

Lesson 31 • engineering

Structures: strong and stable

Lesson at a glance

Open with a GAA goalpost or church spire and the challenge: tallest free-standing tower that holds a small weight. Agree success criteria, brainstorm wide bases, triangles and rolled tubes, then sketch one design on the Design Brief page. Groups build from newspaper, masking tape, straws and card, measure height in centimetres, load-test with a ~200 g weight, make one improvement, and record results plus the choice that helped most on the Prototype Eval page.

Learning objectives

- Design and build a free-standing tower that meets agreed height and load criteria
- Test a prototype, make one improvement, and explain the design choice that helped most

Before the bell – prep

Print Design Brief and Prototype Eval pages. Pre-tray per group: ~6 newspaper sheets, 1 masking-tape roll, ~10 straws, card offcuts. Optional: pre-roll 2–3 tubes on support trays. Keep one ~200 g bean tin and one metre stick per group aside until Test. Clear desk space.

Materials

Item	Qty	Per	Source	Low-cost substitute
newspaper	6	group	classroom	scrap A3 or A4 paper rolled into tubes
masking tape	1	group	classroom	sticky tape or packing tape used sparingly
drinking straws	10	group	classroom	rolled paper tubes
card offcuts	4	group	classroom	cereal-box card cut into small pieces
test weight (small bean tin or about 200 g mass)	1	group	classroom	a full small water bottle or a stack of identical books
metre stick	1	group	classroom	30 cm rulers placed end to end, or a tape measure
Investigation Journal pages (Design Brief and Prototype Eval)	1	pupil	classroom	plain paper: one page for the labelled sketch; one page for height, free-standing result, load result, one improvement and design choice that helped

**Safety watch-point**

Collapsing towers: stand back during load tests; mind eyes and fingers. Tidy tape scraps as you go so floors stay clear.

**Teaching moves**

- **Ask and Imagine:** Write the three success criteria on the board with the class: free-standing, tallest possible in cm, holds the test weight for a few seconds. Brainstorm shapes that help (wide base, triangles, rolled tubes, cross-braces) on the IWB. Head off 'taller always wins' — both height and load count.
- **Plan your tower:** Project the kit list so groups plan from known quantities. Trays stay aside. Circulate for labelled sketches: base shape, braces, tubes, joins. If a group draws only a stick figure, ask where the wide base is and what stops sway. Move on once plans are buildable, not perfect.
- **Build the tower:** Hand out trays in under a minute. Remind: no tape to the desk. Praise groups that pause to fix a wobble. Prompt pure-height towers with 'What if the floor shakes a little?' Give five- and two-minute warnings so joins finish; every group needs something free-standing for the load test.
- **Test height and load:** Same method every group: metre stick from desk to tower top; hands-off free-standing check; same weight placed gently in the centre. Record height, free-standing Y/N and load Y/N on Prototype Eval. A fail is useful data. Keep the room calm — stand back if a tower leans.
- **Improve and share:** One change only (~4 min): wider base, triangle brace, stronger join or better top — not a rebuild. Quick re-test if time. Neighbouring pairs share height, load result, one improvement and the choice that mattered; harvest 3–4 highlights whole-class. Revoice engineering language: base, brace, triangle, tube, load.

What it should show

Successful towers are free-standing, measurable in cm, and hold the ~200 g weight a few seconds. Wide bases, triangular braces and rolled tubes usually beat pure height. Common surprise fails: narrow base tips under load, weak tape joins buckle, or the weight sits off-centre — fix base width or the top platform, then re-check.



Misconceptions & interventions

- **Taller always means better — a wobbly tall tower is a win even if it tips under the weight.** — Point back to the three board criteria: height and load both count. A shorter tower that holds the tin beats a tall one that collapses.
- **Taping the tower to the desk or holding it during the test is fine if it looks tall.** — Run the free-standing check first with hands off and no desk tape. If it needs holding, it has not met the challenge yet — fix the base, not the rules.
- **Flat newspaper sheets are strong enough; rolling or bracing is optional decoration.** — Compare a flat sheet to a rolled tube in your hands — show how the tube resists bending. Prompt groups to add a triangle brace or tube where it sways.

Differentiation

Emerging	Developing	Proficient
• Offer pre-rolled newspaper tubes so the group can focus on a wide base and braces; aim for a shorter rock-solid tower that still holds the weight.	• Prompt one extra stability check mid-build (gentle desk tap) and one labelled brace on the Design Brief before time is called.	• Chase height while still passing the load test; after one improvement, explain which join or shape carried the load and why.

Cross-curricular hook

Tie to Maths Measures — groups read tower height in centimetres with a metre stick and compare class results.