Your teacher may watch to see if you can:
● take careful measurements.

Aim

To investigate the **extension** and work done when applying forces to a spring and a rubber band.

Method

A Set up the apparatus as shown in the diagram. The zero on the ruler should be level with the bottom of the unstretched spring.

B Measure the length of the spring with no masses hanging on it and write it down.

C Hang a 100 g mass on the spring. Record the extension of the spring (the length shown on the ruler).

D Repeat step **C** until you have found the extension of the spring with 10 different masses. Each 100 g mass puts a downwards force of 1 N on the spring.

E Repeat steps **A–D** for a rubber band.

Apparatus

● stand and two clamps
● spring
● rubber band
● ruler
● masses
● eye protection

⚠ Safety

Wear eye protection.

Recording your results

1 Draw a table like this to record your results. You will need a separate table for the rubber band.

Force (N)	Extension (cm)	Extension (m)
0	0	0
1		

2 Draw a scatter graph to show force against extension. Put extension on the horizontal axis and force on the vertical axis. Plot points for the spring and the rubber band on the same graph and join them with smooth curves or lines of best fit.

Considering your results/conclusions

3 Compare and contrast the shapes of the two lines on your graph. (How are they similar? How are they different?)

4 Describe the relationship between force and extension for the spring and for the rubber band. Use some of the following words in your answer: directly proportional, linear, non-linear.
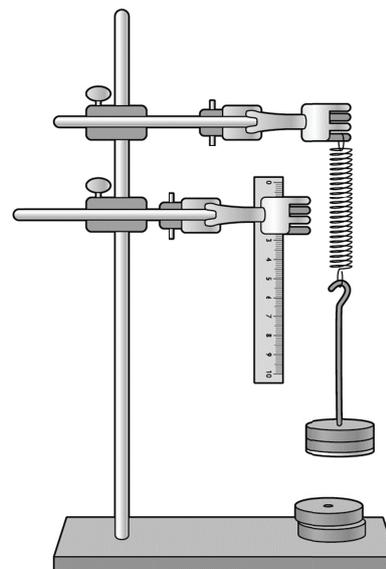
Your teacher may watch to see if you can:
- take careful measurements.

Introduction

Tennis balls are designed to bounce well on a firm surface. To do this they are able to deform (change shape) and then return to their original shape. The manufacturer needs to know just how much a tennis ball will squash when different forces are placed on it.

Aim

To measure how squashy a tennis ball is.

Method

A Place a tennis ball on the bench and tape it so that it will not roll. Place the large card tube on the bench so that the ball is in the centre of the large tube.

B Place the board on top of the tennis ball, so that the ball is in the centre of the board. It is all right for the board to sit at a slight angle. However, the board should not rest on the cardboard tube at all.

C Measure the distance from the bench to the corners of the board, being careful not to move the board.

D Repeat the measurements after placing a range of masses on the board.

Apparatus
- ruler
- tennis ball
- large card tube
- board
- masses
- masking tape

⚠ Safety

Be careful not to drop the masses on your hands or feet.

wooden board

tennis ball

cardboard tube
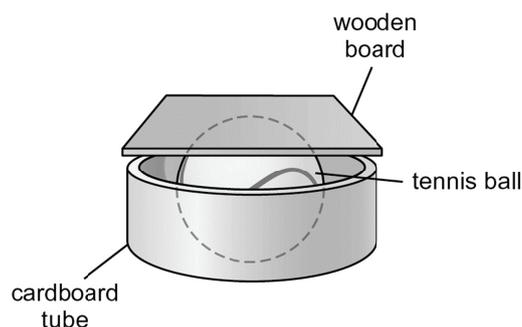
Recording your results

1 Draw a table like this for your results.

Mass (kg)	Weight (N)	Height of board (cm)				
		corner 1	corner 2	corner 3	corner 4	mean
0	0					

2 Each kilogram of mass has a weight of 10 N/kg. Work out the weight of each mass you used and write it in the table.

3 Calculate the mean height of the corners of the board for each mass and write it in the table.

4 Draw a scatter graph of weight against mean height. Put the independent variable on the horizontal axis. Draw a line or curve of best fit through your points.

Considering your results/conclusions

5 Describe the shape of the line on your graph.

6 Calculate the deformation of the tennis ball for each mass by subtracting the mean height from the mean height with zero mass. Plot another graph to show this.

7 Describe the relationship between force and deformation shown by your second graph.