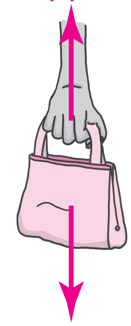
What happens to a sweet when we stretch it?

In this experiment you will investigate how a sweet is stretched when we apply a pulling force. Our sweet is fixed at the opposite end to the pulling force so it can't move.

Our aim is to find out how the shape of a sweet is changed by a pulling force. Does the size of the force matter? Do all stretchy sweets behave in the same way?

We will:



- Describe how a sweet's length changes as the force applied increases.
- Use a graph to identify different types of stretching.
- For small forces, predict how much the sweet will stretch if we know the size of the force used.
- For small forces, predict how much force we will need to extend the sweet by a certain length.
- Describe what happens to the sweet when large forces are used.

Equipment

- Retort stand with boss and clamp
- Two strawberry laces and one apple ring
- Mass holder and slotted masses (10 g and 100 g)
- 30 cm ruler
- Marker pen
- G clamp

Method

1. Set up a retort stand with the G Clamp. Get a teacher to check this.
2. Tie two strawberry laces to the clamp. The laces will dangle over the end of the bench.
3. Tie the mass holder to the other end of the strawberry laces.
4. With a pen make 2 marks on the lace 30 cm apart. This is the "unstretched length". (Think: is this really the unstretched length and why do we use that measurement.)
5. Gently add 10 g masses one at a time and record the new length between the marks.
6. Keep adding masses till the lace breaks. Make sure your feet are not underneath! Remember to measure the length between the markers each time.
7. Calculate how much the sweet has extended for each of your measurements.
8. Plot a graph of weight against extension using the graph paper and axes provided.
9. Repeat the experiment with an apple ring. Hang the apple ring on the clamp. Your pen marks should be 5 cm apart. You will be adding 100 g masses to the mass hanger.
10. Plot a graph of weight against extension for the apple rings, what differences are there between your graph for the apple ring and the strawberry laces?

Results

Use the following two tables to write down the results for your experiment.
We can convert from mass to weight by multiplying the mass, *in kilograms*, by the strength of gravity:

$$\text{weight} = \text{mass} \times \text{strength of gravity} = \text{mass} \times 10\ \text{m/s}^2.$$

Strawberry lace

Mass (g)	Length between markers (cm)	Weight (N)	Extension (cm)
0	30	0	0
10			
20			

Apple ring

Mass (g)	Length between markers (cm)	Weight (N)	Extension (cm)
0	5	0	0
100			
200			

Plotting your graph

Two sheets of graph paper are provided at the end of the handout for you to plot your graphs. It is good practice to plot each point as you collect your data in the tables above.

Once you have plotted your data then you will need to draw a **line of best fit**. This is a straight line that agrees with your data as well as you can make it. You should not "join the dots", but instead draw a single straight line with a ruler. Do not worry if your line does not go through all of the data points (but it should be close to most of them). You may find you can only draw a sensible line of best fit for part of your data.

Discussion

1 Look at the shape of your graph from the **strawberry laces** experiment. Describe the shape of your graph.

2 Look at the shape of your graph from the **apple ring** experiment. Describe the shape of your graph.

3 (a) When you add a force of 2 N to the **apple ring** what is the extension?

(b) What is the extension when you add 4 N?

(c) What is the extension when you add 6 N?

(d) Can you spot a pattern? (fill in the blanks)
When you double the force on the apple ring, the extension ____________. When you treble the force on the apple ring, the extension ____________. As long as the graph is ____________, if you multiply the force on the apple ring by any number then the extension is also multiplied by the ____________ number.

4 What about small weights with the strawberry laces? (fill in the blanks)
When you double the small weight added to the strawberry laces the extension ____________.
So the extension fo the strawberry laces follows ____________ pattern as the apple ring.
For small extensions their graphs are both ____________.

5 When you add larger weights to the strawberry laces what do you notice?

Calculations

6 In an experiment, as long as the mass added to the hanger is less than 80 g, some strawberry laces stretch by 1.0 cm for each 10 g mass added.

(a) A 30 g mass is hung from the strawberry laces. How much longer will they get?

(b) When a 10 g mass hanger is hung from the laces, the laces are 6.0 cm long. An extra 50 g mass is now hung from the strawberry laces. How long are the laces now?

7 In an experiment, when the total mass added is less than 1500 g, an apple ring got longer by the same amount every time a 100 g mass was added to the hanger. To start with it was 7.0 cm long. After 1200 g had been added, it was 12.0 cm long. How much mass was on it when it was 9.5 cm long?

Conclusions

8 Write conclusions for your experiment, to do this try answering the following questions.

(a) Which sweet was stretchier?

(b) Which was stronger?

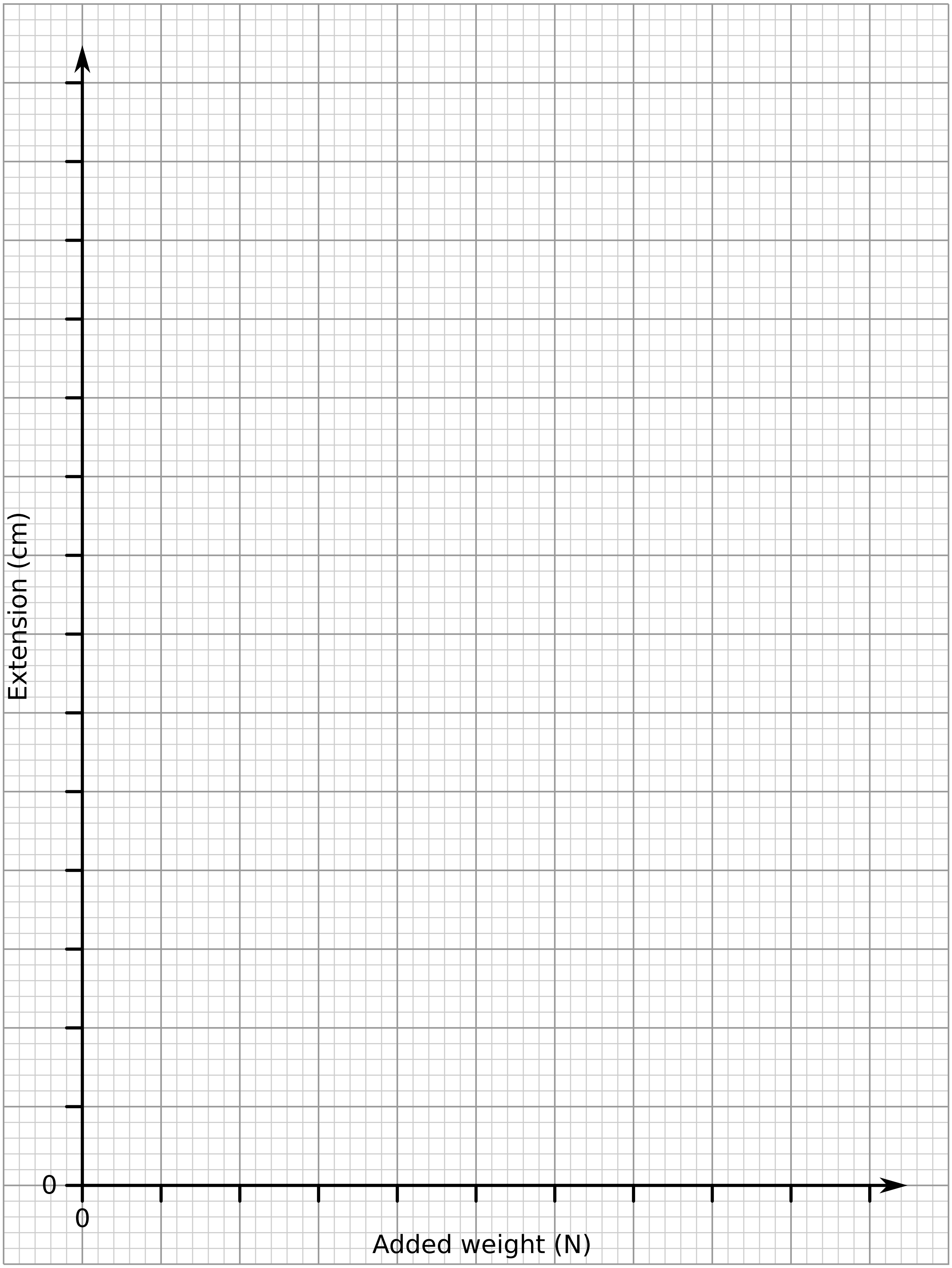
(c) Did this fit in with your prediction?

(d) Did you have any challenges doing the practical?

(e) Are there any improvements you would make if you did this experiment again?

Use this graph paper to plot your strawberry lace data. You will have to **choose an appropriate scale** for your axes. Depending on your data you may not use all the available space.

Title: A graph of the extension of two strawberry laces against the weight added.



Use this graph paper to plot your apple ring data. You will have to **choose an appropriate scale** for your axes. Depending on your data you may not use all the available space.

Title: A graph of the extension of an apple ring against the weight added.