

engineering

Which join actually holds?

Lesson at a glance

Open with two pre-made samples — a swinging split-pin and a locking gusset — and ask where the room needs each kind of join. Groups build the same open-V joint three ways (sticky-tape wrap, split pin, triangular gusset), then hang each and add 1c coins until it fails, jotting load and failure mode. Results go onto the ExperimentRecord page; pupils sort firm vs pivot and name a real job for each. Close by strengthening a weak L-corner and comparing before/after coin counts.

Learning objectives

- Compare three join types by the load each holds and how it fails
- Sort joins into ones that hold firm and ones that let parts pivot, and name a job for each kind
- Improve a weak join on a small braced corner using evidence from the tests

Before the bell – prep

Pre-cut equal card strips (~15 cm) the night before; pre-punch split-pin holes or station one adult at the punch. Per group: sticky tape, split pins, scrap card for gussets, string, light cup or loop, tub of 1c coins (washers if short), chair-back hang point. Optional overnight: one pre-dried PVA sample per confident group.

**Materials**

Item	Qty	Per	Source	Low-cost substitute
equal card strips about 15 cm long	10	group	classroom	strips cut from cereal boxes
sticky tape roll	1	group	classroom	masking tape
split pins	4	group	classroom	paper fasteners or a short length of pipe cleaner twisted through holes
round-tip scissors	1	group	classroom	teacher pre-cuts gusset triangles
scrap card for triangular gussets	1	group	classroom	cereal-box card
1c coins or small metal washers	40	group	classroom	identical metal nuts or large paper clips counted as units
string and light paper cup or clip loop for hanging loads	1	group	classroom	a bulldog clip on string holding a small yoghurt pot
hole punch	1	class	classroom	adult carefully makes holes with a sharp pencil onto Blu Tack
scrap paper for load jottings	1	group	classroom	back of scrap card or a sticky note pad
Investigation Journal page	1	pupil	provided printable	ruled paper headed Our question, I predict ... because ..., Firm joins / Pivot joins, and What I found out, with two spare lines labelled L before and L after
optional pre-dried PVA join samples (extension only)	1	group	classroom	skip the glue extension; stick to the three core joins

Safety watch-point

Load low and slowly; stand clear under hanging cups as joins fail. Adult supervises scissors; no standing on chairs to hang samples; use pre-punched holes only — no improvised sharp tools.



Teaching moves

- **Getting Started:** Hold up only the two samples — swinging split-pin and locking gusset — before any kit appears. Ask where in the room a join must swing and where it must not; take three or four quick answers (door, shelf, picture frame). Cue that makers match the join to the job, like an Irish farm gate versus a shelf bracket.
- **What holds a join together?:** Keep the board to firm vs pivot and the three join names. Model only the sticky-tape join in under two minutes: start with 3–4 coins already on the loop, add a few more until it peels, and voice peel-not-tear. Hands up for predictions — which holds most coins, which will swing — then send groups to build.
- **Make three identical joins:** Lead with shared geometry first: open V, right angle, ~2 cm overlap — only the join type changes. Call out how-tos one at a time while you walk: tape wrap once; pin legs flat so it can swing; gusset taped on all three edges so the angle locks. Stop anyone making a straight lap for tape and angled corners for the others.
- **Load each join until it fails:** Demonstrate one safe hang: free end on chair back, join in empty air, feet back, coins added slowly. Before counting, every group gently tries the angle and notes lock or swing. Insist on a scrap jot (coins + how it failed) after each sample; class stop rule is fail or held 20 — no private cut-offs.
- **Record what held and how it failed:** This is a tidy-up of jottings already taken, not a memory test. Put the stem “It failed when the ...” and one filled row on the board. Check every group has three core rows plus two spare lines labelled L before and L after before they leave the page; if rows are short, they draw a mini-table underneath.
- **Firm or pivot?:** Lay real samples into desk zones labelled Firm and Pivot. Expect split pin as clear pivot; well-made gusset as firm; tape may start firm then peel. Draw out jobs: hinge/gate vs shelf bracket/picture-frame corner. Ask whether they would put a split pin on a book shelf and why not.
- **Strengthen a weak join:** Sketch the L on the board with hang point, load point and free corner labelled. Groups build a tiny weak L in about one minute using their worst join, load it, make one change only (often add a gusset), then reload with the same hang and load points. Protect both coin counts on the L before / L after lines — shorten the build, not the second measure.
- **What the evidence shows:** Talk for about three minutes: which join held most, how strong and weak fails differed, when a maker chooses pivot vs firm. Then a named pack-away beat — coins in tubs, pins collected, scissors closed and counted — so tidy does not eat the science talk.

What it should show

Sticky-tape joins often peel at a low-to-medium coin count without tearing the card. Split pins usually swing (pivot success, not always “failure”) and may tear at the hole under higher load. A well-made gusset typically holds the highest load and fails at the tape edge or card, not by swinging. Odd low scores often mean uneven overlap, tape not wrapped fully, or the join pressed against the chair instead of hanging free — re-hang and re-run.

**Misconceptions & interventions**

- **One join is always “best” for everything.** — Point at their own coin table and the firm/pivot sort: “Best for which job?” A gate needs the swing the split pin gives; a shelf needs the lock the gusset gives. Evidence matches join to job.
- **If it swung, it failed — pivoting always means a bad join.** — Re-voice the gate vs shelf contrast with their samples in hand. Record “swung” as what happened; only call it a problem if the job needed a firm lock.
- **A surprising low coin count must be wrong, so erase it to match the prediction.** — Stop the eraser and treat the number as data. Ask what they saw at the joint (peel, short overlap, push instead of hang) and, if needed, re-test one sample rather than invent a neater score.

**Differentiation**

Emerging	Developing	Proficient
• Adult support on the gusset cut and tape edges; pre-joined weak L issued so the group still gets both before/after loads. • Accept two complete ExperimentRecord rows over three empty ones; supply the failure-stem on a card beside the page.	• After three core joins are labelled and fair, add one extension sample only (pre-dried PVA or adult-cut folded tab) and one extra journal row. • Prompt at the joint: “What moved first — the tape edge, the hole, or the angle?”	• Critique another group’s fair-test set-up: same overlap and hang point, or did geometry drift? • On the improve beat, justify the single change from their failure mode (more grip, locked angle, or stop a swing) and predict the new coin count before reloading.

Cross-curricular hook

Tie to Maths Data — order joins by coin count, compare L before/after, and read the class range of loads held.