

SPECTACULAR SCIENCE



**DO-IT-YOURSELF
SCIENCE SHOW!**

WARNING — Not to be used by children except under adult supervision.

Important information for parents and adult supervisors

The lights are up and the stage is set! With these experiments, your child will soon be performing exciting tricks before astonished spectators. The experiments in this series have been carefully selected to help your little performer astound and impress the audience with fascinating phenomena from the worlds of chemistry and physics. This creates a fun and entertaining way to put the spotlight on science!

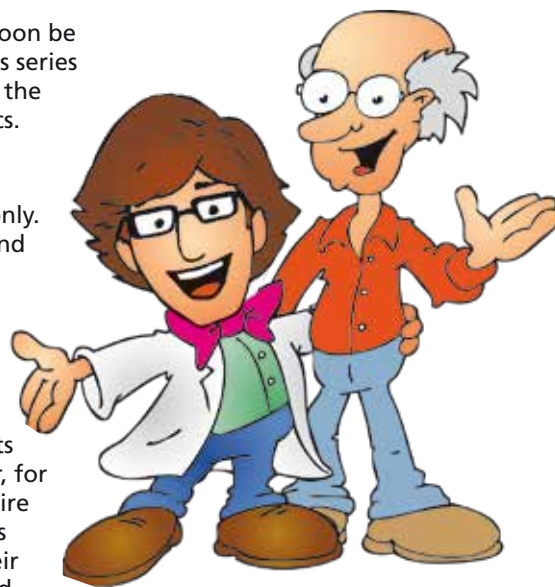
This chemistry activity series is intended for children older than the age of 12 only. In these experiments, your child will be working with chemicals, open flame, and denatured alcohol. Safety is particularly important to us, because the incorrect use of chemicals can lead to injury and other health risks. This series complies with all applicable US consumer product safety regulations, including those for chemistry sets. Moreover, this series complies with the more rigorous European safety standard EN 71-4, in which the safety requirements for chemistry experiments are established, to reduce risks to a minimum. This standard forms the reliable basis of all Thames & Kosmos chemistry experiments and experiment kits. The standard contains requirements for the manufacturer, for example that no particularly hazardous substances can be used. They also require the manufacturer, however, to carefully inform the parents or adult supervisors of the possible hazards and to require them to accompany their children in their new hobby with a helping hand. Therefore, please read and follow the tips and information provided in this activity download.

Perhaps the most important EN 71-4 requirement is the one that obligates the manufacturer to inform parents or guardians about any possible dangers and to encourage them to support their children and stand by their sides ready to help with the experiments. Be your child's "invisible" helping hand, both while practicing the experiments and while putting on the actual show. Even if your child has practiced carefully, the excitement and stage fright of the performance can make everything seem different. That's why every performer needs an assistant! So it's at this point that we turn to you to let you know what this involves. Take a look through this series of downloadable science experiments and pay particular attention to the basic rules for safe experiments, the information about hazardous materials, first aid in case of accidents, and waste disposal.

Since the abilities of children in this age group can vary quite a bit, please also take a look at the safety notes accompanying each experiment and select those experiments within the series that seem safe and appropriate for your child. If the experiments involve working with open flame, lit candles, or denatured alcohol, you will see corresponding symbols printed on the side. Given that denatured alcohol (also known as methylated spirits or rubbing alcohol) and its vapors are highly flammable, it is always important to work carefully with this substance and to close the container immediately after use. Please pay particular attention to the notes on working with denatured alcohol and fire.

Before starting the experiments, discuss the warning notes and safety rules with your child or children. Be absolutely clear about the fact that they must read and follow these instructions, the safety rules, and the first aid information and keep them on hand for reference. Only give the required quantities of household chemicals to your child. The area around where the experiments are to be performed should be free from any obstacles and far from locations where food is stored. It should be well lit and well ventilated, and equipped with a working sink. A sturdy table with a heat-resistant surface should be available.

We wish you dazzling success with the Spectacular Science experiments!



A great team — the performer and his adult assistant!



This symbol indicates that an open flame is part of the experiment.



This symbol indicates that an experiment calls for denatured alcohol.

Basic rules for safe experiments

All of the experiments described can be performed safely as long as you carefully follow the advice and instructions. In particular, keep the following basic rules in mind.

Advice for chemical experiments

1. Read the experiment before starting the experiments, follow its instructions, and keep it on hand for reference. Pay particular attention to the quantities indicated and the sequence of individual work steps. Only carry out the experiments described.
2. Keep young children, pets, and any individuals not wearing eye protection away from the experiment area.
3. **Always wear eye protection.** If you wear glasses, you will need safety goggles for people who wear glasses. The safety glasses are particularly important for experiments with open flame, denatured alcohol, and chemicals, which are identified by the adjacent symbol. Wear suitable protective clothing (old smock or old shirt) while working.
4. Keep the experiment materials out of the reach of young children.
5. Clean all equipment after use.
6. Clean your hands after finishing the experiments. If any chemicals get onto your skin by mistake, rinse immediately under running water.
7. Only use the equipment that is specifically recommended for use in each individual experiment.
8. Do not eat, drink, or smoke in the experiment area. Do not use eating, drinking, or other kitchen utensils for your experiments unless specifically told to do so. In that case, wash them thoroughly before returning them to the kitchen for use (in other words, don't just leave them in the kitchen!).
9. **If you are investigating foods or foodstuffs (for example, table salt), transfer the appropriate quantity into one of the measuring cups. Do not return food or foodstuffs to their original container, and do not consume any leftovers. Dispose of them immediately (in the household garbage or down the drain).**
10. Do not bring any chemicals into contact with your eyes or mouth.
11. During experiments with open flame, be sure that there are no flammable objects nearby. Extinguish all flames before leaving the experiment area, even if only briefly. Always be careful not to burn yourself, and avoid reaching above a flame (practice thoroughly before each show).
12. Immediately wipe up any spilled liquids with a paper towel.
13. Always close spirits-filled measuring cups with a lid, so none of the flammable vapors get into the air! The same thing is advisable with vinegar, on account of the odor.
14. Be sure to keep young children, pets, and other onlookers a safe distance away from the stage. Ideally, close off the room where you will be giving your performance after you have set things up.
15. Keep a bucket or box of sand ready in case you have to extinguish any flames. A large blanket can also help to put out a fire. If you can't put out a fire right away, call the fire department immediately.
16. Before starting an experiment, obtain all the required supplemental materials and have them ready for use.



Also pay attention to the notes accompanying each experiment, because they point out specific dangers and tell you how to avoid them. If they make reference to hazardous materials, the hazard symbol will also be shown, and reference will be made to the information about hazardous materials.

Instructions for handling denatured alcohol and fire

You will always find these symbols next to an experiment's heading when you will be working with fire, open flame, or denatured alcohol.

Be very alert during experiments with open flame, including when you are working with candles. That particularly applies to experiments with **denatured alcohol (methylated spirits)**, because it is **highly flammable**. Keep the supply bottle far from the flames, only decant the amount required for the experiment, and close the bottle again right away. Immediately wipe up any spilled denatured alcohol. Let the cloth dry outside and avoid inhaling the vapors. Also, be careful when **lighting denatured alcohol**: Do not hold the stick lighter directly in the liquid. You only need to hold it a **little above** the spirits in order to ignite them. Denatured alcohol is highly flammable, and strictly speaking you are lighting the vapors that are rising up from it. It is particularly important with these experiments for an adult assistant to stand by your side to help and support you. You can actively involve your assistant in the show and instruct him to perform specific steps. Never leave an open flame unattended, and always extinguish it at the end of the experiments. **At the start of the show, tell your audience** that no smoking is allowed during the performance.

Your own science show

Setting your stage

Now we want to give you some suggestions for preparing the stage for your science show in a safe and entertaining manner. For your experiment table, a sturdy old table with a washable surface that is heat resistant, would be best. Given the proximity of foodstuffs, the kitchen is not an appropriate place for chemistry experiments. Since you will need some space for your performances, your experiment table should be free of any unnecessary objects, such as tablecloths, curtains, or other flammable items. Your table should only have those things on it that you will need before and during a portion of the show. For show portions using flames, the table should be covered with aluminum foil. That will provide protection against flying sparks or in case something tips over. In addition, the reflection on the foil looks “magical” and magnifies the light of the flames!

It is important for your table to be sufficiently well lit, so you can stand in the spotlight and your audience can see everything properly. The room where you give your performances should have a floor that can take a little abuse (ideally a tile floor), and it should be well ventilated, since some of the experiments will feature a little smoke or smoldering.

You will often require water while preparing for a show, so it's a good idea to equip your workplace with a watering can or large pitcher filled with water.

It is also handy to have a small table or storage box next to your work table on which you can place used materials. You can also keep a roll of paper towels there for wiping up spills, or maybe even a tissue box decorated for the show.

For any dry trash produced during the show, you can decorate a large, clean aluminum can with foil and place it on your performance table.

To keep onlookers away from your lab materials before and after the show, you should close off the room that holds your stage. That way, you can be sure that everything remains the way you tested it.

Your master of ceremonies costume

When experimenting, wear old clothes with an old white smock or shirt pulled over them. Loose-sleeved pullovers, scarves, bandannas, or long chains, all of which could fall into the experimental setup or even into a flame, are awkward and would just get in the way while you perform your experiments. If you have long hair, tie it up with a hair band. And don't forget: During your preparations as well as during the show, always wear safety glasses!



Before, during, and after your show

Preparing for your experiment show

To turn the experiments in this series into real show experiments, they will need something really special: **you!** You are the one who will be presenting the experiments to your audience. You are the star of your science show!

But don't worry, it won't be too difficult. The experiments alone are impressive enough, and you will just have to slip into the role of a star performer in order to guarantee yourself some applause.

There are just a few things you have to pay attention to:

- **Perform the experiments only after you have mastered them.**
- You should **practice every show at least once from beginning to end**. This is the only way to be sure, for example, that materials from one experiment don't get in the way of another. Get used to clearing away the used material at the end of each experiment, so it doesn't get in your way during the next one.
 - **Consider beforehand what you want to say during the experiments.** In this handout, you will find scripts for each experiment that will help you find the right words for your show. Or maybe you can think of something much better!
 - **Don't make your show too long.** You should not perform more than five experiments in one show. After all, you won't just be performing experiments, you will be entertaining your audience. That requires some concentration, and it can be pretty tiring. So don't try to do too much. You will find suggestions for thematically complete show portions in this manual. You can also combine your own favorite experiments into your own show if you like.



My suggestions for what you should say are formatted in this font. Use this as your script.

Testing

Every show has to be tested. After all, you have to be sure that everything is going to work well in front of the audience. This is the best way to do it:

1. First try the experiment without presenting it. Recruit an adult helper to assist you during the show as well.
2. When you can execute the experiment itself without having to think about it too much, study your lines. You can also think up your own lines, of course.
3. Practice the experiment while speaking your lines. Have an adult assistant help you with this. Pay attention to how long it takes and whether there are any parts that give you trouble. And if, despite your preparations, you do forget your lines during the show, your assistant will be ready to help with this instruction sheet.

Stage fright

Sometimes people can get a little nervous before a performance, or maybe even quite anxious. They might be afraid that something will go wrong, that they might forget their lines or that the audience just won't enjoy the show. This kind of feeling of anxiety is known as stage fright. Almost all experienced performers, actors, and musicians get it before a performance, even if they have stood on the stage hundreds of times before. There is no prescription for it. But there's nothing wrong with it. On the contrary, stage fright often motivates people to put on a particularly good show, and it's just part of the process.

But here are a few tips you can use to calm your stage fright a little:

- Before the show, find a quiet place where you can be alone one last time.
- Think about the fact that nobody except you knows what you have planned. No body knows what you will say, either. So nobody will notice if you don't say your lines exactly as you planned!

The elements of the show

In professional shows, people often use music to introduce the show, and they may use other light and sound effects as well. With the help of your assistant, you can do it too. Here are some ideas.

Drum roll

A drum roll is often used to build tension. Instead of an actual drum roll, you can simply ask your audience to beat on their thighs with their hands or to stamp their feet. That's fun for everyone and works just as well to build tension. The audience will catch on more quickly if you also do it yourself when you ask them to.

Light

Some show elements really only make a good impression when the light isn't too bright. You will find instructions to that effect in some of the experiments. Make sure that your assistant can dim the lights when you ask him to.

Music

With some of the show experiments, you will have to kill a little time while waiting for something to happen. You can use music to bridge those periods — have your assistant be ready to start it at your signal, and then stop it again.

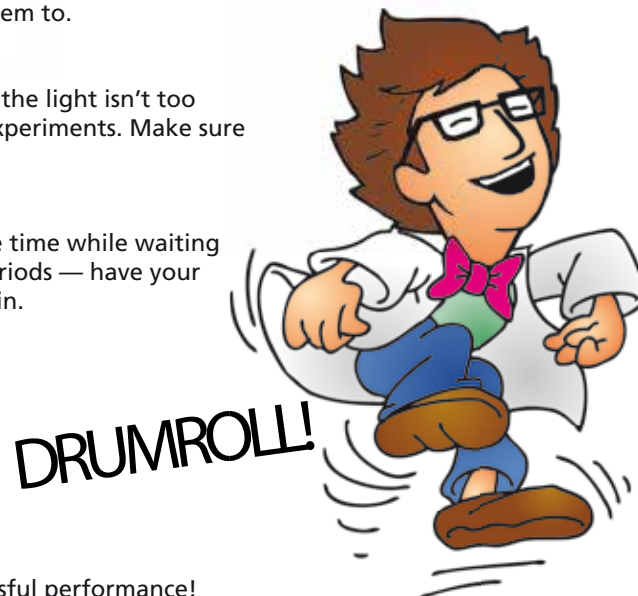
Closing words

You can use the same closing words for every show. Then take a deep bow! And wait for the calls for an encore. Then, with your prepared encore experiments, you'll be digging deep into your box of chemistry tricks again.

After the show

First of all, enjoy the applause and accept praise for your successful performance! Bow to your fans, and if you like you can hand out home-made autograph cards (with your photo). But when the audience finally leaves the room, there will still be a few things to do: air out the room thoroughly. Once the experimental material has cooled off, you can start cleaning up. Dispose of residues and wash all the parts. It's easier to clean up fresh dirt than dried-on dirt. Usually, lukewarm tap water and dish washing liquid will work. Carbonized or sooty residues can be scraped off and cleaned with a little scouring powder. Dry everything with paper towels, which you can then toss into the trash. Then return everything to its place and put it someplace out of the reach of young children (for example, lock it away in a closet). Finally, don't forget to wash your hands!

! No matter how nervous you might be, take your time when handling the lighter, open flames, and chemicals, and don't rush yourself! The show will come off even better that way, because the audience's anticipation will rise as they wait.



THE FIRE-WATER-AIR SHOW



Welcome to my experiment show! Today, everything will have something to do with fire, water, and air. Let's go!

THE CRUSHED SODA CAN



A soda can will be crushed in spectacular fashion, with a loud bang.

MATERIALS:

- 3 tealight candles
- measuring cup
- well-cleaned empty soft drink can (thin-walled)
- glass bowl with cold water
- barbecue tongs
- stick lighter
- hot tap water
- old saucer

First of all, a tip: Practice turning the can filled with cold water over with the tongs! Always turn the can smoothly, not jerkily.

BEFORE THE SHOW

Squeeze the sides of the soft drink can together a little, because it will be easier to grab with the tongs if the sides are indented.

Use the measuring cup to measure 10-20 ml of the hottest water you can get from the tap and pour the water into the empty soft drink can. Arrange the tealight candles in a triangle on the saucer, with the candles touching one another. Place the soft drink can next to the saucer, keeping the stick lighter and barbecue tongs within reach. Set the bowl filled with cold water to the left, beside the candles.



PERFORMANCE



We are all surrounded by a huge quantity of air. And this air presses down on us with a powerful force. Ten tons of weight are exerted on every square meter of Earth's surface! Fortunately, you don't normally notice it. But in the next experiment, I am going to release this force!

To do that, I'll need nothing more than these flames (Light the tealight candles) and this can (Show the can), which holds a little water. (First shake the can a little so people can hear the water, and then hold it over the candles with the tongs.)



Now you will have to kill a little time until the water in the can starts to boil — add long pauses following each of your lines and observe whether steam is coming out of the opening yet. **When heating the can, always hold it so that the opening is pointed away from you and other people.**

When I bring the water in this can to a boil, it fills with steam. That forces out the air inside of the can. In a few moments, I will be letting the powerful force of air pressure exert itself on the can, by suddenly removing the steam from it.



Have the spectators drum until steam is really pouring out of the opening. The can will turn a little bit black from the soot of the candles in the process.

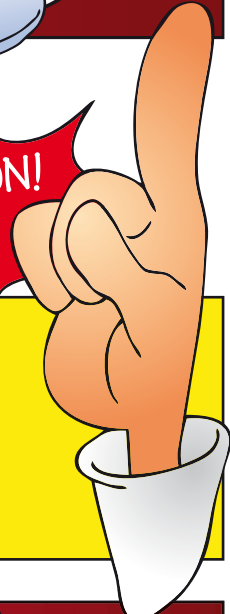


Drum roll please!

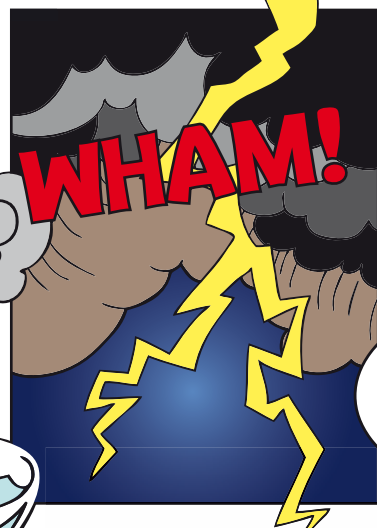
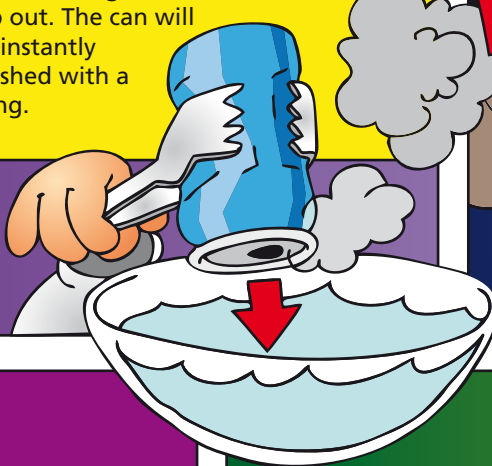
DRUM ROLLLL!

ATTENTION!

Make a sign to stop the drum roll.



Use the tongs to turn the can **upside down** over the bowl of water and lower it **into the bowl with the opening pointed down**. Hold the can tightly with the tongs so it doesn't slip out. The can will be instantly crushed with a bang.



BRAVO!



A gigantic applause for the gigantic air pressure, please! (Take a bow and blow out the candles.)

CAUTION

Hot water can spray or flow out of the can!

TIP:

It doesn't usually take too long for the water in the can to boil. But the hotter it is to start with when you add it to the can, the faster it will come to a boil during the show.



EXPLANATION

When you immerse the can in the bowl of water, the **steam instantly turns back into liquid water**. Then the can is, in fact, practically empty, creating a **vacuum**. When that happens, the pressure inside the can drops very quickly. The external air pressure then promptly crushes the can. Granted, it won't be a full 10 tons of weight exerted on it, but **still around 300 kg!**

MAGIC RACING CONFETTI

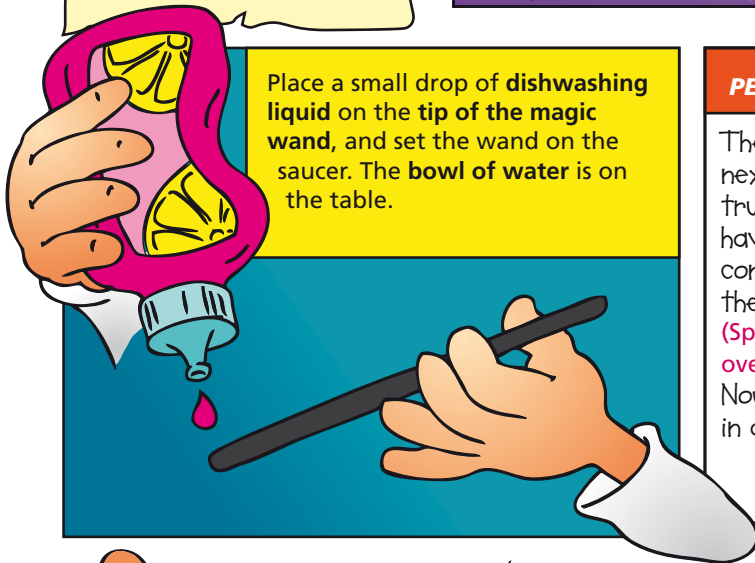
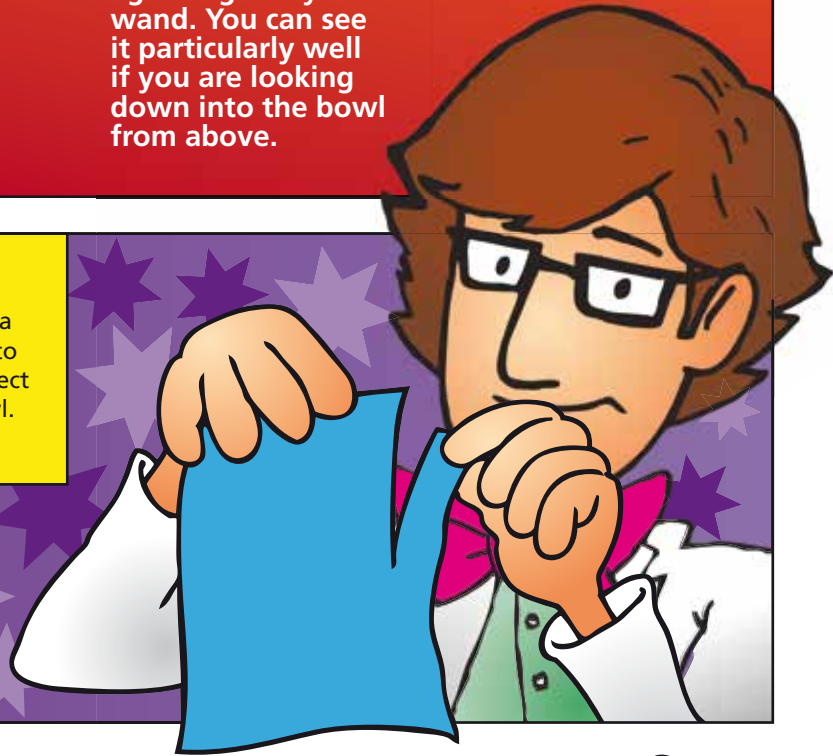
Snippets of paper are floating in a bowl of water. When you touch the water with a "magic wand," they will move like lightning away from the wand. You can see it particularly well if you are looking down into the bowl from above.

MATERIALS:

- plastic tube (magic wand)
- glass bowl with cold water
- dishwashing liquid
- colored snippets of paper or confetti (for example, from a hole punch)
- small bowl
- old saucer

BEFORE THE SHOW

Before the show, tear a little colored paper into little snippets and collect them in the small bowl.



Place a small drop of dishwashing liquid on the tip of the magic wand, and set the wand on the saucer. The bowl of water is on the table.

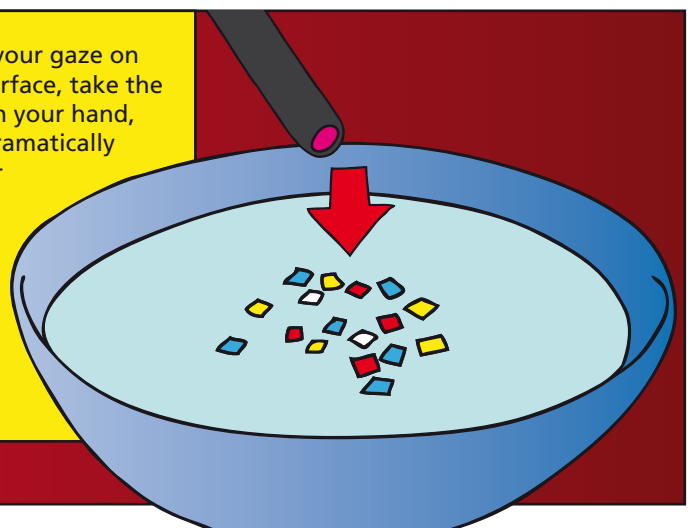
PERFORMANCE

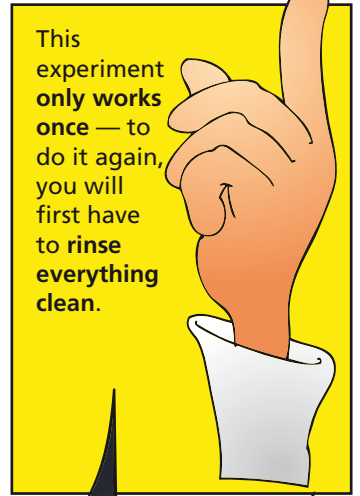
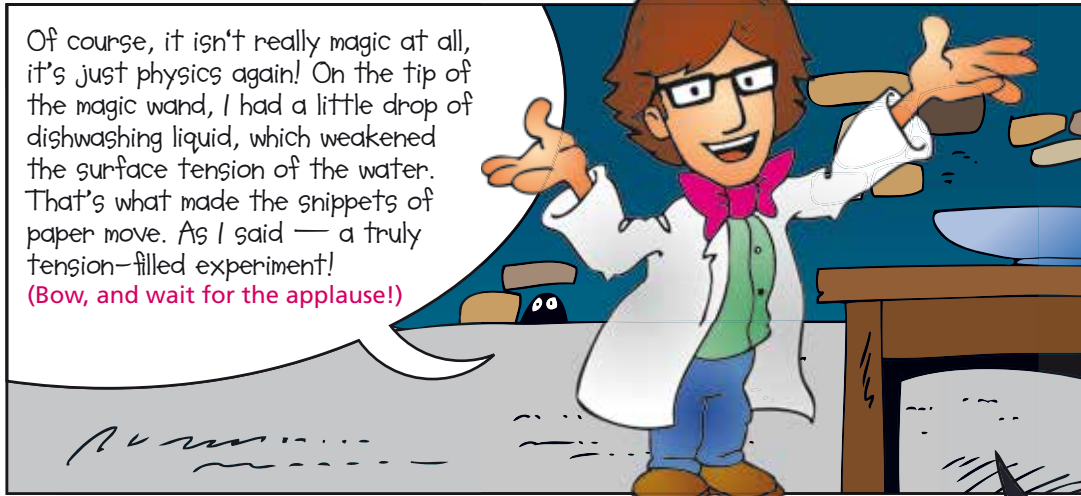
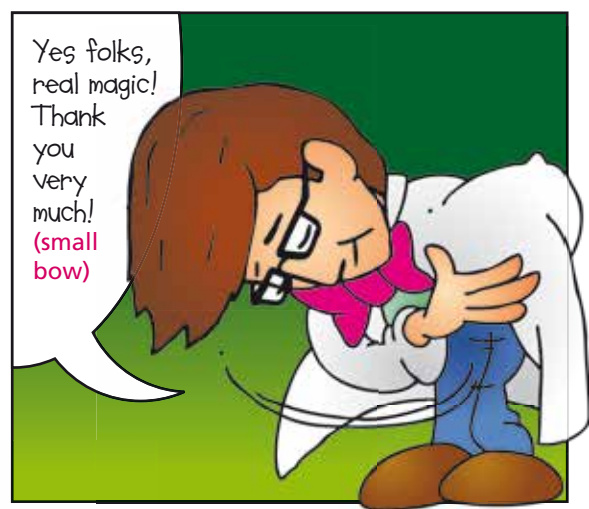
The tension will mount in this next feat, too — in the truest sense of the word! I have here a little homemade confetti. It is floating on the surface of the water. (Sprinkle the snippets evenly over the water's surface.) Now I will make it move in a magical way.



ATTENTION!

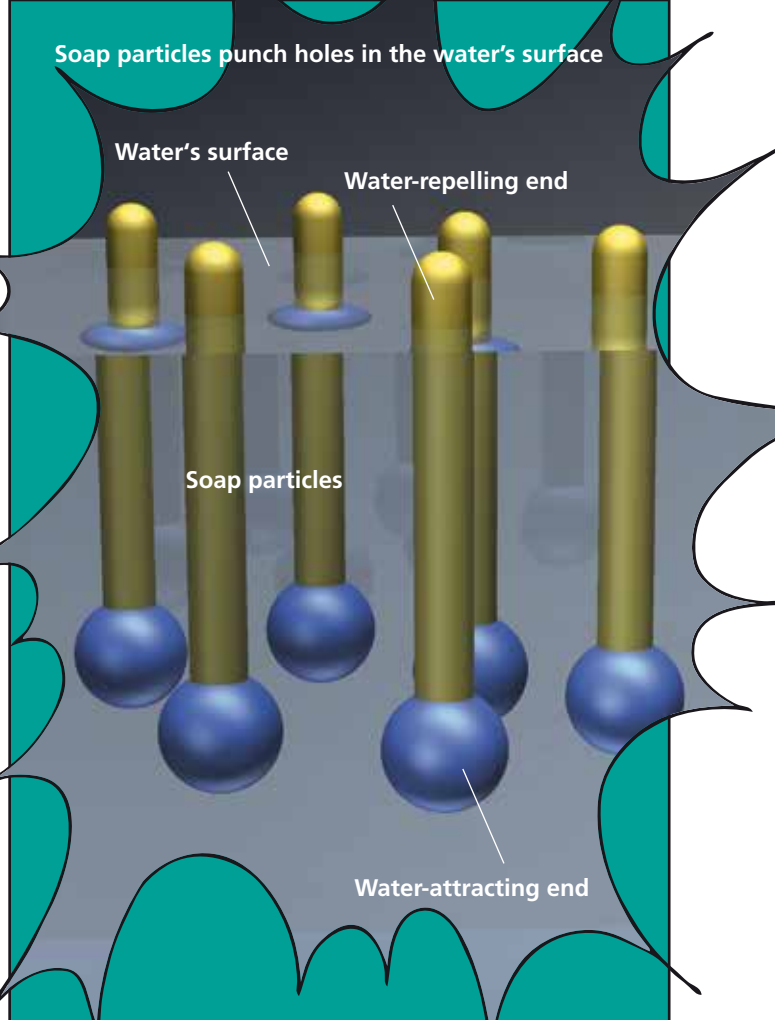
Concentrate your gaze on the water's surface, take the magic wand in your hand, and wave it dramatically over the paper snippets. Then, tap lightly on the water with the end of the wand with the dishwashing liquid on it. The snippets will suddenly dart away from the magic wand.





EXPLANATION

The water in the bowl acts as if it had a layer of skin stretched over it. This phenomenon is known as **surface tension**. It comes from the fact that the water particles on the surface exert a particularly powerful attraction on one another. The **soap particles** in the dishwashing liquid "punch holes" in the skin of water, **reducing its surface tension** and making the paper snippets move. In this process, the water-repelling (*hydrophobic*) ends of the soap particles stick up into the air and the water-attracting (*hydrophilic*) ends stick down into the water.



THE FIREPROOF SHROUD



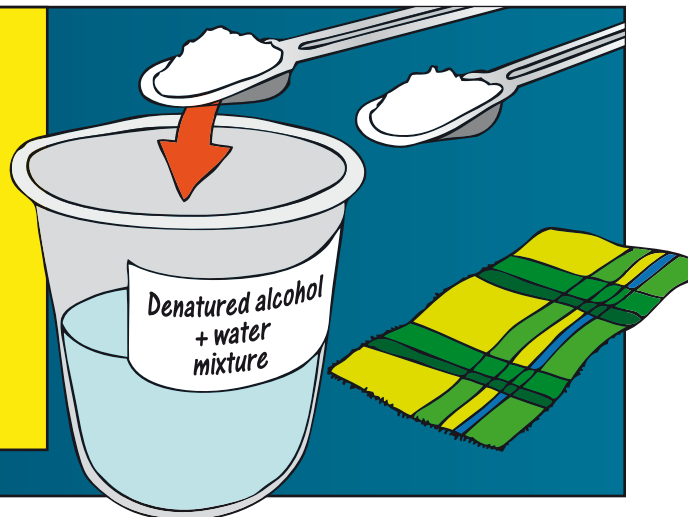
A supposedly fireproof cloth will be held in a flame. It will ignite and proceed to blaze away. But when the fire has gone out, the cloth is unharmed!

MATERIALS:

- 2 measuring cups, 1 lid
- measuring spoon
- candle (on fire-resistant surface)
- stick lighter
- water
- denatured alcohol
- piece of cotton material (about 7 x 5 cm), such as material from an old shirt
- glass bowl with cold water
- table salt
- barbecue tongs

BEFORE THE SHOW

Add 25 ml water and 25 ml denatured alcohol (in other words, 50 ml alcohol-water mixture) to the labeled measuring cup. Add 2 large spoonfuls of table salt to the mixture. Then stir the mixture well with the spoon — but don't let the salt dissolve completely.



Place the piece of cotton material in the liquid, so it becomes completely saturated. Then take the cloth out again, and let a little of the liquid drain off into the measuring cup. Pour the liquid down the drain and rinse the sink with water. Finally, place the cloth back into this measuring cup and close it with the lid. Fill the second measuring cup with 50 ml water. Place both measuring cups at one end of the table. Set the barbecue tongs next to it. Place the candle in the center of the table. Set the bowl of water next to it. Place the stick lighter in easy reaching distance on the table.



This cup holds a very special fluid. (Show the measuring cup with the water) I will be able to use it to prevent material (Show the piece of cloth in the cup) from going up in flames.

PERFORMANCE

In this experiment, you will be availing yourself of an age-old trick to build the tension even higher: You will be acting as if the whole thing were going wrong!

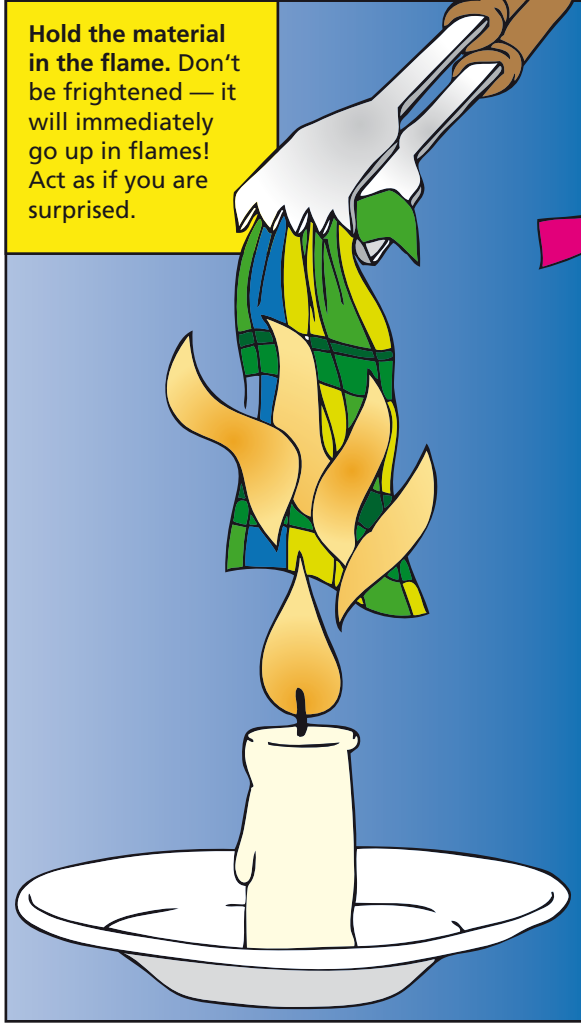
Dear audience: Fire is a very dangerous thing (Light the candle), and entire cities have been destroyed by it. In the next experiment, I will show how to use the tools of chemistry to keep the danger of fire under control.





For several days, I have treated this piece of material (**Take the piece of material out of the cup with the tongs**) with this fluid. This treatment has transformed it into a fireproof super-material. See for yourself. (**Light the candle.**)

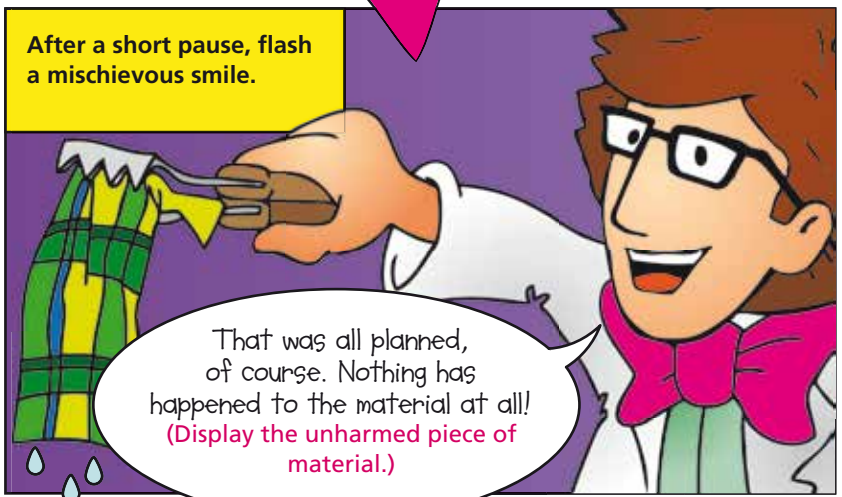
ATTENTION!



Hold the material in the flame. Don't be frightened — it will immediately go up in flames! Act as if you are surprised.



Shoot... (**Yes, you can say this now!**), uh-oh... that shouldn't have... (**Extinguish the flame in the bowl of water after a little while.**)

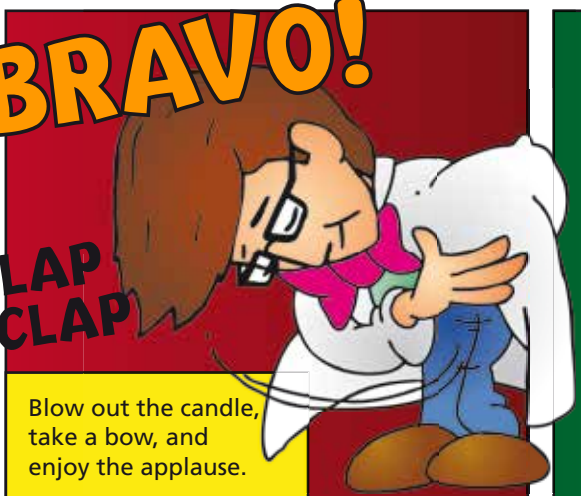


After a short pause, flash a mischievous smile.

That was all planned, of course. Nothing has happened to the material at all! (**Display the unharmed piece of material.**)

BRAVO!

CLAP CLAP!



Blow out the candle, take a bow, and enjoy the applause.

EXPLANATION

It isn't the cloth itself that's burning — it's the methylated spirit vapors. The water portion in the mixture cools the cloth so well that it keeps it from burning. The table salt also helps to make the flame turn a little yellow. We'll perform another experiment about that in a minute.



Denatured alcohol is highly flammable.



BENDING WATER

A stream of water will be made to bend.

MATERIALS:

- magic wand
- small watering can with water
- bowl or plastic tub
- dish towel, scarf, or fleece

BEFORE THE SHOW

Fill the watering can with water. Place the magic wand and the cloth within reach on the table. Position the bowl on the table so that you can pull it quickly to the center.

In this show experiment, you will be recruiting a volunteer from the audience. Of course, he won't really be a complete volunteer, since you will be selecting him yourself. Ideally, before the show starts look for someone you think will be happy to help you!



PERFORMANCE



There are people who claim to be able to bend spoons using nothing but the power of their thoughts. Of course, that's nonsense — just a trick.

But I can do something much better: *(in a dramatic voice)* right before your eyes, I will be using invisible forces to bend something that you never imagined could be bent — *(Pause briefly)* a stream of water! Completely without any phony magic, purely with the help of physics!



For that, I will need a volunteer, namely...YOU!



Point directly at your (preselected) volunteer and ask him to come up to your table.



A little applause for Peter! *(Instead of Peter, say the name of your assistant.)*

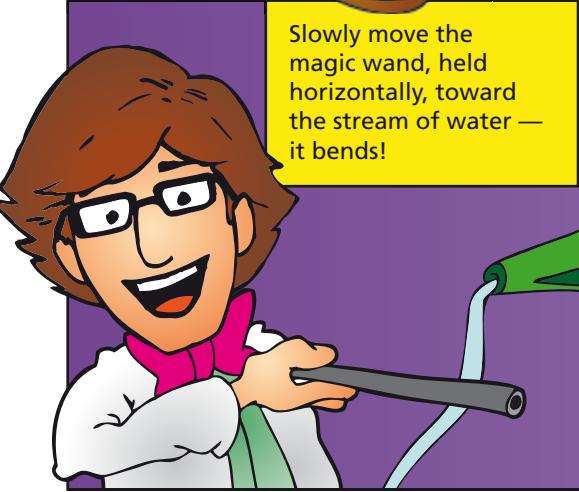


Turn to your assistant.

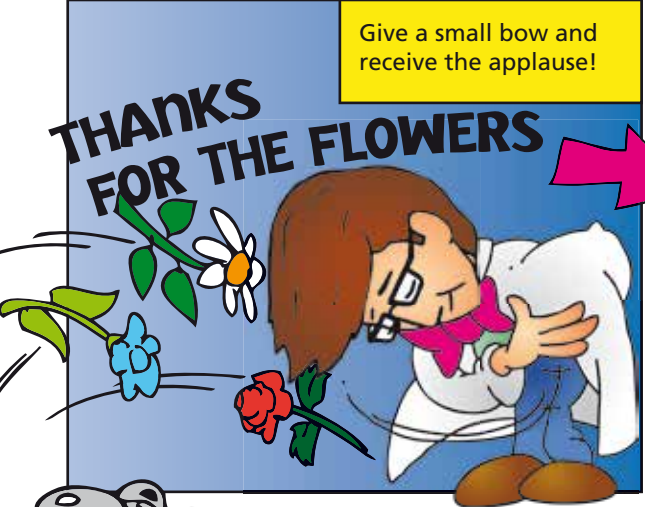
Please pour a nice thin stream of water from this watering can into this bowl. (Help find the right stream thickness.)



Now all I will need is a magic wand (Pick up your wand) and a magic cloth (Take the cloth). Now the tension is really going to mount! (Grab the magic wand tightly, push it through the cloth, and rub it vigorously against the cloth by pushing it rapidly back and forth. You might hear a little crackling: That is, in fact, electrical voltage.)

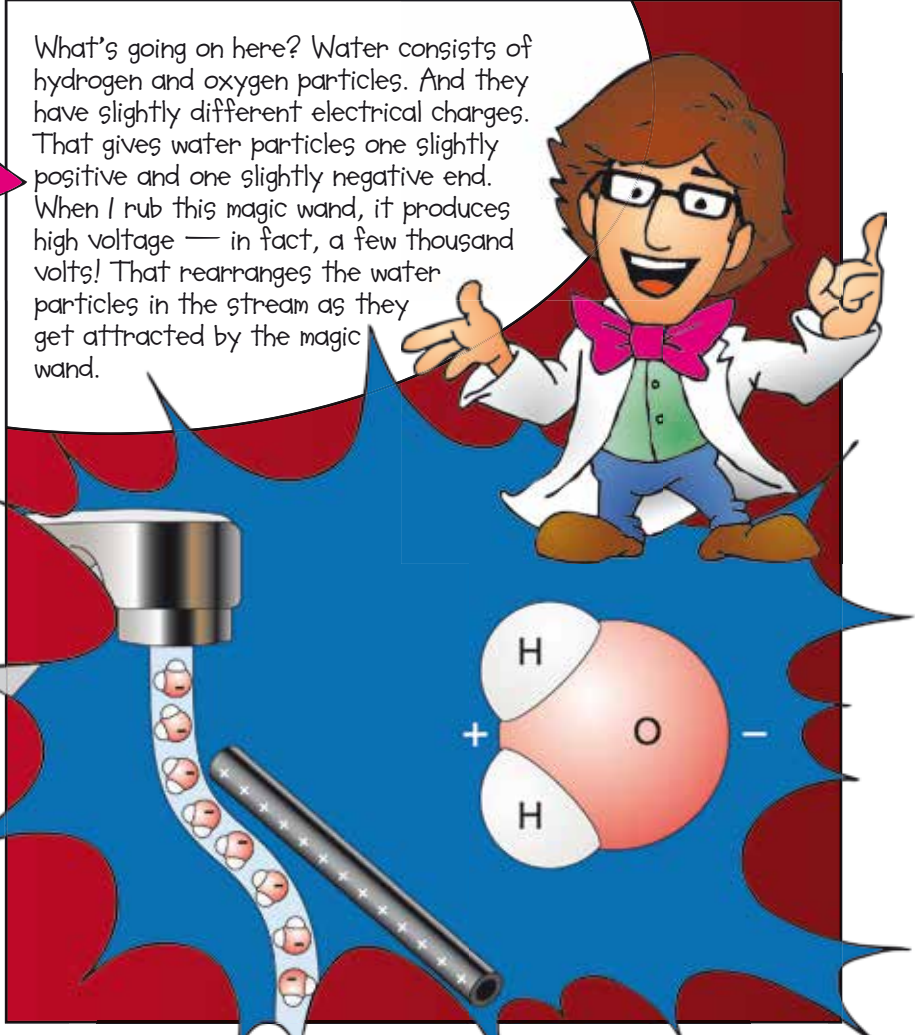


Slowly move the magic wand, held horizontally, toward the stream of water — it bends!

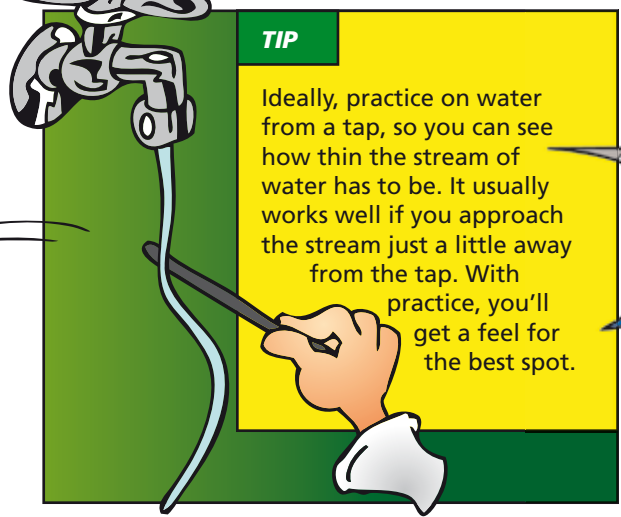


Give a small bow and receive the applause!

THANKS FOR THE FLOWERS



What's going on here? Water consists of hydrogen and oxygen particles. And they have slightly different electrical charges. That gives water particles one slightly positive and one slightly negative end. When I rub this magic wand, it produces high voltage — in fact, a few thousand volts! That rearranges the water particles in the stream as they get attracted by the magic wand.



TIP
Ideally, practice on water from a tap, so you can see how thin the stream of water has to be. It usually works well if you approach the stream just a little away from the tap. With practice, you'll get a feel for the best spot.

THE FIREPROOF BALLOON



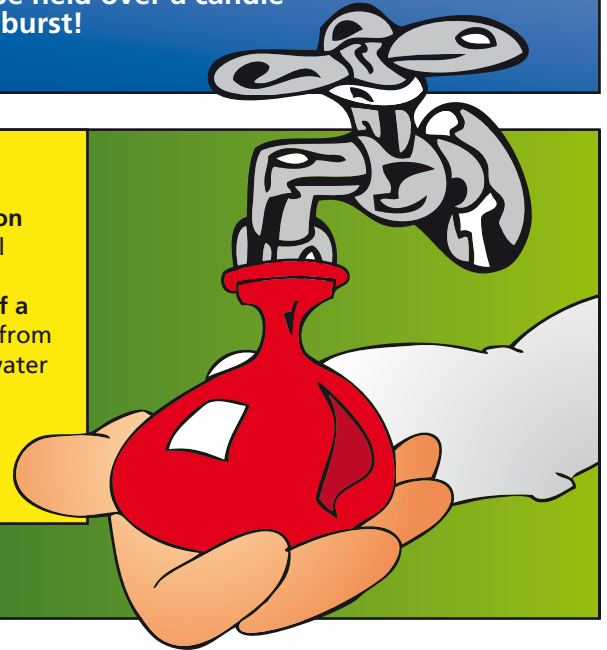
A balloon will be held over a candle flame. It won't burst!

MATERIALS:

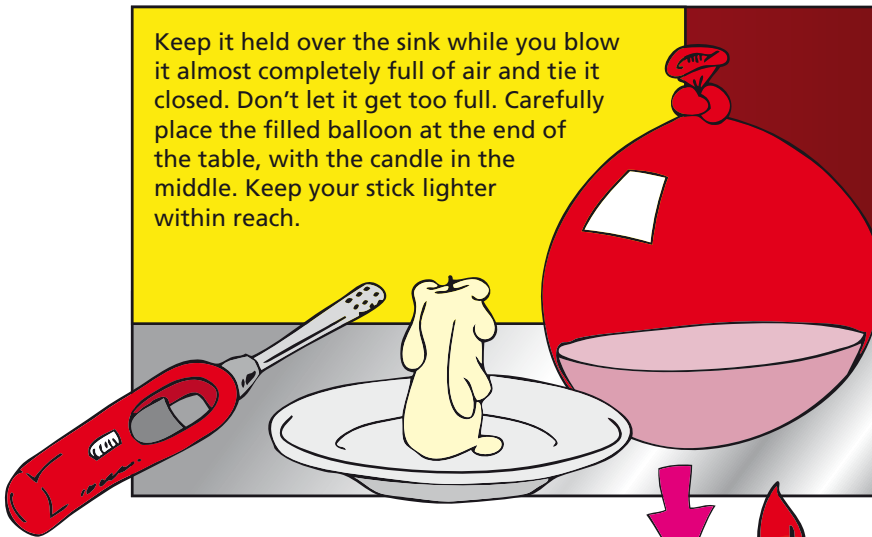
- balloon
- candle (on fire-resistant surface)
- stick lighter
- water tap (only for the preparation stage)
- empty glass bowl (for practicing)

BEFORE THE SHOW

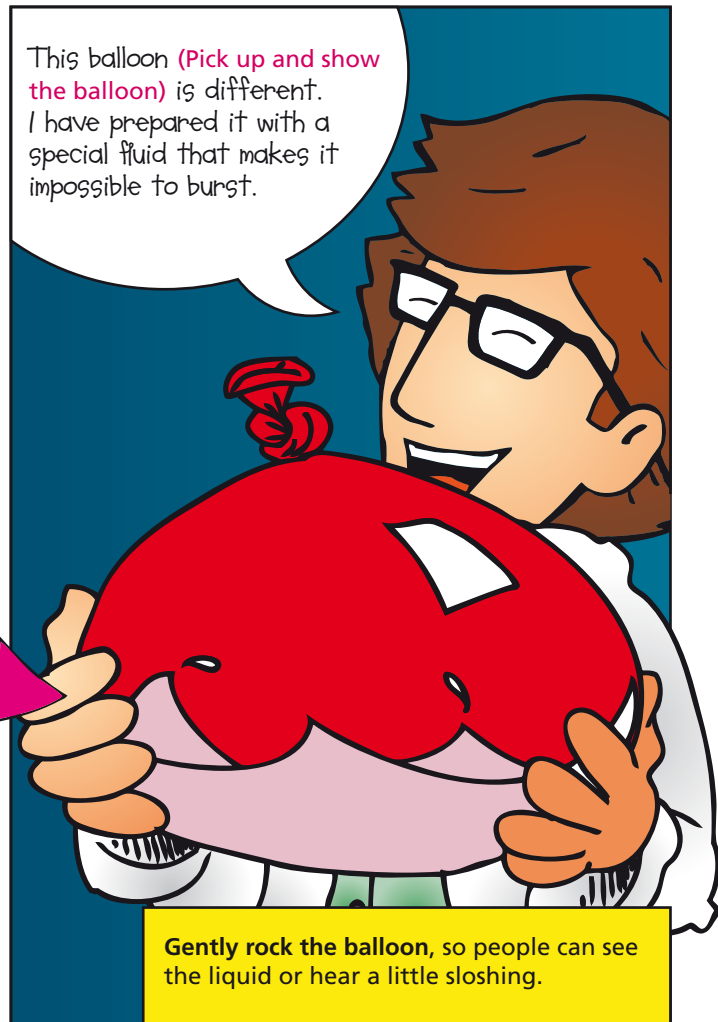
Before the performance, fill the balloon with some cold water. To do that, pull its mouth over a water tap and pour water into it until it's about the size of a tangerine. Then, when you remove it from the tap, hold it tightly closed so the water doesn't spray out at you!



Keep it held over the sink while you blow it almost completely full of air and tie it closed. Don't let it get too full. Carefully place the filled balloon at the end of the table, with the candle in the middle. Keep your stick lighter within reach.



This balloon (Pick up and show the balloon) is different. I have prepared it with a special fluid that makes it impossible to burst.

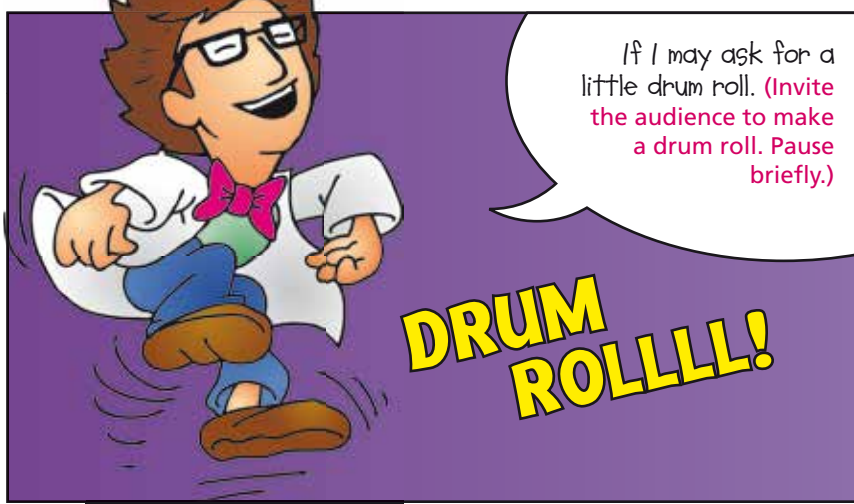


PERFORMANCE

Balloons are certainly among the most sensitive things in the world. A needle or a tiny little flame (Light the candle) would be enough to burst the balloon, normally.



Gently rock the balloon, so people can see the liquid or hear a little sloshing.



If I may ask for a little drum roll. (Invite the audience to make a drum roll. Pause briefly.)

DRUM ROLLLL!



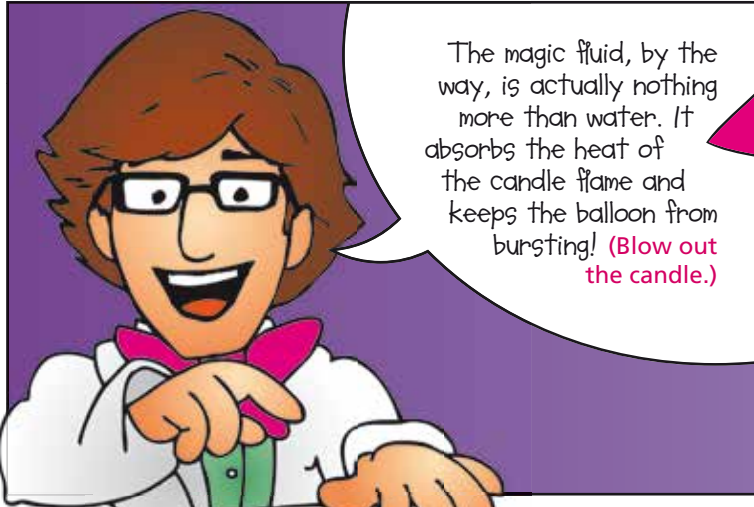
Now hold the balloon directly over the candle flame for a few seconds. The balloon remains undamaged.



Thank you very much!

**BRAVO!
GREAT!**

TIP
Be sure that the flame only touches the balloon where the water is. Otherwise, it really will burst. When practicing, you should set the candle in a large glass bowl in case you do break the balloon!



The magic fluid, by the way, is actually nothing more than water. It absorbs the heat of the candle flame and keeps the balloon from bursting! (Blow out the candle.)





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