TL;DR
Plasticine's super-power is that it can be reshaped in seconds, sticks to things on impact and sinks slowly in syrup. Those three traits unlock at least **seven** physics ideas—from density checks to perfectly inelastic collisions—that frequently appear in IP weighted assessments and H2 practical papers. This article lays out the exact mini-labs, common slip-ups and a 5-day micro-practice plan so you can turn a $2 block of clay into solid grades.

Exam-Scope Disclaimer

*Stokes' Law is **not** listed as required knowledge in the current IP Physics or H2 Physics syllabuses. Examiners may, however, supply unfamiliar relationships (including Stokes'drag) in an open-ended design or data-handling question and ask you to **derive or apply** them using provided graphs or first-principles ideas. Memorising the Stokes'Law equation is therefore **optional** — keep sub-section 2.2 as an enrichment task, or skip it entirely if you prefer to focus strictly on examinable content.*

1 Why every H2 lab issues a lump of plasticine

- **Malleable & re-usable** - one block can be rolled into spheres, flattened into pucks or packed onto carts in seconds.
- **Safe & classroom-friendly** - no shards, no bounce, no toxic dust.
- **Density** $\approx 1.4\ \mathrm{g \cdot cm^{-3}}$—heavy enough to sink in water yet light enough to reach terminal velocity in a 1 m-tall syrup column.
- **Sticky on impact** - guarantees a *perfectly inelastic* collision every time, a requirement in many momentum tasks.

*IP exam setters exploit those virtues because they let students focus on **data handling and uncertainty**, not tricky apparatus.*

---

2 Seven physics ideas a clay lump can prove

2.1 Density without Archimedes

Roll five different-mass spheres, measure mass (digital balance) and diameter (vernier calliper). A log-log **mass-vs-diameter³ plot** gives the density as the gradient. Students spot linearisation *and* propagate percentage uncertainties in one go.

2.2 Stokes' law in a jam jar

Drop the spheres through glycerine or honey, time the last 10 cm fall. Plot radius² against terminal velocity; gradient yields the fluid viscosity via
$v_t = \frac{2}{9} \frac{(\varrho_{\text{sphere}} - \varrho_{\text{fluid}})g}{\eta} r^2$.
A single kitchen jar turns into an H2-level viscometer.

2.3 Perfectly inelastic collisions on a bench-top

Load a rolling dynamics cart with a motion sensor, fire a plasticine bullet from a spring launcher. The bullet sticks; momentum is conserved but kinetic energy drops —students calculate the lost KE and discuss energy pathways.

2.4 Centre of mass & counter-intuitive balance

Shift tiny lumps along a ruler until it balances on a pencil; plot distance-of-lump vs centre-of-mass position to verify the lever rule. A neat visual for stability questions.

2.5 Elastic vs plastic deformation

Clamp a strip of plasticine and hang masses; strain rises but never returns—an instant demo of plastic region beyond Hooke's law. Compare to a steel spring on the same rig.

2.6 Rolling friction & energy dissipation

Roll an iron ball into a plasticine target on a smooth track; measure the embed depth to estimate the work done by rolling friction. AAPT's experiment shows how multiple concepts intertwine.

2.7 Pressure imprint mapping

Press a loaded test-tube onto a plasticine pad; the contact area reveals pressure distribution—great for qualitative questions on pressure = force/area.

---

3 Sample WA-style design-question $write-uptemplate$

Prompt
“Design an experiment using plasticine to determine the dynamic viscosity of cooking oil.”

Variable legend

- **Independent variable IV :** sphere radius — the value you deliberately change.
- **Dependent variable DV :** terminal velocity — the outcome you measure.
- **Control variable CV :** oil temperature — kept constant so it does not skew results.

Setup

Section	Key student moves
Diagram	Tall measuring cylinder, stopwatch marks, plasticine sphere
Variables	IV = sphere radius, DV = terminal velocity, CV = oil temperature
Procedure	Release sphere centrally, ignore first 5 cm, time next 20 cm three repeats
Safety & neat tricks	Wear gloves; mark cylinder with masking tape for clear timing gates
Data handling	Plot v vs r^2; gradient x constants → η; uncertainty from LINEST

Teachers can mark against H2 practical rubrics: MMO, PDO, ACE.

Rationale & theory

At low Reynolds number \(Re\<1) the net force on a falling sphere equals weight minus buoyancy minus Stokes drag, giving

$$\eta = \frac{2r^2(\varrho_{\text{sphere}} - \varrho_{\text{oil}})g}{9v_{\text{t}}}$$

Stokes' law is valid only when the flow is laminar and the sphere radius is small compared with the tube diameter.

Equipment list $suggestedminima$

- $500\ \mathrm{mL}$ graduated measuring cylinder \(\geq \pu{3 cm} inner diameter).
- $3-5$ plasticine spheres, radii $3\ \mathrm{mm}\ -\ 7\,\mathrm{mm}$, measured with a vernier calliper.
- Electronic balance $\pm 0.01\ \mathrm{g}$.
- Cooking oil \(\approx \pu{0.065 Pa s} at $25\ ^{\circ}\mathrm{C}$).
- Digital thermometer $\pm 0.1\ ^{\circ}\mathrm{C}$ clipped midway down the column.
- Stopwatch capable of $0.01\ \mathrm{s}$ or phone camera 120 fps for video timing.

Step-by-step method (justified)

1. **Calibrate & condition**: Warm the oil bath to $25 \pm 0.5\ ^{\circ}\mathrm{C}$ and stir gently to ensure uniform temperature (controls viscosity).
2. **Measure sphere mass & diameter** three times each; compute mean radius and density to \pu{\pm 1 \\%}.
3. **Release protocol**: Hold the sphere with tweezers at centreline to avoid wall effects, then let go without imparting spin.
4. **Timing window**: Start timer 5 cm below the oil surface (allows acceleration phase to finish) and stop 25 cm lower. Distance is marked with masking tape for consistency.
5. **Repeat** for each radius thrice; discard trials where the sphere touches the wall or creates visible wake (possible $Re > 1$).
6. **Clean-up**: Retrieve spheres with perforated spoon; wash glassware with detergent, dry, store. Follow glassware safety to prevent breakage.

Uncertainty & error analysis

- **Random**: reaction-time error (~0.2 s) divides by long timing distance, so percent uncertainty \pu{\approx 0.2 s / 4 s \cong 5 \\%}. Reduce by video analysis.
- **Systematic**: ignoring buoyancy term overestimates η by ≈ 10
. Always subtract ϱ_{oil} from ϱ_{sphere}.
- **Wall effect**: keep cylinder diameter ≥ 10 x sphere diameter to keep correction < 1
.
- **Temperature drift**: viscosity of vegetable oils changes $\approx 2-3$
; record bath temperature every two trials.

Apply propagation of uncertainty formally (GUM) when reporting η.

Typical data & sample calculation

For a $5.00\ \mathrm{mm}$ radius sphere mass = \(\pu{0.52 g}) falling $0.25\ \mathrm{m}$ in $3.60\ \mathrm{s}$ at $25\ ^{\circ}\mathrm{C}$:

1. $v_{\mathrm{t}} = 0.25/3.60 = 0.0694\ \mathrm{m \cdot s^{-1}}$
2. $\varrho_{\mathrm{sphere}} = 0.52/\left[\frac{4}{3}\pi(2.5 \times 10^{-3})^3\right] = 1380\ \mathrm{kg \cdot m^{-3}}$
3. $\eta = \frac{2(2.5\times10^{-3})^2(1380-920)\ 9.81}{9\times0.0694} = 6.9 \times 10^{-2}\ \mathrm{Pa \cdot s}$

Literature viscosity for canola oil at $25\ ^{\circ}\mathrm{C} \approx 0.067\ \mathrm{Pa \cdot s}$ — within 4 of accepted value.

Validity checks & improvement ideas

- **Check linearity**: plot v against r^2; $R^2 > 0.99$ confirms Stokes regime.
- **Lower Re further**: use smaller spheres or colder oil if curvature appears.
- **Automate timing** with Light-Gate + Data-logger to cut human reaction error to < 1

  .
- **Compare liquids**: run the same spheres in water and glycerine to highlight viscosity contrast and reinforce concept transfer.

---

4 Common mistakes & lightning fixes

Slip-up	Why it hurts	Fix in 10 s
Forgetting buoyancy term in Stokes analysis	Over-estimates viscosity by 10	Write $\varrho_{\mathrm{sphere}} - \varrho_{\mathrm{fluid}}$ *first*, highlight in colour
Calling collision “elastic” because carts rebound slightly	Loses theory marks	Stick an extra sliver of clay to guarantee zero rebound
Measuring sphere diameter with a ruler	$\pm1\ \mathrm{mm}$ error dominates	Use a vernier; take three perpendicular readings
Rounding mid-calculation	Data scatter inflates	Keep one extra s.f. until final line

---

5 5-Day micro-practice sprint

Day	15-min mission	Concept locked
1	Roll 3 spheres, plot $\text{mass vs diameter}^3$	Density & linearisation
2	Drop one sphere in honey, record video at 120 fps	Terminal velocity
3	Glue clay to air-track glider, do a sticky collision	Momentum conservation
4	Balance a ruler with clay lumps, sketch CoM shift	Centre of gravity
5	Quiz yourself: list every uncertainty source seen	PDO reflex

Tick each box, snap a photo, post to class chat—peer accountability matters.

---

6 Quick FAQ

Q Why does IP love “plasticine questions”?
Because the same blob lets exam writers weave density, kinematics and mechanics into one neat package, mirroring the cross-topic flavour of A-Level practicals.

Q Won't the clay absorb oil and change mass?
Mass change over a $30\ \text{s}$ run is < 0.1
— well inside typical measurement uncertainty.

Q Is Blu-Tack a valid substitute?
Blu-Tack is visco-elastic; rebound spoils perfectly inelastic assumptions. Stick to plasticine.

---

7 Further reading & ready-to-borrow ideas

1. Optional Practical - Density of Plasticine | InThinking IB Physics
2. Stokes' law | Wikipedia
3. Measuring Rolling Friction with Plasticine | The Physics Teacher (AIP)
4. H2 Physics Syllabus 9478 | SEAB
5. H2 Physics Practical Discussion | Reddit r/SGExams
6. Density of Plasticine Lab Report | Scribd
7. Hooke's Law and Plastic Materials | Physics Forums
8. Air-Track Inelastic Collisions Demo 24.12 | UCSB Physics
9. Momentum Conservation: Shooting Clay Balls at a Cart | YouTube - Zak's Lab
10. Centre of Gravity Balance Trick | YouTube - Science Experiments

Next step: grab $50\ \mathrm{g}$ of plasticine, run **one** experiment tonight, and log your biggest surprise.