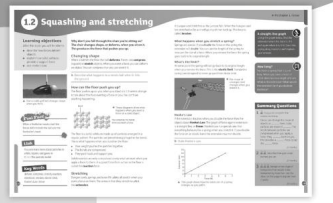
# 1.2 Squashing and stretching





**Physics NC link:**

- forces: associated with deforming objects; stretching and squashing – springs
- force–extension linear relation; Hooke's Law as a special case
- opposing forces and equilibrium: weight held by a stretched spring
- energy changes on deformation.

**Working Scientifically NC link:**

- present observations and data using appropriate methods, including tables and graphs.

| Band | Outcome | Checkpoint | |
|---|---|---|---|
| | | Question | Activity |
| Developing | State an example of a force deforming an object (Level 4). | A, B | Starter 1 |
| | Recognise a support force (Level 4). | 1 | Starter 2 |
| | Use Hooke's Law to identify proportional stretching (Level 4). | | Main 1 |
| | Present data in a line graph and identify a pattern (Level 4). | | Main 1 |
| Secure | Describe how forces deform objects (Level 5). | A, B | Starter 1 |
| | Explain how solid surfaces provide a support force (Level 5). | 1–3 | Starter 2 |
| | Use Hooke's Law to predict the extension of a spring (Level 6). | | Maths, Main 1 |
| | Present data on a graph, and identify a quantitative relationship in the pattern (Level 5). | | Main 1 |
| Extending | Explain how forces deform objects in a range of situations (Level 7). | A, B | Starter 2, Main 1 |
| | Explain how solid surfaces provide a support force, using scientific terminology and bonding (Level 7). | 2, 3 | |
| | Apply Hooke's Law to make quantitative predictions with unfamiliar materials (Level 7). | | Maths, Main 1 |
| | Present data in a graph and recognise quantitative patterns and errors (Level 7). | | Main 1 |

**Maths**
In the student book students complete a maths task using direct proportion, measuring extension for a given force.

In the practical students can plot data on a line graph, or interpret data from a line graph of extension and force.

**Literacy**
Students read and summarise information about applications of Hooke's Law such as toys or bungee jumping.

Students can use their ideas to explain how a newtonmeter works.

**APP**
Plan and carry out Hooke's Law experiment (AF4).

Interpret data, conclusion, and evaluation (AF3).

**Key Words**
deform, compress, stress, reaction, extension, tension, elastic limit, Hooke's Law, linear

### Answers from the student book

| | |
|---|---|
| In-text questions | **A** The shape of the tennis ball changes/is deformed.<br>**B** Hooke's Law says that if you double the force the extension will double. |
| Activity | **A straight-line graph**<br>When the force is 3 N the extension is 6 cm and when the force is 6 N the extension is 12 cm. This shows that if you double the force the extension doubles. The spring obeys Hooke's Law.<br>**How long**<br>The extension = 6 cm – 4 cm = 2 cm<br>If you doubled the force the extension would be 4 cm. |
| Summary questions | **1** deform, bonds, support, push, reaction (5 marks)<br>**2** The bonds between the particles in the solid behave like springs<br>When they are compressed they push you back up (2 marks)<br>**3** Example answers (6 marks):<br>Use a range of springs that stretch differently.<br>Some springs would not stretch so much/be stiffer.<br>You would bounce less.<br>Some springs would stretch more.<br>You would bounce more.<br>Different areas of the trampoline could have different springs.<br>You would bounce differently depending on where you were.<br>Would be more fun because the bounce would vary. |

kerboodle

| Starter | Support/Extension | Resources |
|---|---|---|
| An alternative question-led lesson is also available.<br>**Changing shape** (10 min) Hand round a selection of objects, for example, sponge, springs to stretch or squash, plasticine, rubber band, balloon. Students explain what happens when a force is applied and when the force is removed. Introduce the idea of the reaction force, how this is formed, and the energy transfers associated with deformation of material.<br>**Why don't you fall through the floor?** (10 min) Place a heavy ball on the table, on a sponge, and in a beaker of water. Identify similarities and differences (weight acts down – table provides support but not the sponge or water). Explain that some support forces seem invisible but are present. Support forces vary in size. Introduce the idea of the reaction force and how this is formed. | **Support**: Students describe what happens; the teacher explains why in terms of forces.<br>**Extension**: Students identify elastic and non-elastic objects and how to distinguish between them. | **Question-led lesson**: Squashing and stretching |
| **Main** | **Support/Extension** | **Resources** |
| **Investigating elastic (35 min)** Make two marks 10 cm apart in the middle of the elastic. Loop one end of the elastic from the boss head of the clamp stand. Add the hanger to the loop at the other end of the elastic and measure the new length between the marks. Repeat measurements whilst adding extra masses. Record results in a table and calculate each change in length. Students then plot a line graph of change in length against force, draw a line of best fit, and describe the pattern. This is done as part of the questions on the practical sheet. A partially labelled graph grid may be used to support students and to speed up the process. Introduce Hooke's Law. | **Support**: A support sheet is available with a pre-drawn table.<br>**Extension**: Students understand that extension should be proportional to force and use their graph to predict extension for different masses. | **Practical**: Investigating elastic<br>**Skill sheet**: Choosing scales<br>**Skill sheet**: Calculating means<br>**Skill sheet**: Recording results |
| **Plenary** | **Support/Extension** | **Resources** |
| **Bungee jumpers** (10 min) Show a video clip of a bungee jumper. Explain that the rope is elastic. Students explain how to calculate the right length of rope to use, and what happens if you get it wrong.<br>**Stretching experiment** (10 min) Interactive resource that can be used as a recap for the experiment carried out in the lesson. | **Support**: Students describe what happens to the rope in the video and why it helps to keep the jumper safe.<br>**Extension**: Students explain problems caused if the wrong spring or elastic is chosen. | **Interactive**: Stretching experiment |
| **Homework** | **Support/Extension** | |
| Students research one idea about the application of springs. They must find out why the elastic behaviour is used, how it is controlled, how problems are avoided, and the energy changes that occur on deformation of the spring. | **Support**: Students can be supported by coming up with uses of springs during the lesson. | |