Demo insights for teachers from science communicators

british science week

Get set... demonstrate

Running inspiring science demos

Contents

Demo Day and this resource

Demo Day is an annual campaign to inspire secondary school teachers and technicians to run science demonstrations in their schools.

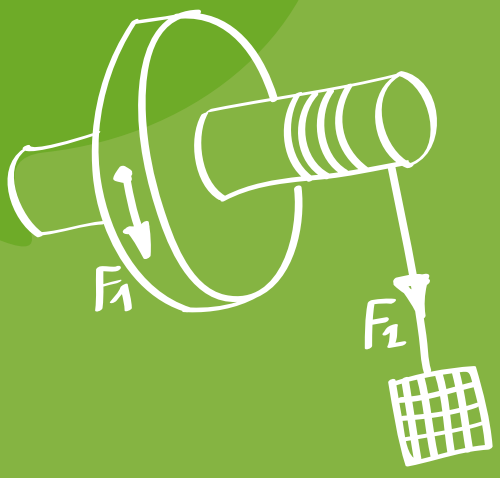
The day itself falls on the Thursday of British Science Week (formerly National Science & Engineering Week) in March, and is thus part of a national celebration of science, technology, engineering and maths.

There are a number of video and written guides for delivering specific demonstrations, and we encourage you to visit www.getsetdemo.org to see a list.

This resource is meant to complement these guides by providing additional inspiration and practical advice for running demonstrations on Demo Day and throughout the school year. You'll find tips, stories and thoughts from professional science communicators, including presenters, writers, lecturers, magicians and filmmakers (see page 22 for the full details of the contributors).

When trying out any of these ideas, make sure you research the health and safety guidance before carrying them out, consulting the employer's risk assessment and guidance including risk assessments produced by CLEAPSS (or in Scotland SSERC).

> "The novelty, spectacle and inherent drama of a classroom demonstration can provoke significant interest from students."
>
> **Paul McCrory** learn differently ltd

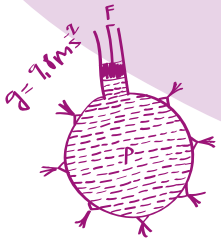


Preparation

Preparation is crucial to almost everything teachers and technicians do in the classroom, but it is particularly crucial for demonstrations.

> “There’s a myth that people are natural presenters. Some people do find it easier than others, but there’s no such thing as a natural presenter. All good presenters have thought carefully about what they want to achieve and prepare diligently to make it happen.”
>
> **James Soper** Science Shows for Schools

"Know your learning objectives. As with all practical work, be clear what it is you want your students to learn from the demonstration. Ask yourself, 'Why am I doing this demonstration?' and 'What do I want my students to learn?'" Alom Shaha



"You *always* run a demonstration for yourself before you run it for an audience. That seems so obvious it's barely worth saying, but we all get caught out. We assume that one type of film canister works just as well as another, or that adding a bit of food colouring won't change anything. Guess what? It always does. You practice not only to hone your presentation, but to explore the awkward corners of your demonstration. How might it trip you up? Familiarity leads to confidence." Jonathan Sanderson

"Research - find out more! You need to be scientifically rigorous with your explanation. Read around to find out all you can about the subject matter. Google the demo to see what others say as extra points of interest. The students can ask surprisingly searching questions and it's great to have extra links and asides up your sleeve.

"Also, don't clutter your demonstration space. It's ideal to have a clear central area as a focus for a short demo. Alternatively you can direct the audience attention around your work space, but avoid having any unnecessary equipment that you aren't going to use - it can be distracting or even disappointing for the audience."
Shaaron Leverment

"I reckon 90% of on-stage mistakes can be prevented (or minimised) before even walking out in front of an audience… There are three key areas that need practice and preparation:

"Knowledge: During a live demonstration you don't want any surprises or points where you have to figure something out. Do you understand the science behind the demo? And can you explain the science in a simple, jargon free and engaging manner?

"Props/Apparatus: Don't step out in front of an audience if you've never used the equipment before. See what the equipment does and does not do. Do all the buttons, valves, etc. work? Do you know how to switch on that piece of electrical equipment and what units it measures? Have a checklist of props/apparatus for each demo so that you can check them off before presenting. Does the apparatus still work? Are the batteries charged up? (If an item has a battery compartment with a screwed down cover I will often remove the screw so that it's much quicker to change last minute.) Have spare parts that are easily accessible: spare batteries, balloons, etc. Gaffer tape and a set of screwdrivers are also good to have around in case of last minute repairs.

"Handling: There is a difference between practice and rehearsal. Practice focuses on small elements, e.g., learning lines, opening a valve with one hand, connecting a gas hose, lighting the fire. When you rehearse you put all the elements together as you would when giving the final demonstration. You'll soon learn that you need three hands for certain parts of the demo or that a piece of apparatus is in the wrong place. Unexpected things will happen. It's much better to have these surprises in advance so that you can come up with strategies to prevent them rather than discovering them in front of an audience. Rehearsal will also aid the transitions between demonstrations and your memory of what's needed. It's also good to have an observer watching to give feedback after the rehearsal, as it's easy to miss things. For example, a common mistake is that props are not displayed so that the audience can see them."
Dr Matt Pritchard

“ a) Make sure the demo works. If you end up having to say ‘X should have happened here’, it defeats the point of doing the demo and can makes you look a bit stupid to your students. This means preparing the demo properly and practising it repeatedly to make sure that it is reliable.

b) Make sure the demo works well. There’s a world of difference (and a lot of effort) between a demo that sort-of works, and one that works really nicely. Find the time to practise and rehearse the demo properly so that you are confident in managing all of the things which you need to do automatically and can therefore focus on interacting with the pupils when presenting the demo.” Alom Shaha

“Practise, practise and practise! Polished demonstrations don't happen overnight; when you see a magician or a successful science presenter doing an act, everything they do has been thoroughly rehearsed, including the positioning of props.

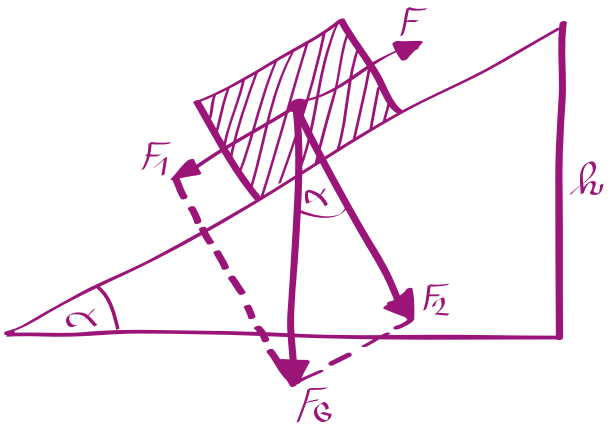
“When you set up a demonstration, practise where you are going to keep your various demo items, tools and props, including your personal protective equipment. There is nothing worse than having a big build up to a demonstration and then not being able to find your gas lighter or safety glasses! Investing a bit of time to organise your tools and props will pay dividends in the long run.” Matthew Tosh

“If you can persuade a colleague to join you they can be very useful in checking out how the demo set-up looks from different parts of the classroom so you can ensure you, the equipment and your students are in the best position to capture everything.

“It's also a good idea to think about what you're going to say before, during and after the demo and try it out once or twice. You may find that the demonstration speaks for itself with only a short introduction and class discussion afterwards. In other cases you may need to explain to the students what you are doing as the demo progresses. Check that you can do this without distracting from the demonstration, or with the demonstration distracting from your explanation!” SMS (Rosie Coates)

“Everybody can learn; it’s a craft, not an art. Presenting or teaching: anyone can learn to do it and we can all learn to do it better.” James Soper

“The point of demonstrations is to attract and direct attention — if a demonstration is dull you’re probably better off not doing it. As part of your preparation, think through what it is about the demonstration that’s appealing, interesting, or surprising. Work out how your presentation helps reveal that for your audience. That may be as simple as how you arrange the apparatus, where your hands are as you manipulate it, and which bits of vocabulary you introduce when.” Jonathan Sanderson

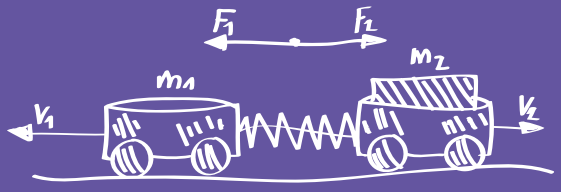


Presenting with presence

Teachers and technicians are experienced in speaking to their classes, but everyone can improve how they convey confidence during presenting.

> What is 'presence?
>
> - Connecting with the hearts and minds of others to engage and inspire them - a two-way process
> - Seeing and being seen
> - Being 'in the moment' and flexible enough to respond and adapt to our audiences, their needs and what is happening.

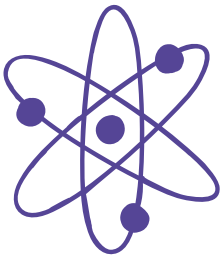
David Hall David Hall Workshops and Shows



"One of the major factors is the confidence that comes from knowledge and preparation. If you know your subject, know the apparatus, have backups and have rehearsed, you have eliminated a major source of worry. Your mind as well as your body can be present during the demos.

"There is a strong link between your physical body and your thoughts and emotions – they influence each other. This can either be a constructive or destructive cycle. Taking a confident body posture will result in more confident thoughts and emotions, which will result in more confident body language."
Dr Matt Pritchard

"It's not what you say, it's how you say it! You can be talking about an amazingly interesting piece of science, but if the students don't believe you're excited by it, they won't be either. Suck your audience in through how you use your voice, gestures and facial expressions, and they'll have no choice but to be caught up in your enthusiasm - and share it." SMS (Zoë Randell)

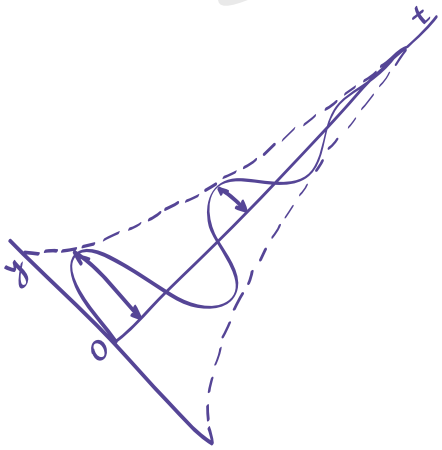


"Some performers enjoy a bit of showmanship and grandstanding: they like to build the suspense and ensure they have their audience's attention. Others believe the performer should take a back seat to the phenomenon, that too much showbiz replaces science with needless pizazz. Everybody's right. Don't be afraid to let the demonstration speak for itself, and don't feel you have to push yourself as a performer to make it work. If you're straining to play a part that doesn't come naturally, you're probably drawing attention away from the demonstration anyway."
Jonathan Sanderson

"Give the audience time for the journey. Pauses give us and our audience time to think - to really 'take things in' and savour the moments that, though they might be 'old hat' to us, may well be new to them. It gives time for their emotions to develop - particularly if you hold your own 'emotional intention' in mind (whilst looking at your audience until you can see that it's landed..!)." David Hall

"Once you have confidence in your demonstration(s), then you can think about your patter. You'll have your own style and there are no set rules; what works for one person may not work for another. You are an individual. Some people are naturally funny; others are quiet and very good at stimulating curiosity. Are you a loud 'Wow look at that!' person, or a quiet 'Let's see what happens if...' person?...I may look like my acts are a bit chaotic, but everything has been rehearsed to the nth degree, including the apparent chaos. At the end of the day, for it to remain safe, I need to be in control of the demonstrations at all times." Matthew Tosh

"We, as leaders, set the energy of the room. Our confidence in ourselves and all our emotions will carry to our audiences. When we're comfortable, our audiences are comfortable. When we enjoy it, they enjoy it. Our ease will set them at ease, and they will thank us for any risks we take to make it somewhat 'out of the ordinary' - be adventurous." David Hall

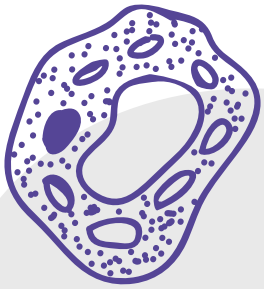


"How can we bring 'presence' and a full range of emotions to our work? As a performer and teacher I believe that we can prepare and rehearse to have presence, to be responsive and to connect. There are many ways, and we each bring our own passions and styles.

"I believe we need to connect with ourselves, our material, our response to (feelings) about our material, how we would like our audiences to feel and how we would like to achieve this connection with their hearts and minds. We should therefore be concerned not just with the 'what', but also with the 'how' of our presentations. If we can foster a quiet, open confidence in ourselves - a 'high presence' one might call it - then we can set out both to achieve our goals and be flexible enough to respond to our audience's changeable needs at the same time. We need to be 'in the moment'.

"So how can we achieve this? As a true scientist – by experimenting! Try out some different approaches - different vocal varieties, different intentions, etc. - have a bit of fun, play, try out some less obvious options and rehearse.

"Perhaps think of your demo as a story or a play (it's no accident it's called a "play"..!). Look for opportunities for contrast and variety - in pace, vocal delivery, intentions, emotions, use of the 'stage', use of props (speed, distance, scale, etc.). Consider your options and craft an 'emotional journey' for your demos and presentations - what do you want your audience to feel about them as well as think about them?" David Hall



"Ground yourself, stand tall and ooze confidence! When your audience is confident in you (and they want to be), they can enjoy the demonstration more. Preparation and a plan to just have fun will help your confidence.

"Let your own personality shine through - whether you are sarcastic, overly-enthusiastic, dry-witted – BE NATURAL. You and your personality are the strongest assets to your presentation.

"Finally, smile. Lots. Especially if it goes wrong." Shaaron Leverment

"**Some signals of confidence:**
Note: this is not a 'right' and 'wrong' way list. It's a set of choices: we can use any of them at any time, depending on what our audiences need and what we would like to achieve. Which of these come most and least easily to you?" David Hall

Signal	High	Low
Eye contact	Steady	Unsteady
Language	Complete sentences Few qualifiers	Sentence fragments Many qualifiers ("like", "sort of")
Breathing	Full, deep breaths	Out of breath
Head movement	Very Little	A lot
Face touching	No	Yes
Feet	Planted beneath hips	Uneven, toes turned in
Body	Own the space Deliberate gestures	Stiff moves Wandering feet
Voice	Warm, confident Downward inflection	Stressed Upwards inflection
Silence	Uses silence	Avoids/ fills silence ("er", "um")

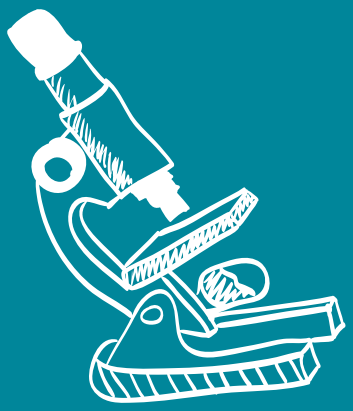
This table presents indicators when doing a demonstration that may reflect a high or low level of confidence

Engaging your audience

How can teachers and technicians grab their students' attention and maintain it during a demonstration?

> "Demonstrations provide an opportunity to engage students in a different way to other types of lesson activity; in particular, they can provide an opportunity to insert some drama and entertainment into your lessons."

Alom Shaha science teacher, writer, film-maker



"Let's find out" is a much more powerful concept than "Let me show you."
Jonathan Sanderson
science filmmaker

"Set up your demo for maximum engagement. Think about the positioning: will it be in place when the students enter the classroom? This can help the students to engage straight away, but may not be so helpful if you need to explain any background before you start the demo. Mystery is a brilliant tool for engagement; try to avoid all but the absolutely essential explanation BEFORE the demo. Ask the students for predictions instead, and discuss whether they were right after the demo." SMS (Rosie Coates)

"*Exploit curiosity*: Demonstrations are perfectly suited to exploiting curiosity, the powerful engine driving most of our learning. When a demo creates, or makes students aware of, a small gap in their knowledge of the world, they will be compelled to try to fill that gap.

"Be patient and tease your students with clues. Curiosity does inevitably require time to nurture, so it is up to your professional judgment to balance this need against other learning outcomes. It is also vital to monitor your students carefully, so that curiosity does not tip over into frustration.

"However, to help students appreciate what they are observing it is essential to be explicitly clear where you want your students' attention when watching demonstrations and to help them identify what changes might be significant. For demonstrations with a surprising reveal, this cueing is often better done when you repeat the effect." Paul McCrory

"Earn the audience's respect early on. If after the first few minutes of a presentation nothing of interest has happened, then most of the audience will switch off for the rest of the show." Dr Matt Pritchard

"When you have an effect that runs for many seconds, such as a vortex in a water bottle, you can just stop and look at it. If you look at an object intently, your audience will take an interest in it too."
SMS (Simon Jones)

"Stories and humour are an amazing way to engage an audience."
Matt Pritchard
Science Magic Shows

"Think about what makes a good story. Plan a start, middle and end to the demo. Add some back story, anecdotes and set the scene to help with creating a special atmosphere for your demo – a bit of magic and mystery! Allow time to include the children if you can. Add any relevant links to things the students like and understand.

"Enjoy! Presentation is 100% better when you are having a good time. So have fun with your audience."
Shaaron Leverment

"Consider dramatising the mundane. One of my great physics teachers at A-level, the wonderfully eccentric Colonel Downing - tall, tiny waist, trimmed moustache - on taking one end of a slinky spring to demonstrate longitudinal and transverse waves, used to bend his knees and 'brace himself' as a fencer might, as if what he was about to demonstrate were a tough military assignment requiring accuracy, courage, determination, strength and plenty of traditional British military precision and pluck! And all for a slinky spring…Great fun, not at all required, but I'll never forget it!" David Hall

"Share your passion: Students, like theatre audiences, enjoy shared emotional experiences. Demonstrations can emotionally engage your students and reveal your passion for your subject. Your students will feel what you feel, or at least what feelings you model – curiosity; anticipation; uncertainty; confusion; surprise; intellectual joy of understanding; wonder; sense of imagination; amusement; sense of beauty; fear; or amazement.

"By exposing your genuine enthusiasm for science through demonstrations, you are undeniably making yourself vulnerable to mockery. It is precisely the risk and truthfulness inherent in this self-disclosure, however, which makes your performance so watchable to your students. This strategy can also help to develop better relationships with your students.

"Predictions: Encouraging students to publicly predict the outcome greatly increases the suspense and emotional jeopardy of any demonstration – not only are they curious about what will happen; they now intensely care if their own public prediction will be correct."
Paul McCrory

Special Educational Needs (SEN)

Running demonstrations for students with SEN presents its own challenges. Here are some top tips from Dr. Sarah Bearchell of Sarah's Adventures in Science.

> "Science is such a multi-sensory subject, every child can engage with it."
>
> **Sarah Bearchell** Sarah's Adventures in Science

Try to do the demonstrations in their usual class groupings as SEN students tend to be more comfortable in their own environment. They know they like the blue chair and not the red chair, and will be more likely to sit quietly and listen.

Have clues to the scientific nature of your demo. Use a table to display equipment and have pictures. A white coat may scare some children, but if not it might be a good idea to wear one to show that you'll be "doing science".

Try to incorporate hands-on activities with the demo that are multi-sensory and simple. Some SEN children have reduced dexterity but all will learn much more if they do accompanying activities themselves.

Loud noises, flashing lights, tastes and smells can be a problem for some children. Take this into account when planning your demo.

Add countdowns, shape identification and new scientific language to make sessions cross-curricular.

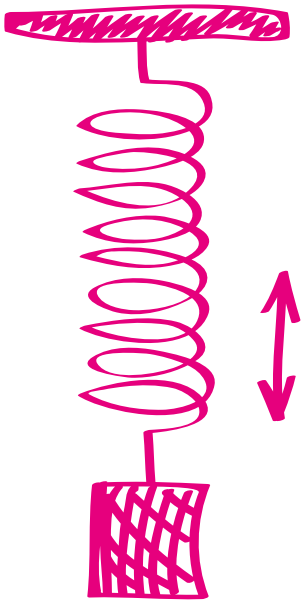
Ask the children to describe what they see.

Arrange the chairs so the children know where to focus their attention and have space if they need to leave. For example, set the chairs in a horseshoe with lots of space around it.

SEN students can have shorter attention spans. There needs to be something that instantly grabs their attention at the start of the session. Try 10-minute sessions for younger children and 20 to 25 minutes for older children.

Repeat technical language and get them to repeat it back to you if they can. Research specific signs in advance.

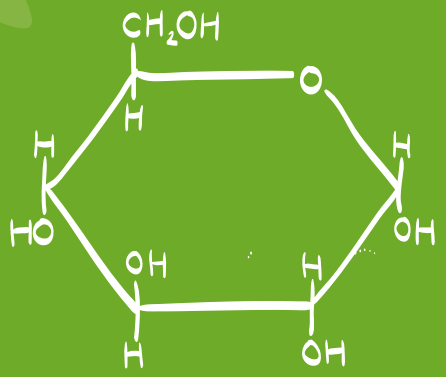
Repeat the demo, for example do it in the morning and repeat it in the afternoon or the following day. The second time they know what to expect and will build on their knowledge.



Behaviour management

Teachers and technicians are often masters of behaviour management in the classroom, but managing behaviour during a demonstration can be tricky. Our science communicators have a few tips they've picked up, many of which can be used at any time in the classroom.

> "During a demonstration you can step out of your usual "teacher/lecturer" boundaries a little. Create a feeling of being "in this together" and involve the students in the demo as much as possible."
>
> **Shaaron Leverment**
> Explorer Dome Hands On Science Outreach



"What will happen if your opening is too loud or too exciting? How you start will set the tone for the whole lesson." Mike Dennis

"A quiet child isn't necessarily listening, but for a child to hear it to be quiet." James Soper

"Careful transition makes a huge difference to behaviour management. Think in advance how to make transitions as smooth as possible." Mike Dennis

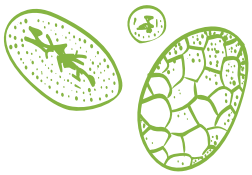
"**It comes down to two words: 'clear' and 'consistent'.** If you can be clear about your expectations and you can be consistent in reinforcing them, you will be okay. If you're not clear, if you're not consistent, that's when trouble starts.

"If a behaviour is becoming more frequent or intense, it is being reinforced. It is easy to blame external forces and events when things go wrong, but the first place to look is toward yourself. By not being clear and consistent, we often unwittingly reinforce the behaviours we would rather not see. It's really, really difficult in the heat of battle to work out what is actually happening, but often it is us who are causing the problem." James Soper

"Consider having the children sit on the floor. The sightlines are much better; they're not trying to see through someone on the same level and instead are looking up and can see much better what's going on. Chairs are also really annoying; the fiddle factor with a chair that creeks a bit or one that you can move is huge. I think children concentrate less well sat on chairs than they do sat on the floor. I used to not struggle to do hour-long shows with 60-70 children sitting on the floor.

"Also, if you're going to include discussion, assign the kids 'talk partners' and then ask the class a good, open question. It will break things up a bit, and can minimise how destructive the break is." Mike Dennis

"It's essential to maintain good behaviour when you're doing a demo; however, [illegible] line between ex[illegible] chatting about the demo and disruptive behaviour. Try to engage the students with the demo and not be too authoritarian - the students will be more inclined to engage if they are being encouraged rather than reprimanded, and their learning will be enhanced if they can comment on and discuss the demo with a friend." SMS (Zoë Randell)



"If a student is playing with an object rather than concentrating, I'll always try to take it from them to incorporate it into what I was saying - exactly as if I'd asked them to have it available at that point in the show!" David Hall

"If you've got a clear idea of what you need to do your demo, if you've then clearly communicated to your audience how you're going to do these things, and you consistently praise people when they do it right, your demos will get better and better." James Soper

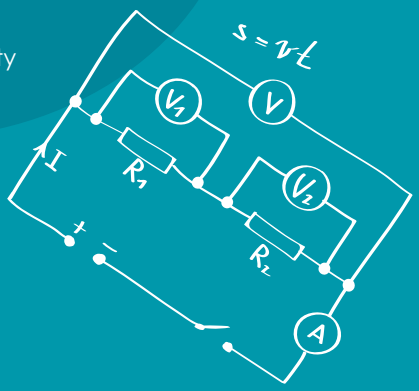
"If the audience are engaged in what you're presenting, the job of behaviour management is much easier, but don't hype an audience up if you don't know how to diffuse the excitement." Dr Matt Pritchard

Being adaptable and flexible

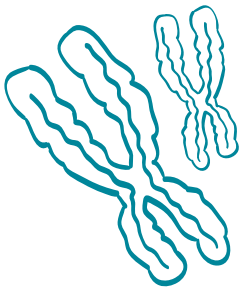
The fear of making mistakes or having things not work can prevent teachers and technicians from trying demonstrations. Here's how science communicators get on.

"A bad show isn't necessarily your fault. There might be a million reasons why it hasn't gone well. Don't try to use an excuse too often, but occasionally you need to let yourself off."

Mike Dennis Oxford Brookes University



"Certain demos are unreliable, but in my experience that is fine as long as the audience is told this is the case. This can make it all the more surprising when it does work."
SMS (Simon Jones)



"Learn from each 'performance' and incorporate the 'happy accidents' and interactions which spontaneously occurred into your plan for when you do the demo next time - write them down or you *will* forget these gems." Alom Shaha

"Breathing, smiling and pausing are all great ways to recover our 'balance' mid-demo, to mentally and emotionally regroup. It's also helpful to physically relax by shaking out tension or lifting into a more relaxed and open 'power pose' - and 'checking-in' with how it's going for your audience." David Hall

"If you know your subject and how to use the apparatus then it should be easy to make adaptations. Having backups and contingencies allows further flexibility. When I'm presenting a show, I've always got additional materials that can be used if necessary." Dr Matt Pritchard

"Sometimes, even with the best preparation, demonstrations do not work as planned. There are a number of ways you can deal with this, including having a second go (if time and resources allow) or showing a video of the phenomenon. A 'failed' demonstration may provide you with an opportunity to discuss with your students why the demonstration didn't work."
Alom Shaha

"If you get a question that's a bit awkward that you can't answer write it down on a post-it. The important thing is to value the question; if you gloss over it and move on you're not valuing the question. Put it on a post-it and deal with it later. This gives you the perfect opportunity to value it but quickly move on with the demo."
Mike Dennis

"A reliable experiment can stop working for no obvious reason, and you can count on it being that one time out of ten it fails when you are in front of an audience. Don't worry if it doesn't go to plan; sometimes the best demonstrations happen when you make something up on the spot. Or try out a student's suggestion of what to do next rather than the textbook method. By being adaptable you can explore new ideas with the students, and will be able to improvise if the unexpected does happen." SMS (Zoë Randell)

"We need to find a way of letting go of any 'mistakes' or 'errors' that might occur along the way. The unexpected will probably happen, so accepting and discarding (or 'letting go' of) it will help both us and our audiences to refocus and carry on. In my workshops I encourage folks to develop a 'How fascinating…' approach if they can: 'How fascinating that that just happened - we can't do anything about it right now, but we can get fascinated about it afterwards to find a way of avoiding it in the future!'.

"I also like this phrase as it encourages us to breathe - very helpful - and combining it with a jazzy up-and-down hand movement makes it a rather fun celebration and release of anything that might have gone wrong.

"We all strive for perfection - at least many of us do - particularly if we've put a lot of work in. We'll want our work to be as good as it can be, but accidents do happen and we should remember that only we know what we were setting out to achieve!" David Hall

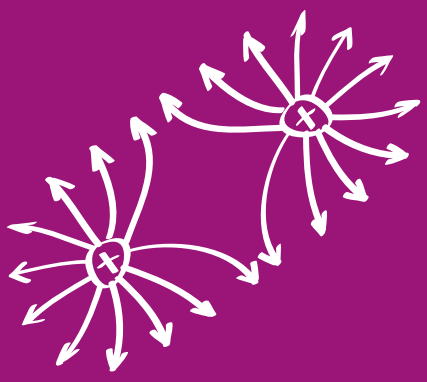
Favourite demonstrations, examples and stories

Here are some brief descriptions of our science communicators' favourite demonstrations. See anything new that you can try?

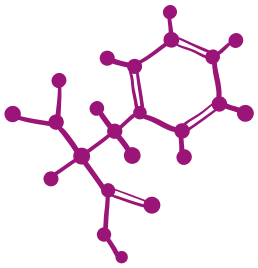
Remember, these are just ideas, so make sure you research fully the details for any demo before trying it out, including appropriate health and safety precautions.

"In my Newton show I love the beauty of the rainbow as it's suddenly revealed, as a complete surprise, from a prism placed in front of a single slit of white light. If I'm lucky, I'll get a second refraction off to one side, which the children spot themselves and I can pretend not to have seen."

David Hall David Hall Workshops and Shows



"Years ago at the Royal Institution a weighted 'cheese wire' with masses on either end was laid across a huge block of ice at the beginning of a lecture. During the lecture pressure, forces, the structure of water, the effect of pressure on water's melting point (c.f. ice skating) and disappearing airbases on the polar ice-caps in the war were all discussed. Then, precisely as the lecture ended, there was a huge crash as the wire completed its journey, falling through the still intact block of ice..!" David Hall



"I started science made simple with a show about music and science, and I continue to be endlessly fascinated by the physics (and biology and chemistry and engineering) of music. My choice is a simple demonstration that often catches people out! Take a wine glass and fill it with water. Dip your finger in the water and run it gently around the rim of the glass. As your finger sticks and slips, the glass (and the water) vibrates, creating a sound. Now remove some of the water from the glass. What do you think will happen? Will the sound change? If it does, how will it change? Once you've practised you might even be able to play this simple instrument as well as this musician!" SMS (Wendy Sadler)

"For this one you're going to need to raid the kitchen, well, the oven anyway. Take the metal grill from an oven and two pieces of string. Tie one piece of string to each of two of the corners. Wrap the end of one piece of string around your right index finger and the other round your left index finger. Put your fingers in your ears. Gently bang the oven grill against something. What can you hear? What can the people around your hear? Will your friends ever look at you in the same way again?! I like this demo because almost everyone has an oven grill, they all sound different, the sound is so unexpected, and you have to look silly to hear it but no one minds!" SMS (Ruth Perkins)

"The first experiment I remember doing myself was the 'Film pot rocket'. An old plastic film canister with a tight pop off lid was filled with vinegar and bicarbonate of soda (or water, citric acid and bicarbonate of soda). The build up of pressure from the produced carbon dioxide gas would after about 20 seconds blow the lid off. If the canister was placed upside down, a rocket that launches to a height of around 10 metres could be created. I now present this demo using half an effervescent vitamin C tablet and water - much simpler to present. Vitamin C tablets are both cheaper and safer (from kids eating them) than using the more popular Alka-Seltzer tablet." Dr Matt Pritchard

"Lots of demos rely on something unexpected happening and there's certainly always an element of the unexpected in this demo. Take a basketball and a tennis ball (or a ping pong ball) and bounce each one individually. Then hold them both in the air with the smaller ball on top of the larger one. Let them both drop together. What do you think will happen? This demo has an unexpected element for the presenter: you never quite know where the balls will end up! It's always a surprise to see how much the smaller ball bounces. That extra bounce comes from the transfer of the bigger ball's momentum to the smaller (lighter) ball. I love the way the surprisingly big bounce you get from the tennis ball demands an explanation – the audience just has to know what's going on." SMS (Rosie Coates)

Health and Safety reminder
These are just suggestions, so do check the appropriate guidance including risk assessments produced by CLEAPSS (or in Scotland SSERC) when carrying them out.

"I love presenting science demos that appear like magic. I then go onto challenge the audience to tell me how it's done and in doing so they are using the scientific method. A good example of a trick to use with this is what I call the "anti-gravity tin".

"This will take five minutes to make with simple to find materials. You need the following: a sweet or biscuit tin (mine has a 23cm diameter and a depth of 7cm), a rubber sheet, 20 coins or washers and tape.

"Put the coins/washers into a stack and run some tape around the diameter to make a counter weight. Tape this stack of coins onto the inside edge of the sweet tin (you may want to line the weight up with the seam of the tin to help identify its position when looking on the outside.) Now add the rubber sheet to the outside perimeter of the tin and tape it down. The rubber sheet provides grip for the tin when on the ramp.

"Place the "anti-gravity tin" on a ramp with the counter weight on the uphill side. You will need to experiment to find the best incline. Let go of the tin and it should roll up hill giving the illusion of defying gravity. That is until the counter weight rolls around until it reaches the bottom of the tin.

"The added weight changes the centre of mass (COM) of the tin, which would normally be at the centre of the cylindrical tin. The COM is now situated close to the extra weight on the edge of the tin. Gravity acts on the COM and pulls it downwards. In order for the COM to move downwards, the tin has to roll up hill. Physics and not magic."

www.sciencemagician.wordpress.com/2012/10/02/anti-gravity-tin-a-simple-science-demo
Dr Matt Pritchard

"Our current favourite demo is the hot ice stalagmite. Here's a link to the standard recommended prep from the Royal Society of Chemistry (RSC): **www.rsc.org/eic/2013/10/exchem0413-hot-ice-stalactite-sodium-acetate-solution**

"Here's how we do it differently:

- Having made up solutions of sodium acetate trihydrate - and wanting to use large enough quantities to produce a more impressive stalagmite than described in the RSC notes – we soon realised it is famously tricky to prevent the solution from crystallising before being poured out. So we have found using heat packs is far more stable and predictable. Cut them open and pour into a jar or suitable glass container with a lid.
- You can re-use the same solution quite a few times, but will need to gather the solid and reheat – rather than messing around with boiling up the mixture, the microwave works well (if your container is microwave safe).
- After microwaving the solutions, they will require an hour or so to cool down. If the super saturated solution is still warm on pouring, it's unlikely to crystallise.
- Preparing three jars for the single demo is good insurance – with the thought that it's likely that two out of three may crystallise early.
- We use a dish on top of a light table as a platform for the demonstrations. Lower the lighting in the room so the demo is lit from beneath.
- Don't forget a few 'seed' crystals on the plate.
- If the solution does crystallise early, enjoy looking at the beautiful growing crystals within the glass container.
- For secondary students, there will be teenagers who giggle at the shape of the stalagmite! It's pretty hard not to, but that can be a presenting challenge. We always pre-empt with an appropriate quick comment and wry smile, so we can acknowledge and hopefully move on!" Shaaron Leverment

Contributors

Dr Sarah Bearchell of Sarah's Adventures in Science studied biology at the Universities of Oxford, Aberdeen and Reading. She aims to turn children's natural curiosity into a lifelong love of science. Her work with Special Educational Needs children earned her The Joshua Phillips Award for Innovation in Science Engagement 2014.
www.sites.google.com/site/sarahsadventuresinscience

Mike Dennis is a Senior Lecturer in Primary Science at Oxford Brookes University, training primary teachers on BA and PGCE courses. After several years as a classroom teacher he worked for 16 years at The Oxford Trust, later known as Science Oxford, developing and performing interactive science and technology shows and workshops for schools.

The majority of the content in this resource was compiled from members of the BIG STEM Communicators Network, an organisation comprised of people involved in interactive science communication activities and hands-on education projects in the UK.

For more information about BIG, please visit www.big.uk.com.

David Hall is a former science teacher, professional actor and executive coach. He performs interactive one-man shows (in association with Johnny Ball Productions) as Sir Isaac Newton, IK Brunel or Michael Faraday and 'Mathmagics!', his interactive maths show, across the UK and beyond. He runs Shakespeare and drama workshops, 'Communicating with Impact' sessions for science communicators and teachers of all subjects and levels, and courses on 'Personal and Leadership Presence' for executives across the globe.
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Shaaron Leverment graduated from Bristol University with a 1st class science degree and is currently studying for a PhD in neuroscience. She has over 16 years' experience in science communication and hands-on science education, and is the founder/company director of Explorer Dome Hands On Science Outreach. She has written and presented shows for a wide range of audiences on behalf of universities, companies and educational organisations both in the UK and abroad.

Paul McCrory is the Director of learn differently. He is passionate about encouraging science educators to make more effective use of demonstrations in their work. He has a BSc in physics and mathematics, an MSc in science communication, a PGCE in secondary education and a PhD in science education, and now has over 15-years' experience working in informal education. We recommend reading his article "In defence of the classroom science demonstration" (*School Science Review*, September 2013, 95 (350*)*:
www.learn-differently.com/informal-educators/resources/in-defence-of-the-classroom-science-demonstration).

Dr Matt Pritchard of Science Magic Shows is an independent science communicator and magician who creates inspirational presentations for schools, festivals and business. Previously Matt conducted atomic physics research at Durham University before joining the Education department at Thinktank Science Museum, Birmingham.
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Jonathan Sanderson earned a degree in physics and then fell into television more-or-less by accident. Since 2005 he's worked with NESTA to develop the school's film competition SciCast, helped the Royal Institution launch RiChannel.org, and delivered training for FameLab, Abu Dhabi Science Festival and a host of universities. In 2014 he joined a team at Northumbria University to deliver Think Physics, a three-year project funded by HEFCE. His teacher training film DEMO can be found at www.demothemovie.com.

Science made simple is a social enterprise with a passion for science and all things associated with it. They aim to share their enthusiasm by offering a selection of inspirational and educational experiences that are tailor-made for schools, festivals, adult audiences and the public. Their mission is to inspire the next generation of scientists and engineers, to engage the wider public with STEM as part of popular culture and to strengthen connection between researchers and the public. Contributors from Science made simple include Rosie Coates, Simon Jones, Ruth Perkins, Zoë Randell and Wendy Sadler.
www.sciencemadesimple.co.uk

Alom Shaha is a science teacher, writer and film-maker. He is author of *The Young Atheist's Handbook*, producer and director of the Royal Institution's "ExpeRimental" films and blogs about science demos at sciencedemo.org. We recommend reading his blog post "The Use of Science Demonstrations in Science Teaching" (9 April 2012: www.alomshaha.com/2012/04/the-use-of-demonstrations-in-science-teaching.html).

James Soper is a teacher, live science presenter and an ex-professional circus performer. For 15 years he has visited schools and festivals to present science shows written to complement and enhance existing science teaching. James also provides CPD about science teaching and behaviour management.
www.ScienceShowsForSchools.com

Matthew Tosh has a background in teaching and presenting, both on television and live on stage. A former head of physics, he regularly lectures and coaches on teaching, presentation and demonstration skills at a number of HE institutions and teacher CPD sessions around the country. More recently, his professional pyrotechnics work has become part of his science presenting work, as he demonstrates dramatic special effects and pyrotechnics on stage.
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