

Push and pull: ties and struts

Lesson at a glance

Hold up string and a lolly stick and take quick guesses on which can push and which can only pull. Groups run four short push-pull tests on a light book, then build a simple A-frame from two sticks and a bottom string and press gently on the top to feel the string tighten and the legs squash. Findings go on the Investigation Journal page. Close by pointing out ties and struts on crane, cable-stayed bridge and tent photo cards.

Learning objectives

- Identify parts of a structure that are being stretched (ties) and squashed (struts)
- Build a simple A-frame and explain what the string and sticks are doing under load

Before the bell – prep

Night before: pre-build one demo A-frame from the same kit and print the crane, cable-stayed bridge and tent photo cards. Bag string, lolly sticks and tape or split pins per group. Clear a flat desk space for each group.

Materials

Item	Qty	Per	Source	Low-cost substitute
lolly sticks	4	group	supermarket	thin dowel pieces or sturdy drinking straws
string	1	group	classroom	wool or thin garden twine
masking tape or split pins	1	group	classroom	sticky tape
demo A-frame (pre-built)	1	class	classroom	build one quickly at the start of the build step while groups watch
structure photo cards (crane, cable-stayed bridge, tent)	1	group	provided printable	show the three photos on the IWB for the whole class
light book or small soft object for the push-pull feel test	1	group	classroom	an empty pencil case

**Safety watch-point**

Gentle one-finger press only — no stacked books or heavy loads. Supervise split pins and any string cutting; keep frames on the desk.

**Teaching moves**

- **Getting Started:** Hold up one length of string and one lolly stick. Take two or three hands-up guesses on which can push and which can only pull — do not demonstrate yet. Move straight into naming the three words as a tease.
- **Push or pull?:** Model one full cycle first (~2 min): wonder, predict, push then pull a light book with the string, observe it go floppy then tight, conclude string can only pull. Repeat with the stick. Then release groups; circulate asking 'What happened when you tried to push with the string?' Fold watchers in with 'Do you agree?'
- **Build an A-frame:** Hold up your pre-built demo so groups can match the shape. Guide: overlap two sticks at the top with tape or a split pin, open into a V, tie string across the base, stand and press one finger gently on the join. Revoice on the board after they feel it: string = tie (stretched), sticks = struts (squashed). If string stays loose, open the base; if it collapses sideways, retape the top.
- **Record your findings:** Give this about 7 minutes while the feel is fresh. Keep them on string vs stick, on which material can only ever be a tie, and on the A-frame's tie vs its struts, asking each time how they could tell. Cold-call stuck groups: 'Which part of your A went tight?'
- **Find ties and struts:** Model Card A (crane) whole-class first: cables above are ties, solid jib is a strut — link back to string vs stick. Groups then try Cards B and C. Cold-call: 'On the crane, what is the cable doing?' Optional Irish anchors: goalposts, campsite guy-ropes, a cable-stayed bridge pupils may know.
- **What you covered:** Quick oral recap only. Start with one pupil answer to 'what can string never do?', skim the bullets, revoice one or two crane answers. Tidy kits: sticks, string offcuts and photo cards.

What it should show

Every group should conclude string only pulls (floppy when pushed) and a stick can push and pull. On a loaded A-frame the bottom string goes tight (tie) and the two legs press down and out (struts). Photo cards: crane cables/bridge stays/tent guy-ropes = ties; jib, towers and poles = struts. Loose string usually means legs too close or press too light; sideways collapse means a loose top join.

Misconceptions & interventions

- **Any thin part is a tie** — ‘the string looks thin so it must be the tie.’ — Name the force, not the look: ‘A tie is being stretched under load.’ Have them press the A-frame again and feel the string go tight — that stretch is what makes it a tie.
- **String can push if you hold it taut enough.** — Replay the book test: hold both ends and try to push. Revoice ‘it went floppy — string can only pull, so it can only be a tie.’
- **Both sticks and string are doing the same job on the A-frame.** — One finger on the top join: ‘Which part went tight? Which parts pushed down and out?’ Label tie vs struts on the board from what they felt.

Differentiation

Emerging	Developing	Proficient
• Pair at the teacher table with the pre-built demo A-frame already standing; they only press the top and say which part went tight. • Offer a two-word desk note prompt (pull only / push + pull) before the journal page.	• After the first press, ask ‘what happens if you open the base a little wider?’ and re-feel the string. • On Card B or C, name one extra tie or strut beyond the first pair.	• Fair-test style critique: ‘Why must the top join stay fixed when you compare before and after loading?’ • Explain why a crane needs cables above and a stiff jib below, linking back to the string vs stick tests.

Cross-curricular hook

Link to Maths shape — the capital letter A — and to familiar Irish goalposts or campsite guy-ropes as everyday ties and struts.