

## engineering

# Load it, improve it, load it again

## Lesson at a glance

Groups reopen their full-size load-bearing builds and answer one question with numbers: how much does it hold, and does one careful change make it hold more? They load slowly to a target, record a before number and failure point, swap builds for one module-based piece of peer advice, then make a single immediate-hold fix (tape, pin, brace). A fair re-test gives the after number. The data-recorder interactive pools before/after bars so the class can see which module ideas gained most.

## Learning objectives

- Test a prototype against a measured load and record the number held
- Use peer feedback to choose one module-based improvement and re-test it
- Compare before-and-after loads to prove whether the change worked

## Before the bell – prep

Set out shared loads (books, coins, coats or a tablet) plus a bucket and string for hanging. Clear floor space for safe failure. Prefer tape, split pins, slotted card and lolly-stick braces ready — ban fresh PVA today. Groups need their existing builds, Design Brief criteria and Investigation Journal pages.

**Materials**

| Item                                                                                             | Qty | Per   | Source             | Low-cost substitute                                     |
|--------------------------------------------------------------------------------------------------|-----|-------|--------------------|---------------------------------------------------------|
| group load-bearing prototypes from earlier in this project                                       | 1   | group | classroom          | the half-size test piece if a full build was unfinished |
| real load for the job (library books, tablet, coats) or a tub of 1c coins and small weights      | 1   | group | classroom          | identical reading books from the class library          |
| bucket and string for hanging loads                                                              | 1   | class | classroom          | a strong carrier bag and string                         |
| spare card and corrugated card offcuts (for triangular braces, gussets, wider feet)              | 1   | group | classroom          | cereal-box card from home                               |
| lolly sticks                                                                                     | 10  | group | school kit         | straight twigs or folded paper rods                     |
| sticky tape                                                                                      | 1   | group | classroom          | masking tape                                            |
| PVA glue (only for joins already fully dry from an earlier lesson — not for today's timed tweak) | 1   | group | classroom          | tape or split pins for any fix that must hold today     |
| split pins                                                                                       | 6   | group | school kit         | paper fasteners or a short twist of pipe cleaner        |
| scissors                                                                                         | 1   | group | classroom          | teacher pre-cuts strips                                 |
| Investigation Journal page                                                                       | 1   | pupil | provided printable | plain paper ruled into before / change / after          |

**Safety watch-point**

Load low and slowly with adult supervision; only two groups load at a time. Stand clear as builds fail. Stop at the target — never stack past a safe limit.



### Teaching moves

- **Getting Started:** Keep the hook light: one question on the board — how much does it hold, and does one change make it hold more? Check every group has its build, target load and journal page. Do not start stacking yet.
- **Load it and record the number:** Model sag, tip and peel on a scrap build, then voice the full cycle once (wonder → predict → test → observe → think). Only two groups load at a time while you stand with them; others prepare journal rows and watch for the first failure cue. Stop at the agreed target if it still holds.
- **Swap builds and name the weak spot:** Ban vague praise. Push module language: diagonal brace, gusset, wider feet, stronger join. Each group leaves with exactly one piece of advice written on the owners' journal page — and it must be an immediate-hold fix, not wet glue.
- **Make one change:** Police the one-change rule hard. If a group wants brace and join, ask which failure mattered most and keep that one. Stop any fresh PVA and switch to tape or a mechanical fix. End when the change is made and named — no re-loading yet.
- **Load it again:** Same units, same place, same pace, same two-group supervision. Only load builds whose fix already holds. Soft joins write 'not re-tested — join still setting' instead of inventing an after number. Flat or falling results still count as evidence.
- **Pool before and after on the chart:** Open the data-recorder interactive: Group, Change, Before, After. Enter rows as groups call out, then toggle talk between tallest after bars and biggest before-to-after gains linked to the Change label. Cluster groups that used the same fix.
- **Share the one change and the gain:** Triage first: half the groups (clearest gain/loss) use the full sentence frame for 30–40 seconds; the rest give before → change → after only. Peer listeners name one idea worth stealing — no gallery walk.

### What it should show

Most builds should hold a countable before load and show a clear failure mode (middle sag, tip, peel, feet spread). After one module-based fix, the after number often rises; flat or falling numbers are valid and usually mean the wrong weak spot was treated or the fix was poorly placed. A group whose after number collapses often changed two things or stacked on a soft join — re-check the one-change and immediate-hold rules.

### Misconceptions & interventions

- **If it looks neater or stronger, the change worked — we don't need the after number.** — Point at the class chart: a neat brace that holds fewer books is not an improvement. Evidence is the before-to-after difference, not appearance.
- **We can add a brace and fix the join so it gets even stronger.** — Stop them and ask which failure mattered most. Two changes make the after number unreadable — keep only one.
- **Failure on the first test means our build is bad.** — Revoice: engineers want the first failure — it shows exactly where to fix. Record where it failed; that detail drives the one change.

**Differentiation**

| Emerging                                                                                                                                                                                                                                                                                                                                      | Developing                                                                                                                                                                                                                                              | Proficient                                                                                                                                                                                                                                                                                                  |
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| <ul style="list-style-type: none"><li>• Pair at the teacher table for the supervised load; teacher acts as spotter while pupils count and record the before number and failure place.</li><li>• Offer a short choice card of four module fixes (triangle brace, wider feet, stronger join, diagonal) so peer advice stays concrete.</li></ul> | <ul style="list-style-type: none"><li>• Prompt them to name where it failed and match one module idea before swapping builds.</li><li>• On the re-test, ask whether the number rose, stayed flat or fell — and what that says about the idea.</li></ul> | <ul style="list-style-type: none"><li>• Ask them to critique fairness: same units, same place, same pace — what would make the comparison stronger next time?</li><li>• On the class chart, compare gains across groups that used the same fix and suggest which module idea paid off most often.</li></ul> |

**Cross-curricular hook**

Tie to Maths Data — enter before/after loads on the chart and read which change gave the greatest gain.