

Simple forces experiments

The use of simple experiments within the study of Mechanics helps students to visualise and experience what is happening. It gives the opportunity to confront and deal with some of the misconceptions they hold and also provokes discussion about the modelling that is involved in any study of Mechanics.

The first of these experiments involves students pausing to 'feel' the forces which act on them. The second involves observing a ball that is projected vertically into the air and helps to uncover a common misconception. The third experiment involves considering the forces when 'weighing' yourself on a set of scales and attempting to explain the result through the use of force diagrams and a modelling process.

Experiment 1: Feeling forces

These (very) short experiments can lead to discussion of the forces of weight, normal reaction, friction, etc that act on stationary bodies.

(a) For this experiment simply ask students to stand and then get them to concentrate on the force which they feel pushing up into their feet.

Q: What is this force? What are the forces acting on the student?

Q: What happens when they press down onto the table in front of them with their arms?

Q: What happens when they lift one leg up?

(b) Ask students to stand at arms' length from a wall and place their palms against the wall at about shoulder height. They are to note the force in their feet and then see what happened as they press with increasing force against the wall. (They should feel the force 'move backwards' into their heels.)

Q: What happens?

Q: Why does this happen?

(c) In pairs ask students to pull either end of a piece of string

Q: What do they feel? This is tension.

Now ask students to push either end of a pen

Q: What do they feel now? How is it different from the string? This is thrust (or compression).

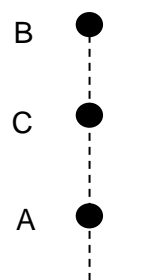
Q: Can you feel tension in the pen? Thrust in the string? Why?

Experiment 2: A ball thrown vertically into the air

Purpose: To deal with the misconception of force acting in the direction of motion

Equipment: - a ball

- Throw a ball vertically upwards into the air. Ask students to think about the resultant force acting at each point of the journey.
- Show a copy of the diagram below and describe the journey of the ball as passing through A on the way up, reaching its highest point at B and falling back through point C on the way down.
- Students could replicate the diagram below on a mini-whiteboard and then mark an arrow on the diagram showing the direction of the force acting at each of A, B and C.



- Discuss the responses and highlight that motion is different from force.

Notes:

- Many students will place arrows for resultant forces that match the direction of motion for the ball i.e. A up, B nothing, C down.

Experiment 3: Bathroom scales and a broom

Purpose: To discuss force, in particular weight and normal reaction.
To model a situation using force diagrams

Equipment: - set of bathroom scales
- broom

- Pose the opening question 'How can I use this broom to make me 'lose weight' ie. reduce the reading on the scales?
- Ask for a volunteer to attempt the suggestions and see what happens
- A class discussion can follow exploring the following:
 - what are scales actually measuring? This can be tested by pressing on the scales against a wall
 - what makes the reading increase? decrease?
 - what happens if you push down with the broom on the scales?
- Explore why this happens through modelling the situation using force diagrams.

- There is a version of this activity in 'Mechanics in Action' (p61) called 'Bathroom Scales and a Broom' which can be found via this link:
<http://www.nationalstemcentre.org.uk/dl/353023137026c932e0b7a67d3d9b79de1e67986a/3635-Mechanics%20in%20action.pdf> This comes with a photocopyable handout.