engineering

Build it full size

Lesson at a glance

Open from each group's Design Brief and sketch: name the classroom job and where the build might sag, tip or peel. Live-model a flat card shelf that fails under books, then add a triangle brace and corner patch. Groups build a full-size shelf, stand, short rail or organiser using one load-carrying shape and one strong join, testing under light load as they go. One clear fix, one reload, then record saw/think on the Investigation Journal and share what idea saved the build.

Learning objectives

- Build a full-size load-bearing prototype from the group's sketch
- Test under load during the build rather than only at the end
- Fix a weakness by changing shape or join, and record what was changed and why

Before the bell — prep

Return each group's sketch and Design Brief; rescale any yard-bridge or heavy-rail plans to desk scale. Set a materials station per group: card, corrugated card, lolly sticks, short dowels, tape, split pins, string, scissors. Keep PVA off load joins. Have controlled loads ready (few books, tablet, one light coat).

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Materials

Item	Qty	Per	Source	Low-cost substitute
group sketch and Design Brief from earlier in this project	1	group	classroom	a fresh sketch on plain paper if the original is missing
half-size test notes or prior investigation record from earlier in this project (if available)	1	group	classroom	Design Brief success criteria and sketch notes only
card sheets (plain and corrugated)	8	group	classroom	cereal-box card brought from home
plain paper	5	group	classroom	scrap paper
lolly sticks	20	group	school kit	strip of firm card folded lengthwise
wooden dowels (short lengths)	4	group	hardware shop	rolled tight paper tubes taped shut
sticky tape	1	group	classroom	masking tape
PVA glue (optional, non-load parts only)	1	group	classroom	skip glue; use tape or pins for all joins today
split pins	12	group	school kit	string ties through punched holes
string	1	group	classroom	yarn or wool
scissors	2	group	classroom	teacher pre-cuts difficult pieces
real load for the build (few books, tablet, one light coat, or light weights)	1	group	classroom	a tub of 1c coins or identical classroom books
Investigation Journal page	1	pupil	provided printable	plain paper labelled with the same recording prompts

Safety watch-point

Load low and slowly; stand clear if a build tips. Adult supervision on scissors and awkward cuts; no climbing on builds; keep feet clear of falling loads.

Teaching moves

- **Getting Started:** Have Design Briefs and sketches out before materials. Ask two groups to name their job in one sentence. Key question: looking at your brief, where might it sag, tip or peel first full size? Do not hand out the full kit yet.
- **Shape and join do the work:** Live-model first (about 2 minutes): flat card shelf, tape-only ends, add books until it dips or peels; then add one triangle brace and one taped triangle corner patch and reload. Board stays short: shape list (triangle brace, rolled tube, braced span) and join list (triangle corner patch, locked split pin, string tie). Head off 'more tape' by insisting they name a choice from the lists.
- **Build it full size:** Before cutting, each group points to the board and names one shape and one strong join. Mid-build call at about 12 minutes: frame up and brace going on, not still cutting the base. Circulate asking which shape carries the load and which join takes the strain. Adult makes difficult cuts; PVA only for non-load decoration.
- **Test under load and fix one weakness:** One book, light coat or weight at a time; count aloud. When the first clear weakness appears, freeze the class briefly: that group shows sag, tip or peel; watchers name a shape or join fix from the board; then that group changes and reloads while others continue. Protect time for one clear change and one reload per group.
- **Record the build:** Show the board saw/think example first. Pupils record on the Investigation Journal only: job/build, what sagged tipped or peeled, which shape or join idea fixed it, and why it helped. If nothing failed, they still record what carried the load and the place they would strengthen next.
- **What idea saved the build?:** Take three or four groups quickly. Revoice into engineering language: triangle brace, rolled tube, braced span, triangle corner patch, firm join versus pivot. If a group only says 'more tape', ask which shape or join the tape was serving.

What it should show

Expect flat beams to sag in the middle, tape-only corners to peel, tall narrow stands to tip, and unlocked split pins to pivot. After one shape or join change (brace, tube, braced span, corner patch, locked pin, string tie), the reload should hold better. If nothing fails, the strong shape/join is working — strengthen the place that would fail first if the load doubled. Wet PVA peels are join-not-ready, not a shape failure; switch to tape or pins.

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Misconceptions & interventions

- **More tape or thicker card everywhere will fix the weakness.** — Point them back to the board lists and ask which load-carrying shape or strong join they will choose instead of piling on material. Model the triangle brace under the sagging span.
- **We only need to test when the whole build is finished.** — Stop the class and revoice the objective: test under load during the build. Have them add one light load now, name what fails, fix it, and reload before decorating.
- **Any join is fine if it sticks for a moment — including wet PVA.** — Treat a wet-PVA peel as 'join not ready'. Switch them to tape, locked split pins or string so today's test is about shape and join idea, not curing time.

Differentiation

Emerging	Developing	Proficient
• Offer a simple shelf or stand frame already marked where a brace could go; the group still chooses and fits the brace and join from the board lists.	• Prompt mid-build: name the one place most likely to fail first and strengthen it before any full load test.	• If the first reload holds, ask what would fail if the load doubled and strengthen that point with a second shape or join idea they can explain on the journal.

Cross-curricular hook

Link to Maths measures next in the project — how much load it held before and after one change.