materials

Everything has mass, even air

Lesson at a glance

Hook with an apparently empty cup and two claims to test: air takes up space and air has mass. Pupils jot both predictions, then run the dry-paper cup-in-water test in groups and watch a whole-class beam-balance demo where one of two identical balloons is gently deflated. They record observations and an "I think..." line on the Investigation Journal page, then link both results to the particle idea in a short make-sense talk before packing wet gear.

Learning objectives

- Demonstrate that air takes up space and has mass using evidence from fair tests
- Explain in simple terms that materials, including air, are made of tiny particles

Before the bell — prep

Dry-run the beam balance the night before until the tip is clear from the back of the room; prefer balloons, with sealed sandwich bags ready as fallback. Per group: clear water tub, cups, small dry paper scraps, cloths. Pre-inflate two identical balloons (or bags), equal strings, 30 cm ruler and low-friction pivot set level.

Lesson 12

Materials

Item	Qty	Per	Source	Low-cost substitute
clear plastic tub or washing-up bowl of water	1	group	classroom	a deep baking tray or large mixing bowl
clear plastic cup	2	group	classroom	any stiff disposable cup that holds its shape under water
small dry paper scraps	4	group	classroom	torn scrap from an exercise book
identical balloons	2	class	supermarket	two identical sealed sandwich bags inflated equally with air (preferred primary fallback on the same beam)
spare identical sealed sandwich bags (inflated equally)	2	class	classroom	a second pair of matching balloons
30 cm ruler	1	class	classroom	a straight metre stick used as a shorter beam with strings closer in
string	1	class	classroom	wool or thin ribbon of equal lengths
pivot for the beam balance (pencil, dowel or triangular block)	1	class	classroom	a marker pen or the edge of a sturdy book used as a fulcrum
cloths or paper towels for spills	1	group	classroom	old tea towels
bucket or second sink access for staggered tub emptying	1	class	classroom	empty tubs two at a time into the classroom sink

Safety watch-point

Wipe floor spills as they happen; keep water tubs away from table edges. Deflate balloons slowly away from faces — never pop for the mass test.

Teaching moves

- **What will we find out?:** Write both questions and the plain mass line on the board. Use the stems aloud, then give one quiet minute for both predictions on the Investigation Journal page before any test. Expect many to accept "takes up space" but doubt mass — keep both ideas visible for later.
- **Does air take up space?:** Model the full cycle once in about three minutes: paper high inside, cup level, push straight down, lift, then tip for bubbles. Circulate for level cups; if paper wets, dry a new scrap and retry once. Cue early emptiers so tubs are not all full at the end.
- **Does air have mass?:** Take the three-way predict vote by hands up — heavier, lighter, the same — before touching either balloon. Deflate slowly — never pop — restating what stays the same. Wait for the beam to settle; if the tip is unclear, hang farther out once or switch to the sealed bags. Invite pairs to judge whether the tip counts as evidence.
- **What did we notice?:** One minute for groups to pick one observation per claim, then share only what was seen — dry paper, bubbles and water in, inflated side dips. Revoice "suction/magic" talk toward matter language. Check remaining tubs are emptied before journals.
- **Record on your Investigation Journal page:** In class now, not homework. Board stems: I predicted... I observed... I think this shows... Keep dry-paper and balance tip in observe; space/mass claims in think. Leave one blank line for the particles sentence. Stretch: why deflating, not popping, kept the test fair.
- **Tiny particles make up materials:** Point first to the cup and balloon sights, then name particles as the scientist's word for that "something". Partner talk must restate both tests in particle language; model if needed. Half-minute journal finish: I think air is made of particles because... linked to a sight from today. Head off "dust in a sunbeam".

What it should show

Cup: paper stays dry when level; tipping releases bubbles and water rushes in. Balance: after gentle deflation, the still-inflated side dips — air had mass. Wet paper usually means a tilted cup or paper too low; unclear tip means unequal hangers, sticky pivot, or under-inflated pair — re-level or switch to sealed bags.

Misconceptions & interventions

- **"Air is nothing — an empty cup really is empty."** — Hold up the dry paper after a level push: something already filled the cup so water could not share that space. When bubbles leave, water can enter.
- **"Only heavy solid things have mass; air is too light to count."** — Point at the settled beam: same balloons, strings and distances — only the air left, and the inflated side went down. That air had mass.
- **"Particles means the dust you can see floating in a sunbeam."** — Say particles are far smaller than anything we can see; visible dust is itself made of many particles. Link back to the invisible "something" in the cup and balloon.

Lesson 12

Differentiation

Emerging	Developing	Proficient
• Sit at the teacher-model table for the first cup push; use board stems I predicted… I observed… I think… on the Investigation Journal page. • Pair with a peer who steadies the cup level while they watch the paper and bubbles.	• Add one sentence on why tipping the cup changed the result, or why deflating (not popping) kept the balance test fair.	• Critique the balance evidence: what would make the tip clearer next time without changing what is being compared? • Restate both tests in particle language and say which observation best supports mass vs space.

Cross-curricular hook

Link to Maths measures — equal string lengths and equal distances from the pivot make the mass comparison fair.