Magic science lessons

Inspire your primary pupils with these science lesson ideas that combine essential scientific theory with magic tricks

1. Hot and cold water

How can water be hot and cold at the same time?

You will need
Three bowls or dishes: one containing cold water, one hot water, one lukewarm. Arrange the bowls in a row with the lukewarm water in the middle.

Safety note: Test in advance to make sure that the hot and cold water is not dangerously hot or cold. Pupils should be able put their hands in the bowls without discomfort or risk of scalding.

The trick
Ask for two volunteers from the audience – I mean the pupils – and explain that you are going to perform a special bit of magic with three bowls of water. Ask each of your volunteers to roll up their sleeves. One dips a hand into the cold water, while the other does the same with the hot water. Leave the volunteers standing in place for a minute or so, while you explain to the class that these two bowls contain perfectly ordinary water, but the middle bowl contains magic water, which has the amazing property of being both hot and cold at the same time.

Then ask your volunteers to remove their hands from their bowls and put the same hand into the middle bowl. Ask: 'Is the water in this bowl hot or cold?' The pupil whose hand was in cold water should say 'Hot', while the pupil whose hand was in hot water should say 'Cold'.

Ask them to take their hands out of the bowl, swap places and put their other hand into the opposite bowl. Again leave them with their hands in place for a minute or so, then again have them put the same hands into the middle bowl. This time they should give the reverse answers.

How it works
So how can the water be both hot and cold at the same time? Ask the children for suggestions, and they should tell you that because one child's hand was in cold water to begin with, the lukewarm water would have seemed hot by comparison and vice versa. The point to establish is that the way we sense the world is relative; we become used to our surroundings, so how we perceive a different environment depends on where we approach it from. For example, go into the playground from a warm room and it might feel cold; go outside from a cold room and the playground would feel warm. Ask the children if they can think of other similar examples and to devise experiments to test their theories, such as going from a darkened room into a brightly lit one and vice versa.

2. Levitating ice

How can you make an ice cube defy gravity?

You will need

- Some cotton thread (or very thin string or twine).
- Ice cubes.

  Safety note: have these on a tray so that water doesn't drip on to the floor.

- Some salt (magic powder).

The trick
Gather the children round so that they can all see, and ask them if it is possible to lift something with a length of cotton without tying it around the object first. Offer to let some of them have a go; give them some ice cubes on a tray and let them try to lift them using only untied cotton. They will conclude that it is impossible.

Now place another ice cube on the tray, lay the cotton flat across the top of the cube with the ends hanging off either side, say a few magic words and sprinkle a pinch of 'magic powder' over the top of the ice cube. Wait for a minute or so, and then take hold of one end of the thread with each hand and slowly lift up the ice cube (it may be a good idea to practise this a few times before showing it to your pupils).

How it works
Give the pupils a chance to make suggestions about how it works, but then explain that it is, of course, science, not magic, in action. The magic powder is just common salt, which lowers the temperature at which the ice freezes, thus causing the top of the ice to melt. However, it quickly freezes again, and this traps the cotton under a thin layer of ice, making it possible for you to pick it up. Can the pupils think of a practical use for this property of salt to melt ice (such as de-icing paths and roads in winter)?

3. Invisible water

Can you put out a fire with the contents of a seemingly empty bottle?

You will need

- A stoppered bottle of some sort, pre-prepared to contain carbon dioxide gas.
- A lighted candle.

Safety note: always take appropriate precautions when using a naked flame in the classroom.

The trick
Place the lighted candle where all the pupils can see it and ask: 'How can I put out the candle?'. There will be numerous suggestions, including blowing it out or perhaps pinching it out. Say that none of these methods will do. If anyone suggests pouring water on it, say that that's what you had in mind, but it would be a bit messy. Then show them an apparently empty bottle. Ask what's in it – most of the children will probably say 'Nothing'. Tell them that it does contain something – magical invisible water. You can then demonstrate by unstoppering the bottle and upending it over the candle – which will go out as if by magic!

How it's done
Ask the children for suggestions about what they think happened, pointing out that you didn't blow on the candle or touch it in any way. Then explain that the 'empty' bottle contained a gas called carbon dioxide. A flame needs oxygen from the air to burn, so without oxygen it goes out. The carbon dioxide was heavier than air, so you could just pour it over the candle, where it replaced the air around the candle – and as carbon dioxide doesn't burn or support burning, the flame couldn't burn. This could lead into a general discussion about carbon dioxide. Where have the children heard about this before? What uses does it have? Why can it be dangerous? And so on.

4. Ghostly writing

Your classroom is haunted – or is it?

You will need

- Lemon juice
- A fine paintbrush or a cotton bud
- Paper
- A source of heat, such as a naked light bulb, a candle, a Bunsen burner or perhaps an iron, if you have one available.

Safety note: always take appropriate precautions when using a naked flame or very hot objects in the classroom.

The trick
In preparation, use the paintbrush or cotton bud to write some messages on pieces of paper with lemon juice. Leave this to dry overnight and then distribute them around the room, along with several sheets of untreated paper.

Gather the pupils together and tell them that you have discovered something amazing – that your classroom is being haunted by a mysterious ghost. They will probably dispute this, so tell them you can prove it; you will ask the ghost to make a message appear on a blank piece of paper. Hold up one of your prepared pieces of paper to your heat source (or iron it if you're using an iron). The ghostly message will slowly appear as if by magic.

Safety note: be careful not to burn yourself or set fire to the paper!

You can then ask the pupils to find the other pieces of paper you have hidden around the class and you can test each one in turn to discover whether the ghost has left any more messages.

How it's done
Tell the class that of course it wasn't a ghost who was writing, it's all down to science again. Can they work out what really happened? Explain that all living things contain carbon, so if you write on paper with a clear juice from something once living, it will char and turn into black carbon when heated. The writing was made with lemon juice, which is invisible once it dries, but when it was heated enough, the carbon in it was released and it became visible. As an extension activity, you could have the pupils make invisible writing with other organic liquids, such as milk or onion juice, and see if the same thing happens.

In conclusion
These are just a few of the many 'tricks' which appear to be magic until you understand the science behind them. There's an old saying that science begins with wonder, and getting your pupils to wonder how tricks like these work is an excellent way of getting them to want to know more about the science behind them.