Before the bell, set 2–3 pulley stations: metre stick secured across two stable chair backs, cotton reel or pulley wheel, string ready. Per group: ruler or card strip, pencil pivot, light load (cube bag, half-full bottle, few books). Low-kit fallback: one front pulley hang for turns.

Materials

Item	Qty	Per	Source	Low-cost substitute
30 cm ruler or equal card strips	1	group	classroom	a stiff strip of cardboard from a cereal box
pencil or dowel to use as a lever pivot	1	group	classroom	a marker pen or thick crayon laid on its side
cotton reel or small pulley wheel	1	station (2–3 stations per class)	school kit	a smooth empty thread spool or a sturdy cardboard tube short section
string or strong twine (about 1.5 m)	1	station (2–3 stations per class)	classroom	thin rope or thick wool doubled up
metre stick	1	station (2–3 stations per class)	classroom	a long straight broom handle or a sturdy cardboard tube laid across two chair backs
two stable chairs for hanging the metre stick	2	station (2–3 stations per class)	classroom	two desks of equal height with a gap between
small load (cloth bag with multilink cubes, or light plastic bottle less than half full)	1	group	classroom	a small soft-cover book tied with string
Investigation Journal page	1	pupil	provided printable	plain paper with the teacher prompting what to record

Safety watch-point

Light loads only; secure metre sticks so they cannot roll; nobody under a hanging load or climbing chairs; keep string ends short away from necks.

Teaching moves

- **What is a lever?:** Project only simple machine and lever. Live-model the ruler on a pencil with a small book: pivot middle, then nearer the book, same finger and load. Voice the observation that the press feels lighter but the hand travels further, and name that bargain as the trade-off. Hold pulley off the board until stations.
- **Build a lever, then try a pulley:** Reveal lever steps first and call stop-and-try so every table builds. Only then reveal pulley lines and rotate groups to stations for 2–3 minutes while others keep comparing pivot positions. At stations, ask them to show the easiest lever pivot and whether the pulley pull felt less, more, or about the same.
- **Compare and agree your claim:** No rebuild and no writing yet. Push a fair comparison: same load, same person judging effort, same starting height on the pulley. Circulate with what stayed the same, what changed, and if effort fell what they gave up. Listen for one spoken group sentence you can revoice before recording.
- **Record on your Investigation Journal page:** Pupils write only here, on the paper ExperimentRecord page in lesson. Put both stems on the board so groups whose fixed pulley felt the same effort are not forced into a trade-off sentence. Look for same load, two lever trials or hand-versus-pulley, and one clear sentence on trade-off or direction change.
- **Effort and distance side by side:** Drive the simple-machines interactive yourself on the IWB; pupils predict hands-up, no devices. On lever, slide the pivot toward the load and ask what they give up when pushing gets easier. Switch to one pulley and dwell on direction change matching the cotton-reel feel.
- **What did we learn?:** Revoice lever trade-off and that a single fixed pulley still counts when it only changes direction. Take school examples first, then name Dublin Port cranes, warehouse lifts and historic mill machinery. Pack away: lower loads, untie string, check floors.

What it should show

Lever: pivot nearer the load makes the push easier and the hand travels further. Single fixed pulley: effort often similar to a direct lift; the win is pulling down to lift up. A group claiming free power or a much easier pulley pull usually changed load, pushed the lever instead of pressing steadily, or compared different people — re-run same load and same judge.

Misconceptions & interventions

- **The machine makes free power — it takes the hard work away.** — Point back to their longer hand travel on the lever: the work is shared differently, not removed. Name the trade-off — easier push, further distance.
- **A single pulley that does not feel easier is broken or not a real machine.** — Have them lift the same load by hand then pull down on the string. Affirm similar effort is expected; the useful change is direction, which is why cranes are built that way.
- **Any pivot place is the same as long as the ruler balances.** — Retest middle versus near the load with the same book and finger. Ask which press felt lighter and whether the hand moved a short or long way.

**Differentiation**

Emerging	Developing	Proficient
• Work at the teacher table with a partly set ruler-and-pencil lever; use spoken stems: The lever felt easier when... The pulley changed...	• Add a second deliberate lever pivot trial or a clear hand-lift versus pulley comparison before writing the claim sentence.	• Stretch: is a machine that only changes direction still useful, and why might a crane operator want to pull down rather than lift up?

**Cross-curricular hook**

Link to Geography and local industry — Dublin Port cranes and historic Irish mill machinery use the same lever and pulley ideas.

