Ready Steady Science
activity pack

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SERIOUS SCIENCE
SERIOUS FUN!

MAKING BUBBLES with no troubles

Explore the ancient art of bubble-ology with some easy-to-find household bits and pieces. There are more tips and techniques to try than you may have realised, and on a sunny day, this activity can keep a whole family occupied for hours…

What you'll need:

- Straws – plastic bar straws are the best for constructing frames, but drinking straws are the best for blowing bubbles.
- String
- Pipecleaners
- Soap Solution (Washing up liquid / glycerine / water)
- Water pistol or plant sprayer
- Washing up bowl
- Scissors
- Gelatine (for advanced bubblers)

What to do:

- Make a soap solution with washing up liquid (10%), water (89%) and glycerine (1%). Mix carefully – and don't whisk it or you'll get lots of small bubbles appearing that make blowing larger ones difficult.
- Use a simple hoop of wire to test out your bubble mixture.
- Use the water pistol to moisten the air – squirt a haze of water droplets towards where you're going to blow the bubble.
- Go for it!

Squares and other advanced bubble shapes:

- Now design different hoops to make a square bubble – can you do it? (Six bubbles together yield a square bubble in the centre). If not, go for the big finale and make one huge bubble.

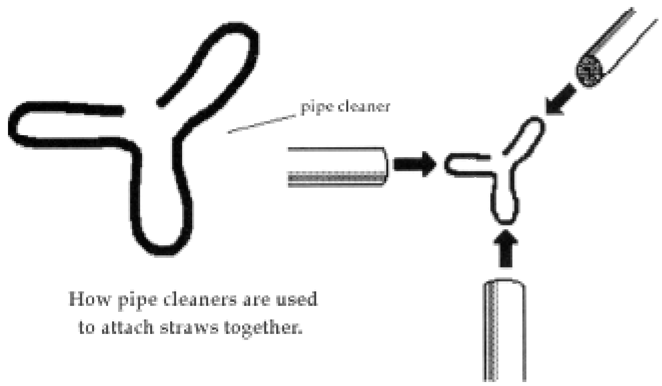
Try Different Dippers

The basic wire loop - Take a short piece of pipecleaner and form a loop in it about 4 cm in diameter. Dip into the bubble solution and gently blow.

Drinking straws make fairly good bubble blowers. They will hold more bubble juice if 4 short slits (about 5cm) are cut at the bubble end. The resulting tabs should splay out.

The big bubble loop - Slide two drinking straws onto a piece of string about 1m long. Tie off the ends to form a loop. Hold the straws apart to form a big rectangle. Bring the straws together to close the rectangle and dunk it into a bucket of bubble juice. Pull it out again and slowly separate the two straws. A film should form around the loop. If it doesn't break, pull the loop through the air to form a giant bubble.

Make frames – Us the drinking straws to form the straight sides of your bubble-blowing frames, and connect them together using the pipecleaners. To do this, double the pipecleaners up and insert them into the end of each straw. In places where you want three straws to meet, fold the pipe cleaners three ways as shown below. Then attach a pipe cleaner handle to your frame.



How pipe cleaners are used to attach straws together.

Other ideas: Try constructing cubes or tetrahedrons, or just let your imagination run wild. Mix the soap solution in the bucket. Make sure that you have enough solution to fully cover the frames when they are dipped.

Dip the frames into the soap solution, and observe the fascinating geometrical shapes that the soap films form. Also notice the shimmering colours in the soap film.

Add some bounce

Tip: if you replace the glycerine with gelatine, you'll find that the bubbles will be able to bounce on the ground … if you perfect your technique!

OK, SO WHAT'S HAPPENING?

Here's how to explain what's going on when they ask you…

The Shape: As you lift your frame out of the solution, the soap film flows into a state of ***minimum energy***. The soap film is in this state of minimum energy when it's covering the least possible amount of surface area. The intricate shapes you see inside the frame represent the minimum area the soap film can cover. You may notice that a soap film will sometimes take on different shapes when you dip the frame into the solution again and again. That's because there may be more than one way for the soap film to form a minimum surface area.

Those rainbows: Bubbles consist of two thin films of soap with water in between. When white light (which contains all the colours of the rainbow) hits the soap films, it will be reflected back, but is sometimes spread out into a spectrum (or rainbow). When two sets of reflected waves meet, they can add together, cancel or partially cancel each other out depending on the thickness of the film and the initial colour of the light. When light waves of a particular colour meet and cancel each other, then that colour is subtracted from white light. For example, if the red light waves cancel, then you see white light minus red light, which you perceive as blue-green light.

Smile please, for our PINHOLE CAMERA

Capturing the world we can see onto a flat surface can be quite an amazing experience. It only takes a few simple household items – and when you see that recognisable image appear on the tracing paper, you'll be recreating the principle on which the whole of today's photography industry was built…

What you'll need:

- Toilet roll
- Tracing paper
- Black paper / marker pen
- Drawing pin
- Magnifying glass
- Masking tape / elastic bands

What to do:

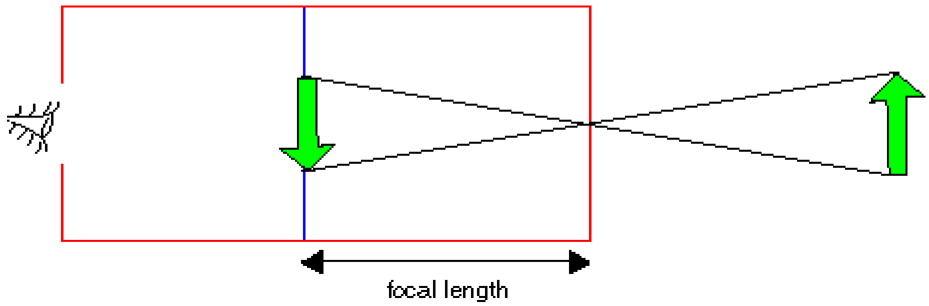
- Cover one end of a toilet roll with black paper.
- Cover the other end with tracing paper (keep it flat!).
- Make a small hole in the black paper. Start with a pinprick. Face the hole to a light source and watch the tracing paper. Increase the size of the hole, and use a magnifying glass to pull the image into focus.

Expert tip:

A small hole will give you a sharp image. A large hole means more light will get in from different directions, which will lead to a less focused image. Using the magnifying glass will allow you to focus the light better.

What's happening?

The diagram below illustrates how the projection pinhole camera works. The light enters the small pinhole in the front of the camera, and projects onto the wax paper screen (blue line). The image the person sees projected onto the wax paper is upside-down and backwards. A 'real' camera works the same way, but instead of having a wax paper screen, the image projects onto film.



Ideally, the pinhole in a pinhole camera would be small enough so that only a single "ray" of light from each point of the object would be allowed to reach the screen. This would create perfectly sharp images. Unfortunately, even if this were possible, the images thus produced would be very dim, and would be difficult to see in our camera. (In the cartridge camera, it would require long exposure times, allowing the image to blur due to motion of the object being photographed.)

To create a brighter image, we can increase the pinhole size, allowing more light in. This blurs the image, because "rays" of light from the same point on the object travelling in slightly different directions would all be allowed to enter the camera.

It's an upside down world…

You can see that the image formed on the screen is upside down. The same thing happens to images that form on the retina at the back of your eyes.

So how come we don't see the world upside down? The answer is that our brains 'know' to reverse the incoming images, so that up is still up and down is still down.

But that hasn't stopped psychologists from experimenting with the phenomena. Experiments have been recorded in which subjects were asked to wear up/down reversing prisms on their eyes to explore whether their brains could cope with a "real" upside down view of the world. And the answer was: after several days of banging into things, yes, the subjects' brains were able to readjust, so that the world looked the right way up again…

READY STEADY SCIENCE 3

MAKING AN IMPACT – anyone for cocoa craters?

If you've ever looked at the Moon through a telescope or seen a picture of it close up, you'll have noticed that it's not exactly as smooth as a baby's bottom… In fact it's covered with layer upon layer of craters, which have been created as rocks have repeatedly smashed into its surface over the millennia.

This simple demo will allow you to create your own craters using some simple baking ingredients. It's great fun – but wear an apron and put plenty of newspaper down – that flying moondust gets everywhere…

What you'll need:

- Flour
- Cocoa powder
- Baking Tray
- Marbles
- Newspaper

What to do:

- Spread the newspaper out, and put the baking tray onto it. This activity is known as 'protecting one's carpet' in scientific circles!
- Make a thick layer of flour in the baking tray. Smooth it out.
- Cover this layer with a thinner layer of cocoa powder.
- Standby for action: drop marbles from different heights and observe the craters they make.

What's Happening?

What does your tray of baking ingredients have in common with the Moon? The circular features you can see on the Moon's surface are **impact craters**, like those you've just caused in the flour and cocoa. They were formed when **impactors** (ie incoming objects) smashed into the surface, and on the Moon, you can see where layers upon layers of these craters have been created over the millennia. (Check out some images of the Moon's surface at http://nssdc.gsfc.nasa.gov/photo_gallery/)

The explosion and excavation of materials at each impacted site creates piles of rock (called **ejecta**) around the circular hole, as well as bright streaks of target material (called **rays**) which can be thrown great distances out of the crater.

Two basic ways in which craters are formed in nature are:

1) impact of a **projectile** on the surface
2) collapse of the top of a **volcano** creating a crater termed ***caldera.***

By studying all types of craters on Earth and by creating impact craters in experimental laboratories, geologists concluded that the Moon's craters are “impact” in origin.

The factors affecting the appearance of impact craters and ejecta are the size and velocity of the impactor, and the geology of the target surface.

By recording the number, size, and extent of erosion of craters, **lunar geologists** can determine the ages of different surface units on the Moon and can piece together the geological history. This technique works because older surfaces are exposed to impacting **meteorites** for a longer period of time than are younger surfaces.

READY STEADY SCIENCE 4

PERSISTENCE OF VISION … and what's that got to do with Hollywood?

Have you ever noticed how spokes on a bike wheel seem to blur into a silvery mass when they're moving? Or how your eye is tricked into thinking those blinking light sequences round shop windows at Christmas are really 'moving'? This is because your eyes aren't quite as quick as you might think – and it's thanks to this that movies look like smooth sequences, rather than a series of still pictures. So crack open the popcorn, and have a go at making a mini-movie for yourself!

What you'll need:

- Disk of card
- Paper
- Felt tips
- Fantastic drawing ability (optional!)

What to do:

- Draw a rat on one side of the card.
- turn it over, and draw a cage on the other side (in the same position as you drew the rat).
- Punch two holes right at the edges of the disc, on opposite sides of it.
- Tie string to each side and knot securely
- Then, wind the card round and round, so the string gets good 'n' twisted. Pull the strings in opposite directions – and spin that card baby!

Did you catch the rat?

If you've lined up the rat and cage correctly, the rat will appear to be inside the cage…

What's Happening?

When we see something, the image is retained on our retina for a fraction of a second. This is known as 'persistence of vision'. Our brain interprets the two images being shown in quick succession as the same image – and the rat is caught.

Very simple, and very easy to demonstrate. Amazing to think that persistence of vision is the scientific principle on which the entire movie and animation industries were built!

And now you've done rat-in-cage, you can move on to rat-in-cat, cat in basket and many many other variations. Try putting the hat on the bald man, or whatever seems appropriate for your own favourite family member!

READY STEADY SCIENCE 5

THE SOAP-PROPELLED BOAT – or how to brighten up bath-time

Prove to your kids the amazing power of soap with this simple demo!

What you'll need:

- Card
- Scissors
- A baking dish full of water (or you can do it in the bath at home – your call!)
- Liquid detergent

What to do:

- Cut out a boat shape from the card. (Make it about 6cm long and 4cm wide)
- Cut out a small triangular notch at the back of the boat.
- Place the boat gently on the water in the dish.
- Pour a little detergent into the notch in the end of the boat.

Your boat should zip across the water…

What's Happening?

Water molecules are strongly attracted to each other and stick close together, especially on the surface. This creates a strong but flexible "skin" on the water's surface that we call surface tension. Adding soap disrupts the arrangement of the water molecules and breaks the skin, making the boat go forward.

Custard Gone Crazy

If you've got some custard powder or cornflour in your larder, you've got all you need to make up a batch of very very very weird liquid … or is it solid?…

What to do:

- Mix 8 eggcups of custard powder or cornflour with 4 eggcups of water
- Stir in the water slowly so you don't get any lumps. (Don't cook it!)
- Now you're ready to get your hands dirty - have fun!

The result is a strange yellow substance that will either act like a solid - if you punch it quickly or roll it into a ball, or it'll act like a liquid, if you touch it gently.

What's Happening?

The custard powder and water mixture is a mixture of solid particles suspended in a liquid, called a "colloid". When you stir the mix slowly, the custard powder particles can move around in the water quite freely, and so it acts as a liquid. When you stir the mix faster or hold it in your hand tightly, the solid particles rub against each other causing friction. This makes them stick together and act like a solid.

Slime City

Always a winner with kids, this slime-tastic activity – sometimes referred to as ‘make your own snot’ if green food colouring is used (sorry to mention it!) – is easy but may require a bit of luck and practice to get the results just slimey enough…

What you’ll need:

- Borax approx 4% solution (you can buy this in the local chemist)
- White Glue
- Water
- Food Colouring
- Jam jar (with tight-fitting lid)
- Plastic cups
- Tablespoon

What to do:

- Put _ teaspoon of borax and add it to _ cup of water.
- Mix 1/4 cup glue with 1/4 cup of water.
- Pour half of each solution into the jam jar.
- Add a few drops of food colouring and seal the jar.
- Shake it like crazy for a minute or two.

Your slime is now ready to go…!

What's happening?

The borax enables the glue (polyvinyl acetate) molecules to join together to form larger molecules called polymers. This makes a thickened, slimey gel.

READY STEADY SCIENCE 8

Help! Help! Volcano!

Fortunately in the UK we don't have any active volcanoes … but you can have one in your kitchen if you follow these instructions. The result can be extremely impressive … but as with a real volcano, 'lava' can fly out at unexpected angles, so make sure all nearby surfaces are covered with newspaper and you're not wearing your best cashmere sweater!

What you'll need:

- vinegar
- baking powder
- washing up liquid
- food colouring
- small plastic bottle
- balloon
- plate/tray
- clay (optional)
- tablespoon

What to do:

- Put 1 tablespoon of baking powder in the plastic bottle. If you have time make a volcano shape with the clay around the bottle (supercool parents will of course have 'prepared this earlier … but no matter!)
- Add a small amount of washing up liquid, and a few drops of food colouring.
- Make sure that the volcano is on the tray / plate… Add vinegar and stand well back…

Variation 1: Place a balloon over the end of the bottle and collect the gas – it is heavier than air.

Variation 2: Put a bung in the bottle and watch it fly out.

Variation 3: Assign two children the roles of BBC news reporter and volcano expert, and get them to do a live news interview as the volcano explodes…

PS. BEWARE – this experiment is great – but it does stink. Don't use repeatedly!!

What's Happening?

This experiment demonstrates a classic 'acid base' reaction. Carbon dioxide is given off when the vinegar reacts with the baking powder, causing much fizziness!