

engineering

Load it, improve it, load it again

Lesson at a glance

Open by framing the project question: how much does the build hold, and does one careful change make it hold more? Groups load their full-size builds slowly to a target, record the before number and failure point, then swap builds to name one weak spot using module language. Each group makes exactly one immediate-hold fix, re-loads with the same units, and pools before/after numbers on the data-recorder interactive. Close with short evidence shares and a display-only talk on 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

Have each group's full-size build, Design Brief and Investigation Journal ready. Set books, coins or coats in a shared tray plus bucket and string for hanging loads. Clear floor space for safe failure. Prefer tape, split pins, slotted card and lolly-stick braces: PVA will not set in time for a fair re-test.

**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; only two groups load at a time under adult watch; stand clear as a build fails; use a freeze signal if a load looks unsafe. Adult makes difficult cuts.

Teaching moves

- **Load it and record the number:** Before anyone stacks, model sag, tip and peel on a scrap build. Run the supervised cycle aloud 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 target if it still holds. Record that number plus 'still held'.
- **Swap builds and name the weak spot:** Ban vague praise. Push module language: diagonal for a leaning square, gusset for peeled tape, triangles under a sagging beam, wider feet for a tip. Each group leaves with one piece of advice that can hold straight away: no wet PVA fixes.
- **Make one change:** Police the one-change rule firmly: two changes make the after number unreadable. Allow only tape, split pins, slotted card, lolly-stick diagonals or string. If a group starts a wet join, stop them and switch to a mechanical fix, or note the build cannot be fairly re-tested today. End when the change is made and named. Do not re-load yet.
- **Load it again:** Same load type, same place, same pace, same two-group rotation. Only builds with an already-holding fix may stack; soft joins write 'not re-tested: join still setting'. Prompt: did the number rise, stay flat or fall, and what does that say about the module idea?
- **Pool before and after on the chart:** Open the data-recorder on the IWB with columns Group, Change, Before, After. Enter one row per group; label the change briefly (diagonal brace, wider feet, gusset). Toggle talk between tallest after bar and biggest gain, then cluster groups that used the same fix.
- **Share the one change and the gain:** Triage before the first share: about half the groups give the full sentence frame (30–40 seconds); everyone else gives before → change → after only. Peer listeners name one idea worth stealing: no gallery walk.

What it should show

A well-chosen brace, wider base or stronger join should raise the after number; flat or falling counts are still valid evidence that the idea missed the weak spot. A surprising drop often means the fix was soft, the load was placed differently, or two changes were made at once. Check the journal and re-run only if the fix already holds.

Misconceptions & interventions

- **Pupils want to add a brace and change the join at the same time so it will 'definitely' be stronger.** Ask which failure mattered most on the before test and keep only that one change. Point at the journal: two changes make the after number unreadable.
- **Pupils think a neat-looking fix counts as an improvement even if the after number stays flat or falls.** On the class chart, point to a row where after did not rise. Re-voice: engineers prove a fix with the measurement, not how it looks.
- **Pupils keep stacking past the target until something dramatic fails, or invent an after number for a soft join.** Stop at the agreed target if it still holds. If the join is not ready, have them write 'not re-tested: join still setting' rather than force a bad number.

**Differentiation**

Emerging	Developing	Proficient
• Pair at the teacher table for the supervised load; teacher helps count units and scribe the before number and failure place on the journal row. • Offer a partly-chosen change from the peer advice list so the group only has to fix and name it.	• Prompt them to record where it failed as well as the number, then link that place to the single module idea they choose. • Ask why the after number rose, stayed flat or fell before they share.	• Critique the fairness of their own re-test: same units, same place, same pace, and say what would make the next trial cleaner. • Compare two groups that used the same fix on the chart and explain which gain was stronger and why.

Cross-curricular hook

Tie to Maths Data: pupils enter before/after on the class chart, read gains and compare which module idea paid off most.