SCIENCE TEACHER.IE

Falling Down – literacy task

Why do things fall at different speeds? Weight only gives us part of the answer.

When Dave Scott went to the Moon on board Apollo 15 he took along a hammer and a feather. He dropped them together, and they both accelerated at exactly the same rate and hit the ground together. There was more force on the hammer, because it had more mass, but it also takes more force to accelerate a more massive object. The two effects cancel each other out, so the hammer and the feather fell at exactly the same rate

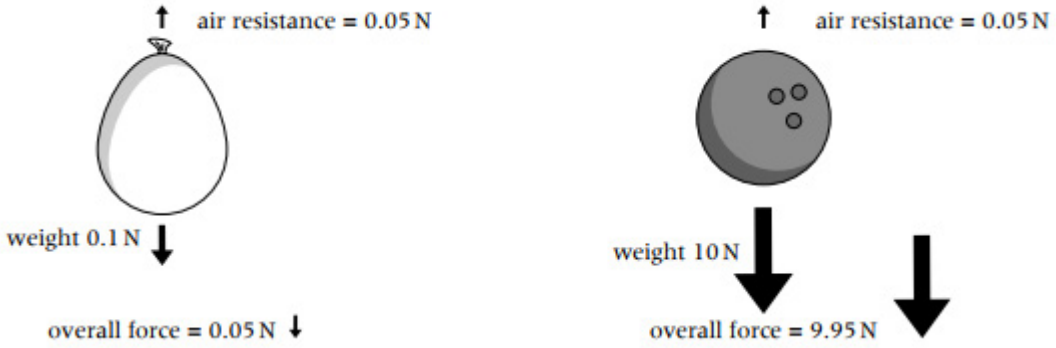
If you tried the same experiment on Earth you would get a very different result. The hammer would fall much faster than the feather. The difference is due to air resistance. The amount of air resistance depends on an object's shape, so it is easier to work out why this happens if we think of two objects with roughly the same shape.

A balloon full of air has a mass of 10 g. Its weight is 0.1 N. A bowling ball is about the same size as the balloon, and it has a mass of 1 kg. Its weight is 10 N. (On Earth, 1 kg has a mass of 10 N.)

The effects of mass and weight cancel each other out, and both objects start to fall at the same rate. They have only just started to move, so there is no air resistance.

If you drop the balloon and the bowling ball, they will both accelerate at the same rate to start with. There is more force from gravity (weight) on the bowling ball, but because it also has more mass it only accelerates downwards at the same rate as the balloon. Once the two objects are moving, air resistance starts to act on them. If they are the same shape and moving at the same speed, the air resistance on them will be the same.

The overall downwards force on each object is now the difference between its weight and the air resistance. The air resistance is a much smaller proportion of the weight of the bowling ball, so air resistance has less effect on the speed that it falls and it falls faster than the balloon.



The balloon now only has 50% of the original downwards force on it, but the bowling ball still has 99.5% of its original force.

Questions

(1) The hammer that Dave Scott dropped on the Moon had a mass of 1.32kg.

a) What was its weight on the Moon? (Gravity on the Moon is approximately 1.67N/kg.)

b) What would its mass have been on Earth?

c) What would its weight have been on Earth?

(2) A football is the same size as the bowling ball described above. It has a mass of 0.5kg.

a) What is the weight of the football on Earth?

b) When it has reached the same speed as the balloon and bowling ball in the second picture, what will its air resistance be? Explain how you worked out your answer.

c) What will the effective downwards force on it be when it has reached this speed?