

Test a structure fairly: which shape is strongest?

Lesson at a glance

Open by holding three sample paper columns—round, triangle, square—and tally hands-up predictions of which will hold most books before folding. Plan the fair test on the fair-test planner interactive: change only end-shape, measure books until buckle, keep paper, height and stacking the same. Groups build three matched-height A4 columns, then stack the same books one by one, centred, recording each buckle count straight into the Investigation Journal. Close by pooling which shape won most groups and linking round tubes to scaffolding poles and lamp-posts.

Learning objectives

- Build paper columns with different cross-sections kept to the same height and paper
- Fair-test how much load each shape holds before it buckles
- Conclude which shape was strongest and link it to real structures

Before the bell – prep

Day before: three identical A4 sheets per group plus spares; lightly pre-crease triangle sheets into three equal panels and square into four (leave round plain). Make three sample columns to hold up. Gather matching lightweight reading books or thin magazines per group plus a shared reserve. Mark one class height line (~21 cm). Tape cut as thin strips only.

**Materials**

Item	Qty	Per	Source	Low-cost substitute
identical A4 paper sheets (plain copier paper)	3	group	classroom	pages from a reused scrap paper pile, all the same full A4 size
masking tape or sticky tape	1	group	classroom	a short shared class roll passed between groups
lightweight books or magazines of similar size	15	group	classroom	exercise copies or thin reading books from the class library
30 cm ruler	1	group	classroom	a height mark drawn on the board or a strip of card cut to the agreed height
sample paper columns (round, triangle, square) for the hook	3	class	classroom	sketch the three end-shapes large on the board if samples are not ready
Investigation Journal page	1	pupil	classroom	plain paper with a simple three-row results table drawn ready

**Safety watch-point**

Stand back while stacking; keep fingers out from under books; catch books if a column fails suddenly; do not stand on chairs to reach higher.



Teaching moves

- **Getting Started:** Hold up the three pre-made samples side by side and point at each open top so the end-shapes are clear. Do not load them yet. Capture a quick board tally of predictions and one reason each—keep it light; fair-test talk comes next.
- **What makes the test fair?:** Lead with the question and the fair-test definition from the key-concepts table. Treat cross-section as ‘end-shape’ while pointing at the sample tops; name buckle once only. Say the worked model aloud so pupils hear predict-test-observe before they build.
- **Plan the fair test:** Run the fair-test planner interactive on the board with cards free to drag; pupils call placements and you move them. Correct map: Change = column shape; Measure = books until buckle; Keep the same = paper sheet, height, how we stack. Ask what would make the test unfair (extra tape, different paper, rough loading).
- **Build the three columns:** Demo once in about 30 seconds: fold a pre-creased triangle, then a square, then show a finished round tube. Stress one thin tape strip only—extra tape spoils the fair test. Circulate for matched height, free-standing columns and clearly distinct shapes; rebuild a short column rather than stretch it.
- **Load until it buckles:** Agree the class buckle definition and one counting rule on the board before anyone stacks. Groups test one shape at a time with the same books, centred, one by one; the recorder writes the count at the moment of buckle. Walk the room asking which keep-the-same rule they are watching and whether the number is already written.
- **Record our results:** Quick check only—counts should already be on the Investigation Journal page. Confirm three shapes and three numbers are present. Prompt strugglers aloud with ‘The round column held... The triangle held... The square held...’
- **What does the evidence show?:** Collect a few group results orally and note the pattern on the board. Take questions in order: which shape was strongest and what evidence shows it; what we kept the same; then one quick real-world link (scaffolding poles, lamp-posts; triangle frames in bridges/roofs as a related idea). If one group’s square won, treat it as data about joins and tape, not ‘wrong’ science.

What it should show

Expect the round tube to hold the most books in most groups—the load spreads evenly around the sides. Square often buckles first at a face or edge; triangle can be strong but tends to fold at a crease. A surprising square ‘win’ usually means neater joins or firmer tape—use it in the make-sense talk. If all three fail after only one or two books, switch to thinner books or magazines.

**Misconceptions & interventions**

- **‘We can use thicker paper or make one column taller if it looks stronger.’** — Point back at the keep-the-same cards on the fair-test planner: only the end-shape changes. Same sheet, same height, same stacking—or the comparison is not trustworthy.
- **‘Extra tape on the join is fine—it just makes it neater.’** — Hold two joins side by side: a thin strip versus layered tape. Extra tape changes the material, so it is no longer a fair shape test. Rebuild with one thin strip.
- **‘Our square held more, so round isn’t really strongest and the science is wrong.’** — Treat their result as real data. Ask what was different about their joins or stacking, then compare with the class pattern—neat building is part of the evidence.

**Differentiation**

Emerging	Developing	Proficient
• Extra adult help at the tape join; leave sample columns standing as models throughout the build. • Spoken stems for the Journal: ‘The round column held... The triangle held... The square held...’	• Confident groups check finished height with a ruler and adjust before taping. • Ask what else could stay the same (same person stacking, same table surface) after the planner is complete.	• Stretch: critique another group’s setup—what would have made their test unfair? • After pooling results, ask how they would redesign the columns to hold more while still keeping the test fair.

**Cross-curricular hook**

Tie to Maths Data: pool group book counts on the board and compare the mode across shapes.