Einstein's Birthday Party Pack!

2005 is Einstein Year, part of World Year of Physics, an international celebration of physics marking the centenary of the publication of Albert Einstein's most famous theories. Einstein's work changed the way we view the world for ever and Einstein Year is a unique opportunity to explore how physics affects us all.

What better way to celebrate Albert's birthday on March 14th, along with National Science Week, than by doing some weird and wonderful physics experiments? Below you'll find a selection of physics experiments that could be performed at a birthday party for Albert Einstein.

1) Wobbly Water

A balloon (sausage shaped balloons work best)
A plastic ruler
A tap or hosepipe
Paper and marker

Adjust the tap or hosepipe until you get a thin stream of running water. Rub the balloon on your hair, or woolly jumper. Bring the balloon close to, but not touching, the stream of water. What happens to the stream? Can you explain this? Mark how far the water has moved on a piece of paper attached to the wall behind the tap and find whose balloon can move the stream of water the furthest. Try using a plastic ruler instead of the balloon and see if this works better or worse!

2) Slime Time

Cornflour
Water
Food colouring (optional)

Liquid or solid? This is one confused mixture! Put two cups of cornflour in a bowl, add two teaspoons of food colouring (this is optional) and 1 cup of water. Mix it all up with your hands until all the powder is wet and then continue adding a few drops of water at a time until you have a thick, smooth mixture. Now play with it, hit it, squeeze it, push it slowly and smack it hard! Do you notice anything strange about this material?

3) A Fizzics Experiment

A balloon
Some fizzy drink

A self-inflating balloon? Well, almost! Take a balloon and blow it up before letting all the air out (this is just to stretch it so that it is easier to inflate from now on). Now put some fizzy drink in the balloon, tie the end, and shake the balloon. The balloon should start to inflate. What's happening? Who can get a balloon to inflate the most?

4) Bubbletastic

A large bowl
2 cups of warm water
1/2 cup of washing-up liquid
5 tsp glycerin (if available)
Coat hangers

Fill the bowl (the bowl must be large enough for a coat hanger to fit inside) with the warm water. Now add the detergent and glycerin. If you need more mixture, continue adding the ingredients in the same proportions.

Take a coat hanger and stretch it so that it makes a circular shape (~12cm diameter works well). This is your bubble wand. Dip it in the bubble mixture and pull it out slowly so that a film of mixture fills the circle. Now drag the wand through the air to form a bubble. Who can make the biggest bubbles?

What is it about soapy water that allows it to form bubbles? What do you think the glycerin is for? Why are bubbles rainbow coloured? Why do they eventually pop?

5) Bubble Tennis

Bubble mixture and large bowl as above
2 coat hangers
Tube from a ballpoint pen (without the ink cartridge)

Shape the coat hangers until they are in the shape of a circle (~12cm diameter) with a handle. Dip each hanger in the soap solution and pull them out so that a film of soap fills up the whole circle. You're going to use the hangers as racquets. Dip one end of the pen tube into the bubble mixture for a few seconds. You can make tennis balls by blowing through the other end. Now you can play bubble tennis. This may take a little practice and works better if you are able to add glycerin to the bubble mixture. Make sure your actions are gentle or the bubble and racquet will burst!

6) Test your sucking power

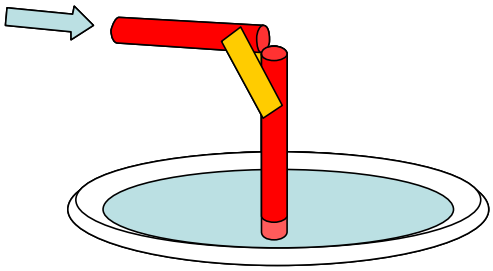
Lots of drinking straws (approximately 50)
Sticky tape
Some drink

How many straws can you stick together before you stop being able to suck up any drink? Start with one straw and increase the number to find the biggest sucker – the person who can still get the drink with the most number of straws stuck together into one long super-straw. Why does it get harder to suck the drink with more straws? Can you explain what's going on?

7) The Magic Straw

2 drinking straws
A pair of scissors
Sticky tape
2 saucers full of water
2 paper targets

Cut the drinking straw into two pieces, one longer than the other. Using sticky tape, join them back together, end to end, at an angle of 90 degrees. There will be an opening where the two straws form the right angle. Stand the smaller piece of straw in the saucer and blow through the longer piece aiming at a target a set distance away. The team to knock over their target first wins.



8) Blowing hot and cold

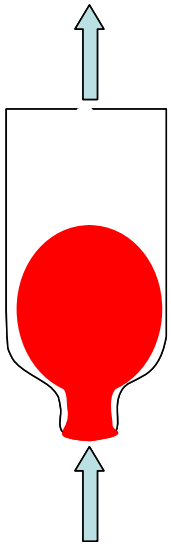
A balloon (pre-blown is best)
A plastic bottle
A bucket or any other large container
Hot water from the tap (don't use boiling water)
Ice in cold water from the tap

Stretch the neck of the balloon over the mouth of the bottle before placing the bottle into a bucket of hot water. Wait for a while. What do you observe?

Now place the bottle in a bucket of ice and water. What happens now?
Can you explain what's going on?

9) The Magic Balloon

A balloon (pre-blown is best)
Plastic transparent bottle



With a pen or pencil, make a small hole (about 2mm diameter) in the bottom of the bottle. Push the balloon inside the bottle and stretch the end of the balloon over the mouth. Now blow into the bottle to inflate the balloon. While you are blowing, check that air is coming out of the hole you made. Just before you finish blowing, cover the little hole with your finger. What happens to the balloon with the open end when you stop blowing? Uncover the hole and see what happens now!

Do the trick again. With the balloon filled, place your palm over the bottle's mouth and uncover the little hole. What happens to the balloon?

10) The Unbreakable Balloon

A balloon
A pin
Sticky tape

The idea is to blow up a balloon and pierce it with the pin without making it go "pop"! Teams can try different ways of piercing the balloon; the successful team is the one with a balloon with a hole that is still inflated. Can you pierce the balloon without using the sticky tape and still avoid bursting it? Why does a burst balloon look like it has been shredded? Why does a burst balloon go "bang"?

Background Notes

1) Wobbly Water

Rubbing the balloon on your hair or woolly jumper causes movement of charged particles from one surface to the other and you end up with a negatively charged balloon. Water molecules are polar, which means they are positive at one end, and negative at the other. When you bring the charged balloon close to the stream of water, the positively charged hydrogen end of the water molecules are attracted to the balloon, and bend towards it as a result.

2) Slime Time

You'll notice when you start mixing the water with the corn flour that the powder immediately turns to a thick, almost solid, paste. As you add more water and stir, it will clump together like a solid but when you leave it alone it will look runny.

When you slowly push your finger into the mixture it should resemble a thick paint. When you try to pick up a piece of the material you find it's one big solid lump. When you push your finger onto the surface of the 'liquid' quickly, and with a lot of force, it appears solid. The harder you hit it, the more solid it appears.

The mixture is an example of a *dilatant colloid suspension*. These substances get more viscous (even solid) when you hit them hard. When a small sideways force is applied, by shaking the bowl, or pushing a finger into it slowly, the weak bonds between the particles break, and the substance flows just like a liquid.

3) A Fizzics Experiment

Fizzy drink has carbon dioxide dissolved in it. This is what gives it its bubbles. Gases take up a larger volume than liquids, therefore, when you shake the drink, causing large amounts of carbon dioxide to be released, the volume of the balloon increases. Can you explain why it's a bad idea to shake a bottle of fizzy drink and then open it?

4) Bubbletastic

A bubble is formed because of a fine balance between the surface tension of the water and the pressure of the air inside the bubble. Normally the surface tension, caused by forces between water molecules, is too high, so the bubble's skin contracts and breaks. When detergent is added to water, it reduces the forces between water molecules, so there is less surface tension and you are able to make bubbles.

Light waves, like water waves, can interfere with each other. A bubble film is made up of two layers of soap molecules, with a layer of water molecules in-between. Light waves reflecting from one layer of soap molecules meet up with light waves reflecting from the second layer and the two sets of waves interfere. Some waves add together, making certain frequencies or colours of light brighter. Other waves cancel each other, removing a frequency or colour from the mixture. The colours that you see are the ones that are left behind after the light waves interfere.

If you look at the bottom of a bubble you should see water dripping out of the bottom. The layer of water will eventually get too thin to support the air inside, and the bubble pops.

The addition of glycerin makes the bubbles last longer as it slows down the rate of evaporation and dripping of the water.

5) Bubble Tennis

Detergent contains molecules called hydrocarbons. Each molecule has a 'head' and a 'tail'. If the head of the molecule loves water, the tail hates it. This means that all the tails arrange themselves so they are on the outside of the film, as far away from the water as possible.

When two soap films come into contact they repel each other because the tails on the surface of one want to avoid the water in the other film. This is why the soap ball and racquet don't stick to each other.

6) Test your sucking power

When you suck through a normal length straw, you're creating a vacuum at the top of the straw with your lungs. The pressure of the air (the weight of the atmosphere) around the drink in the glass then causes the drink to be pushed up through the straw. There is a limit on the height, and weight, of liquid that atmospheric pressure can support. This means that, even if you created a perfect vacuum with your lungs, you couldn't get the drink to rise above a certain height in the straw.

7) The Magic Straw

When air moves, its pressure falls. So when you blow through the horizontal straw, the pressure at the top of the vertical straw drops. Because the air pressure over the saucer remains the same, the water is pushed up the straw from the normal pressure to the low pressure and squirts your target!

8) Blowing Hot and Cold

The hot water heats up the air inside the bottle. This causes the volume of the gas to increase and the balloon to expand. When the bottle is placed in the cold water the gas reduces in volume and the balloon deflates.

9) The Magic Balloon

As the balloon is blown up, it pushes air out of the hole you've made. The pressure inside the balloon is much higher than the pressure on the outside. If you didn't cover the hole with your finger after you've finished blowing, air would rush back into the bottle to equalise the pressure, pushing the air out of the open end of the balloon. When your finger is over the hole, it stops this from happening so the balloon stays in place.

In the second part of the experiment, you kept your hand over the mouth of the bottle, and let go of the hole. Now air is allowed back into the bottle, so it flows into the bottle, raising the pressure on the outside of the balloon. The balloon shrinks until the pressure inside the balloon is equal to the pressure on the outside.

10) The Unbreakable Balloon

When a balloon is blown up, the rubber stretches and becomes thinner. When the thin rubber is pierced it tears and cracks spread out easily across the stretched layer - the result is that the balloon bursts. The balloon is full of air at high pressure. With the balloon gone, the high-pressure air is released as a wave. Sound is a wave of high-pressure air. When this air hits your ears it makes a bang!

The spread of the cracks makes it appear like the balloon has been shredded. However, if the rubber is reinforced with, say, a piece of sticky tape, then the rubber is not only thicker but the tears and cracks are held together so they are not able to spread across the surface of the balloon. To pierce the balloon without the use of sticky tape, it is easiest to insert the pin through the thickest bits of rubber at the base of the balloon, where the rubber hasn't been stretched by inflation. The thick, slack rubber area is only broken very close to the point of the pin and the cracks do not spread so the rest of the balloon is left undamaged.

Problem-Solving Activities

Rocket Science

You will need:

A balloon
The inside of a toilet roll
A length of string
Sticky tape
Two walls
Decorations e.g. pens, glitter, coloured paper etc

You're each going to build a rocket and race them to see who can get theirs to go the fastest.

The propulsion system is a balloon, so begin by taping one side of the balloon to the toilet roll, either tape loosely over the balloon neck (so you can still blow the balloon up) or use double sided tape to attach the balloon to the toilet roll. Make sure that you have enough of the balloon neck over the end of the toilet roll to blow the balloon up. Then decorate your balloon using felt pens, glitter, card, and anything else that comes to hand. This is your rocket! Now use the sticky tape to fasten two lengths of string to the walls so that they run parallel to each other, in a straight line from one wall to another. Before you attach the strings, thread a rocket onto each string. Each team will have to blow their balloon up, and let them go at the same time. Who wins the race? How can you get your rocket to go faster? What makes the rocket move in the first place?

Balloon Bursting Machine

You will need a selection of any of the following materials:

Balloons
Assorted pins
Elastic bands
Glue stick
Cotton/string
Syringes
Dominoes
Plasticine
Scissors
Paper/card
Plastic tubing
Assorted plastic bottles
Marbles
Sticky tape/masking tape
Pencil
Plus…assortment of items of the judge's choosing.

Objective: to construct a 'Balloon Bursting Machine' with as many moving parts as possible.

Rules: 1/ Items other than those supplied may be used only if prior permission is obtained from the judge.

2/ The machine may be manually started after which it should run by itself.

3/ The judge's decision in all matters is final!

Judging: If the machine works the team is awarded 50 points.
Each team receives a bonus of 10 points for each moving part (a set of dominoes counts as one moving part).

Party Time

You will need:

1 sheet of A4 paper (for the final cup)
A few sheets of A4 paper to practice with
Party pop of your choice!

Objective: To make yourself a party cup from a sheet of A4 paper (to drink your party 'pop' in!).

Or, if you want to make this competitive…

You will need for a team of three people:

5 sheets of A4 paper per team
A bucket of water
An empty bucket to transfer water into

Objective: To transport as much water as possible across a room using only a container (or containers) constructed from the paper supplied. Time allowed: 15 minutes

Rules: 1/ Only one cup of water at a time can be transferred.
2/ A second water run can only be commenced when the first team member returns to the water bucket.
3/ Only the materials supplied may be used.
4/ The judge's decision in all matters is final!

Judging: The winning team will be the one that transfers the greatest volume of water across the room in the time available.

Background Notes

Rocket Science

Your rocket is a demonstration of Newton's third law: every force has an equal and opposite force. As the air is being forced out of the balloon by the air pressure inside, it exerts an equal and opposite force on the balloon, which is what makes your rocket move.

The rocket also demonstrates the principle of conservation of momentum. Momentum is the velocity of an object multiplied by its mass. In this case, the momentum of the rocket is zero before it is released, and remains zero once it has stopped moving. The momentum of the balloon is equal and opposite to that of the air coming out, so they cancel each other out.

Balloon Bursting Machine

Bursting the balloon in this activity isn't quite as easy as it sounds. The balloon needs to be held firmly in place so that the pin can pierce it.

Ideas for moving parts might include the following

- Clothes peg releases a string weighted with Plasticine that swings and hits…
- Elastic band stretched taught is released and…
- Two syringes joined together with a piece of tubing, start the machine by pushing in the plunger of one syringe and the plunger on the other moves out and causes…
- A row of dominoes, knock one and they knock each other in sequence, and then finish by knocking…
- A marble runs down a ramp and knocks…
- A plastic bottle filled with water, rolls down a ramp and causes…
- A simple seesaw, weight lands on one side, causes the seesaw to tip and…

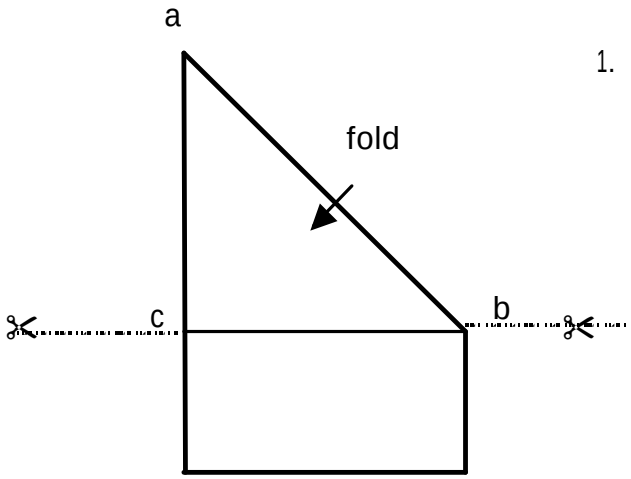
A junk box can be used at your discretion. It contains extra things that the teams can use. There could even be a bonus score for including one particular nominated item in the machine.

Party Time

This activity is effectively a relay race with water – but the water carrying devices have to be designed and made out of paper. You can either use the diagram below to make a cup or you can use your imagination and invent one of your own. Do you want to make 5 cups from your paper or do you want to make fewer, stronger cups?

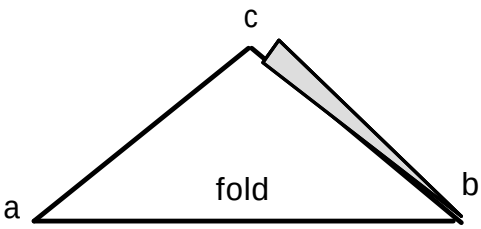
It is generally best to set up your course outside with a full bucket of water at one end and an empty bucket at the other. Be careful not to slip over on any of the spilt water!

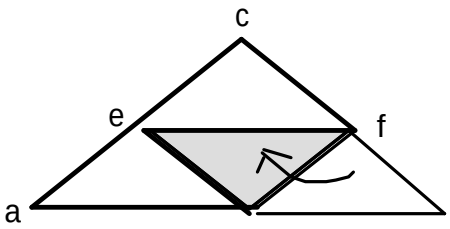
Instructions on how to make a paper cup



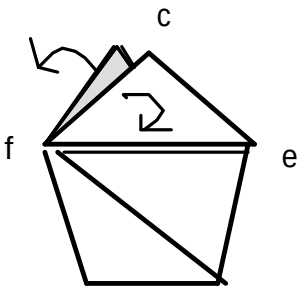
1. Fold a piece of A4 paper and cut to make it square

2. Fold corner **b** to point **e** on **ac** (so that **ce** equals **cf**)





3. Turn paper over and fold corner **a** to point **f**



4. Open out - fold back pointed corners(**c**)and tuck in

Educational links

All activities in this pack contribute towards Key Stage 1 Investigation and Skills in science, Skills in designing and making and Skills in social subjects in the 5-14 Guidelines. We recommend that you consult the National Curriculum on the website (www.nc.uk.net), and the 5-14 Guidelines (www.ltscotland.org.uk/5to14).

Do you want more?

If you have enjoyed the activities in this pack and would like to do more, then why not start one of the BA's award schemes:

- First Investigators (5-8 year olds)
- Young Investigators (8-13 year olds)
- BA CREST awards (11-19 year olds)

To find out how to complete your Bronze Young Investigators award, or how to turn these activities into a Silver or Gold Young Investigators award, or even a BA CREST award, then contact the BA young people's team on 020 7019 4943.

Acknowledgments

'Party Time' and 'Balloon Bursting machine' are taken from the 'The Instant Egg Race File', a collection of tried and tested practical problem-solving activities written by Elizabeth Robertson. To obtain a copy of this publication send £7.50 (which includes postage and packing) to Science Designs, 6G Salmon Lane, Stonehaven AB39 2NZ.

Thank you for using Einstein's Birthday Party Pack!

We hope you enjoyed the activities. To help us to continue to provide new challenge packs we'd like to ask you to tell us a little about what you did for National Science Week.

Please take a few minutes to fill in this form and return it to the National Science Week office.

Name: _____

Organisation: _____

Address: _____

_____

Town: _____Postcode:_____

Tel: _____Fax:_____

Email: _____

Which dates did you do National Science Week activities on? (please circle as appropriate).

Fri 11 March	Sat 12 March	Sun 13 March	Mon 14 March	Tue 15 March	Wed 16 March	Thu 17 March	Fri 18 March	Sat 19 March	Sun 20 March

or other:_____

What did you do?

_____

_____

Please make any comments about this Challenge Pack and/or National Science Week.

_____

_____

Please return to:

Fax:	0870 770 7102
Post:	National Science Week FREEPOST LON 20848 London SW7 5BR