Magic, science or mystery? (KS 2)

SUPPORT NOTES

Welcome to the world of the science magician where nothing is quite as it seems. This is magic with a difference – the audience is encouraged to figure out the science behind the tricks.

Purpose of these notes

These notes are intended to provide teachers with a brief overview of the main demonstrations and concepts presented in the show, and to suggest some topics for discussion or follow-up after the show. We also hope that the show will encourage teachers to integrate some of the ideas and techniques that they find useful into their own teaching. If you would like any more information about any of these topics please get in touch with us.

safety information
Although each demonstration presented in the show only involves everyday equipment, each activity has been subject to the normal risk assessments. It is important to emphasise that if any of the demonstrations are to be used or adapted for classrooms they should, of course, be thoroughly assessed by each teacher in advance. *Pupils repeating the experiments at home should be encouraged to involve their parents or carers for reasons of both safety and education.*

Format of the show

This interactive show uses demonstrations that seem like magic tricks to engage the audience and then challenges them to work out how each trick was done. The intention is to present science in a way that will enthuse the audience and perhaps make them think differently about some of their attitudes towards science. Each trick demonstrates specific principles in science and these can be followed-up through with questioning and activities by teachers after the show.
The show will not expose the tricks and techniques used by professional magicians. Instead it explores tricks that can be easily learnt already through magic books for children.

A selection of the demonstrations outlined below will be used in the show. The exact activities used in each show will depend on the length of the show, the performing conditions, the age and background of the audience, and any particular topics requested by the teachers.

Curriculum connections

Our shows are designed to support and enrich the science strand of the revised NI curriculum learning area *The World Around Us* for Key Stage 2.

The topics covered in the show are concerned with a wide range of topics under the "movement and energy" and "change over time" themes – how things move; how things work; sources of energy; how sounds are produced and travel; importance of light in our everyday lives; and chemical changes. The way that the demonstrations are explored also develops the abilities of pupils to ask questions and test out their ideas.

Inertia and friction

key ideas:

- a force is another word for a push or pull;
- objects don't move until they feel an unbalanced push or a pull (this is called inertia);
- friction as the force between surfaces that rub against each other;
- the importance of confidence in being successful in whatever you do.

tablecloth pull

The tablecloth, table and plate should be smooth and dry. Objects that are at rest tend to remain stationary. Because of this you need to give the objects an unbalanced force to make them move. When the tablecloth is pulled the force of friction between these smooth objects is not large enough to overcome this inertia, so they remain motionless.

scientific Jenga

This demonstration is another illustration of low friction and inertia in action – if you pull the bottom block out quickly enough and the force of friction between it and the next set of blocks is small, the column will remain standing. Playing Jenga involves a good understanding of friction and gravity.

telephone directory challenge

The combined effect of the force of friction between each of the pages of the telephone directories is much stronger than you might think. The weight of the directories squeezing the pages together makes the force of friction greater.

Gravity

key ideas:

- gravity is the force that pulls all objects on Earth down towards the ground;
- all objects have a centre of gravity/centre of weight – the point where all the weight of the object can be assumed to act;
- the location of this centre of weight affects how the object will move;
- objects that have their centre of gravity over the point at which they are in contact with the ground will be balanced;

the confused can

The heavy weight at the top of the can on the uphill side means the can will over-balance this way when you release it. Watch how the centre of weight of the can (effectively the heavy weight) moves as the can is released – does it move up or down? So is this can really rolling uphill?

The presentation of this demonstration illustrates how scientists work in practice - in science we try to come up with as many ideas as possible that might explain what we have seen; we then test each idea separately by doing an experiment to rule it out; the easiest explanation that we are left with that still accounts for what we have seen is usually called “the truth”.

Light

key ideas:

- how we see objects depends both on the light entering our eye and on how our brain makes sense of the information it gets from the eye;
- some objects make their own light (sources of light), but we see most objects because of the light they reflect towards our eyes;
- shiny surfaces and mirrors reflect most of the light back towards the direction from which it came.

the magic arcs
The curvature of the plastic arcs, one on top of the other, creates the convincing optical illusion that top piece is always smaller compared to the bottom piece. They are actually the same size. Don’t always believe what you see! In this case it is your brain rather than your eye that is being fooled.

the magic box
A mirror placed diagonally across the inside of the box reflects light hitting it so that anyone looking in simply sees a reflection of the empty front half of the box. Whatever you want to produce can be stored behind this mirror without being seen.

Air pressure

key ideas:

- air is all around us pushing in all directions (air pressure);
- when an object contains air that pushes harder than the air surrounding it, then the object will tend to be pushed outwards; if the air outside the object pushes harder than the air inside then it will get squashed;
- fast-moving air cannot push as hard in all directions as slow-moving air (fast-moving air has lower pressure);
- air tries to move from high pressure areas to low pressure areas;
- air pressure gets lower as you go higher up in the atmosphere – there are fewer molecules.

tornado bottle puzzle
The air trapped in the bottom bottle, pushing in all directions, stops the water falling into it from the top bottle. Every time a bubble of air escapes into the top bottle, a drop of water can fall into the bottom bottle. Spinning the bottle creates a vortex that allows the air to move upwards at the same time as the water falls. This is the fastest way of emptying the top bottle.

balloon in the bottle trick
Trying to push the balloon into the bottle by hand is difficult because the air trapped in the bottle pushes back. As the paper in the bottle burns, however, some of the warm air in bottle rises around the balloon sitting on top. When the flame goes out, the air left inside the jar cools and contracts. There is less air inside the same space now than before – so the air left inside the bottle can’t push up as hard on the balloon as the air outside the bottle pushes down on the balloon. The balloon therefore gets pushed into the bottle by the air in the room (air pressure).

the shrinking marshmallows
The vacuum food container uses a pump to remove some air from inside the jar. The remaining air inside the jar is not then pushing on the marshmallows as hard as the air inside the marshmallow is pushing outwards – the marshmallows get pushed out. When the air is let back into the jar the marshmallows shrink, as the air in the jar can now push just as hard as the air inside the marshmallows (they are at the same pressure).

wind bag
Our lungs would not be big enough to blow this bag up with one breath. By blowing with your mouth held back from the entrance to the tube you are making the air around the mouth of the tube move quickly. This means there is a region of low pressure immediately in front of the tube. Because all of the still air in the room is pushing harder (higher pressure) it gets pushed into this region of low pressure, blowing the bag up very quickly. This is the easiest way of blowing the bag up.

Sound

key ideas:
- all sounds are produced by something vibrating or shaking;
- these vibrations or sound waves can travel through gases, liquids and solids;
- the greater the volume of air you can make vibrate, the louder the sound will appear to our ears;
- the faster the object vibrates the high the pitch of the sound it makes.

the cheap loudspeaker
The small music box can only move a small volume of air backwards and forwards between it and your ears – it sounds very quiet. The tray will vibrate like the music box but it can move much more air and therefore sounds louder.

singing rod
The rod is vibrating because of the friction between it and the person's fingers. It vibrates so fast and moves so little than our eyes cannot see the movements in the rod. These vibrations travel through the air and can be felt by our ears as a very high-pitched squeal. When the rod is touched at the top, the vibrations in the rod stop immediately, and therefore the sound stops – no vibrations mean no sound.

Absorption and materials

key ideas:
- observation is very important in science;
- some chemicals can absorb many times their own weight in water;
- differences between liquids and solids – liquids can flow and take the shape of the container whilst solids keep their shape.

follow the cup
The second cup that the water was added to already had a small amount of a chemical powder in it. This special powder absorbs all of the water and turns it from a liquid into a thick gel. That is why the cup can be turned upside down without the water falling out. This powder is designed by chemists to be very good at absorbing water, and it is used in disposable nappies.

making snow
This powder is slightly different to the nappy powder and this time instead of absorbing the water to become a thick gel, fluffy flakes of fake snow are produced as the water is absorbed. This powder is used by special effects artists to make “snow” for the movies.

Heat

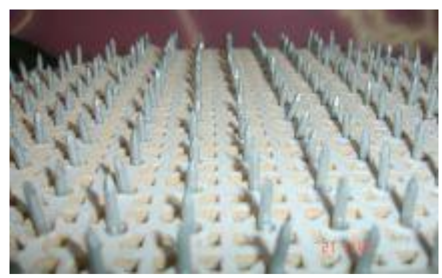
key ideas:
- heat can be conducted through some materials;
- water can absorb a lot of energy before it increases in temperature.

the fireproof balloon
The heat energy from the flame is conducted through the rubber of the balloon into the water. The water requires a lot of heat energy to increase its temperature. In fact, the water in the balloon should be able to be boiled without the rubber of the balloon getting hot enough to burst (although of course this should not be attempted over someone’s head). What would happen if the flame was held at the top of the balloon against the air-filled part of the balloon? Can you explain why?

Pressure

key ideas:
- putting all your weight on a single point is sore;
- the greater the area or the number of points holding your weight, the more comfortable it will be – your weight is spread over the points (lower pressure).

seat of nails



Sitting slowly on all of the nails covering the seat means that your weight is spread out evenly over each nail – each nail only has to support a small proportion of your weight. If any nails are slightly higher than others then they will have to support more weight and you will feel the painful difference this makes.

Central forces

Key ideas:
- objects spinning in a circle try to keep moving in a straight line;
- there needs to be a force towards the centre of the circle to keep the object spinning (centripetal force).

in a spin
The force from my arm on the tray keeps pulling it into a circle, preventing the water from leaving the cup to keep moving in a straight line. The slower the tray is spun the weaker the force keeping the water inside the cup. So slowing down the tray and cup usually takes bit of practice. You may have felt the same thing whenever you have moved quickly in a circle on a roller-coaster or in a car. Have you ever felt that you are being pushed into your seats when you loop-the-loop, or pushed up against the side of the car when you go round a roundabout too quickly?

Sources of more activities and information

suggested activities to try:

- Does the magic arc trick work with two bananas of the same size?
- Try making your own magic boxes using cardboard boxes and plastic mirrors.
- Help pupils to repeat the tablecloth trick demonstration with different types of tablecloth, table and plastic plates. What are the most important factors that affect the successful of the trick?
- Test a cloth nappy and different brands of disposable nappy to investigate which one can hold the most water.
- Encourage pupils to review the show by having them describe and draw their favourite demonstration, and explain how it worked in their own words.
- Challenge pupils to practice some of the demonstrations and then show them to the rest of the class or to other classes that haven't seen the show.
- Ask pupils to read science experiment books for ideas to present as their own science magic tricks. Once they have practiced the tricks and written them up, they could put on their own science magic show for the rest of the school.

books:

- "Science Magic in the Living Room: Amazing Tricks with Ordinary Stuff", Richard Robinson, Aladdin Paperbacks (and others in the Science Magic series);
- "Magic science", Jim Wiese, Jossey-Bass.