engineering

Which join actually holds?

Lesson at a glance

Open with two pre-made samples: a swinging split-pin join and a locking triangular gusset. Name firm vs pivot, model a quick sticky-tape peel under coins, then take predictions. Groups build three identical open-V joints (sticky tape, split pin, gusset), load each with 1c coins until it fails, and jot counts on scrap. They write findings on the Investigation Journal page, sort firm vs pivot with real jobs, then improve a weak L-corner and compare L-before and L-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

Day before: pre-cut equal ~15 cm card strips (six-plus per group), scrap for gussets, optional overnight PVA samples. Pre-punch split-pin holes or station one adult at the punch. Set one hang station per group (chair back, string, paper cup) and tubs of 1c coins or washers. Ready two demo samples only: swinging split pin and locking gusset.

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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

Add coins low and slowly; stand clear as a join drops. Adult on scissors and the hole punch; no standing on chairs to hang samples; no improvised sharp tools.

Teaching moves

- **Getting Started:** Hold up only the two samples—split pin that swings, gusset that locks. Ask where in the room a join must swing and where it must not; take three or four answers (door, shelf, picture frame). Keep the full kit off the desks.
- **What holds a join together?:** Board only firm vs pivot and the three join names. Model the sticky-tape join in under two minutes: start with a few coins already on the loop, add until it peels, think aloud peel not tear. Hands up: which join holds most, which swings—note two or three predictions before they build.
- **Make three identical joins:** Say the shared geometry first: open V, right angle, 2 cm overlap—only the join type changes. Call out sticky tape, then split pin, then gusset one at a time while you walk. Stop groups making a straight lap for tape and angled corners for the others. Success is three labelled fair samples, not five joins.
- **Load each join until it fails:** Hang so the joint is free in air. Before coins, every group gently tries the angle and notes lock or swing. Insist on scrap jots after each sample: join name, coins, how it failed. Class stop rule: fail or held 20. Ask what one thing changed and what stayed the same.
- **Record what held and how it failed:** Match the printed Investigation Journal page only—question, prediction stem, What I found out sentences from scrap jots, blank L before / L after lines. No inventing a three-column grid. One sentence per join with a coin number and a specific fail word, not just "broke". Surprising lows stay.
- **Firm or pivot?:** Lay real samples into desk zones labelled Firm and Pivot; pupils fill the journal sort table. Draw out jobs: pivot for gate or door hinge; firm for shelf bracket or picture-frame corner. Ask whether they would put a split pin on a book shelf and why not.
- **Strengthen a weak join:** Show hang point, load point and free corner on the IWB or a physical L. One-minute weak L using their worst join; baseline load; one change only; reload; write L before and L after under What I found out. Do not name the fix—send them back to which join held and how it failed. Keep both measured loads even if the build is shortened.
- **What the evidence shows:** Three minutes on which join held most and when a maker chooses pivot vs firm; two minutes tidy after the talk. Coins in tubs, split pins collected, scissors closed and counted.

What it should show

Sticky tape often peels at a low-to-medium coin count; the card rarely tears. Split pin swings (pivot) and may tear at the hole under higher load. A well-made triangular gusset usually holds the highest load and fails at the tape edge or card, not by swinging. Odd results often mean unequal overlap, a joint jammed on the chair back, or a push instead of a hang—re-check free-in-air geometry and re-run.

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Misconceptions & interventions

- **One join is always "best" for every job.** — Point back to their own coin counts and fail words: strength depends on the job. Ask which join they would choose for a gate versus a shelf and why the evidence differs.
- **If it swung, the join "failed" or is useless.** — Record "swung" as what happened, then sort: pivoting is success on a gate or hinge and only a problem when the job needed a firm lock.
- **Pupils write only that it "broke" with no coin number or fail type.** — Send them to the scrap jot: peeled, tore, swung, or held 20. Model one full What I found out sentence on the board before they write.

Differentiation

Emerging	Developing	Proficient
• Adult support on the gusset cut and punch queue; still complete all three core joins with shared geometry checked before taping. • If only two joins finished, two full journal sentences beat three empty ones; re-test one sample rather than invent numbers.	• After three labelled samples, add one extra scrap jot detail: where on the join the fail started (edge peel, hole tear, angle change).	• After the three are fair and labelled, test one overnight PVA or adult-cut folded-tab sample and compare fail type to the core three. • On the L-corner, justify the single change from their fail words and critique whether hang and load points stayed identical.

Cross-curricular hook

Link to Maths measures and data: ordered coin counts, held-20 cap, and before/after comparison on the L-corner.