Lesson 32 · engineering

Structures: bridges and load

Lesson at a glance

Open with Irish bridge shapes (stone arch vs Samuel Beckett Bridge) and the question: does shape change how much a bridge holds? Groups predict, then build four paper bridges—flat, folded, arched, trussed—from one 8-strip card budget across a fixed 20 cm span. They load coins or washers one at a time at the centre and record failure counts on the Investigation Journal page. Class figures go into the data-recorder interactive for a bar chart and evidence talk.

Learning objectives

- Build four bridges of different shapes from the same materials and span
- Fair-test how much load each shape holds before failure and compare the shapes using the evidence

Before the bell — prep

Night before: cut A4 card lengthways into equal strips (~29.7 cm); bag 8 matching strips per group. Mark 20 cm gaps with tape or identical book stacks. Put scissors, tape, and a shared pile of coins or washers on each table. Print the Investigation Journal page.

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Materials

Item	Qty	Per	Source	Low-cost substitute
card strips of equal size, long enough for a 20 cm span (e.g. A4 cut lengthways into matching strips)	8	group	classroom	cereal-box card cut into equal strips at least 25 cm long
scissors	1	group	classroom	teacher pre-cuts brace pieces if scissors are limited
masking tape	1	group	classroom	sticky tape
book stacks or wooden blocks as bridge supports	2	group	classroom	two identical boxes or tins of the same height
30 cm ruler (to set a 20 cm gap)	1	group	classroom	a marked 20 cm string or strip of paper
coins or metal washers for load testing	40	group	school kit	identical marbles or large metal nuts counted one by one
Investigation Journal page	1	pupil	classroom	ruled paper for design choice, load counts and a short meaning note

Safety watch-point

Scissors for truss cuts stay on the table; stand faces and fingers back as bridges fail and weights drop. Count coins or washers back in at pack-away.

Teaching moves

- **Getting Started:** Show a stone arch road bridge and a modern Irish example if you have photos; otherwise lean on the pupil text. Keep it to one curiosity question—why bother with different shapes?—then state today's challenge. Do not hand out card yet.
- **Question and predict:** Sketch the four forms on the board. Agree fair-test rules aloud: same 20 cm span, same 8-strip budget, load at centre one piece at a time, failure = sag to table or collapse. Say the material note clearly—flat, folded and arched use about one strip each; the truss may use the rest as braces. Take a quick show-of-hands prediction; groups write design choices (ridge count, triangle placement) on the Investigation Journal before building.
- **Build the four bridges:** Model build-only with no loading: set 20 cm with a ruler, then one strip each for flat, zigzag-folded and arched, plus two simple triangles under a deck for the truss. Circulate checking span and the 1+1+1+5 strip guide. If a group stalls on the truss, ask for at least two clear triangles under the middle third. Tape is for joins only—not wrapping strength into one shape.
- **Fair-test the load:** Model loading once on the flat strip: centre only, one coin or washer at a time, record the last count that still held. Groups run one clean trial per shape; prioritise all four over repeats. Stand clear as structures fail. Walk the room watching for end-loading or a changed span.
- **What the results mean:** Counts should already be on the Journal from step 4. Push a one-or-two-sentence meaning note only: which shape held most, and did it match the prediction. Optional prompt while circulating: did the strongest shape also use more of the strip budget?
- **Pool the class results:** Drive the data-recorder interactive with exactly four agreed class figures—Flat, Folded, Arched, Trussed—not every group's raw rows. Show the bar chart. Ask which bar is tallest, whether every group ranked the same, and what would make the test unfair. Link briefly: arches push load down and outward; trusses share push and pull through triangles.

What it should show

Flat usually holds least; folded and trussed often beat flat; a well-made arch or truss often holds most. Rankings vary with build quality. A group whose flat out-holds the others likely loaded off-centre, used a shorter span, or stacked extra card—re-check span with a ruler and re-run from a still centre start.

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Misconceptions & interventions

- **"The strong shapes can use thicker or extra card from the scrap box."** — Hold up the group's 8-strip bag and restate: every deck, ridge, brace and thin wedge comes from this budget only. No scrap-box top-ups; only form and arrangement change.
- **Pupils concertina the folded strip into a short pack that no longer reaches both supports.** — Check with the ruler that ends still seat on both supports at 20 cm. Ridges must run along the span to stiffen the middle, not shorten the strip.
- **Pupils treat thin arch wedges as thick piers or stacked layers under the deck.** — Show a slip-stop wedge versus a pier: wedges only stop ends sliding; stacked layers add material and break the fair comparison of shape.

Differentiation

Emerging	Developing	Proficient
• Pair at the teacher table and build flat and arched first from the worked model; add folded once those two span cleanly. • Offer a partly-started truss with one triangle already taped so the group only adds a second under the middle third.	• If time allows a second trial on one shape, add the two counts and halve them (the mean)—do not say "middle" for two values. • Prompt on the Journal: did the winning shape also use more of the strip budget, and does that still count as a fair shape comparison?	• Critique the class test: name one change (different span, end-loading, unequal strip use) that would make a ranking unfair. • Stretch talk: how would an engineer choose between a strong shape that uses more material and a lighter shape that holds enough for the job?

Cross-curricular hook

Tie to Maths Data—enter four class load figures, build the bar chart, and read which shape is the mode winner.