

Pulleys and gears

Lesson at a glance

Open with a heavy bag of books and ask whether pupils would rather lift it by hand or pull a rope over a wheel above it. Groups rig a single pulley from a metre stick across two chair backs, lift a light load by pulling down, then compare that lift with a hand lift of the same bag. They pack the pulley kit away and mesh gear wheels to watch direction reverse and speed change. Three short notes go on the Investigation Journal page before a whole-class talk on effort, load and everyday Irish machines.

Learning objectives

- Rig a single pulley and compare effort with and without it
- Explore how linked gears or wheels turn and change direction or speed
- Explain that a single pulley mainly changes the direction of effort, and that linked gears can change direction or speed

Before the bell: prep

Before the bell: pair chairs with space between groups, check each metre stick sits firm across two backs, pre-cut 1.5 m lift strings and 30–40 cm hanging loops, and set one stable front rig. Pre-thread cotton reels on short pencils if proper pulleys are short. Gear sets (2–3 wheels per group) ready on a side tray for the changeover.

Materials

Item	Qty	Per	Source	Low-cost substitute
metre stick	1	group	school kit	a strong broom handle or wooden dowel long enough to span two chair backs
sturdy classroom chairs	2	group	classroom	two low tables of equal height if chairs are unstable
pulley wheel	1	group	school kit	a roll of sticky tape or masking tape slid onto a pencil (or a cotton reel on a pencil), hung in a string stirrup from the metre stick
short hanging string or cable ties (to hang the pulley from the stick)	2	group	classroom	strong twine or a soft cable tie
short pencil or wooden skewer (only if using a cotton-reel pulley)	1	group	classroom	a blunt cocktail stick is too weak; use a full pencil or thick skewer
string (about 1.5 m lengths for the lift line)	1	group	classroom	strong twine or thin rope
light load (small bag of books or kit weights)	1	group	classroom	a small bag of sand or a water bottle half full
plastic gear wheels (set of at least 2–3 per group) or linked wheel set	1	group	school kit	construction-kit gears, or 2–3 bottle lids linked with rubber bands
Investigation Journal page	1	pupil	provided printable	plain paper ruled into a simple experiment record

Safety watch-point

No standing on chairs. Keep heads and fingers out from under hanging loads; stop any swinging of weights. Lower every load before untying string at the gear changeover.

Teaching moves

- **Getting Started:** Hold up the bag of books only. Do not reveal the pulley yet. Take two or three quick predictions on what a wheel and rope might change about the lift, then park any “it would feel lighter” talk for the test.
- **How pulleys and gears help:** Project the short board text and name load, effort and pulley from the bag hook. Leave full gear talk for later. Head off “the pulley makes it lighter” by saying a single fixed pulley mainly changes direction, even if pulling down can feel easier to control.
- **Rig the pulley:** Model the hanging-loop method once on the front rig in under three minutes: wonder, predict, pull down, observe the bag rise. Send groups to build. Circulate for tipping sticks and wheels balanced on top of the stick: re-show the hanging loop. Keep loads light and fingers clear.
- **Compare the effort:** Name the fair comparison out loud: same bag, same slow lift, only the method changes. Let each group choose how they will judge “easier to control” and agree one sentence they will stand by. Steer language toward direction and control, not “half as heavy”.
- **Watch the gears turn:** Run the pack-down briskly: loads down first, then strings, sticks two-to-a-stick, chairs stacked, floor clear (about two minutes), then hand out gear sets. Rest wheels flat, mesh teeth, turn slowly. Ask watchers to predict before a volunteer turns; look for opposite turns and a slower large gear.
- **Record what we found:** Say the three prompts aloud: which lift felt easier and how they judged it; how pull direction changed; one gear note on direction or speed. Offer the stem “When we used the pulley, I noticed... so I think...”. Keep it to three short notes on the Investigation Journal page.
- **Make sense together:** Lead a display-only science talk. Revoice change of direction, effort, load, opposite gear turns. Draw out the three ideas: single pulley redirects effort; linked gears reverse direction and size can change speed; both are simple machines in everyday Irish life (flagpole, bike, crane).

What it should show

Pulling down on the single pulley should lift the bag steadily upward: direction of effort changes. Most groups find the down-pull easier to control, not truly half the force. Linked gears turn opposite ways; a third gear matches the first; a larger gear driven by a smaller one turns more slowly. An odd “no lift” usually means the string slipped off the groove or the stick tipped.

Misconceptions & interventions

- **Pupils say “the pulley makes the bag lighter” or “half as heavy”.** Accept that pulling down can feel easier to control, then revoice: a single fixed pulley mainly changes the direction of the effort. Point at the same bag still hanging: the load has not changed.
- **Pupils think gears only make things go faster.** Have them turn two meshed wheels and name the reverse turn first. If sizes differ, slow-turn a larger gear driven by a smaller one and ask which idea they just saw: direction, speed, or both.

**Differentiation**

Emerging	Developing	Proficient
• Lighter load and cotton-reel pulley if the proper wheel is fiddly; teacher table helps seat the hanging loop. • Writing stem on the board: When we used the pulley, I noticed... so I think...	• Agree one clear “easier to control” measure before the two lifts and stick to it. • Add a third gear and say aloud which way it turns relative to the first.	• If the rig is rock solid, try a slightly heavier load and critique what would make the comparison unfair. • Tiny labelled sketch of the pulley rig or gear train on the same Investigation Journal page.

Cross-curricular hook

Link to everyday Irish machines (school flagpole rope, bike gears, and building-site cranes) as Physics pupils already meet outside class.

