Comparing elastic materials: rubber and wire

Student activity • investigation and reasoning

YEAR 10 / LESSON 8 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

Can a material recover its shape without obeying Hooke's law?

Measure a rubber band's loading and unloading, then observe a staff-operated wire demonstration. Compare these with the spring records from Lesson 7.

Equipment

- Sound rubber bands, clamped stands, rulers, light hangers and padded trays
- Eye protection, timer and graph paper
- Staff-only guarded copper-wire extension apparatus and deformation photographs

Wear eye protection. Use only approved loads on clamped rigs and keep faces away from tensioned materials. Check latex sensitivities before issuing rubber; provide a suitable alternative. The wire setup is staff-only behind a guard with padded catch trays. Do not touch, cut or break loaded wire.

Course coverage: Shared Physics / Double Award: 1.22–1.24. Comparing force–extension behaviour and recovery.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Wear eye protection. On a clamped stand, measure the unloaded distance between two marks on a sound rubber band. Keep a padded tray below the light hanger.

2. Add the five small staff-approved loads one at a time, including the hanger mass. Read the marked length after the same ten-second wait at each load.

3. Unload in reverse order, using the same waiting time. Record the final unloaded length after one minute. Do not stretch by hand or test to breaking point.

4. Observe staff loading a guarded copper-wire setup in small steps. Record the actual force and calibrated extension shown; no pupil handles or loads the stretched wire.

5. Plot loading and unloading data separately and compare with Lesson 7. Decide whether recovery and proportionality are both demonstrated, neither, or only one.

6. Examine staff-prepared photographs of permanently deformed wire. Explain why a curved loading graph alone is insufficient evidence of permanent deformation.

Cleanup

- Unload gently; staff isolate and unload the wire rig before removal. Return sound bands and report damaged ones.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Elastic recovery means returning towards the original dimensions after unloading. Hooke’s law requires a proportional force–extension relationship over a stated range. Rubber can be elastic while nonlinear, and its loading and unloading paths may differ. Wire extensions can be too small for an ordinary ruler; record the instrument’s resolution and do not invent a visible change.

Total force / N	Loading length / mm	Unloading length / mm	Extension / mm

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Can elastic behaviour be nonlinear?

2. Why keep the waiting time consistent?

3. What does a different unloading path show?

4. How do you identify permanent deformation?

5. Why might a wire need a magnified readout?

6. Can an uncalibrated pointer reading be called millimetres?