engineering

Design and build the solution

Lesson at a glance

Open with the class tablet or hardback book tipping when propped for filming. Pupils agree a short user need, then use the fair-test-planner interactive to sort Change, Measure and Keep the same for a wide-versus-narrow base option test. Groups assemble pre-cut base samples, count fingertip nudges to tip, and pick a winner. They sketch a labelled side view on the Investigation Journal page from the kit list, then build a first cardboard-and-tape prototype to keep for next lesson's full test.

Learning objectives

- Agree a clear user need for a real classroom problem (a stand for a tipping tablet or book)
- Use a quick fair test to choose between design options
- Design and build a first working prototype of the chosen solution

Before the bell — prep

Night before: pre-cut matched-height base templates per group (both ~5 cm upright; wide ~15×10 cm, narrow ~6×10 cm). Set out one flexible kit per group: card, lolly sticks, masking tape, string, clean boxes/tubs, scissors. Same book or tablet mock-up as load for every trial. No PVA.

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Materials

Item	Qty	Per	Source	Low-cost substitute
class tablet or hardback book of similar size (stand-in load)	1	group	classroom	a plastic lunchbox filled with exercise books to match the weight
pre-cut same-height wide and narrow base templates (about 5 cm upright face; wide footprint ~15 cm × 10 cm, narrow ~6 cm × 10 cm)	1	group	classroom	cereal-box card cut to the same footprints and 5 cm upright height
flexible build kit (cardboard sheets, clean recycled boxes or tubs, lolly sticks, string, masking tape; optional glue sticks for paper only; optional pre-cut upright strips and small shelf pieces)	1	group	classroom	cereal boxes, newspaper rolls and sticky tape from home collections
scissors	1	group	classroom	one shared class pair with adult cutting support
Investigation Journal pages	1	pupil	provided printable	plain paper with the journal headings listed in Before the Lesson copied from the board

Safety watch-point

Supervised or round-tip scissors only; adults cut tough card. Keep loads modest so nothing falls toward faces. Count tools back; wash hands after glue and card dust.

Teaching moves

- **Getting Started:** Show the tipping tablet or hardback book once and ask who the stand is for and what it must never do. Keep the build kit away; do not name variables yet.
- **Name the user need:** Pairs talk, then capture agreed phrases on the IWB. Steer toward: holds a tablet or book upright on a desk, stays steady when lightly bumped, and is easy to load and unload. Head off 'coolest-looking wins' — the user need decides success.
- **Plan the option test:** Drive the fair-test-planner interactive: Change = base shape; Measure = nudge count to tip (stop at 10); Keep the same = load, nudge force, height. Say the worked model aloud, then groups complete the option-test section of the Investigation Journal page.
- **Run the option test:** Hand each group the two pre-cut templates, tape and the shared load. Agree one gentle fingertip nudge method. Circulate cold-calling 'Was that nudge the same both times?' Stop freehand bases of different heights — re-match height before they record a winner.
- **Plan the full design:** Display success criteria and the kit list on the IWB. Plan only: one labelled side sketch (base, support, resting place), materials ticked, criteria ticked. Check the winning base from the option test is in the sketch before anyone builds.
- **Build the model:** One kit per group; masking tape for structural joins only. Look for a base that matches the option-test winner, stands alone, and has at least one support. Call a hard stop even mid-join — a standing base-plus-support is a valid Part 1 outcome.
- **Reflect and set up next time:** One group names a success already met; another names one wobble risk for next lesson's test. Label and store models upright; count scissors back.

What it should show

Wide bases usually need more gentle fingertip nudges before tipping than narrow ones at the same height and load. Mixed results almost always mean height or load did not match, or the nudge force changed. A successful Part 1 prototype stands alone on the winning base with at least one support and a started resting place — full bump and load-in/out checks are next lesson.

Misconceptions & interventions

- **'The coolest-looking stand is the best.'** — Point back to the agreed user need on the IWB: beauty is fine, but success is upright hold, steady when bumped, and easy load in/out. Ask which of those the 'cool' feature actually serves.
- **Pupils change base height as well as width, or push harder on the second trial, then treat the tip count as fair evidence.** — Hold the two samples side by side and check the upright faces match ~5 cm. Re-voice the class nudge method and re-run once with matched load and force before they pick a winner.
- **Groups think a half-finished model is a fail if it does not yet hold the load through a full bump test.** — Re-state today's look-fors: winning base, stands alone, one support. Name the standing base-plus-support as useful evidence for next lesson, not a fail.

Lesson 35

Differentiation

Emerging	Developing	Proficient
• Allow tips / does not tip instead of nudge count to 10, and start them with the pre-cut wide/narrow cradles already folded so they only tape, load and nudge. • Accept a standing base plus one taped support as the full Part 1 build target.	• Prompt a second nudge trial to check the reading before they lock in the winning base. • On the plan, ask them to tick which success criteria the resting place and support each address.	• If they can still change one thing and match height, allow an alternative fair pair (e.g. three legs versus solid base) noted on the IWB. • Early finishers strengthen one weak join or sketch one improvement for next lesson's test — no on-device task.

Cross-curricular hook

Tie to Maths measures — same height in centimetres and a counted nudge scale make the option test fair.