

# Build it full size

## Lesson at a glance

Open from each group's Design Brief and sketch: name the classroom-scale job and where it 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 full size choosing one load-carrying shape and one strong join, test with light load mid-build, make one fix, and record saw/think on the InvestigationLog page before a quick share.

## 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 plan to desk scale. Station card, lolly sticks, short dowels, tape, split pins, string and scissors per group. Keep PVA off load joins. Stage controlled loads (few books, tablet, one light coat).

**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 or drops. Adult cuts awkward pieces; supervised scissors only. No climbing on builds; count pins back; clear offcuts from floors.

## Teaching moves

- **Getting Started:** Have Design Briefs and sketches ready; if half-size notes exist, return those too. Ask two groups to name their job in one sentence. Check sketches and rescale any out-of-scale plan before kits go out. Keep materials back — key question only: where might it sag, tip or peel first full size?
- **Shape and join do the work:** Board stays short: two labels and the choice lists. Live-model once (~2 min): flat card shelf, tape-only ends, add two books — name the dip or peel — then add one triangle brace and one triangle corner patch and reload. Say the modelled cycle aloud. Head off “more tape” by insisting on a named choice from the lists.
- **Build it full size:** Before cutting, each group points to the board and names one shape and one join. Assign flexible roles (holder, joiner, sketch checker, load monitor). Mid-build call at ~12 min: frame up and brace/join going on, not still cutting the base. Circulate: which shape carries the load, which join takes the strain? Keep real load nearby but off unfinished work.
- **Test under load and fix one weakness:** Load one book, coat or weight at a time and count aloud. When the first clear weakness appears, freeze the class ~1 min: that group shows sag/tip/peel; watchers name a shape or join fix from the board; then tables continue. Each group makes one clear change and reloads. If nothing fails, strengthen the place that would go first if the load doubled.
- **Record the build:** Show the board saw/think example first. Pupils use the InvestigationLog only: job/build, weakness observed, idea used, reason or evidence. Groups with no failure still record the shape and join that carried the load and the place they would strengthen next. Keep the beat moving for tidy pack-away.
- **What idea saved the build?:** Three or four groups, one sentence each — what weakened, which idea, did the reload improve. Revoice into triangle brace, rolled tube, braced span, corner patch, firm versus pivot join. If they only say “more tape,” ask which shape or join the tape served.

## What it should show

Successful builds hold a light classroom load after one shape or join change: triangle braces or tubes limit mid-span sag; corner patches and locked pins stop peel or pivot; wider bases reduce tip. Common odd results: wet PVA peels (join not ready — switch to tape/pins); overload or a push instead of gentle place-on load; a narrow base that tips before the span sags.



### Misconceptions & interventions

- **“We’ll just put more tape / thicker card everywhere and it’ll hold.”** — Point them back to the board lists: name one shape (triangle brace, tube, braced span) or one join (corner patch, locked pin, string tie). Remind them engineers stay light and strong with a better idea, not more stuff.
- **Pupils treat the load test as end-only, or stack the full load on an unfinished frame.** — Keep the load staged and controlled. Enforce low-load checks during the build and the one-change-then-reload cycle so the objective is testing as you go.
- **A group relies on wet PVA for a join that must take today’s load, then reads the peel as a shape failure.** — Call it “join not ready,” switch that join to tape, pins or string, and reload so the learning stays on shape and join idea, not curing time.



### Differentiation

| Emerging                                                                                                                                                                                               | Developing                                                                                                                                                                                                   | Proficient                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• 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.</li></ul> | <ul style="list-style-type: none"><li>• Prompt mid-build: show on the sketch and the real build which shape carries the load and which join takes the strain before the first full low-load check.</li></ul> | <ul style="list-style-type: none"><li>• Mark on the sketch the one place most likely to fail first and strengthen it before any full load test; explain the precaution even if nothing failed.</li></ul> |



### Cross-curricular hook

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