engineering

A local problem: define and design

Lesson at a glance

Hook with a familiar school annoyance (markers rolling off the board ledge) and model naming the user, three testable success criteria, and a rough labelled sketch. Groups pick one of four school problem cards, pin down user need and criteria on scrap paper, then transfer onto the Investigation Journal Design Brief with a junk-kit sketch labelled in centimetres. Partner groups swap briefs for a strength-and-question pass, then designers tighten one criterion or label before briefs are stored for the build session.

Learning objectives

- Define a real school problem in terms of user need and clear success criteria
- Sketch a buildable solution on a Design Brief that a group can follow next

Before the bell – prep

Print one set of the four problem cards and one Design Brief page per group. Have clipboards, plain paper and rulers ready. Note one shared class measurement (e.g. typical door width) for groups that cannot leave to measure. Optional: clear wall space for later display.

Materials

Item	Qty	Per	Source	Low-cost substitute
Investigation Journal Design Brief page	1	group	provided printable	one A4 sheet per group ruled into sections for problem, user, criteria and sketch
problem cards (seed-tray cover, ball barrier, book stand, draught-stopper)	1	group	provided printable	four A5 handwritten cards using the same card texts from the teacher notes
clipboard	1	group	classroom	a hardback book or a sheet of stiff card as a writing board
30 cm ruler	1	group	classroom	a marked strip of card in centimetres
scrap paper for rough notes	2	group	classroom	the back of used worksheets

Safety watch-point

If a pair leaves to measure a door or flowerbed edge, go with them or an SNA; keep the rest of the class on the cards so the room stays manageable.

Teaching moves

- **How engineers start:** Live think-aloud on a problem not on the pupil cards (markers rolling off the ledge). Name user and need, write three testable criteria, sketch a shallow rail with cm labels. Protect the last minute for a whole-class call-out: Who is the user? Name one success criterion. Head off material-first talk with Who is it for, and what must it do?
- **Choose the problem and find the need:** Hand each group one card set. Give 1–2 minutes to choose, then 8–9 minutes on scrap paper for user, need and three testable criteria. Circulate with Who uses it every day? Could we test that with water, a ball, a book, or a fan? Steer invented fifth problems back to the four cards. Optional: one pair may measure a door or flowerbed edge with you for two minutes.
- **Sketch the solution:** Hand out one Design Brief page per group. Coach in order: transfer problem/user/criteria; stay inside cardboard, tape, string, lolly sticks and fabric; sketch with labels, materials and at least one size in cm (estimated with a unit label is fine). Pull fantasy castles back with Does this still solve the problem on your card?
- **Finalise the plan:** Run structured pairs of groups on hard timing: 2 min read-only, 2 min one strength and one question, about 4 min designers edit one criterion or one label. Signal each beat. Push vague criteria (it should look nice) toward observable checks. Fold the class in: Would you know how to start building from that sketch?
- **Finish the Design Brief:** Walk-round checklist: three criteria, at least one measurement, group names on the page. Collect into a project folder or clip to the group tray. Unfinished groups may only finish labels and kit notes — no outdoor site measurements as homework; offer a brief in-school catch-up or a shared class measurement.
- **What we decided:** Fast whip-round: each group names one non-negotiable for the build (wide base, correct door width, waterproof top). Confirm where Design Briefs are stored and tidy cards and clipboards.

What it should show

Each group leaves with a Design Brief naming a real school user, three testable success criteria, and a labelled junk-kit sketch with at least one size in cm. A weak brief usually jumps to materials or uses vague checks like "looks nice" — send them back to Who is bothered? and What could we actually test?

Misconceptions & interventions

- **Pupils jump straight to materials — "We'll use cardboard" — before naming who it is for or what it must do.** — Hold the card and ask Who is bothered every day, and what must it do? Only then let them name kit materials on the sketch.
- **Success criteria stay vague: "It should be good" or "It should look nice."** — Push for an observable check tied to the card: stays upright with two books, keeps soil dry under a light water spray, stops a tennis ball on a gentle roll.
- **The sketch becomes a fantasy build that no longer matches the problem or the shared junk kit.** — Point at the card criteria: Does this still solve that problem, and can children build it next time with cardboard, tape, string, lolly sticks and fabric only?

Differentiation

Emerging	Developing	Proficient
• Offer the board sentence frame: Our user is... They need... We will know it works if... Scribe labels while the pupil directs the drawing. • Allow draw-first then label, or list parts then draw; pair a confident sketcher with a strong ideas person.	• Prompt one tighter criterion: Could we test that with water, a ball, a book, or a fan? • Ask What joins the parts? Where is the base? What fails first if we tip it?	• Add a real constraint on the brief (max height, must pack away, must use no tape on paintwork). • In the swap, critique whether a builder next session could start from the sketch alone and which measurement is still missing.

Cross-curricular hook

Link to Maths Measures — pupils label estimated sizes in centimetres on the Design Brief sketch.