

## Choose the job, then test a small version first

### Lesson at a glance

Open by asking who in school needs something held up without tipping or falling. Demo a pre-built half-size card bracket on a desk edge, loading 1c coins until the tape peels, then name the user need and must-dos from what failed. Groups pick a real school job, build one half-size piece with one strong shape and one join, and load it to failure. They complete the Design Brief plan page with the failure note, two must-dos and a marked sketch.

### Learning objectives

- Name a real person or place in school and what must be held up for them
- Build a half-size model and load it until something gives way
- Write two or three must-dos for the full build from what failed on the small test
- Sketch the full build and mark the shape that holds the weight and the join that might break

### Before the bell – prep

Pre-build one rough half-size triangle shelf bracket from three card strips and sticky tape with a small card platform; place it on a desk edge for the demo. Per group: card strips/scraps, lolly sticks, sticky tape, split pins, string, scissors, rulers, and light weights (1c coins, washers or cubes). No PVA today.

**Materials**

| Item                                               | Qty | Per   | Source             | Low-cost substitute                                                |
|----------------------------------------------------|-----|-------|--------------------|--------------------------------------------------------------------|
| card strips and card scraps (plain and corrugated) | 1   | group | classroom          | cereal-box card brought from home                                  |
| lolly sticks                                       | 8   | group | school kit         | strips of folded newspaper rolled tight                            |
| sticky tape                                        | 1   | group | classroom          | masking tape                                                       |
| split pins                                         | 6   | group | school kit         | paper fasteners or a single staple applied by an adult             |
| string                                             | 1   | group | classroom          | wool or thin strip of fabric                                       |
| scissors                                           | 1   | group | classroom          | teacher pre-cuts strips                                            |
| 1c coins or small metal washers                    | 30  | group | classroom          | identical counting cubes or marbles in a small pot                 |
| small pot or cup for hanging loads                 | 1   | group | classroom          | paper cup with two holes for string                                |
| 30 cm ruler                                        | 1   | group | classroom          | a marked strip of card as a rough half-size guide                  |
| Investigation Journal Design Brief page            | 1   | group | provided printable | plain paper with headings: job, user, what failed, must do, sketch |

**Safety watch-point**

Adult help with scissors; load low and slowly with light weights only; everyone stands clear of the fall zone. No heavy tools or PVA on today's piece.



## Teaching moves

- **Test small before you build big:** Take predictions first with only the opening line on screen, then load coins one at a time on the pre-built desk-edge bracket. Stop the moment it fails and name what gave way in plain words. Only then write the two board labels: who/what must be held up, and what the full build must do from what broke. Say aloud: how it failed guides the fix; the real user sets the real load — eight coins is not four books.
- **Choose the job and the user:** Keep kit in the press. Two minutes quiet think, then groups must say out loud who, what load, and why it matters. Probe watchers: does that sound like a real need? Redirect any outdoor full-span bridge brief to a short classroom prototype of a yard need.
- **Build a half-size test piece:** Kit on desks before you say go. One strong shape and one main join only — tape, split pin or string; no PVA. Stop groups building full-size or outdoor-scale spans. Offer a starter triangle to groups who freeze; remind them a rough desk-scale piece is enough.
- **Load it until it fails:** Load low and slowly with light weights; everyone clear of the fall zone. Circulate and ask what will give way first — shape or join. Listen for peel, bend or tip. If nothing fails, add load or gently push sideways. Keep the broken piece for the Design Brief.
- **Turn failure into a plan:** One Design Brief plan page per group, full ten minutes in class. Push three items only: what failed in plain words, two measurable must-dos from that failure, and a quick sketch marking the load-carrying shape and the strained join. Reject vague criteria like 'make it stronger'.
- **Share and look ahead:** Bag half-size pieces with names and collect Design Briefs first, then sample at most two groups. Revoice any vague must-do into a measurable one. One-sentence look-ahead: full-size build next, with glue allowed because drying time exists between lessons.

## What it should show

The demo bracket should hold its triangle shape while the tape peels at the back join under coins. Group pieces typically fail by tape peel, mid-span bend, or forward tip. A piece that never fails still needs the note 'held all our coins; next time need a heavier real load.' Success on the Design Brief is two checkable must-dos plus a sketch that marks one shape and one join.

## Misconceptions & interventions

- **Breaking the small piece means the idea is bad and we must start again with a new design.** — Frame the failure as useful news: engineers load scale models until they fail so the weak spot shows early and cheaply. Point at the peeled join or bent strip and ask what the full build must fix.
- **If the half-size held eight coins, the full build must hold eight books — coin count scales straight to the real load.** — Revoice the demo line: the way it failed guides the design fix; the real user need sets the real load. Eight coins is not four books.

**Differentiation**

| Emerging                                                                                                                                                                                                                                                                                                            | Developing                                                                                                                                                                                                                      | Proficient                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Offer a starter triangle or tube so the group can focus on one join and a clear load point rather than inventing the whole form.</li><li>• Less confident groups take a job straight from the four board ideas and use the sentence starters on the Design Brief.</li></ul> | <ul style="list-style-type: none"><li>• Ask groups to name whether the failure was shape, join or tip before they write must-dos.</li><li>• Prompt a second measurable must-do if they only have one vague criterion.</li></ul> | <ul style="list-style-type: none"><li>• Refine the brief (e.g. hold four books and not tip when the front book is pulled) and mark on the sketch where the real load will sit.</li><li>• Note one material swap for the full build that would stop the same failure, such as a gusset or split-pin brace instead of tape.</li></ul> |

**Cross-curricular hook**

Tie must-dos to Maths measures — pupils set a countable load target (four books, one tablet) they can check later with a clear yes/no.

