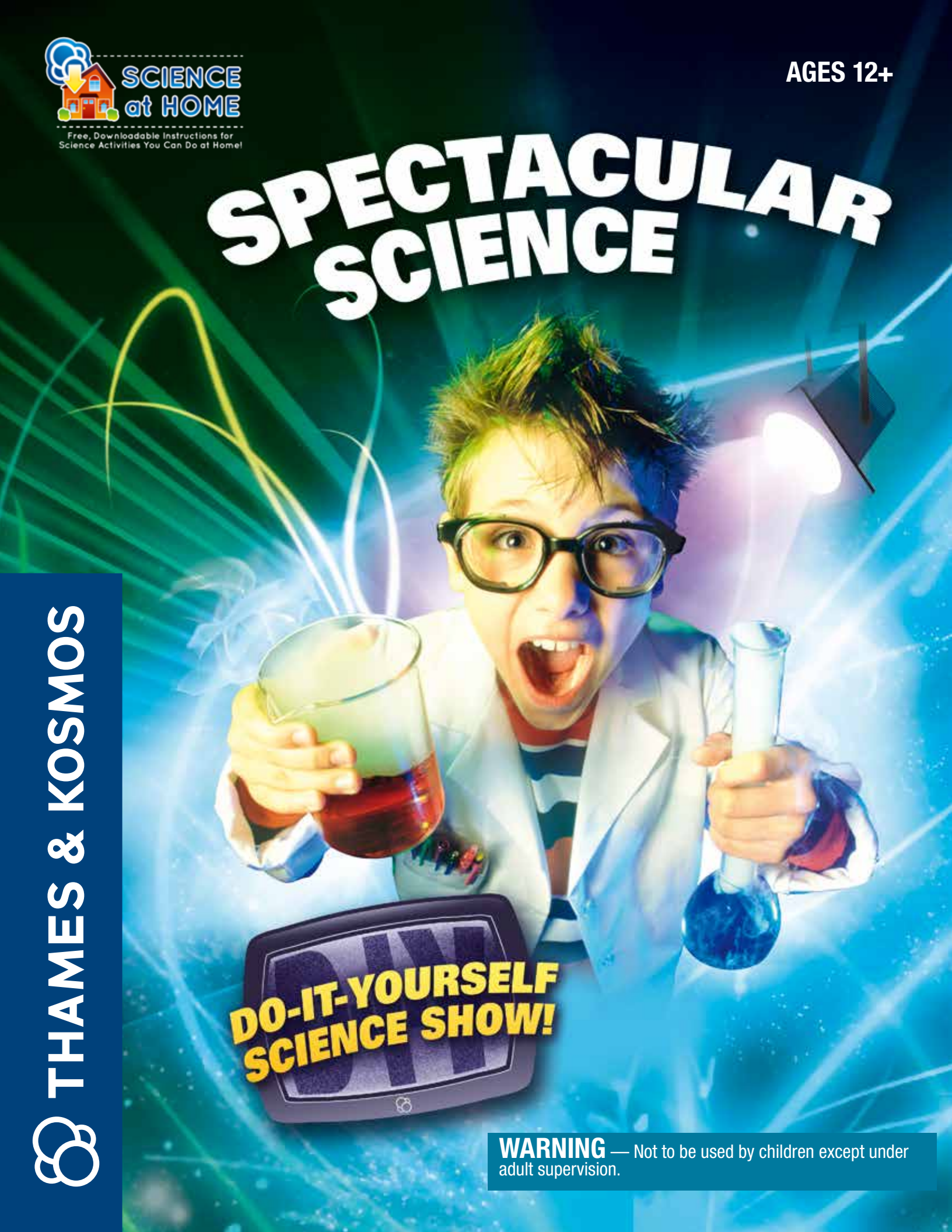
SCIENCE at HOME

Free, Downloadable Instructions for Science Activities You Can Do at Home!

AGES 12+

SPECTACULAR SCIENCE

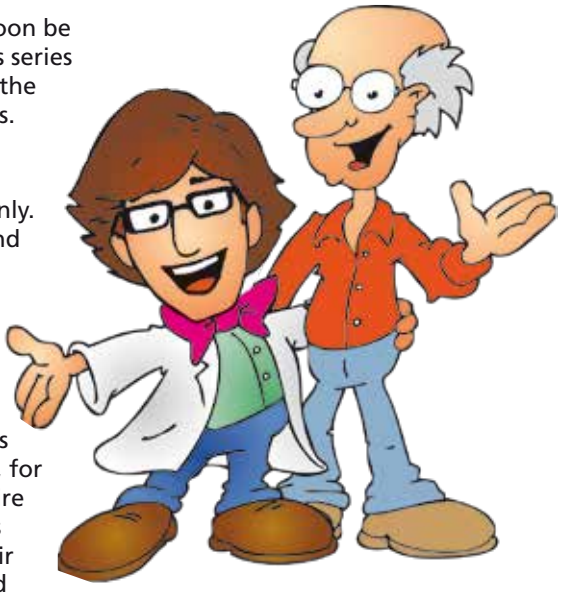


THAMES & KOSMOS

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!



A great team — the performer and his adult assistant!

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 rigourous 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.

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

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.

This symbol indicates that an experiment calls for denatured alcohol.

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!

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

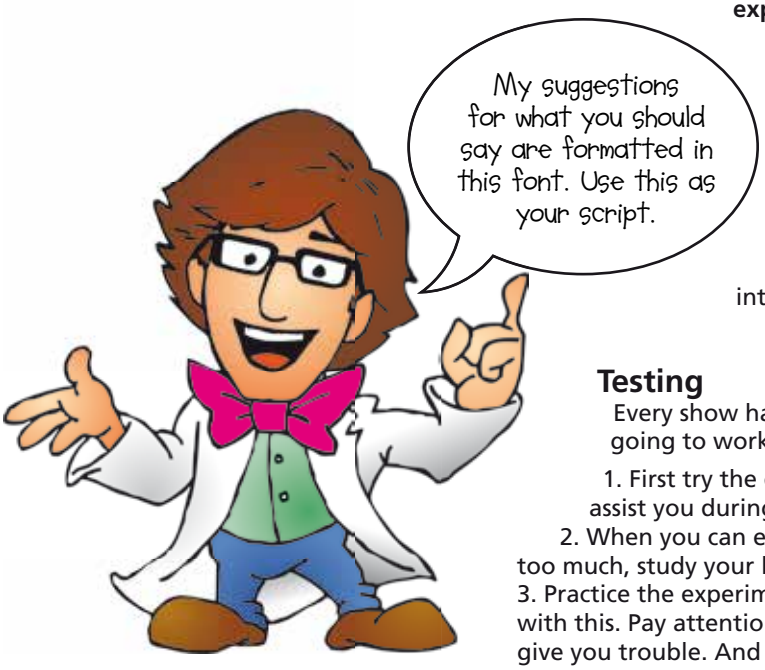
Preparing for your experiment show

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.



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!

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 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!

THE CARBON DIOXIDE SHOW

THE SELF-INFLATING BALLOON

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

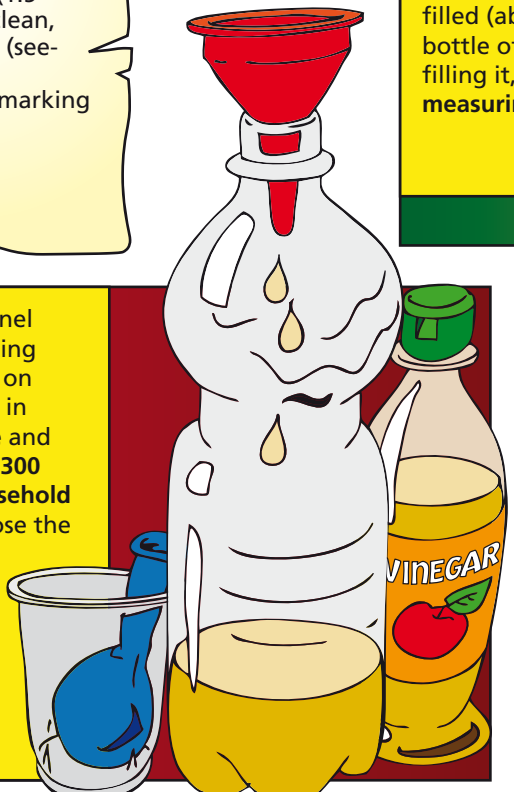
MATERIALS:

- balloon
- sodium bicarbonate (baking soda)
- funnel
- measuring cup
- household vinegar
- empty, thin-walled non-reusable plastic water bottle (1.5 liter), rinsed clean, without label (see-through)
- permanent marking pen

BEFORE THE SHOW

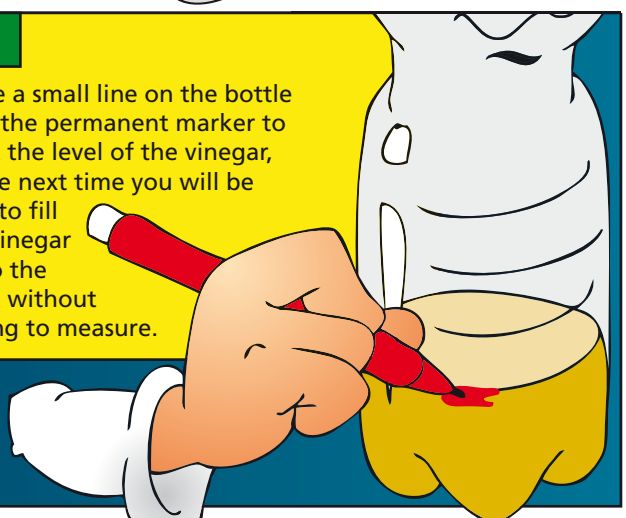
CAUTION! Wear the **safety glasses** while preparing as well!
First, use the **funnel** to pour **baking soda** into the **balloon**. It should be loosely filled (about 25 g, or half the bottle of baking soda). After filling it, set it aside in the **measuring cup**.

Rinse off the funnel so there's no baking soda residue left on it. Set the funnel in the **plastic bottle** and fill it with about **300 milliliters of household vinegar**. Then close the bottle until the performance.



TIP

Make a small line on the bottle with the permanent marker to mark the level of the vinegar, so the next time you will be able to fill the vinegar up to the mark without having to measure.



PERFORMANCE

Blowing up a balloon and talking at the same time is impossible! But I wouldn't be me if I didn't get a clever idea: In this bottle, we have some vinegar. (Take the bottle and open it. Act like you're sniffing it and finding the smell unpleasant.)

Before the show, I filled this balloon with baking soda. (Hold up the balloon briefly. Then fit the neck of the balloon over the opening of the bottle. Be careful that none of the baking soda falls into the bottle yet. Just let the balloon hang down beside the bottle.)

And now, a little drum roll please... Attention!

DRUM ROLLLL!

Lift up the balloon so that the baking soda falls into the vinegar in the bottle. As you do that, you can also **shake** the balloon a little so none of the powder remains behind in it.

Things will begin to bubble and foam in the bottle. **The balloon will start to blow itself up!** Vinegar and baking soda react together to **produce the gas carbon dioxide.**

A neat experiment, wasn't it? (Take a small bow, wait for the applause.)

Now carefully remove the **balloon** from the bottle before it has a chance to explode. **Give it to an audience member** to hold shut, but don't let him tie its neck shut or put it in his mouth. You will soon be needing the gas for the "crumpled soda bottle" experiment. Also, **save the bottle**, because you will need it for the next experiment, "Hot or cold." So **close it** with the cap.

HOT OR COLD – A QUIZ

In the "self-inflating balloon" experiment, vinegar reacts with baking soda. Does the bottle get hot in the process?

MATERIALS:
- sealed bottle (with baking soda and vinegar) from the last experiment

BEFORE THE SHOW

You first have to perform the "self-inflating balloon" experiment.

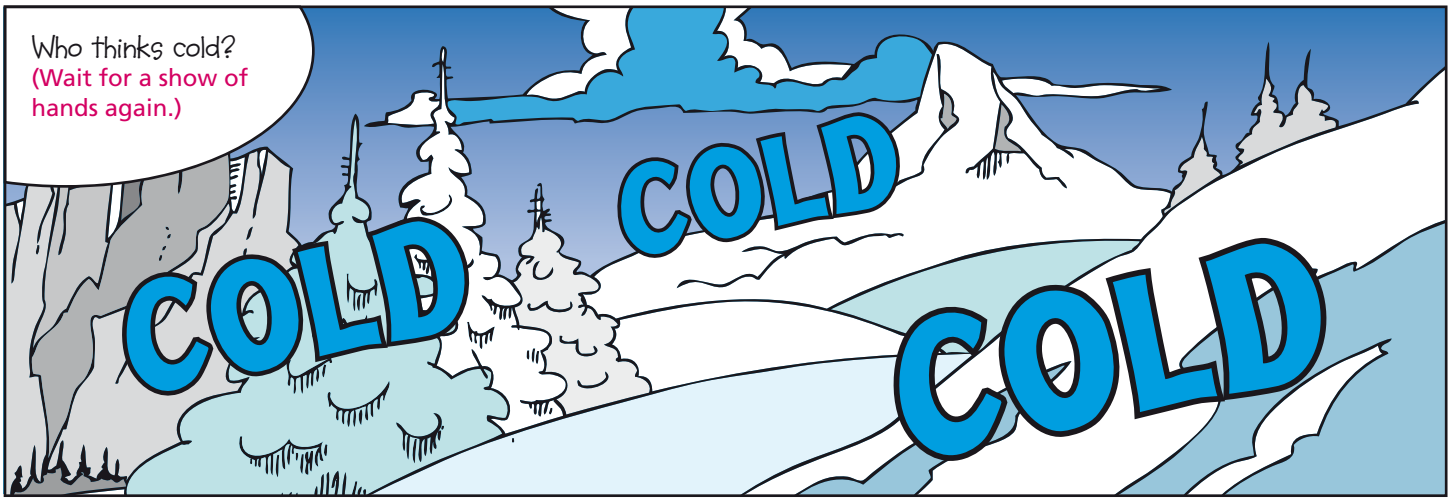
PERFORMANCE

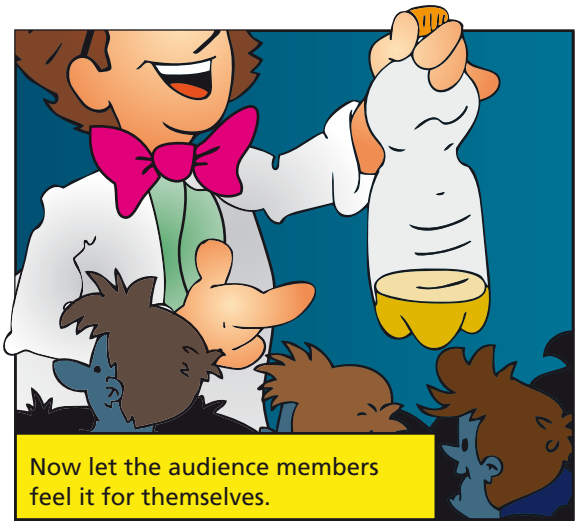
What happened here? The vinegar reacted with the baking soda. When that happened, carbon dioxide was produced, which blew up the balloon. But what do you think: In the process, would the bottle have gotten hotter or colder?

QUIZ

(Address the question to the audience:)
Who thinks hot?
(Wait for a show of hands.)

HOT HOT HOT





EXPLANATION

A lot of chemical reactions will release energy, which they then give off into their surroundings — for example, when something is burned. But there are also reactions like this one, which **require energy from their surroundings**. In the process, the surroundings are cooled. This kind of process is familiar from various **freezing mixtures**: If you mix ice with table salt, the ice turns into liquid, but it also becomes noticeably colder. Try it yourself!

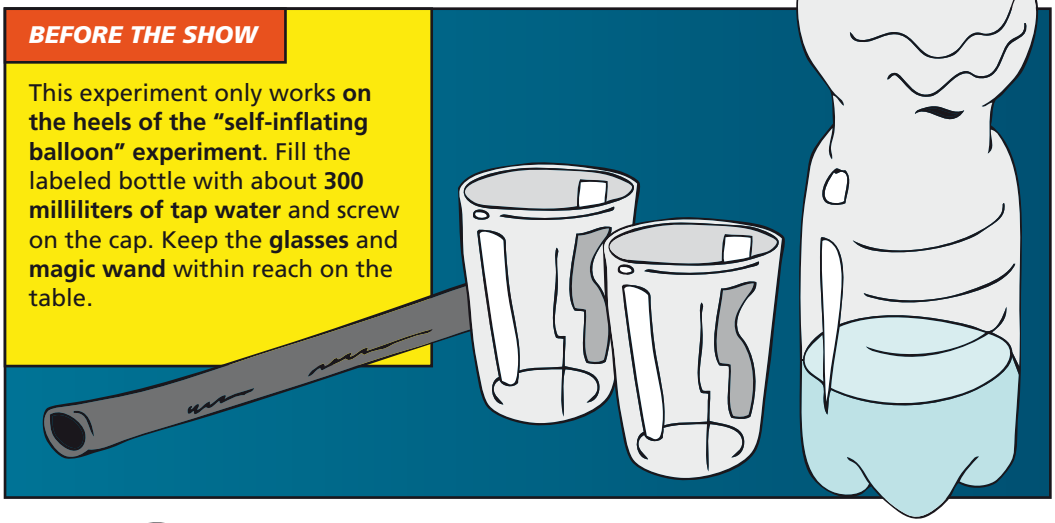
THE CRUMPLED SODA BOTTLE

A bottle filled with tap water and carbon dioxide is shaken. As the water turns to soda water, the bottle crumples.

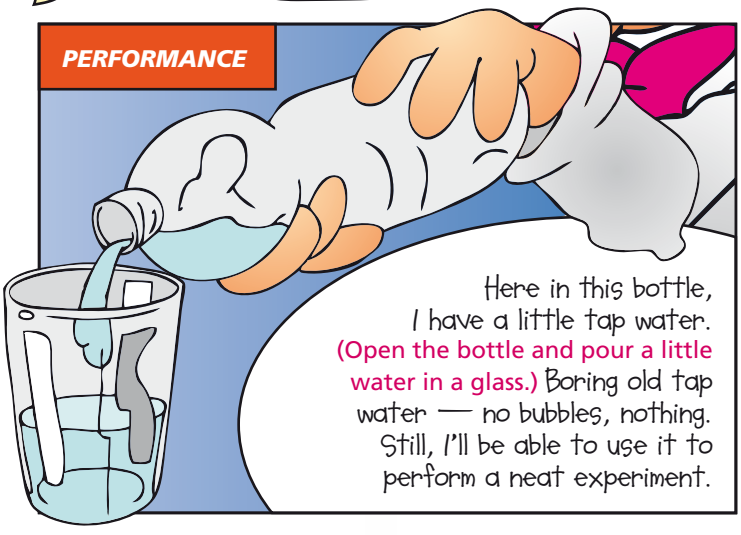
MATERIALS:
- magic wand
- balloon filled with carbon dioxide (from the balloon experiment)
- empty, thin-walled non-reusable plastic water bottle (1.5 liter), rinsed clean, without label (see-through)
- 2 glasses
- water

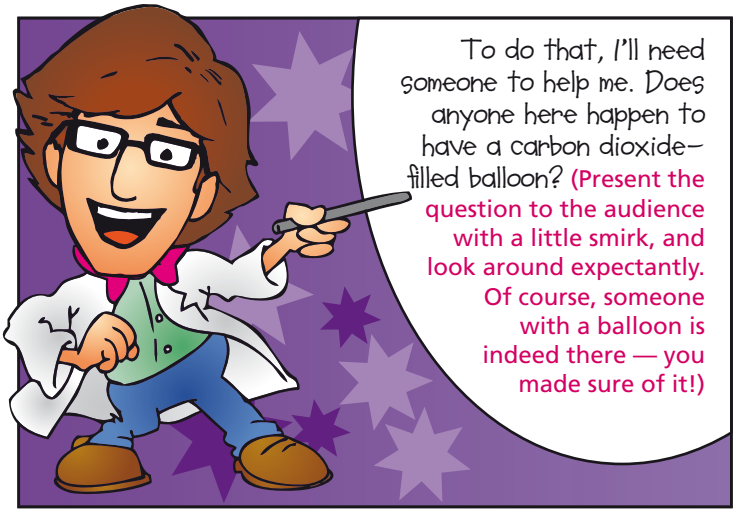
BEFORE THE SHOW

This experiment only works **on the heels of the "self-inflating balloon" experiment**. Fill the labeled bottle with about **300 milliliters of tap water** and screw on the cap. Keep the **glasses** and **magic wand** within reach on the table.

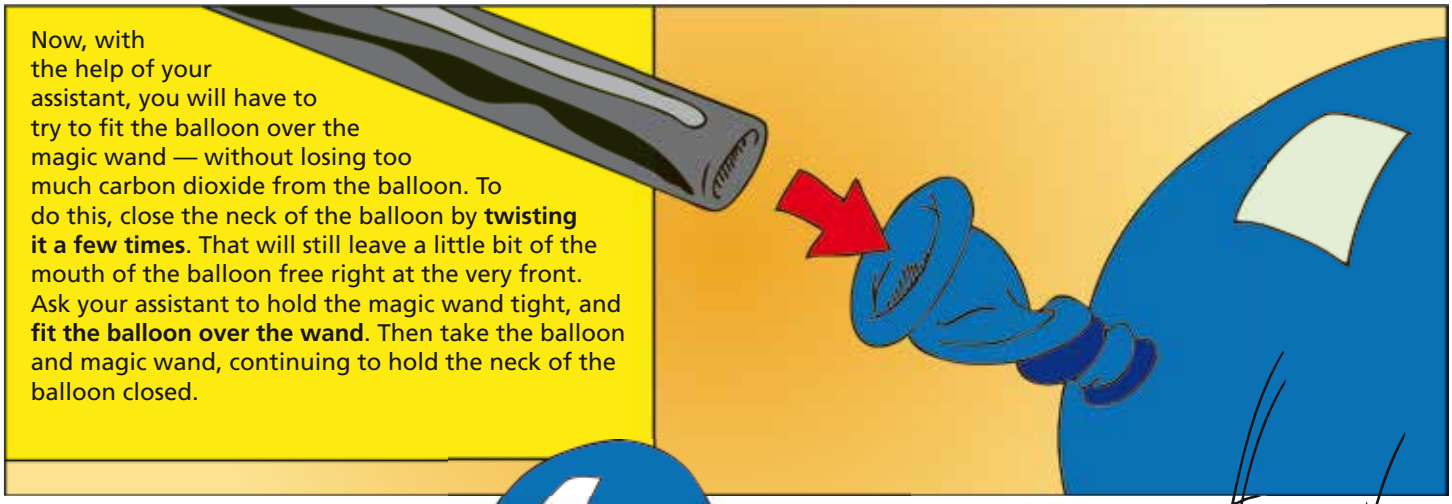


PERFORMANCE

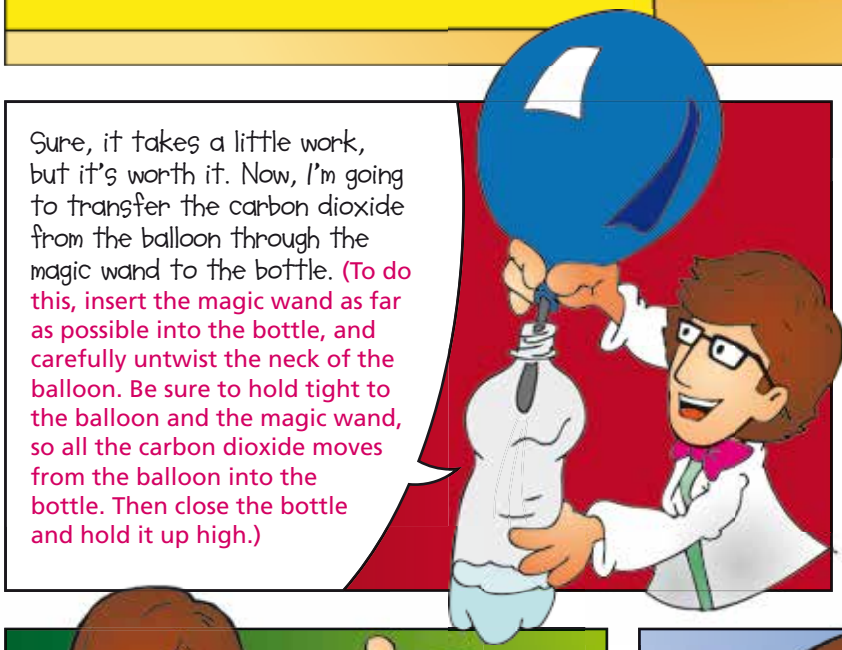




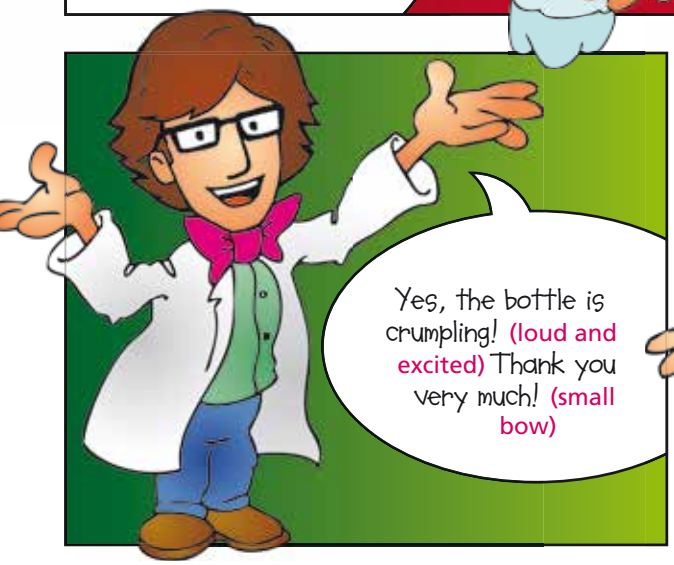
Now, with the help of your assistant, you will have to try to fit the balloon over the magic wand — without losing too much carbon dioxide from the balloon. To do this, close the neck of the balloon by **twisting it a few times**. That will still leave a little bit of the mouth of the balloon free right at the very front. Ask your assistant to hold the magic wand tight, and **fit the balloon over the wand**. Then take the balloon and magic wand, continuing to hold the neck of the balloon closed.



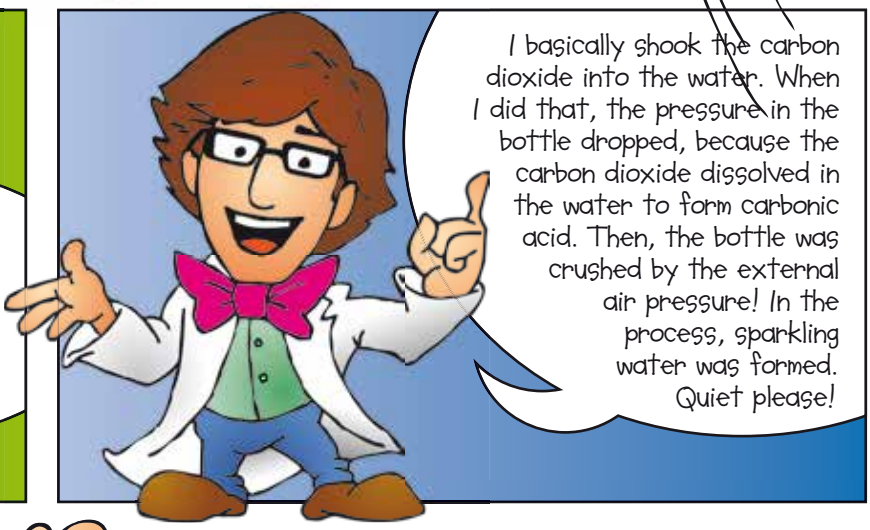
Sure, it takes a little work, but it's worth it. Now, I'm going to transfer the carbon dioxide from the balloon through the magic wand to the bottle. (To do this, insert the magic wand as far as possible into the bottle, and carefully untwist the neck of the balloon. Be sure to hold tight to the balloon and the magic wand, so all the carbon dioxide moves from the balloon into the bottle. Then close the bottle and hold it up high.)



So now we have a bottle filled one third of the way with water and two thirds with carbon dioxide. OK, here it comes. Pay attention! (Shake the bottle up and down a few times. The bottle will start to crumple!)



Yes, the bottle is crumpling! (loud and excited) Thank you very much! (small bow)



I basically shook the carbon dioxide into the water. When I did that, the pressure in the bottle dropped, because the carbon dioxide dissolved in the water to form carbonic acid. Then, the bottle was crushed by the external air pressure! In the process, sparkling water was formed. Quiet please!

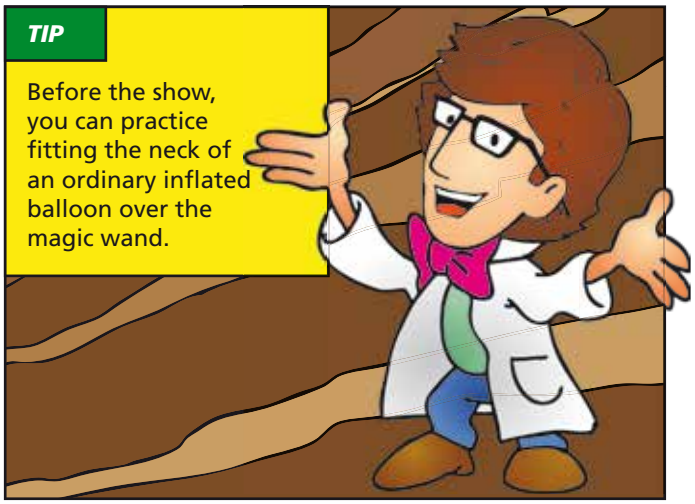
Open the bottle and pour a little of the water in the second glass. You can hear it fizzing!

Genuine sparkling water! Thank you for the applause!

CAUTION! This sparkling water is not to be drunk!

TIP

Before the show, you can practice fitting the neck of an ordinary inflated balloon over the magic wand.



THE LEVITATING SOAP BUBBLES

Soap bubbles levitate in a glass bowl.

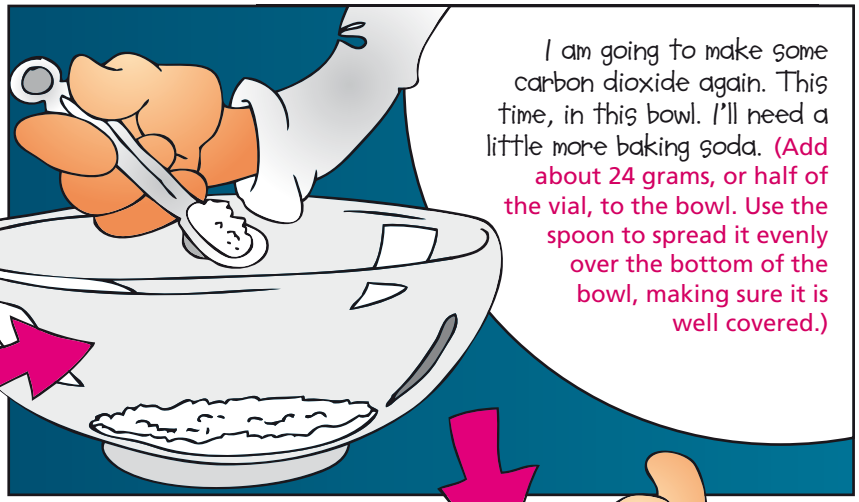
MATERIALS:
- measuring cup
- lid
- measuring spoon
- sodium bicarbonate
- soap bubble bottle
- large glass bowl
- household vinegar
- (fireplace) matches and box

BEFORE THE SHOW

Fill the **labeled measuring cup** halfway with **household vinegar** and put the **lid** on the cup. Place everything within reach on the table.

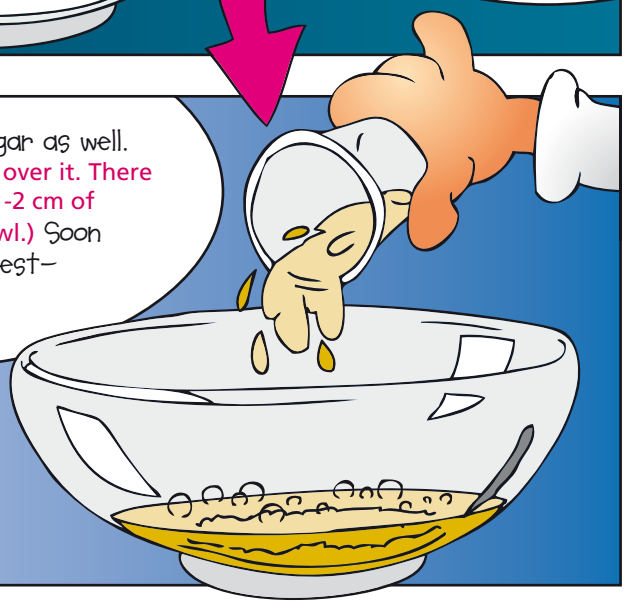
PERFORMANCE

The next experiment is very delicate. I would like to ask you to close all windows and doors, and to hold your breath for the next 15 minutes. (smirk) Just kidding. But it really is important to avoid any gusts of air.



I am going to make some carbon dioxide again. This time, in this bowl. I'll need a little more baking soda. (Add about 24 grams, or half of the vial, to the bowl. Use the spoon to spread it evenly over the bottom of the bowl, making sure it is well covered.)

And a little vinegar as well. (Pour the vinegar over it. There should be about 1-2 cm of vinegar in the bowl.) Soon we'll have the finest-quality CO_2.



CO_2 is an abbreviation for carbon dioxide. You can't see it, but you can sort of feel it: with a match. (Wait a moment and then light the match.) As is well known, carbon dioxide will put out any flame.

Slowly lower **the match into the bowl**. As soon as it dips into the bowl, it should go out.

Exactly, an invisible lake of CO_2!

But carbon dioxide has another interesting property as well. It is heavier than air! As I would now like to demonstrate.

ATTENTION!

Take the **soap bubble bottle** and **blow** soap bubbles toward the bowl from a good distance away. The soap bubbles that land softly on the lake of CO_2 will hover above it.

Look pleased! Levitating soap bubbles! Floating on the invisible lake of carbon dioxide! Thank you! (bow, applause)

NEAT!

BRAVO! GREAT!

A few more tips:

The **exact quantity of baking soda and vinegar** depends on the size of your **bowl**. You will just have to experiment a little beforehand.

It isn't all that easy to blow the bubbles just right. The **soap bubbles shouldn't be moving too fast** when they drop into the bowl. The easiest thing is to **blow horizontally** and adjust your distance from the bowl. It's something you'll just have to practice!

If you're not too sure of yourself, just try to get **one or two levitating soap bubbles**. It isn't easy to get a lot of bubbles to levitate. And the **lake of carbon dioxide** will also quickly **disappear**.

Wait until the **baking soda/vinegar mixture is no longer bubbling** so strongly. Otherwise, the soap bubbles will be popped by the splatters.

THE CANDLE QUIZ

A little quiz experiment for your audience: Which of two tealight candles, one taller than the other, will go out first when you place them under a glass?

MATERIALS:
- short tealight candle stand with tealight candle
- tall tealight candle stand with tealight candle
- 2 identical glasses (e.g., tall water glasses)
- stick lighter

BEFORE THE SHOW

First you will have to prepare the tealight candle stands (see page 9). Place one tealight on the short stand and one on the tall stand, and set the two glasses next to them.

PERFORMANCE

Ladies and gentlemen, it's time again for a little audience participation! I have a riddle for you: Here you see two candles. One is taller than the other. (Light the two candles.)

In a moment, I will be placing these glasses (Point to the glasses) over the burning candles. And what I would like to know from you is: Which one of them will go out first? (Address this question to the audience. Give them some time to think about it.)

Ok, let's take a vote: Who thinks the tall candle will go out first? Hands up. (Pause briefly.)

Who thinks that the short candle will go out first? (Point at the short candle as you say this.)

And who thinks that both will go out at the same time? (Pause briefly.)

Ok, let's find out.

Put the glasses over the candles and watch the flames. Now you may have to wait a little. When one flame starts to get weaker — which, by the way, will be the higher one — direct your attention to it.

ATTENTION!

Ahhh, you see: The flame is getting weaker here, aaaaand (Draw out the "and" until the flame goes out completely) it's now clear. The higher flame goes out first.

Let's have some applause for everyone who got it right!

APPLAUSE

BRAVISSIMO

Would you like to know why? (Don't wait for an answer — start explaining right away.) When the flame burns, it produces carbon dioxide, which can put out a flame. CO_2 is heavier than air, so it should sink to the ground. But because the CO_2 is hot in this case, it rises up and the higher flame goes out first.

Thank you very much! (Small bow, applause! Wait until the shorter candle goes out.)

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