

Spanning a gap: beams, arches and triangles

Lesson at a glance

Open with photos of a flat footbridge and an Irish stone arch and take quick predictions on which holds more across the same gap. Groups bridge a fixed 15 cm gap three ways with equal card—flat beam, arch, braced beam—tape both ends the same, then stack 1c coins until each fails and log coins held and failure point in the Investigation Journal. Pool one clear set into the data-recorder interactive for a class bar chart, then rebuild the weakest span with one change and re-test.

Learning objectives

- Compare a flat beam, an arch and a braced beam for load carried across the same gap
- Keep a span test fair by fixing both ends the same way and using equal materials
- Make one change to the weakest span and measure whether it holds more coins

Before the bell – prep

Cut equal ~20 cm card strips and set two same-size books 15 cm apart per group the day before. Pre-fold spare triangle braces for tables that need them. Tub of 1c coins (or identical washers) per table plus a shared classroom reserve for strong spans past ~30–40 coins. Sticky tape ready.

Materials

Item	Qty	Per	Source	Low-cost substitute
equal card strips (about 20 cm long)	8	group	classroom	strips cut from cereal boxes
sticky tape	1	group	classroom	masking tape
same-size hardback books for supports	2	group	classroom	two identical wooden blocks or sturdy boxes of equal height
1c coins	40	group	classroom	identical metal washers or identical counters of the same mass
30 cm ruler	1	group	classroom	a marked 15 cm strip of card as a gap gauge
pre-folded card triangle braces (scaffold set)	2	group	classroom	plain card scraps groups fold themselves
Investigation Journal page	1	pupil	provided printable	plain paper with headings span type, coins held, where it failed



Safety watch-point

Load low and slowly in the middle; hands clear as a span collapses; 1c coins stay on the desk—no heavier weights.



Teaching moves

- **Getting Started:** Show a flat beam footbridge and an arched Irish stone bridge on the IWB only—no card yet. Take three or four predictions with reasons, then hold the key question: if gap and material stay the same, does shape still matter? Do not crown a winner.
- **Three ways to span a gap:** Name beam, arch and braced beam with one image cue each. Live-model only a flat strip across 15 cm, tape both ends the same way, and add one or two 1c coins so the middle sag shows. Ask what must stay the same so you test shape, not slipping—save full failure tests for groups.
- **Build three spans:** Circulate: gap still ~15 cm, both ends taped on every span, braces truly triangular under the middle not loose flaps. If an arch flattens before loading, deepen the curve and re-fix the feet. Hand a pre-folded triangle to groups stuck on bracing.
- **Load until they fail:** Roles: one counter, one stacker, one watcher. Coins only, slow stack in the middle. Stop after each failure so they write span type, coins held and where it failed before the next shape. If tape peels and the span slips, re-fix and repeat that span only. Send a runner for the coin reserve if a braced beam empties the tub.
- **Record and chart:** Drive the data-recorder yourself—columns Span type and Coins held; three rows Beam, Arch, Braced beam from one clear group or a class middle. Show the bar chart and ask which shape held most and whether every group got the same rank order.
- **One change, then re-test:** Name one improvement only—add a triangle brace, firmer foot tape, or a deeper arch—rebuild the wrecked weakest span, one re-test, compare to the first number. Have pairs say: Our one change was... The coins went from ... to ... Celebrate gains and no-change results as evidence.

What it should show

Expect the flat beam to fail first by middle sag; the arch often fails by feet spreading or end tape peeling; the braced beam usually holds most until a joint peels or a brace folds. Rank order matters more than exact coin counts (card thickness varies). An arch beating a braced beam often means the brace was not triangular or not fixed under the middle; a slipped end means re-tape and re-run that span.



Misconceptions & interventions

- **Thicker card is the only way to make a stronger bridge—shape does not matter.** — Point back to the equal strips: same card, same gap, only shape changed. Compare the three coin counts on their Investigation Journal page so the numbers show shape did the work.
- **If the arch slips off the books it was just a weak shape.** — Trace the outward push at the feet and re-fix both ends with tape the same way as the beam. Re-run that span only so they measure strength, not sliding.
- **Any scrap stuck under the beam counts as bracing.** — Hold up a true folded triangle versus a loose flap. Refold so both sides touch the beam and the point faces down, then re-test and compare coins held.

Differentiation

Emerging	Developing	Proficient
• Build beam and arch first; add bracing with a pre-folded triangle brace from the spare pile. • Teacher table: fix ends together, then the group only stacks and counts.	• After the three ranks, name aloud why the arch failed at the feet versus the beam at the middle.	• Try two triangle braces under the beam and compare the new coin count to the single-brace result. • Fair-test critique: if one group’s rank order differs, check gap, tape and brace shape before accepting the number.

Cross-curricular hook

Tie to Maths Data—read the tallest bar, mode and range of coins held across groups.