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For Primary Schools and Teachers of S1/S2 courses

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Science is just magic!

"Science is always discovering odd scraps of magical wisdom and making a tremendous fuss about its cleverness." - *On Freudian theories, The Confessions of Aleister Crowley (1929)* http://www.hermetic.com/crowley/confess/chapter64.html

Now that we are entering a season of festivities and entertainment (for some at least) your pupils might like to learn some 'magic' tricks, which can be performed with readily available props, to amaze their friends and relatives. All have explanations that link to the primary science curriculum and are eminently compatible with at least one of the aims of a Curriculum for Excellence - that learning should be "active, challenging and enjoyable". They let children see through the trickery and offer ideal vehicles for scientific enquiry.

Under pressure

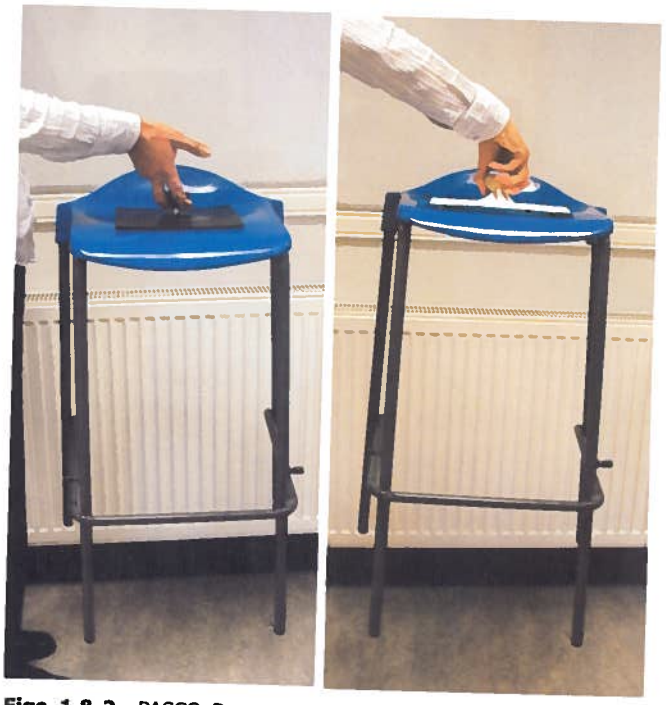
We start with a couple of tricks which rely on the effects of *atmospheric pressure*. You've probably seen on the TV where the weather forecaster tells us about *lows* and *highs*. Generally, *High pressure* gives us good weather and *Lows* bad. This tells us that atmospheric pressure can vary but is always all around us, pressing on the surface of everything and everyone. Check out the first two tricks which let us know it's there and amaze us at the same time!

Get a grip

There is a super little piece of apparatus made by PASCO [1] called the *Atmospheric Pressure Demonstrator*. Consisting of a thick rubber mat (20 cm square with a central handle), it costs a hefty £35 and is available though Feedback Instruments in the UK [2]. If the mat is placed on the top surface of a stool (needs to be pretty flat), see what happens when we try to lift it up with the centre handle? The mat 'sticks' and the stool can be lifted, as if by magic. Show the mat can be easily peeled away from the surface.

Why does the mat 'stick' to the surface? What keeps the mat 'stuck' to the stool. You've guessed it - *atmospheric pressure* and a good seal betwixt mat and stool.

Why not try making your own version using some rubber from a cheap hot-waterbottle, wood handle, glue, card and some paper-clips. See Figs. 2 & 3 and the online version of Newsletter 38 on the ISE 5-14 website for a DIY design [3].



Figs. 1 & 2 - PASCO *Demonstrator* and DIY version

King of Spades holds back the water!

Take a glass and fill it with water. Lay the King of Spades (or any other playing card) on top of the glass. Some say that this court card was a representation of King David from the Bible [4]. Perhaps it may be more aposite to have a 'Moses' card since it 'holds back the water'. The 10 might just fit the bill - look it up!

Ask the children to suggest what might happen if you turn the glass upside down with the card in place. Invert it carefully, maintaining a little pressure on the card to make sure there is a good seal between the glass and the card. Take your hand away from it, the card should stay in position and the water in the glass. (Practise over a sink!).

Explanation - Air is pushing upwards on the bottom of the card with a greater force than the force exerted downwards by the weight of the water.

Figure 3 - DIY atmospheric pressure demonstrator.

Figure 4 - Defying gravity?

Magic carpet?

Cut an A4 sheet of card into 8 pieces. The challenge is to drop as many pieces of card as you can (not crumpled) from arm's length into an empty basin on the floor. Keep a score and allow each child to choose how the paper is released. Don't suggest what method of release may be more successful. Allow a second round and see if a preferred method of release emerges. You will find that if the pieces are held vertically and dropped, the pieces will flip, swerve and weave their way to the floor, frequently missing the target. If, however, you hold the piece of paper horizontally, it tends to descend straight down and you have a better chance of it reaching the basin.

Ask questions about the time it takes for the bits to reach the ground and relate to air resistance.

Tricking your brain

Colour Confusion - This activity, on the face of it, is very simple. Print a list of colours where the actual colour of the text doesn't correspond with the words (Fig. 6). This is an ideal activity for an interactive white board. Time the members of the class on their ability to accurately describe what colour they see and not what it says. Collate the results and see if the teacher can do any better!

Interestingly, this is an activity where poorer readers may have an advantage because they may be less influenced by the written words. Ask the children why they may make mistakes in what seems to be such an apparently simple task. Try the same experiment with fuzzy, indistinct text.

Figure 5 - Colour confusion chart

Optical Illusions - Many things can confuse the signals and communication between the eye and brain. Optical illusions don't actually trick the eye, but our mind. The brain tries to change and distort images in an attempt make sense of them. There are different types of optical illusions. See a varied selection on the web [5, 6 & 7].

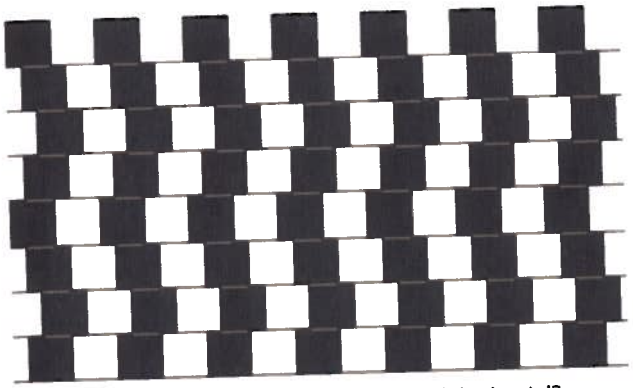


Figure 6 - Are the above lines straight, curved, horizontal?

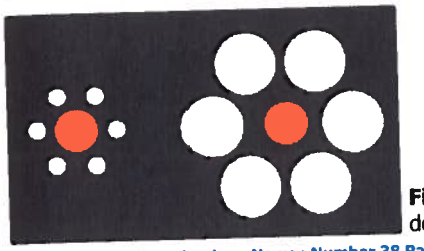


Figure 7 - Which red dot appears bigger?

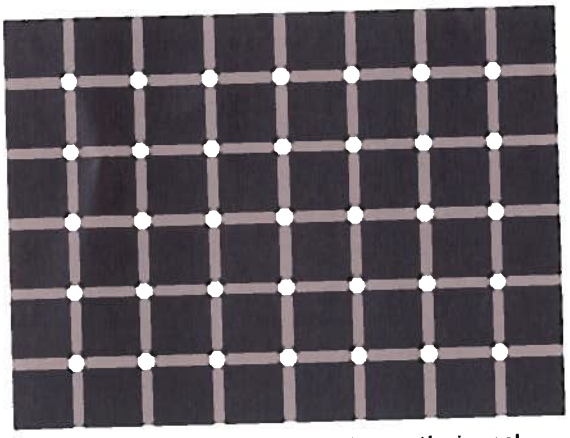


Figure 8 - Count the number of black dots on the image!

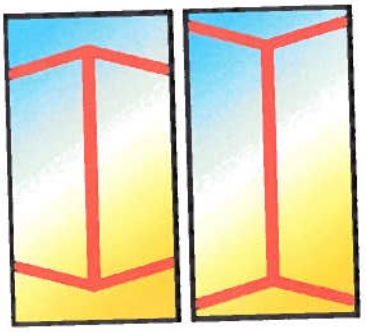
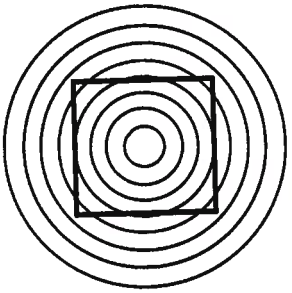


Figure 9 - Which central red line appears to be longer?



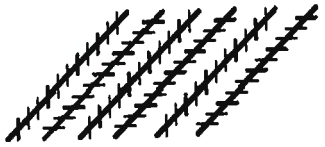


Figure 10 (above) - are the angled lines parallel to each other?

Figure 11 (left) - has the square straight or curved edges?

About face

Tent-fold a piece of cardboard and draw or print a horizontal arrow on it. Place it about 15 cm behind an empty straight-sided glass and challenge a member of the class to change the direction of the arrow without touching the glass or the card. If they fail, fill the glass with water from a jug/bottle which has been sitting inconspicuously on the table. Now, when you look through the glass, the arrow should appear to be facing in the opposite direction.

What is happening to the light from each end of the arrow as it passes through the water? The view from above may help to explain how a reversed image is produced. The water in the glass, which appears circular from above, acts like a lens to bend the light rays.

Figures 12 & 13 - Glass without and with water.

Eye eye Sir

Once light has passed through parts of the eye which are visible from the outside (*cornea*, *lens* and *iris*) it goes, funnily enough, through the watery insides (*aqueous humour*) and falls on the *retina* at the back. The retina has a thin layer of light-sensitive cells, some of which detect colour (*cones*) and others black and white (*rods*). Different cones, of which there are three, are sensitive to green, red or blue.

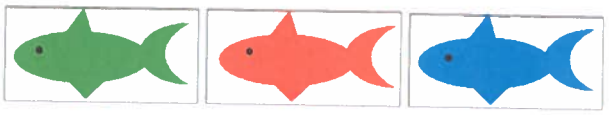


Figure 14 - Fish cards

If you look for a prolonged time at an image of one strong colour (say green), the green sensitive cells will tire. If you then switch your gaze to a white surface, which will be reflecting red, blue and green light, these tired cells will fail to respond to the green light, but the others will react strongly to the red and blue, and you will see a red-blue image.

Prepare cards as above, or use an interactive whiteboard to project images. Give your volunteer one coloured fish and tell them to stare at the fish's eye. Ask them to switch their gaze to a card or whiteboard image of an empty bowl (Fig. 15). They should be able to see a ghostly fish in the reverse colour.

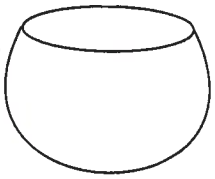


Figure 15 - Fish bowl

Good, good, good, 'good vibrations'

This trick relies on the property that metals have good thermal conductivity i.e. the heat energy from our skin can be easily transferred to the metal of coins.

Figure 16 - Suitable coins for the thermal conductivity experiment

Lay out four different coins on a table (Figure 16). Ask a volunteer to face the class, select one coin (stressing they should not touch any of the others) and hold it with the palm of a hand against their forehead. Make sure you let the class see you cannot see their choice.

Tell the volunteer to "think very hard about the coin" as the vibrations from it "should be transferring into their brain". You should be seen to the class to be concentrating very hard to try and pick up clues about the coin. It is important, for this to work, that the coin spends as much time as possible against the volunteer's skin. Therefore emphasise that they "should try harder as you are having difficulty reading their mind". Of course you cannot.

Ask them to lay the coin back down in its place on the table and inform the class, that with your 'special powers' you will be able to feel the volunteer's vibrations from the coin.

As you pick up and feel each coin in turn, one will be perceptibly warmer i.e. the one that had skin contact with the volunteer. See if the children can work out how you do it.

A bird in the hand

Children may overlook their ability to gather a wealth of information which they have, literally, at their fingertips. They are more aware of using the senses of sight, hearing, smell and taste than that of touch.

Figure 16 - That's torn it

Ask for three volunteers. Tear a piece of paper into three strips (Fig. 16) and give one to each child. The middle strip will have two torn edges, be aware of which one it is and ask the holder of that piece to write the name of a bird on it. Invite the other two to write the name of an animal. You could stand with your back to them so the class can see that no cheating is taking place. They should fold the strips once and place them in a bag or box.

Tell the audience you will be able to pick out the strip with the name of a bird.

Ask for the container with the strips to be placed behind you so there is no question of you having seen the strips. You will be able to feel the two rougher edges of the middle strip and identify the one with the bird's name.

Paper power

This shows how the perceived properties of a material can be altered by using it in an unexpected way.

Show your audience a jug of water sitting on an A4 sheet of photocopy paper. Challenge them to remove the paper from under the jug, without spilling the water or touching the jug. (Attempts to quickly tug the paper from under the jug tend to result in water spillages, so do this in a suitable place and have some dry sheets of paper to hand for further attempts.)

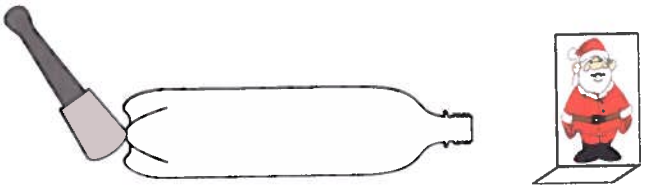
In the event of failure by the audience, demonstrate how, by rolling up the paper from one edge, you are able to push the jug along with the paper tube, and ultimately off the paper.

Figure 17, 18 & 19 - Demonstration of paper power

Santa felled

This is an interesting demonstration which has been the cause of endless debate and conjecture in SSERC recently. Like most of the demonstrations in this issue of the Newsletter the set-up is simple but the answers can be elusive.

Although many more elegant ways can be used, a very simple way to show the power of the sound wave requires only an empty plastic bottle, a striking implement (ruler, wooden spoon, scissors, mallet etc) and a strip of paper.



Figures 20 & 21 - Santa shoot

Cut a strip of paper about 10 cm long by 3 cm wide. Make a fold about 2 cm from one end. Draw/stick a picture of Santa on the paper, and stand him up. Holding the bottle about 15 cm from Santa, and pointing the open end towards him, strike the bottle sharply on the end.

What causes Santa to fall over? Is it a sound wave or a puff of air? What can you do to investigate the whys and wherefores? Answers on a Christmas card to .....

References

[1] http://store.pasco.com/pascostore/showdetl.cfm?&DID=9&Product_ID=1344&Detail=1

[2] http://www.fbk.com/pasco/PASCO-UK-price-list.pdf

[3] http://www.ise5-14.org.uk/Prim3/New_Guidelines/Newsletters/38/body.htm

[4] http://www.usplayingcard.com/gamerules/briefhistory.html

[5] http://www.teachingideas.co.uk/science/optical.htm

[6] http://www.eyetricks.com/illusions.htm

[7] http://www.niehs.nih.gov/kids/illusion/illusions.htm#index

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