engineering

Shapes that stop paper bending

Lesson at a glance

Open by holding a flat paper strip out like a diving board so the class sees it flop, then ask why the paper fails when nothing about the paper has changed. Pupils predict which of three shapes — deep V, tight tube, fan folds — will resist best, then pairs share making and hand-test a flat baseline plus those three shapes from the same strips. They record flopped-or-held results on the Investigation Journal page, hunt tubes and ridges around the room, and close on the idea that shape alone changed the stiffness.

Learning objectives

- Show that the same paper can be floppy or stiff depending on its shape
- Compare a V-fold, a tube and a concertina by how well each resists bending
- Find real examples of tubes and corrugations doing structural work

Before the bell — prep

Night before: cut A4 into strips about 4 cm × 21 cm; each pair needs four to six plus spares. Pre-fold one deep V, one tube and one fan-fold strip per table as support models. Have light tape ready for tube joins, plus one poster tube and one piece of ridged card to pass round.

Materials

Item	Qty	Per	Source	Low-cost substitute
paper strips cut from A4 (about 4 cm × 21 cm)	4	pair	classroom	tear A4 sheets into long strips by hand at the start of the activity
masking tape (small pieces to hold tube joins)	1	group	classroom	a single staple or a tight pinch to hold the tube closed
rolled poster tube	1	class	classroom	empty kitchen-roll or wrapping-paper tube
ridged card sample	1	class	classroom	side of a ridged cardboard box cut into a hand-sized piece

Safety watch-point

Teacher pre-cuts strips; if pupils use scissors for spares, supervise closely. Only a tiny piece of tape on tube joins — no loose tape near mouths or eyes.

Lesson 30

Teaching moves

- **Getting Started:** Hold one flat strip out from one end so the whole class sees it flop. Ask why the paper flops when nothing about the paper has changed. Take two or three quick guesses only — do not correct, name the three shapes, or hand out strips yet.
- **Same paper, different shape:** On the IWB name stiffness and the three shapes in plain language: deep V, tight tube, fan folds (ridges). Keep definitions short and tied to the coming hand test. Do not rank the shapes or model a full comparison — that would give away the prediction.
- **Predict which shape holds best:** Run think-pair-share: which shape will resist flopping best when held out from one end, and why? Capture two or three predictions on the board in the children's own words so you can return to them after the hand tests.
- **Stiffen the strip three ways:** Spend about three minutes on a method-only model: how to fold each shape and how to hold fairly (one end, same length out, nothing underneath or on top). Pairs share the making — one V, one tube, one fan-fold plus a shared flat baseline — but both children hold and feel every shape. Circulate for fair-test breakers: V held on its side, squashed-flat fan, loose tube, ridges running the wrong way. Hand a pre-folded support model to any pair stuck on the tube or ridges so they still finish the compare.
- **Record what your hand told you:** Send pupils to the Investigation Journal page to mark flopped or held for flat, deep V, tube and fan folds, then name which resisted best and one reason. If someone only drew, ask for one spoken sentence about the best shape so the conclusion is secure.
- **Hunt the same shapes for real:** Pass round the poster tube and ridged card, then seed easy room finds (hollow chair legs, ridged display board). Keep the class indoors pointing and naming. Jot finds under two board headings — Tube shapes and Ridged shapes — and add Folded beams only if someone spots a V-angle.
- **What did shape change?:** Return to the board predictions and match them to what hands felt. Draw out: same paper every time; only shape changed; tubes and ridges do real structural work. Spoken reflect only — What surprised you when you held the shapes? Tidy strips and tape scraps.

What it should show

The flat strip flops at once. A deep V held as an upright roof beam holds better; fan folds with ridges standing and running hand-to-end resist well; a tight tube usually feels stiffest. Surprising softness almost always means a loose tube, shallow V, squashed fan, V on its side, or ridges the wrong way — re-hold or re-fold and compare again.

Misconceptions & interventions

- **Thicker or stronger paper is what makes it stiff — shape is just decoration.** — Hold up the flat strip and a shaped strip from the same cut sheet side by side. Ask: is the paper different, or only the shape? Keep every strip the same paper so shape is the only change.
- **Any fold counts, so a V lying on its side or a squashed-flat fan should feel as stiff as the upright versions.** — Re-hold their V as a tiny upright roof beam, or open the fan ridges so they stand with depth. Ask what changed about the hold or the fold — treat it as fair-test talk, not a wrong answer.
- **A tube needs to be solid inside to be strong; hollow means weak.** — Point to the hollow poster tube and any tubular chair leg in the room. Ask why builders use hollow scaffolding poles — strong and light because the walls work together as a tube.

Differentiation

Emerging	Developing	Proficient
• Hand the pre-folded V, tube and fan-fold support models so the pair still completes the feel-and-compare and Journal recording. • Accept a spoken sentence about the best shape if writing is thin; scribe the shape name if needed.	• Prompt why the winner held: same paper, different shape — and whether their fold was tight, deep and upright. • Ask which shape they would trust to hold a light card and why.	• Try a shallower V versus a deeper V, both held as upright roof beams, and say which feels stiffer. • Critique a neighbour's test: what changed about the fold or the hold, and did that make the compare unfair?

Cross-curricular hook

Link to Geography and Irish buildings — ridged steel roofing and hollow scaffolding tubes stay stiff in wind and rain without thick material.