Outreach Toolkit

IOP Institute of Physics

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Beer physics

Summary

Groups of event attendees are challenged to pour the smoothest beer. Cameras, presentation equipment and social media can be employed to encourage further participation and interest from other event attendees.

Depending on the resources and number of volunteers you have, there's a choice of demonstrations that can then be performed in order to explain the science:

1 Why it's easier to carry beer than water

2 Why does liquid glug when you pour it?

3 Where do the bubbles come from?

The explanations for each of the demonstrations are deliberately simple so as to be accessible to participants with no physics knowledge. They can easily be adapted, adding further detail and physics vocabulary according to your audience and your volunteers.

Target audience

- Adults with low science capital

Example events

- Breweries
- Craft-ale festivals
- Food and drink festivals
- Comedy gigs
- Pub quizzes
- Music festivals

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

The challenge

What you'll need

- Fizzy drink
- Pint glasses
- Variety of cans/bottles (with differing mouth sizes if possible) from which to pour the fizzy drink (or create your own by piercing the side to create a second hole)

Task

Challenge groups of adults to a competition to pour the smoothest pint.

Ask them to think about which container they select, the speed at which they pour and the angle at which they hold the glass.

If you have the facilities to do so, get the group to dress up with the fancy-dress items and take a photo of them with their winning pint and sign.

- You can then upload them to your laptop and display them on a screen for the participants to view and attract further people
- Ask the participants if they'd like to be tagged in the tweet/Facebook post (and hopefully increase the number of followers you have!)

Why it's easier to carry beer than water

Start by asking your participants this question... and expect to get some silly answers. Then you can show them the link below on a laptop if you have it, or just do the demonstration/explanation.

youtube.com/watch?v=yPJKfAGzTbk

What you'll need

- Poured pints of liquid of differing head height (foam depth)
- Tray

Demonstration

Use the pints the participants have just poured by lining them up in order of head height on a tray and gently move from side-to-side as in the video.

Explanation

- When you walk with a glass of liquid, this starts waves sloshing around inside the glass
- The bubbles in the foamy beer heads bump into each other and against the side of the glass, so the motion of the liquid is reduced
- Liquids without foam (such as hangover-reducing water) don't encounter the same amount of resistance and so are more likely to spill over the edge

Additional talking point

Ask participants to suggest which beers might be the least likely to spill – prompting, if necessary, to consider beers that have more head on them, such as Guinness.

Why does liquid glug out of the bottle?

Explanation

Explain that as liquid leaves the can/bottle, it leaves behind an area of low pressure inside the can/bottle. Atmospheric pressure pushes air in, disturbing the flow of liquid as it comes out and causes glugging. In order to show atmospheric pressure, you can use the following demonstration:

What you'll need

- Glass
- Water
- Card
- Bucket (just in case)

Demonstration

Fill a glass to the brim with water, cap it with the card, hold it tightly and flip it upside down over the bucket. Show the participants that the water will stay in the cup and explain that it's due to the pressure of the atmosphere keeping the plate pushed up against the water.

Additional talking point

- Ask participants if they remember beer-can manufacturers releasing cans with wider mouths and if they noticed a difference
- Give them a tip for pouring a smoother beer... pour more slowly so that there's an open area at the can/bottle mouth, meaning that air can move in without disturbing the flow of liquid
- Tell them that heavier beers, like stout, require more vigorous pouring to mix up the heavier particles they are made of

Where do bubbles come from and are they rising or falling?

What you'll need

- Pint glasses with bumps on the bottom
- Oil and paper towel
- Fizzy drink
- Lager lamps (see below)
- Pint glass
- Fizzy drink
- Nuts or raisins

How to make a lager lamp

- Fill a pint glass with fizzy liquid so that it is three-quarters full
- Leave for approximately half an hour to reduce the amount of bubbles
- Tip in nuts or raisins and watch as they gradually float up then fall back down

Demonstration and explanation

Coat the inside of a pint glass with oil, creating a smooth surface. Pour in fizzy liquid and show that there are virtually no bubbles. Explain that this experiment shows that bubbles need a rough surface on which to form and that's why improvements in glass manufacturing have meant there are now often small bumpy designs at the bottom of your pint glass.

Have a ready-made lager lamp to use as a further demonstration and explain that the rough surface of the nuts/raisins allow bubbles to form on the surface. They grow larger, eventually providing enough buoyancy to counter the weight of the nut/raisin, meaning they rise upwards. When they get to the top, the bubbles burst and the nut/raisin sinks back down.

Additional talking point

- Give them a tip for pouring a smoother beer… pour the beer in at a lower angle so that the speed at which the beer hits the glass is slower, resulting in fewer bubbles being formed
- Ask if they know why bubbles in stout fall, and explain it's because stout contains smaller bubbles and so is more susceptible to the circulating current
- Ask why the head of a beer is white when beer is brown and explain it's because the bubbles scatter light (you could use other everyday light-scattering phenomena such as rainbows to explain if the participant is interested)

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Beer physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Who can pour the smoothest beer?	Public challenged to pour the smoothest pint of a fizzy liquid	• Cans/bottles • Pint glasses	• Public • Demonstrators	Slipping hazard from spilt liquid	• Pints could be poured over a container to catch spillages • Mopping up equipment nearby	1	2	2	Yes
				Cuts from cans or dropped pint glasses	Use plastic bottles/pint glasses where possible	1	2	2	Yes
Why it's easier to carry beer than water	Demonstrator gently sways tray of pint glasses from side to side	• Tray • Pint glasses • Fizzy liquid	• Public • Demonstrators	Slipping hazard from spilt liquid	• Pints could be poured over a container to catch spillages • Mopping up equipment nearby	1	2	2	Yes
				Cuts from cans or dropped pint glasses	Use plastic bottles/pint glasses where possible	1	2	2	Yes

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Beer physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Why does liquid glug out of a bottle? (experiment showing atmospheric pressure)	Demonstrator fills a glass with water, caps it with a piece of card and flips it upside down. Atmospheric pressure keeps the card and water in place	• Cup • Water • Plate	• Public • Demonstrators	Slipping hazard from spilt water	• Demonstrator to practice trick to reduce chances of water being spilled • Demonstration to be done over a bucket • Mopping up equipment nearby	1	2	2	Yes
				Cuts from dropped wet glasses	Use plastic bottles/pint glasses where possible	1	2	2	Yes

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Beer physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Where do bubbles come from? (experiment showing bubbles don't form on smooth surface)	Demonstrator coats inside of glass with oil and pours in a fizzy liquid	• Glass • Oil • Paper towel • Fizzy liquid	• Public • Demonstrators	Slipping hazard from spilt water	• Demonstrator to practice trick to reduce chances of water being spilled • Demonstration to be done over a bucket • Mopping up equipment nearby	1	2	2	Yes
				Cuts from dropped wet glasses	Use plastic bottles/pint glasses where possible	1	2	2	Yes
Lager lamps	Pint glasses filled ¾ full with fizzy liquid and nuts/raisins added	• Pint glasses • Fizzy liquid • Nuts/ raisins	• Public • Demonstrators	Slipping hazard from spilt water	Keep lager lamp away from table edges	1	2	2	Yes
				Choking hazard from nuts/ raisins	Use IOP warning sign about small parts being used in experiment	1	4	4	Yes

Cafe physics

Summary

These experiments use objects found in coffee shops such as hot chocolate, coffee, newspapers and books. They can be done individually or as a group:

- Musical hot chocolate
- Latte, flat white or Americano?
- The power of words
- Inseparable books

The explanations for each of the demonstrations are deliberately simple so as to be accessible to participants with no physics knowledge. They can easily be adapted, adding further detail and physics vocabulary according to your audience and your volunteers.

Target audience

- Adults with low science capital

Example events

- Bookshops
- Libraries
- Community groups

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

Musical hot chocolate

What you'll need

- Mugs
- Instant hot chocolate sachets
- Metal spoon
- Source of hot water – kettle or urn
- Optional – marshmallows and chocolate flakes

Demonstration

1 Pour some hot water into a mug for a participant but leave some room at the top for the hot chocolate mix.

2 Lift your mug up so it's not on a surface, dunk your spoon in and tap it a few times on the bottom so the participants can hear what it sounds like.

3 Add the hot chocolate mix and give it a good stir.

4 Tap the spoon against the bottom of the mug continuously as the swirling fluid slows. Ask the participants how the pitch changes (it increases).

5 Stir the liquid again to lower the pitch.

6 Add marshmallows and a chocolate flake for your participants to enjoy.

Explanation

- The pitch of a note depends on the speed of sound through the hot chocolate
- Mixing hot chocolate into the water creates a surface foam of tiny bubbles; stirring spreads the bubbles through the drink. Adding hot chocolate slows the speed of sound in the drink and lowers the note we hear because sound travels more slowly through the air-filled bubbles. When you stop stirring, the bubbles rise to the surface so the sound travels through more liquid than air. This means it can travel at a higher speed and as a consequence the pitch of the sound gets higher

Latte, flat white or Americano?

What you'll need

- Cups of different types of coffee – try lattes, flat whites and Americanos – which are filled to roughly the same height
- Tray
- Pendulum

Demonstration

Ask the participants if they've ever spilled a hot drink down themselves – most people will say yes! Then ask them if it seems to happen more with certain drinks than others?

Line up the beverages on a tray and gently move from side to side. Ask the participants to notice which ones are slopping over the edges more?

Explanation

- Walking with a cup of liquid starts waves sloshing around
- The bubbles in the foamy drinks such as lattes bump into each other and against the side of the glass, so the motion of the liquid is reduced
- Liquids without foam (such as black coffee) don't encounter the same amount of resistance and so are more likely to spill over the edge

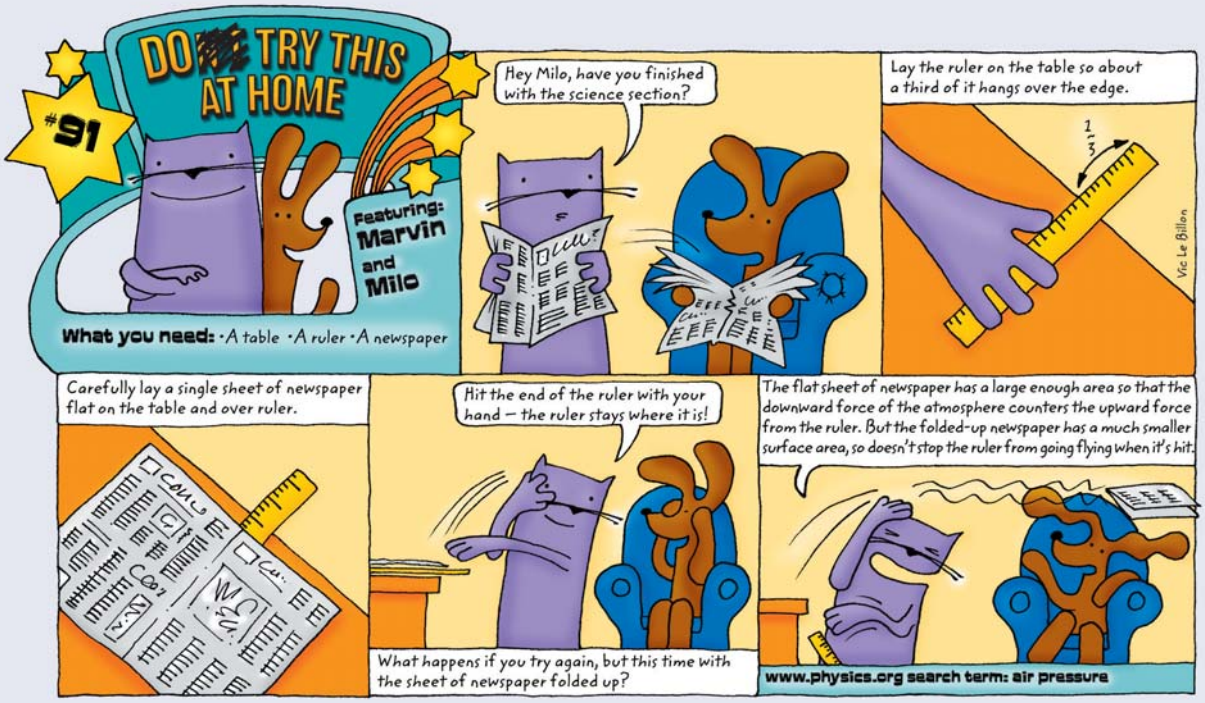
The power of words

What you'll need

- Table
- Ruler
- Newspaper

Demonstration

1 Lay the ruler so that a third of it hangs over the edge, then lay a single sheet of newspaper flat on the table and over the ruler – see Marvin and Milo cartoon:



2 Hit the end of the ruler with your hand and the ruler should stay where it is.

3 Repeat but fold the newspaper up.

Explanation

- Flat sheets of the newspaper have a large enough area that the downward force of the atmosphere counters the upward force from the ruler
- A folded-up newspaper has a much smaller surface area and so doesn't stop the ruler from going flying when it's hit

Optional

Try handing out printouts of the Marvin and Milo cartoon for participants to take away and try again at home.

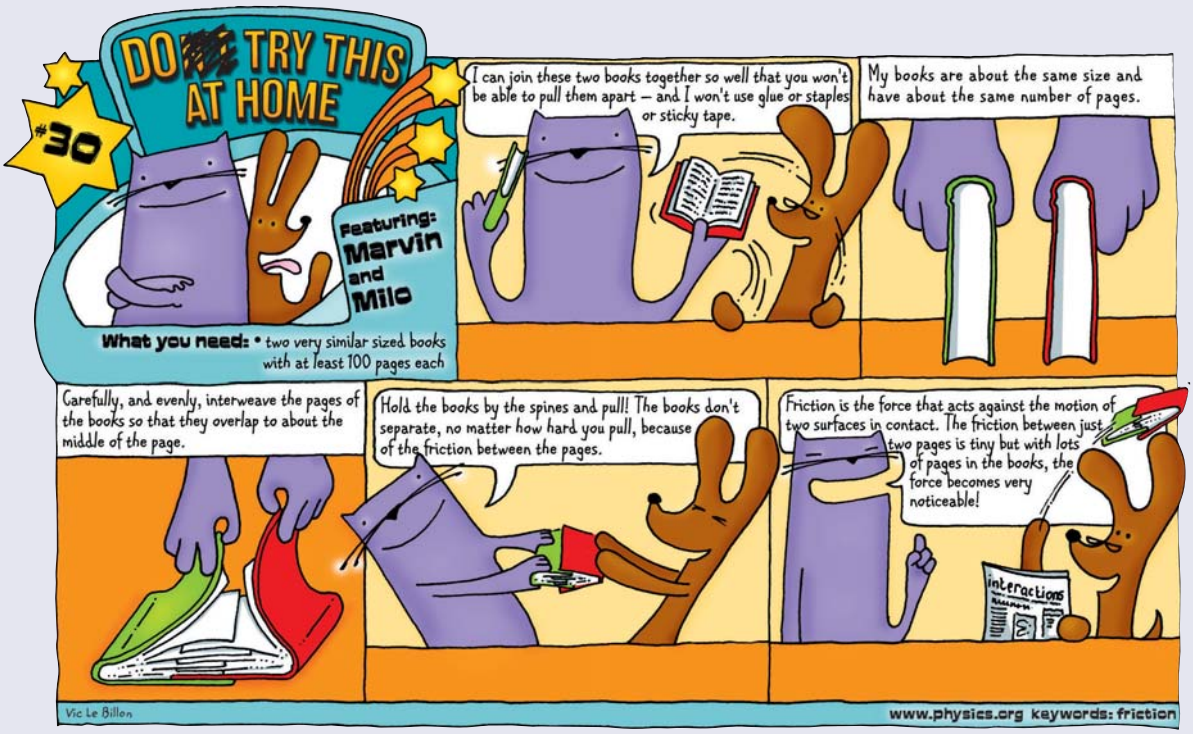
Inseparable books

What you'll need

- Two similar-sized books with at least 100 pages each

Demonstration

1 Carefully and evenly interleave the pages of the books so that they overlap to about the middle of the page – see Marvin and Milo cartoon:



2 Give one book to the participant and hold on to the other one, then ask them to pull.

Explanation

- Friction is the force that acts against the motion of two surfaces in contact
- The friction between just two pages is tiny but with lots of pages in the books, the forces become very noticeable

Optional

Try handing out printouts of the Marvin and Milo cartoon for participants to take away and try again at home.

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Cafe physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Musical hot chocolate	Demonstrator taps bottom of cup of hot chocolate with spoon	• Cup • Hot chocolate • Metal spoon	• Public • Demonstrators	Slipping hazard from spilt liquid	Mopping up equipment nearby	1	2	2	Yes
				Burns from hot liquid	Demonstrators to warn visitors that the drinks are hot	1	2	2	Yes
				Milk allergy symptoms (worst-case scenario anaphylaxis)	• Instructor volunteers to advise participants (and parents/ guardians of under-18s and carers of vulnerable adults) of the milk content • Sign indicating experiment uses allergen-containing ingredients	1	4	4	Yes

Event name:

Event date:

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Cafe physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Latte, flat whites or Americanos?	Demonstrator gently sways tray of pint glasses from side to side	• Tray • Pint glasses • Selection of different types of coffee	• Public • Demonstrators	Slipping hazard from spilt liquid	Mopping up equipment nearby	1	2	2	Yes
				Milk allergy symptoms (worst-case scenario anaphylaxis)	• Instructor volunteers to advise participants (and parents/ guardians of under-18s and carers of vulnerable adults) of the milk content • Sign indicating experiment uses allergen-containing ingredients	1	4	4	Yes

Event name:

Event date:

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Cafe physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
The power of words	Visitors attempt to move ruler with a newspaper laid on top	• Newspaper • Table • Ruler	• Public • Demonstrators	Ruler could potentially hit a visitor	Visitors to be supervised and informed of correct technique	2	1	2	Yes
Inseparable books	Visitors pull apart two books whose pages are leafed together	• Books	• Public • Demonstrators	Visitors could fall if books come apart suddenly	Visitors to be supervised and informed of correct technique	2	2	4	Yes

Conductive paint

Summary

Participants pin electronic components such as cell batteries and LEDs into paper or card, and then use conductive paint to complete the circuit. Designs can be adapted – for example you could create flashing LED star constellations for space-themed events or make them seasonal by using themed greeting cards for Christmas or spooky designs at Halloween.

Target audience

Arts and crafts experiments have broad appeal, so are a good choice when you're not sure who's going to turn up. This is particularly important if you are going to an event at which the participants have low science capital.

- Children
- Young families
- Outreach professionals and teachers looking for new ideas

Event considerations

As the artwork can be adapted easily, this activity could be done at any event. However, you should take into consideration the fact that participants will need to be supervised to ensure they get the components in the right way round and that they don't smudge the paint before waiting for it to dry (15 minutes) – consider whether you will have enough volunteers, space and time.

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

Greeting cards and drawings

You can either buy a pack of cards at **bareconductive.com/shop/flashing-card-activity-pack-robot-parade** (or elsewhere if you can find it cheaper), but at £60 a pack for 30 units, it's cheaper if you design your own cards.

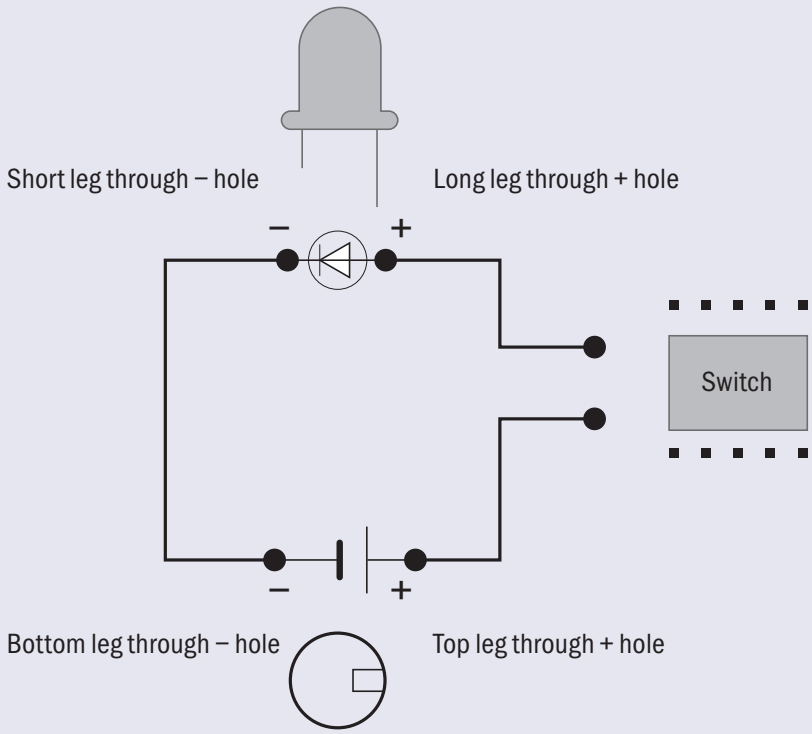
The Bare Conductive pack is a little fiddly and may be unsuitable for younger children because the LED and battery legs aren't the same distance apart as the holes on the circuit diagram. This means it can be difficult to ensure that the conductive paint and the electric component's legs are in contact.

What you'll need (if using the Bare Conductive pack)

- Colouring pencils
- Pin and blue tack
- Scissors
- Space for participants to colour their cards in – either table and chairs or clipboards

What you'll need (if making your own)

- Your own personalised greeting cards
  - Be creative! Adapt the design according to the event and time of year, if seasonal, and don't just stick to greeting cards – try skylines of local landmarks or stellar constellations. It's possible that participants could design their own, but you'll have to provide advice on the requirements for the LEDs and battery (see below)
  - Draw on your circuit:
    - Make sure the polarity requirements of the components are clear and that the holes are the right distance apart for your bought components
    - Create a switch with dotted lines either side, making sure that when it's closed it will complete the circuit



- See the diagram above for the basic circuit that can be reshaped and LEDs added to according to your design

- Make multiple copies

- Share any designs on the branches intranet for others to use!

- Flashing LEDs (try **kitronik.co.uk/leds-and-lamps.html**)
- 3V coin cell battery (try **kitronik.co.uk/c4807-cr1220-pcb-mount-battery-with-pins.html**)
- Colouring pencils
- Pin and blue tack
- Scissors
- Space for participants to colour their cards in – either table and chairs or clipboards

Activity

1 Get your participants to colour their designs in.

2 Cut along the dashed lines to create the switch.

3 Use a pin to pierce holes for the component's legs. Ask your participants to put blue tack on the other side of the card to avoid pricking their fingers.

4 Insert the LED, making sure the long leg goes through the + hole and the short leg goes through the – hole. Turn the card over and bend the component's legs so that it stays in place.

5 Insert the battery, making the top leg go through the + hole and the bottom leg through the – hole. Turn the card over and bend the component's legs so that it stays in place.

6 Use the conductive paint to complete the circuit and fill in the switch.
Tip – get the participants to blob extra around the component's legs to ensure they are connected.

7 It will now take 15 minutes for the paint to dry. Participants could come back later to collect their cards or you could use this time to talk physics
See the explanation section below.

8 Fold the switch so that the black square completes the circuit.

Explanation

- Paint usually doesn't allow electricity to pass through it (insulator)
- Experiment uses paint that does allow a current (conductor)
- LED doesn't light up until the switch is closed as the electric current doesn't flow unless the loop is complete
- LED and batteries have to go a specific way round because they only permit electricity to flow through them in one direction – just think of driving down one-way streets or getting through ticket barriers at the train station

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Conductive paint

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Greeting cards and drawings	Public colour in a design, then make a circuit using conductive paint and circuit components	• Conductive paint • Cards/drawings • Flashing LEDs • 3V coin cell batteries • Pins and blue tack • Scissors • Colouring pencils	• Public • Demonstrators	Injury using stationery such as sharp colouring pencils, pins and scissors	• Supervision of participants by volunteers • Volunteers keep track of the location of scissors • Volunteers advise participants to use blue tack on the back of their cards when piercing with the pins	2	2	4	Yes
				Skin contact, ingestion or inhalation of conductive paint	• Volunteers supervise activity and pay special attention to younger children • Volunteers advise not to ingest or inhale *(cont. on page 2)*	1	3	3	Yes

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Conductive paint

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Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
				Skin contact, ingestion or inhalation of conductive paint	• Have a copy of the Bare Conductive paint risk assessment, paying particular attention to the first-aid section: **bareconductive.com/wp-content/uploads/2015/01/MSDS_BareConductive_ElectricPaint.pdf**	1	3	3	Yes
				Choking from small parts	• Volunteers will supervise the stand • Small parts kept further back so out of reach of young participants	1	3	3	Yes
				LEDs could short circuit and explode	• Supervision by volunteers to ensure that the conductive paint doesn't connect between the component legs	1	3	3	Yes

Food and drink

Summary

This is a collection of experiments using food and drink.
They can be done individually or as a group:

- Musical hot chocolate
- Instant ice cream

If your branch has invested in a Makey Makey, have a look at the activity sheet for that as it contains banana bongos and veggie pianos.

Target audience

Food and drink experiments have broad appeal so are a good choice when you're not sure who's going to turn up. This is particularly important if you are going to an event at which the participants have low science capital.

- Adults with low science capital
- Families
- Health-conscious people (some of the experiments focus on sugar content)

Example events

- Food and drink festivals
- Health promotion

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

Musical hot chocolate

What you'll need

- Mugs
- Instant hot chocolate sachets
- Metal spoon
- Source of hot water – kettle or urn
- Optional – marshmallows and chocolate flakes

Demonstration

1 Pour some hot water into a mug for a participant but leave some room at the top for the hot chocolate mix.

2 Lift your mug up so it's not on a surface, dunk your spoon in and tap it a few times on the bottom so the participants can hear what it sounds like.

3 Add the hot chocolate mix and give it a good stir.

4 Tap the spoon against the bottom of the mug continuously as the swirling fluid slows. Ask the participants how the pitch changes (it increases).

5 Stir the liquid again to lower the pitch.

6 Add marshmallows and a chocolate flake for your participants to enjoy.

Explanation

- The pitch of a note depends on the speed of sound through the hot chocolate
- Mixing hot chocolate into the water creates a surface foam of tiny bubbles; stirring spreads the bubbles through the drink. Adding hot chocolate slows the speed of sound in the drink and lowers the note we hear because sound travels more slowly through the air-filled bubbles. When you stop stirring, the bubbles rise to the surface so the sound travels through more liquid than air. This means it can travel at a higher speed and as a consequence the pitch of the sound gets higher

Instant ice cream

What you'll need overall (serves 30 people with 100 ml portions)

- 4.5 litres semi-skimmed milk
- 200 g caster sugar
- Vanilla extract
- 6 kg ice
- 2 kg salt (rock or kosher salt results in a smoother ice cream as it takes more time to melt, resulting in even cooling, but it does mean you'll need to throw the ice cream around for longer)
- 30 medium zip-seal freezer bags
- 30 large zip-seal freezer bags
- Few pairs of gloves
- Hundreds and thousands/choc chips/decorative extras (optional)
- 30 plastic cups/bowls and spoons

What you'll need per demo (serves two)

- 300 ml semi-skimmed milk
- 1 tbsp caster sugar
- ¼ tsp vanilla extract
- Ice
- 6 tbsp salt (rock salt works best but you can use table salt too)
- One medium zip-seal freezer bag
- One large zip-seal freezer bag

Demonstration

1 Pour the milk, sugar and vanilla extract into the medium sized zip-seal freezer bag and close securely.

2 Put the ice and salt into the large sized zip-seal freezer bag. Add the smaller bag inside too and close securely.

3 Shake the bag, throw it from person to person, jump up and down. The bag will need to be kept moving for 10–15 minutes to freeze the milk so it's a good idea to wear gloves.

4 Empty the ice cream into plastic cups or bowls and serve with decorative extras, if using.

Explanation

- Ice cream freezes at −6° C
- Although water normally freezes at 0° C,adding salt lowers the freezing point (the amount the freezing point is lowered depends on how much salt is present; the minimum temperature for brine is −21.1° C)
- Energy is transferred from the milk in the inner bag by heating the salt and ice combination in the outer bag. The milk freezes, resulting in ice cream

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Food and drink

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Musical hot chocolate	Demonstrator taps bottom of cup of hot chocolate with spoon	• Cup • Hot chocolate • Metal spoon	• Public • Demonstrators	Slipping hazard from spilt liquid	Mopping up equipment nearby	1	2	2	Yes
				Burns from hot liquid	Demonstrators to warn visitors that the drinks are hot	1	2	2	Yes
				Milk allergy symptoms (worst-case scenario anaphylaxis)	• Instructor volunteers to advise participants (and parents/ guardians of under-18s and carers of vulnerable adults) of the milk content • Sign indicating experiment uses allergen-containing ingredients	1	4	4	Yes

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Food and drink

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Instant ice cream	Participants mix ingredients together in ziplock bags and move them around for 10–15 minutes until milk freezes	• Milk • Sugar • Vanilla extract • Ice • Salt • Freezer bags • Gloves • Plastic crockery and cutlery	• Public • Demonstrators	Slipping hazard from spilt liquid	Mopping up equipment nearby	1	2	2	Yes
				Frostnip/bite	Use gloves when handling ice and moving ice cream bags around	1	2	2	Yes
				Milk allergy symptoms (worst-case scenario anaphylaxis)	• Instructor volunteers to advise participants (and parents/guardians of under-18s and carers of vulnerable adults) of the milk content • Sign indicating experiment uses allergen-containing ingredients	1	4	4	Yes

Light painting

Summary

Participants use a torch or other light source with a long exposure from a digital camera to paint a picture with light.

Target audience

Arts and crafts experiments have broad appeal, so are a good choice when you're not sure who's going to turn up. This is particularly important if you are going to an event at which the participants have low science capital.

Event considerations

One thing to consider with this activity is the space and ground requirements of a blackout gazebo.

However, you might not need to use a blackout gazebo if you try using sparklers and other light sources at outdoor night-time events like bonfire nights. Make sure you update the risk assessment accordingly.

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

Activity

What you'll need

- 3 × 3 gazebo with reasonable amount of blackout
- DSLR camera with at least 10 s exposure time (**instructables.com** suggests 11–30 s shutter speed, aperture between f/8 and f/32 and ISO 100 or 200)
- Tripod
- Light source – torch, pen light, mobile phone, glow sticks, laser pointers, sparklers etc. Be creative and adapt to your event by making it seasonal if possible!
- Optional – coloured cellophane can be wrapped around a torch to create different colours
- Optional – objects to paint… again be creative, adapt to your event and make seasonal if possible. For example, why not try outlining a guitar at a music festival?
- Laptop

Activity

1 Set up tripod and DSLR camera, making sure you check the exposure time. Position your objects for painting if using.

2 Give your participant a light source and instruct them on how to "paint" their object or cast a shape in the air.

3 Turn overheard lights off if required, ask your participant to turn their light source on and focus the camera on the light source.

4 Start your participant painting and take the photo.

5 Transfer your photo to your laptop and use standard software (or download lightroom: **adobe.com/uk/products/photoshop-lightroom.html**) if you want to edit it.

6 Upload to your branch Twitter account or Facebook group and ask the participant if they'd like a mention in either so they can find it again (and hopefully gain you a few more followers).

7 If you've got lots of time with a group of participants, try experimenting with different aperture and shutter speeds.

Explanation

There's lots of physics here to talk about – you could focus on the physics of light or specifically on photography, depending on whether you've had time to experiment with different aperture and shutter speeds. Consider the level of knowledge of both your audience and volunteers, as you may have a photography expert in your midst.

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Light painting

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Light painting	Public wave around light source in air or trace objects while camera takes a long exposure picture	• Laptop and camera (see general Physics in the Field risk assessment) • 3 × 3 blackout gazebo • Tripod • Light source	• Public • Demonstrators	Slips, trips and falls while inside blackout gazebo	• Use torch or lamp whenever photograph is not being taken • Keep space clear and tidy of obstacles	2	3	6	Yes
				Person hitting themselves or others while moving light source around to create painting	Volunteers to advise participants to take care and that accompanying members of the public should stand back	1	3	3	Yes
				Safeguarding	• Have two IOP volunteers in the gazebo • Don't allow under-18s to do the activity without their parent/guardian/carer present	1	1	1	Yes

Makey Makey

Summary

This is a collection of demonstrations that you can do with a Makey Makey. The kit can be bought from Maplin for £39.99 (it may be found cheaper elsewhere).

The demos can be done individually or as a group, or you could do them alongside other activities depending on your theme:

- Banana bongos (food/music)
- Veggie pianos (food/music)
- Dance mat
- Game controller for playing Pacman, Tetris, etc

The above activities use programs through a project called Scratch and require an internet connection. However, you can download this to use offline: **scratch.mit.edu/projects/67886196/**.

Another program you can download that allows you attach your own sounds to computers keys is called Soundplant: **soundplant.org/download.html**.

Credit to the original inventors of Makey Makey and their video at: **youtube.com/watch?v=rfQqh7iCcOU** for the initial ideas.

Target audience

Makey Makey activities appeal to a vast audience, so are a good choice when you're not sure who's going to turn up and especially if you're going to an event that will have adults with low science capital.

Example events

The demonstrations above can be used at a variety of events as the items you attach to your Makey Makey can be adapted to your theme and target audience.

It is also possible to use your Makey Makey as a workshop activity if you have a captive audience rather than in a physics busking style. For example, you could create your own interactive artwork or run a music workshop where participants record sounds and create an interactive room to make music. There are plenty of ideas and even lesson guides on the Makey Makey website.

Banana bongos

What you'll need

- Makey Makey
- Two bananas
- Laptop with internet connection (see first page for how to do this activity without)

Demonstration

1 Gauge your audience's level of knowledge by asking them if they know what a conductor is and if they can name any – most people will talk about metals. Ask your participants whether they think bananas and humans can conduct electricity.

2 Plug the Makey Makey board into the computer.

3 Connect a clip to the earth part of the board. You will need to hold onto the other end of the alligator clip when playing the banana bongos.

4 Connect another clip to the left arrow on the board and its other end to a banana.

5 Connect a third clip to the space circle on the board and its other end to a banana.

6 Go to **makeymakey.com/bongos** and follow the onscreen instructions.

7 Ask your participants to review the original question – can bananas and humans conduct electricity?

Explanation

- Makey Makeys work just like a USB keyboard or mouse by sending signals to your computer when the circuit is completed. By touching the conductive objects connected with alligator clips, the Makey Makey sends a command to your computer just like when a button is pressed on a keyboard
- This means that both humans and bananas can conduct electricity, just like metals! Depending on your audience, you could go on to talk about the amount of water and charged ions/minerals in humans and bananas

Veggie pianos

What you'll need

- Makey Makey
- Five vegetables – such as celery, courgettes, apples or peppers
- Laptop with internet connection (see first page for how to do this activity without)

Demonstration

1 Gauge your audience's level of knowledge by asking them if they know what a conductor is and if they can name any – most people will talk about metals. Ask your participants whether they think vegetables and humans can conduct electricity.

2 Plug the Makey Makey board into the computer.

3 Connect a clip to the earth part of the board. You will need to hold onto the other end of the alligator clip when playing the veggie piano.

4 Connect clips from the arrows and space circle to separate the vegetables.

5 Go to **makeymakey.com/piano** and follow the onscreen instructions.

6 Ask your participants to review the original question – can vegetables and humans conduct electricity?

Explanation

- Makey Makeys work just like a USB keyboard or mouse by sending signals to your computer when the circuit is completed. By touching the conductive objects connected with alligator clips, the Makey Makey sends a command to your computer just like when a button is pressed on a keyboard.
- This means that both humans and vegetables can conduct electricity, just like metals! Depending on your audience, you could go on to talk about the amount of water and charged ions/minerals in humans and vegetables.

Dance mat

What you'll need

- Makey Makey
- Cardboard
- Aluminium foil
- Wire
- Wire cutters
- Scissors
- Hole puncher
- Gaffer tape
- Large piece of cardboard, or Bristol board if event is outside
- Laptop with internet connection

Preparation

You will need to make your dance floor pad before the event, unless you're doing a workshop-style activity with a captive audience.

1 Trace four arrows onto cardboard that are large enough to step on and cut them out.

2 Wrap the arrows in aluminium foil and use the hole punch to create a hole in the tip.

3 Cut four pieces of wire long enough to reach from the floor to where you'll have your laptop and wrap the ends around the arrow holes.

4 Place your arrows on the floor or onto the large sheet of board, using the gaffer tape to secure.

5 Cut another piece of wire long enough for the dancer to wear attached to a bracelet made of aluminium foil. This will be the ground.

6 Browse through this site and select what dance program(s) you'd like to run with your participants: **scratch.mit.edu/search/projects?q=dance+dance+revolution** – it may be best to have a selection as the songs could get irritating when played over and over again!

Demonstration

1 Connect the arrow wire ends to the alligator clips that come with the Makey Makey and plug into your laptop.

2 Make a bracelet out of aluminium foil for the dancer to wear. Attach it to the ground alligator clip.

3 Start the game!

Explanation

Makey Makeys work just like a USB keyboard or mouse by sending signals to your computer when the circuit is completed. By touching the conductive objects connected with alligator clips, the Makey Makey sends a command to your computer just like when a button is pressed on a keyboard.

Outdoor adaptation

If you are outdoors, why not try using shallow water bowls as controllers and have your participant splash around in them? Remember you'll need to alter the activity risk assessment.

Game controller

What you'll need

- Makey Makey
- Laptop with internet connection
- Anything fun that conducts electricity! Try conductive dough, graphite pencil sketches or food

Demonstration

1 Gauge your audience's level of knowledge by asking them if they know what a conductor is and if they can name any – most people will talk about metals. Ask your participants whether they think your chosen items can conduct electricity.

2 Plug the Makey Makey board into the computer.

3 Connect a clip to the earth part of the board. You will need to hold onto the other end of the alligator clip when playing the game.

4 Connect further clips to the arrows and space circle on the board with their other ends connected to your conductive items.

5 Use your laptop to get your participant to play Tetris (**scratch.mit.edu/projects/31651654/**) or Pacman (**scratch.mit.edu/search/projects?q=pacman**) or another game of your choosing.

6 Ask your participants to review the original question – can your chosen item conduct electricity?

Explanation

- Makey Makeys work just like a USB keyboard or mouse by sending signals to your computer when the circuit is completed. By touching the conductive objects connected with alligator clips, the Makey Makey sends a command to your computer just like when a button is pressed on a keyboard
- This means that your item can conduct electricity, just like metals

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Makey makey

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Physics in the field stand	Festival stand	• Tables • Gazebo • Tablecloths • Boxes • Banner stand	• Public • Demonstrators	• Trip hazard from objects • Gazebos and banner stands could blow away in strong winds	• All objects and cables to be stored safely • Gazebos and banner stands to be appropriately fixed to the floor or not used if the weather is not suitable	2	2	4	Yes
Laptop, camera and other electrical equipment		• Laptop • Laptop cable • Power source • Camera and cable to link to laptop	• Public • Demonstrators	Trip hazard from wires	• Set up so that cables aren't where people are likely to walk • Keep area tidy	2	2	4	Yes
				Electrical hazard eg, fire, circuit-breaker tripping	Check with event organisers as to whether PAT testing required	1	3	3	Yes

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Makey makey

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Taking photos of participants	Photos used on branch website and social media, or on IOP website and social media	• Camera	• Public • Demonstrators	Public unhappy at use of photos and make complaints.	• Sign to inform visitors that if they don't want a photo taken then to let volunteers know • Generally accepted risk managed by event organisers	1	1	1	Yes

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Makey makey

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Makey Makey	Activities involving use of Makey Makey Arduino board	• Makey Makey board • Alligator clips • Bananas • Vegetables	• Public • Demonstrators	Electric shock	• Used only as intended via the USB cable to a USB port (50 microamps – not large enough to do any harm) • It must not be connected to an AC outlet • Volunteers instructed to alert team leader if there is any damage and discontinue use immediately	1	1	1	Yes
				Injury from incorrect placement of alligator clips	Volunteers to supervise use of alligator clips.	1	2	2	Yes

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Makey makey

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Dance mat	Participants tap their feet on conductive arrows attached to Makey Makey board with wire.	As for Makey Makey board and laptop, plus: • Aluminium-coated cardboard arrows • Wire over 1 m in length • Gaffer tape	• Public • Demonstrators	• Tripping over wire • Falling over or slipping on dance mat	• Set up so that wires aren't where people are likely to walk • Keep area tidy • Secure feet and mat with gaffer tape to ground.	2	3	6	Yes

Musical physics

Summary

This is a collection of activities that can be done individually or as a group, demonstrating different aspects of the physics of sound (and non-Newtonian fluids in the case of cornflour speakers):

- Cornflour speakers
- Boomwhackers
- Musical coat hangers
- Straw instruments

The explanations for each of the demonstrations are deliberately simple so as to be accessible to participants with no physics knowledge. They can easily be adapted, adding further detail and physics vocabulary according to your audience and your volunteers.

Target audience

Music-themed physics experiments appeal to a wide variety of groups so it's a good choice if you're not sure of your audience. The cornflour speaker one is particularly visually interesting and would appeal to those harder-to-engage audiences.

Example events

- Choir and orchestra performances
- Gigs
- Music festivals

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

Cornflour speakers

youtube.com/watch?v=Muu0_1nm4NM

What you'll need

- Packet of cornflour
- Water and a large bowl
- Speaker
- Cling film
- Signal generator or a phone/MP3 player on which you can play a sine wave from the internet
- Food colouring
- Warning sign for ingredients containing allergens (cornflour and food colouring)

Preparation

1 Empty some cornflour into your mixing bowl (the quantity will depend on how big your speaker is) and add small amounts of water slowly until it forms a sloppy paste. It should be of a consistency that you can pick up and roll around like a solid but return to liquid when you stop.

2 Lay the speaker so that it's facing upwards and cover with cling film. Attach a signal generator or music-playing device.

Demonstration

1 Place a small amount of the mixture into the speaker cone. Then play music or use a signal generator, and watch as the cornflour becomes more solid and liquid in different places in response to the sound waves.

2 Add a drop of food colouring to allow participants to track the movement.

Explanation

- Cornflour and water form a type of fluid we call non-Newtonian
- Newtonian fluids, such as water, move faster when you push them
- Non-Newtonian fluids appear to behave counter-intuitively, but their behaviour actually makes sense when you know a bit more about the structure
- Cornflour is made of long chains of starch – imagine microscopic spaghetti. When you touch it slowly, the spaghetti strands slide past each other easily but if you hit it hard, the strands get tangled up and the mixture turns into a solid
- On the speaker, the sound waves provide that hard it – but only at certain places. The reason it's only in certain places is because sound waves build on each other. Imagine shining two torches in the dark – where they overlap, it's brighter than the patches lit by just a single torch

Boomwhackers

What you'll need

- Set of Boomwhackers, available on Amazon for £13.99 and free delivery, but have a look to see if they are available cheaper elsewhere when you come to order them: **amazon.co.uk/Boomwhacker-Tuned-Percussion-Major-Diatonic/dp/B00004TT3F**

Demonstration

1 Get your participants to hit the tubes against the table, floor or themselves (but not anyone else!).

2 Now ask them to change which size of tube they use and ask if they can hear a difference.

3 Have them experiment with a variety of sizes and see if they can spot the pattern.

Explanation

Hitting the tube causes vibrations in the column of air inside the tube. The vibrations are sound waves that travel from the tube to our ears.

You'll notice that the shorter the tube is, the higher the pitch of the sound – just think about the difference in sounds between big instruments like cellos compared to small instruments like violins.

Depending on your audience, you could go on to say...

Standing wave patterns are created along the length of the straw. Shortening the straw means the wavelength of the standing wave is shortened and decreasing wavelength means higher frequency and pitch.

Optional

- If you have time, have a go at putting together a performance piece. There are lots of tutorials on YouTube. You could play as a group of volunteers or even teach a group of participants a simple tune.
- If not, use a laptop and speakers to show the YouTube videos to participants

Musical coat hanger

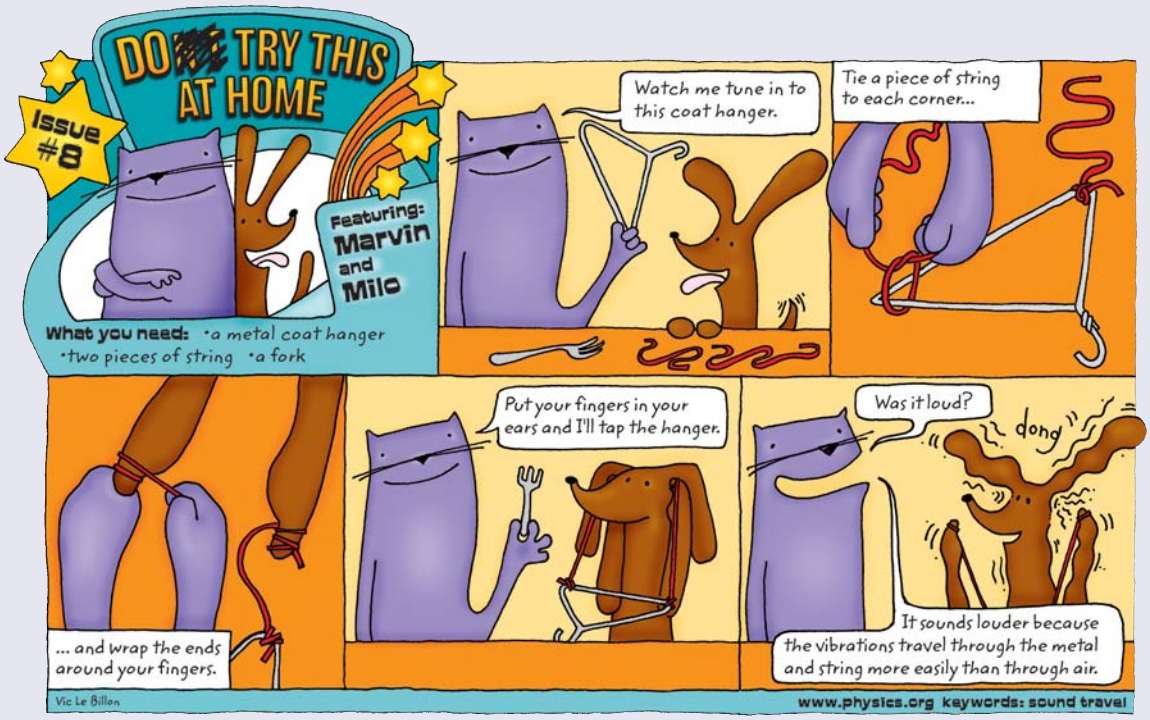
What you'll need

- Metal coat-hanger with string (see cartoon below)
- Fork

Demonstration

1 Tap the coat-hanger with a fork while the participant is holding it in their hands.

2 Then ask your participant to wrap the string around their fingers and put them in their ears – see Marvin and Milo cartoon:



3 Tap the coat hanger again.

Explanation

You can think of sound waves as vibrations. They are caused by objects vibrating, in this case the hanger and string. When I first tapped it, the vibrations travelled through the air. But when I tapped it the second time, the vibration could travel through the solid to your ears and it sounded louder.

Optional

Try handing out printouts of the Marvin and Milo cartoon for participants to take away and try again at home.

Straw instruments

physics.org/interact/physics-to-go/straw-oboes/index.html

What you'll need

- Straws (optional to have a variety of thicknesses)
- Scissors

Demonstration

1 Flatten the end of the straw down and cut it so that it has a point, then gently open it a little bit.

2 Blow gently through the pointed end – it may take a bit of practice to make a noise.

3 Ask the participant to try themselves.

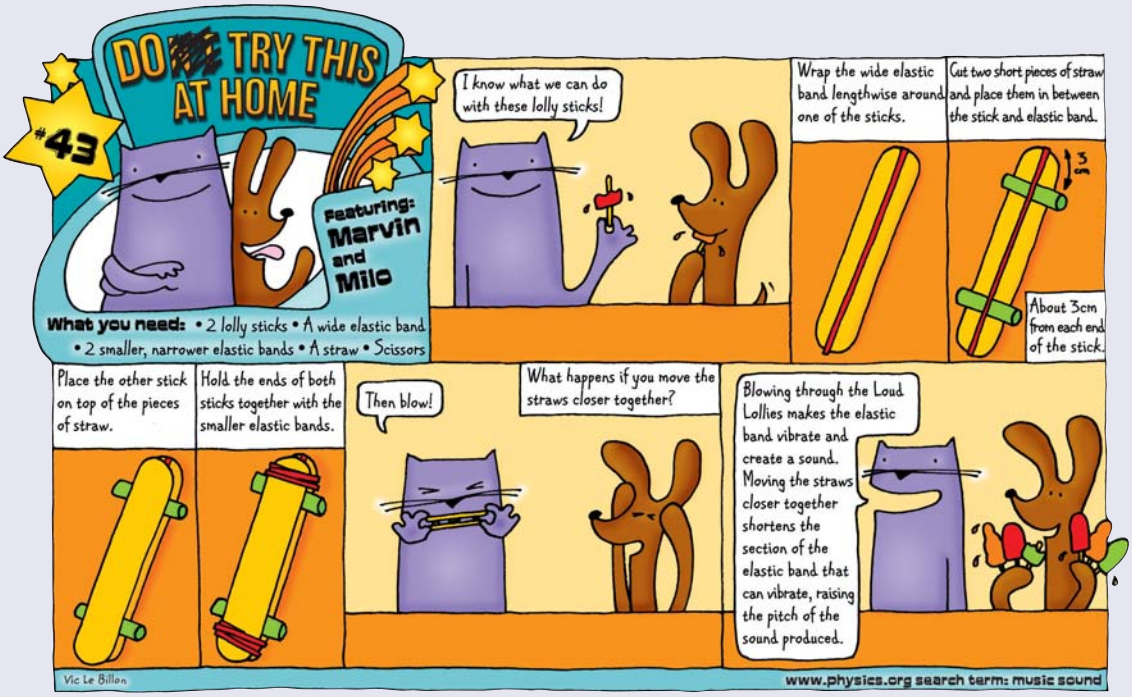
4 Cut the straw shorter and ask the participant if they can hear a difference.

5 Ask the participant to blow harder and if they can hear a difference.

6 Experiment with different thicknesses of straws.

Explanation

That noise you can hear is the vibration of the straw creating sound waves. You'll notice that when we cut the straw shorter, the noise sounded higher – just think about the difference in sounds between large instruments like cellos compared to small instruments like violins. *(cont. on page 6)*



Depending on your audience, you could go on to say: Standing wave patterns are created along the length of the straw. Shortening the straw means that the wavelength of the standing wave is shortened and decreasing the wavelength means higher frequency and pitch.

Optional

- You could also try handing out printouts of the Marvin and Milo cartoon on page 5 as it demonstrates the same principles for participants to take away and try at home
- Create a mini-orchestra by making another mini-instrument using the Marvin and Milo cartoon

Straw instruments extension – panpipes

Now that your audience understand the link between short length and pitch, have a go at making a set of panpipes.

There are a lot of YouTube tutorials on how to make straw panpipes. The instructions below make for the most rigid set, but you could consider adapting it to save time by leaving out the plasticine plug or just using tape to attach the straws together. It's also possible to do some of the steps before the event, so consider what works best for your audience and volunteers.

What you'll need

- Straws (wider ones used for milkshakes, smoothies and bubble tea work better)
- Scissors
- Ruler
- Plasticine
- Lolly/craft sticks
- Double-sided sticky tape

Demonstration

Steps 1 and 2 could be done beforehand, depending on the event.

1 Cut your straws to the following lengths: Do = 17.5 cm; Re = 15.5 cm; Mi = 13.5 cm; Fa = 12.5 cm; So = 11 cm; La = 10 cm; Ti = 9 cm; Do = 8.5 cm.

2 For the best sound quality, you'll need to plug the bottom of each straw. Flatten out the plasticine and take each straw, twist into the plasticine and lift it up.

3 Attach double-sided sticky tape to three lolly/craft sticks. Lay your straws on top from longest to shortest, with the plasticine plug ends furthest away from the sticks.

4 Attach double-sided sticky tape to three more lolly/craft sticks. Turn your instrument over and attach to the other side.

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Musical physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Cornflour speakers	Visitors watch as cornflour dances around on a speaker covered with clingfilm	• Cornflour • Water • Bowl • Speaker • Cling film • Signal generator/music playing device • Food colouring	• Public • Demonstrators	• Slipping hazard from spilt liquid • Electric shock from equipment	• Mopping up equipment nearby • Volunteers ensure speakers are well covered with clingfilm	1	3	3	Yes
Boomwhackers	Visitors hit different sized boomwhackers to explore changes in frequency with size	• Boomwhackers	• Public • Demonstrators	• People getting hurt when using the boomwhacker	• Volunteers to supervise visitors and stress only to hit inanimate objects	2	2	4	Yes

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Musical physics

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Musical coat hanger	Visitors loop their fingers through string tied to a coat hanger and place their fingers in their ears.	• String • Metal coat hanger	• Public • Demonstrators	• Sharp ends on metal coat hanger could cause injury	• Visitors to be supervised when using the coat hanger	1	1	1	Yes
Straw instruments	Participants cut the end of the straw into a point and blow through it	• Straws • Scissors	• Public • Demonstrators	• Cuts or injury through using scissors • Cuts or injury through pointed straw	• Volunteers to snip straws for young children • Constant supervision • Volunteers to keep track of scissors	2	2	4	Yes
				• Choking hazard of small parts	• Volunteers to supervise visitors, paying special attention to younger chidren	1	4	4	Yes

Night-vision cameras

Summary

Old camera phones are combined with infrared light to create a night-vision camera.

Target audience

Night-vision cameras appeal to a wide audience so they're a good choice when you're not sure exactly who will turn up. It can also be adapted to suit a wide range of ages and abilities. It works particularly well with:

- Children
- Young families
- Outreach professionals and teachers looking for new ideas

Event considerations

One thing to consider with this activity is the space and ground requirements of a blackout gazebo, or to conduct this activity at night time in a pitch-black environment. Make sure you update the risk assessment accordingly.

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

Activity

What you'll need

- An old mobile phone with a working camera (see guidance notes below on phone selection)
- Infrared torches
- A blackout tent/gazebo – it does need to be very dark for optimum results
- Something to look at, or search for, in the dark – be creative! For example, you could try hiding sweets in boxes
- Normal lamp for using when activity is not taking place

Instructions

1 Open the camera on the phone.

2 Give your participant the phone and the infrared torch(es). You may find you need to tape a few together to make it easier for the participant to see.

3 Send your participant into the blackout tent or gazebo. The participant uses the light source to illuminate their surroundings. They will not be able to see anything with the naked eye but can instead look at the phone's screen while pointing it in the same direction as they are the infrared torches.

Extension

Try using infrared LEDs instead of torches and have your participants construct their own circuits. This would work for older or more experienced audiences. See a demonstration at **youtube.com/watch?v=BUOiz-SXh7o**.

Explanation

This activity is a great hands-on way of explaining the electromagnetic spectrum and some of its applications.

In the extended version for older or more experienced audiences, you can also include explanations about electricity and building circuits.

Mobile-phone selection

The phone doesn't need a memory card or a SIM as long as it turns on with a working camera and screen.

Newer camera phones have infrared filters. You can easily test whether the phone has an IR filter by pointing the light from a TV remote at the camera phone in a pitch-black room. If you can see a light, then the phone will work for this activity.

Alternatively, you can remove the filter following these instructions (but it's probably easier just to source an old phone): **wikihow.com/Make-a-Phone-Camera-Into-Night-Vision**.

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Night vision

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Night-vision camera	Participants use old camera phone and infrared torches to see in the dark	• Laptop and camera (see general Physics in the Field risk assessment) • 3 × 3 blackout gazebo • Old mobile camera phone • Infrared torches • Lamp	• Public • Demonstrators	Slips, trips and falls while inside blackout gazebo	• Use torch or lamp whenever photograph is not being taken • Keep space clear and tidy of obstacles	2	3	6	Yes
				Safeguarding	• Have two IOP volunteers in the gazebo • Don't allow under-18s to do the activity without their parent/guardian/carer present	1	1	1	Yes

Squishy circuits

Target audience

Squishy circuits have broad appeal so are a good choice when you're not sure who's going to turn up. This is particularly important if you are going to an event at which the participants have low science capital.

- Children
- Young families
- Outreach professionals and teachers looking for new ideas

Event considerations

- Arts fairs
- Schools
- Community groups

Further resources

Make sure all volunteers read the associated risk assessment in the Outreach Toolkit. You'll also find links to a wealth of other useful documents like guidance on effective use of social media and top tips for engaging outreach.

If you have any comments or queries, email **engagement@iop.org**.

How to make conductive dough

Thanks to Abi Ashton for her recipe and tips. Original recipe from **courseweb.stthomas.edu/apthomas/SquishyCircuits/conductiveDough.html**.

It is recommended that you make two or three times this amount in different colours for the activities.

What you'll need

- 1 cup of water
- 1 and a ½ cups of flour (gluten-free flour works if you know you have participants with a gluten allergy. Otherwise see risk assessment)
- ¼ cup of salt
- 3 tbsp cream of tartar (9 tbsp of lemon juice can be used but tends not to keep as well)
- 1 tbsp vegetable oil
- Food colouring

Instructions

1 Mix water, salt, cream of tartar, vegetable oil and food colouring in a pan.

2 Begin to warm the pan and stir so that the salt begins to dissolve – you don't want to get it too hot yet.

3 While still on the heat, gradually add the flour (reserving at least ½ cup for kneading).

4 Continue to cook over a medium heat and stir continuously.

5 The mixture will begin to boil and start to get chunky. Keep stirring as it will start sticking to your pan.

6 Stop once a sticky ball forms. Overcooking makes for dry or even crunchy dough.

7 Tip the ball out onto a lightly floured surface. WARNING – the ball will be very hot. Try flattening it out and letting it cool for a few minutes before handling.

8 Slowly knead the remaining flour into the ball until you've reached the desired consistency.

Storage

Store the dough in an airtight container or plastic bag. While in the bag, you may notice some condensation appearing. This is normal – just knead the dough after removing it from the bag and it'll be as good as new. If stored properly, the dough can be kept for several weeks.

What you'll need on the day

- Conductive dough (see page 2 for recipe)
- Insulating craft materials, eg, straws, wooden ice-cream sticks, pipe cleaners
- Battery packs (4 AA)
- Batteries
- LEDs (recommended 10 mm size in a variety of colours)
- Optional – motors with terminals attached and low current rating ~30 mA
- Optional – buzzers
- Allergen warning signs (if using non-gluten-free dough)
- Camera and laptop for taking photos and tweeting

Activity

Resistance

Start with one lump of dough and insert the battery-pack wires on opposite sides. Then insert an LED into the dough. Does the LED light up?

No – electricity takes the path of least resistance and flows in the easiest loop it can. Conductive dough is easier for electricity to flow through (less resistance) than the LED (higher resistance) so it bypasses the LED and goes through the dough. This is called a short circuit.

Polarity

Next, separate the dough into two pieces and place them so that there's an air gap. Plug one wire from the battery pack into each and bridge the gap between the dough with the LED. Does the LED light up?

Now switch the LED round so that each leg is in the opposite piece of conductive dough. Does the LED light up?

The LED only works in one direction, just like a ticket barrier or an escalator. Show the participant that one of the LED legs is slightly longer than the other and should be attached to the positive (red) wire of the battery pack.

Building circuits

Now your audience know the basics, allow them to build their own circuits using craft materials as insulators.

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Squishy circuits

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Squishy circuits	Public make their own circuits using conductive playdough, insulating craft materials, LEDS and battery packs	• Conductive playdough • Crafts, eg, pipe cleaners, straws, lolly sticks • LEDs • Battery packs and batteries	• Public • Demonstrators	Electric short could create a fire	• Voltages used are small • Battery packs carry warning in Welsh and English • Public advised of risks and supervised	1	3	3	Yes
				Ingestion of putty	• Signs warning participants of allergens and not to allow young children to eat dough • Takeaway bags of dough labelled with allergens	1	4 (if participant has wheat allergy)	4	Yes
				Allergic reaction through touching dough containing gluten or food colouring	• Signs warning participants of allergens • Takeaway bags of dough labelled with allergens • Provision of latex gloves	1	4 (if participant has wheat or food-colouring allergy)	4	Yes

Event name:

Event date:

Venue:

Risk assessment completed by:

Date of completion:

Squishy circuits

Please refer to the risk assessment guidelines before completing this table.

Activity	Description	Equipment	Who is at risk?	Description of hazards	Precautions	Likelihood (L) of occurrence	Consequences (C)	Total score: likelihood × consequences	Is this an acceptable risk? (<8)
Squishy circuits	Public make their own circuits using conductive playdough, insulating craft materials, LEDS and battery packs	• Conductive playdough • Crafts, eg, pipe cleaners, straws, lolly sticks • LEDs • Battery packs and batteries	• Public • Demonstrators	Choking from small parts	• Volunteers will supervise the stand • Small parts kept further back so out of reach of young participants	1	3	3	Yes

				LEDs could short circuit and explode	• Supervision by volunteers to ensure that:
					  • Battery packs kept switched off when not part of circuit
					  • Leads are not connected directly to LEDs when power is on
					• Warnings on battery pack labels
						1	3	3	Yes

Top tips for engaging outreach

Introduction

Most physicists take part in outreach or public engagement activities at some point during their careers. But few physicists have a chance to share their experiences or learn from other activities. Below are some ways you can improve outreach activities, and some pitfalls to avoid.

Thinking about your session:

- **Identify the purpose** of your outreach. This will help you tailor your talk or session.
- Focus on something you find **interesting**.
- **What is the right format?** Is it a talk or a hands-on activity? If a talk, can you incorporate props or hands-on demonstrations involving the audience?
- Come up with **three messages** that you want your audience to take away. Build the rest of the content aroundthese messages.
- **Think about your audience**. What do you know about them? What do they know already?
  - If you're not sure, ask colleagues, your IOP national or regional officer, or friends for advice. You can also email **engagement@iop.org**
  - Sometimes your workplace will have a public engagement, outreach, corporate social responsibility or widening participation team, so it's worth speaking to them for advice
- When you are sure about what your audience already knows, think about what else they need to be able to understand your messages. What other information do they need in order to find this interesting? Can you provide it to them? If not, you may need help, or to refocus your messages.
- With complex subjects it is important to make sure your audience doesn't feel alienated.
  - **Think about the way you use language**, and simplify it wherever possible.
  - If you use humour or cultural references, make sure that your content is relevant, up-to-date, and thoughtful. **Avoid making assumptions** about their habits
- **Be thoughtful about the way you refer to maths and physics.** Surprisingly, most physics outreach activities will include negative comments about maths, and sometimes physics or physicists. While it is commonly understood that both of these subjects are difficult, the aim is make sure the audience appreciate the value and interest of maths and physics.
- **Build spare time into your plans** for your session. This will make sure you are not rushing through your content and also means that if interesting questions come from the audience part way through then you have time to go off on a small tangent.
- **Make your audience feel special**. Refer to them, explain how you have built this activity for them, and make time for their questions and responses. Making them feel that this content has been prepared for them can ensure the best possible experience for you as well as the audience.

- When asking questions of the audience, actively look for those that might be considering answering. Not everyone likes to shout out, especially if they think they might not be right. Consider adding a prompt to your original question to help elicit answers, but then move on. Getting the balance right between deliberate pause and awkward silence is tricky; one way to learn this is to go and watch other well practiced speakers for ideas.
- If the audience asks a question you don't know the answer to, then **it's ok to tell them that you don't know**. You can impress them though by helping them find the answer, such as by providing further reading, weblinks or asking another contact.
- Finally, think about **what success looks like to you for this activity**. You might need to count attendees or get feedback forms completed, so make sure you leave yourself time to do these tasks. But the way most physicists measure the success of their outreach activities is by the number of questions they get asked, and by whether the audience seem engaged throughout.

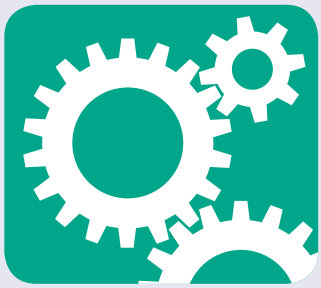
Engaging slides and presentations

Although most of us have been on presentation training at some point, it can be easy to fall into bad habits when creating slides for talks. The tips below should help make your presentation as engaging as possible

- Take out as many slides as you can without missing crucial information.
- Reduce your text to vital information only. Use a large font and plenty of space around the text.
- Reusing slides or content from another event can save time, but think about the audience. If a lecture was prepared for undergraduates or a training scheme then it is unlikely to be inspiring for 16 year olds.
- If you're not excited by the content of your talk then your audience won't be either. How could this content be made more interesting?
- Images are great, but need plenty of space to have impact. Try to use one, large, clear image at a time, and put as little other information on the slide as possible.
- It can be tempting to include videos and animations, but they are more likely to go wrong than you think. If you must use them make sure you test them thoroughly, and that you are not reliant on an internet connection to use them. And keep them short!
- Be thoughtful about if/how you include equations, formulae and proofs
    - Is there a simple version of the formula that would do for the purposes of this talk?
    - Make sure all symbols used on screen are named the first time you show them, and that you explain them as soon as you can within the flow of your talk. If you aren't going to explain why a symbol is there, perhaps you don't need it at all.
    - The normal advice about keeping text light and slides uncluttered is even more important for those slides including mathematical formulae.

You can contact **engagement@iop.org** if you have any questions about your outreach activities. If you would like to know more about the research underpinning these recommendations, please feel free to contact Dr Charlotte Thorley **charlottethorley@gmail.com**

Speaking to young people about careers in physics



The Institute's vision for education and the economy includes ensuring that all young people have access to information that will allow them to make well-informed choices about careers, and focuses on breaking down barriers to inclusivity.

Economy & Education Strategy 2015–19
iop.org/education

Many young people (and their parents) have a narrow view of where studying physics can take you.

They often see it as an abstract and difficult subject with little relevance to their lives. Historical examples used in school physics (such as Newton and Einstein) only exacerbate the problem by celebrating the lone genius, and reinforces the stereotype of a white male physicist.

General advice

- Try to involve parents/guardians in the conversation whenever possible
- Take along, and hand out, age-appropriate careers literature.
  Email **education@iop.org** for advice and to order copies of careers leaflets and posters

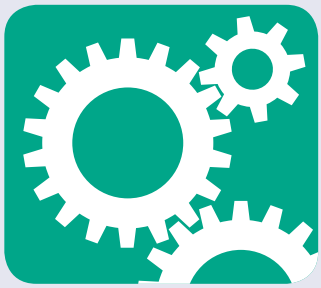
When discussing careers

- Emphasise the transferability of physics skills to areas outside science (such as business)
- Highlight a diverse range of scientists and engineers, including women and those from BME groups
- Ensure you give a broad view of the purpose and applications of scientific research (not just the technical details)
- Suggest your audience visit the following useful websites:
  - **iop.org/careers**
  - **tomorrowsengineers.org.uk**

When discussing educational pathways

- Discuss both university and vocational routes (such as apprenticeships)
- Try to remain impartial in terms of which institution to study at. Research carried out by the IOP shows that the class of degree is more important than university choice in terms of careers prospects
- Direct those considering physics at university to **myphysicscourse.org** for degree listings
- Don't assume that students understand the university application process, as they may be the first in their family to consider university. Help them feel comfortable about asking by not assuming that everyone knows what is involved

Diversity awareness in outreach



Many people have a narrow view of who can be a physicist.

Women and girls, people from some black and minority ethnic groups (BME), those from lower socio-economic backgrounds and disabled people are all under-represented in physics.

Overused historical examples such as Newton and Einstein reinforce the stereotype of a white male physicist. People being encouraged to engage with physics should have the opportunity to see real examples of physicists and their work that they can relate to.

Planning outreach

- Find out what the biggest issues are for you locally – is it girls in physics? BME groups? Those from lower socio-economic backgrounds? Then target one particular group
- Organise events and activities that coincide with different cultural/religious observations, such as Black History Month, Pride, Ada Lovelace Day, Chinese New Year or Diwali
- Contact community groups that already work with your target audience, such as hostels for homeless people, community centres, or LGBT+ support groups
- Select activities that are appropriate to your target audience. You can always ask for advice from the IOP (**engagement@iop.org**) or from other organisations

Tips for being inclusive

When talking to your activity participants:

- Don't assume everyone will have access to expensive technology such as smartphones and Arduino boards
- Use analogies that your participants will relate to
- Give a mix of example physicists (eg, include females and those from BME groups) when asked about careers. Please see the separate document on speaking to young people and their parents about careers in physics for further guidance and links to example career profiles
- Photographs and images are powerful. If you're using them in your activity, try to find ones that represent physicists from diverse backgrounds

- If a practical or group task is involved, try to make sure that it isn't always the same people writing down results while others get hands on with the activity
- Be sensitive towards religious and cultural beliefs by not expressing personal opinions

Disability awareness

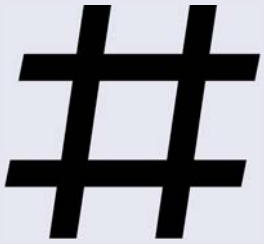
For disabled people, the immediate consideration is usually access for wheelchairs and physical needs. While this is important, other needs may not be as obvious.

For example:

- Those with visual impairment may not be able to follow written instructions, but will gain from the activity if they are part of a group or the instructions are introduced verbally
- Make sure that those you are working with can see you clearly. Those with hearing loss will need to see your face, and will find additional written instructions helpful
- Four times as many students taking physics at university declare a social/communication impairment compared to other subjects, so do bear this in mind if someone is reluctant to act as spokesperson or appears to have more queries about a task than the rest of the group

The Institute of Physics has more information about different disability organisations should you wish to find out more. For more information, please contact **diversity@iop.org**.

Social media and photo consent guidance



Introduction

Using social media is a great tool to increase interest in your outreach and encourage your audience to engage further with the Institute of Physics. Below you'll find some top tips on using common social media platforms as well as the important legal bases you'll need to cover.

Guidelines for IOP branch social media accounts

- Using the IOP name
  - If you're just starting out, email **press@iop.org** for guidance on profile pictures, bios and names. The media officer will also be able to promote your accounts to followers of the main IOP account
  - Remain apolitical, refrain from using profanities and don't engage with aggressive tweeters or accounts that appear suspicious (lack a profile picture, few followers, don't post a lot of content)
- Keep things secure!
  - Use devices that are password-protected (phones, tablets, laptops, etc) and limit how many devices can access an account at any one time
  - Limit also the number of people who have login information and update passwords when committee members change
  - Share your login details with the media officer at the IOP for added security and so that if you leave your role, those details can be passed on to whoever takes your place
- Be aware that using social media takes time and requires regular posting to be effective:
  - Twitter – ideally tweet three or four times a week. This may seem a lot, but it's possible to reach large numbers of people who aren't necessarily already following you
  - Facebook – posts don't need to be as frequent, but it's harder to reach people who haven't already engaged with you. Pages and groups require either liking or joining, but are then very useful for sharing news and upcoming events, so do think innovatively about how to grow your audience

Need some inspiration or help? Check out the following for some hints, tips and content inspiration

- IOP news and social media accounts, the IOP YouTube channel and other branch or outreach accounts associated with the IOP
- Physics World content
- Science news from services like the BBC, the Guardian, BuzzFeed, WIRED, etc
- Search for **#onthisday** and post about anniversaries of famous events in history

- Do your best to make sure physics content is accurate – people will notice!
- Get a general feel for what content and style your audience responds to by checking your tweet impressions and Facebook likes, and adapt accordingly
- Grow your audience by:
  - Following accounts on Twitter that engage with you as this encourages them to follow you in return and also keeps you updated with what they are doing and are interested in
  - Advertising your accounts on flyers, posters and email signatures, and on other social media accounts
  - For Facebook, you can invite people to like the page or join a group, so they're made aware of your existence next time they log in. Ask people who attend events if they'd like to share their Facebook URLs with you to be invited to like the page

Tips on using social media in outreach

- What is already trending? Does your work link to it? If so, use the hashtag to reach a larger audience or try using one that people regularly follow, such as **#scicomm**
- If you are running your own event, create and publicise your own short and specific hashtag so you can easily engage with your audience
- Promote events using Twittercards rather than trying to squeeze event information into 140 characters. Tag speakers or event hosts as this encourages them to retweet to their followers

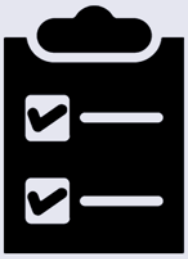
- Using images:
  - Check and follow the photo consent guidelines below
  - Make sure images are good quality, interesting and not repetitive
  - Check copyright restrictions or just use those with a Wiki Commons licence. Alternatively, the IOP has an account with Shutterstock (email **press@iop.org**) or have a look at the ESA image bank
  - If you've got lots of photos from an activity, put them into a Facebook album rather than clogging up your Twitter feed. This way you can also encourage participants to tag themselves, which will then show up on their contacts' newsfeeds
  - Try to get hold of the PowerPoint presentation beforehand if live tweeting a lecture, as you can then use high-quality images directly rather than taking a photo of the screen

Photo consent

Using photos will generate more interest in your outreach and is encouraged, but it's important to make sure that the below points are adhered to:

- Signage should be displayed prominently at all events where photography/filming is taking place
- Photos of people under the age of 18 should follow the NSPCC Ten Golden Rules, of which the main points to remember are:
  - Young people should be appropriately dressed
  - Photo should focus on the activity rather than the person
  - Use small groups rather than individual people
  - Don't name individuals in captions
- Audience members should give their consent if they are the main subject of the image, particularly if they are under 16, where the signature of their parent/guardian is also required

Team leader checklist



Are you a team leader for an Institute of Physics outreach event?
Here's a short checklist to help you get started.

1 Contact the event organisers

Before confirming your attendance, gather the information required to plan your activity and organise your volunteers.

FAQs to ask event organisers

- Who is the expected audience?
- Do they require a risk assessment for your activity?
- How much does a pitch cost? Is a reduction/free pitch possible as we are a charity and providing a service to festival goers, rather than making a profit? Are there any additional charges for things like power?
- Is it undercover or will a tent be provided?
- Are tables/chairs/power/lighting included/available?
- Does my electrical equipment need PAT testing?
- Where would our pitch be relative to any stages? Is the noise level acceptable?
- Are we obliged to be there for the entire festival?
- When can we set up/clear up?
- What times will the event be open to the public?
- What are the arrangements for dropping off/parking for stall organiser with equipment?
- What time will our volunteers need to be there on the day?
- How will volunteers get access to the event? Do they need tickets or to go to a special entrance?
- Do you need a list of volunteers' names in advance, and if so, when by?
- Are there any social media handles or hashtags that the event is using?

2 Plan your activity

You can use resources available through the Outreach Toolkit, draw on your own experience, or search online for inspiration. For further help and guidance, speak to your branch's national/regional manager (NRM) or email **engagement@iop.org**.

3 Create an entry on the branch calendar

Email **branches@iop.org** with the event details so that an entry can be made on Eventsforce. This will then create an event on your branch calendar.

4 Recruit volunteers

Ask your NRO to put out a call in the monthly regional newsletter and to email their list of volunteers who have registered interest in the outreach event. Once you've got a list of names and contact details, you can use the volunteer email templates guide in the Outreach Toolkit, which includes:

- Email templates
- Details of the attachments you'll need to send, including policies, risk assessments and travel expenses forms. These are all in the Outreach Toolkit

5 Plan evaluation

There is guidance in the Outreach Toolkit on how to plan evaluations. For further advice, speak to your NRM or email **engagement@iop.org**.

After the event

1 Send out an email to thank your volunteers.

2 Pass volunteer travel expenses forms to your NRM or branch committee, as appropriate.

3 Email your branch secretary with the number of event attendees so that they can update their annual activity report.

4 Share success and tips for improvement with other branches on the Nations & Branches Portal.

Volunteer email templates

In order to ensure a consistent volunteer experience, we recommend you follow the steps below when organising an outreach activity. You may want to adapt according to your own needs, but remember the main points:

- Reassure volunteers about worries they might have and build confidence by providing the activity sheets in advance
- Ensure volunteers feel supported by giving them the volunteer policy and travel expenses form
- Cover health and safety by providing volunteers with risk assessments and the IOP's Children and Vulnerable Adults Policy guidelines

In order to comply with new data protection laws, contact details of volunteers should be kept on the secure centralised database. If you need volunteers, contact your national/regional officer (NRO). They will put a call out in the branch newsletter for members and email volunteers who have signed up to receive notifications in your area. The NRO will then pass any replies to you.

Team leaders

"Thanks for volunteering for this particular event" email.

- Activity
- Risk assessment
- Summary of policies (volunteering, children and vulnerable adults)
- Reassurance about training on the day

"Event reminder and logistical details" email.

- Travel expenses form

"Thanks for your help" email and any other follow up.

Confirmation of volunteering

Once you've got a list of volunteer email addresses for your event from your NRO, send them the below email along with the following documents, which you will find in the Outreach Toolkit:

- Activity information and their associated risk assessments
- General outreach risk assessment
- IOP policy summaries
  - Volunteering policy
  - Children and Vulnerable Adults policy
- Top tips for engaging outreach

Thanks for volunteering

Dear [name of volunteer]

Thanks for your interest in volunteering with the IOP at [EVENT NAME AND LOCATION] on the [DATE]. I am delighted to say I've reserved you a spot, and we look forward to you joining us on the day. I'll be in touch again in the week before the event to confirm timings, venue address and other specifics. If for any reason you can no longer attend, please let me know as soon as possible so I can recruit new volunteers.

You will find attached to this email:

- Information about the activities we will be running along with their risk assessments. However, your team leader will train you on the activities on the day of the event
- IOP policy summaries (full versions are available upon request)
  - Volunteering policy
  - Children and Vulnerable Adults policy
- IOP's top tips to help you feel more confident about delivering science outreach and public engagement

If you are able to look at this information in advance of the event, that would be great, but it's your team leader's job to ensure you have all the information you need before you start presenting and be there to help everyone during the day. It's meant to be fun for you, so let me know if you have any concerns or questions, otherwise I look forward to seeing you all on the day!

Thanks again,

[NAME OF TEAM LEADER]

Reminder and event information

A few days before the event, send a reminder email that includes event details and an attached travel expenses form.

Event information

Hi everyone

Many thanks for agreeing to volunteer next week at [EVENT NAME]. Below is some pre-event information for you, including the address of the venue, times and the names of the other volunteers. This is in case any of you wish to contact each other and share transport – feel free to reply all and have a chat. I have also attached the volunteer travel expenses form.

[VENUE ADDRESS]

[TIMINGS]

[VOLUNTEER NAMES]

If you have any questions, don't hesitate to get in touch. I look forward to seeing you all on the day!

Thanks again,

[NAME OF TEAM LEADER]

It may be that you will also need to include the following information depending on the event:

- Any restrictions on free movement on/off site once the event is underway
- Is it undercover/outside/muddy/remote/warm/cold
- What should they wear (eg, warm clothes/don't mind getting mucky clothes)
- Where do they need to go (building/site and any particular door or access point)
- Travel details (parking/public transport)
- Do they need to bring anything as credentials for the event organiser (tickets/passes etc)
- When can they have a break
- What is available by way of food/drinks (i.e. should they bring a packed lunch, or will there be stuff to buy)
- What expenses will we be paying (travel, food)

Thank you email

Thank your volunteers by sending them the following email. Of course do please customise it to reflect your experiences on the day.

Why not consider rewarding particularly good work by getting in touch with their heads of department (if they are a teacher) or university tutor (if they are a student)?

Thanks for volunteering

Hi everyone

Thanks very much for your help volunteering this week. You all did a fantastic job! I think the event went very well – the participants enjoyed it and hopefully have been inspired to explore physics further!

I hope you enjoyed the experience and wish to come along again in future. Without your help we can't deliver public engagement and outreach, so your support is very much appreciated. Please spread the word about volunteering with the IOP to your colleagues or friends with scientific backgrounds.

You can find out more about the Institute of Physics and become a member (if you aren't already!) at **iop.org**. Our local branch social media details are [INSERT HERE] and you can follow the main IOP feed on Twitter at **@PhysicsNews** and Facebook at **facebook.com/InstituteofPhysics**.

If you wish to claim back travel expenses, please complete the attached form and email it back to me with any relevant receipts so I can add my signature before sending it to our finance department.

Thanks again for coming along and helping us run a successful event.
We can't do it without you so really appreciate your support, and we hope to see you again soon.

Best wishes,

[NAME OF TEAM LEADER and NRO]

Children and vulnerable adults policy and procedures

This document is intended as a summary only of the Institutes's Children and Vulnerable Adults Policy and Procedures and accompanying guidelines. Copies of these documents can be obtained at any time on request. Capitalised terms have the definitions given in those documents, unless otherwise stated.

What happens if?

What if you suspect abuse or an allegation is made?

The seven main areas of abuse are:

- physical
- neglect
- sexual
- emotional/psychological
- discriminatory
- financial
- domestic violence

These may come to your attention in a number of different ways. Some (nonexhaustive) examples:

- unexplained or serious injuries
- unexplained changes in behaviour
- a Child and/or Vulnerable Adult describes what appears to be an abusive act
- someone else expresses concern about a Child and/or Vulnerable Adult

If a Child and/or Vulnerable Adult tells you about abuse then they see you as "safe". Listen to them and take what you are told seriously. You should help to reassure them.

If a Child and/or Vulnerable Adult speaks to you in confidence:

- react calmly and listen carefully to what they are saying
- avoid making promises to keep secrets
- reassure them that they were right to tell
- allow them to continue at their own pace
- make a full and written record of what has been said, heard and/or seen as soon as possible

The Procedure

If you suspect abuse, a Child and/or Vulnerable Adult confides in you, or a complaint is made about any person or about you, it is your responsibility to report it.

If a Child and/or Vulnerable Adult tells you about abuse by someone else:

- react calmly and listen carefully
- reassure them that they were right to tell
- explain that it is likely that the information will need to be shared
- ensure their safety
- allow them to continue at their own pace
- do not interview them or other witnesses
- keep questions to an absolute minimum and make sure that they are not leading questions
- tell them what you will do next and with whom the information will be shared
- make a full written record of what has been said, heard and/or seen as soon as possible which must be signed and dated
- relay the information immediately to the Group HR Manager (if the allegation relates to a member of staff)/the Head of Public Engagement (if the allegation relates to a member/the volunteer co-ordinator if it relates to a volunteer)
- maintain confidentiality and do not discuss with other persons
- do not contact the Parents until advice is taken from Social Services

In an emergency (where a Child and/or Vulnerable Adult is at immediate risk of harm) contact the police or Social Services directly. Inform the Group HR Manager/the Head of Public Engagement/the volunteer co-ordinator (as appropriate) of the action you have taken and why.

If you have a concern about a Child and/or Vulnerable Adult's safety and wellbeing:

- record the concerns and any conversations with them and their Parents. The written record must be dated and signed
- report the concerns to the Group HR Manager (if the concern relates to a member of staff)/ the Head of Public Engagement (if the concern relates to a member)/ the volunteer co-ordinator (if the concern relates to a volunteer) immediately

If you receive a complaint or allegation about any person, including yourself:

- write careful notes of what you have witnessed, heard or are told. Sign and date them
- pass your notes to the Group HR Manager (if the complaint/allegation relates to a member of staff)/the Head of Public Engagement (if the complaint/allegation relates to a member)/ the volunteer co-ordinator (if the complaint/allegation relates to a volunteer) immediately

Anyone working for or on behalf of the Institute has the right to report any concerns or suspicions about any of their colleagues in confidence and free from harassment.

The Institute does not expect its staff, members, volunteers or representatives to be experts at recognising potential abuse nor should you investigate any alleged abuse. However, you do have a responsibility to act in accordance with the Policy if you have any concerns about the behaviour of anyone (adult or child) towards Children and/or Vulnerable Adults.

Volunteers with the Institute of Physics

As a volunteer with the Institute, you can expect:

- to be involved with an organisation that is devoted to increasing the understanding and application of physics
- a supportive and positive environment that is designed to ensure that you enjoy your volunteering
- opportunities to influence the understanding and application of physics
- to be treated fairly and regardless of gender; age; disability; race, ethnic or national origins; sexual orientation and marital status
- to be treated at all times with respect and courtesy
- an induction and opportunities to carry out any appropriate training
- a named Volunteer Co-ordinator for support
- relevant and current advice and information
- adequate public liability insurance
- recognition and thanks

In return, the Institute asks that you:

- support our aims and objectives
- remember that you are a representative of the Institute
- reach an understanding with us about your role and responsibilities
- are always open and honest in your dealings with us
- treat follow volunteers, Institute employees, members of the Institute, and any other persons to whom you come into contact as part of your contribution, with courtesy and respect at all times
- comply fully with all of the Institute's policies and procedures which relate to your contribution, including the Volunteers Policy and Procedures and the Children and Vulnerable Adults Protection Policy and Procedures
- contact us if you ever wish to change the nature of your contribution
- tell us if you think that we can improve the service and/or support that we give you

Expenses claim form

For office use only:

Authorised by (print name)	Signature

Budget code

Please complete the following in block letters:

Title (Professor, Dr, Mr, Mrs, Miss, etc.)

Name

Address

Postcode	Email

I wish to claim the following expenses incurred by me in connection with:

Occasion	Date

If the expenses are connected with a group/division meeting or event, please include their name in full, further details overleaf.
Please attach all receipts.

Rail/Air/Coach fare:

From: To:

Use of car miles @ 45p per mile

From: To:

Subsistence (meals/hotel):

Parking fee:

Other expenses (please specify):

Total:

Expenses claim form

For direct bank transfer please complete your details below, for cheques please complete the sections following.
Incomplete details will delay reimbursement of the expenses claim.

For all payments:

Bank name:

Account name:

Bank address

For UK payments (for other countries see below):

Sort code:

Account number:

For European payments:

SWIFT/BIC code:

IBAN number:

For US payments:

ABA ; FEDWIRE or ROUTING number:

Account number:

For payments to other countries:

Bank ID (SWIFT/BIC code):

Account number:

If you prefer to be paid by cheque, please indicate here:

Please note that cheque payments take longer and you may incur cheque negotiation charges

Signed

Date

Expenses claim form

Notes for the guidance of members of Council, Institute boards and committees and others reimbursed expenses on the same basis:

1. The Institute will reimburse reasonable travel and subsistence expenses actually and necessarily incurred in connection with attending official Institute meetings and events. In all cases receipts must be retained and attached to expense claims.
2. The Institute does not pay fees, either to individuals or their employers, for time expended on Institute business.
3. Council expects individuals to respect the Institute's charitable status and to travel by the most economical means. Public transport by standard class should normally be used in preference to private cars, first class rail travel or taxis. Advantage should also be taken of off-peak travel whenever possible.
4. Private cars may be used where it is impracticable to use public transport (e.g where quantities of luggage have to be transported). In such instances individuals intending to use their private cars on Institute business must ensure, in advance of travel, that their motor insurance policies cover them for such use. The Institute cannot accept liability for any loss or damage arising from an accident, theft or otherwise where an individual's insurance is found to be inadequate. The Institute publishes mileage rates for cars of different engine capacities. The current mileage rates are available from members of the Institute's staff.
5. If a private car is used when it would have been possible to use public transport, reimbursement will be paid at the lower of the calculated mileage allowance or standard class public transport fare for that journey.
6. Where, unusually, air travel is involved (e.g journeys from Ireland or Scotland to London) travellers are asked whenever possible to book their tickets well in advance in order to take advantage of discounted fares and to use low cost carriers when available. The difference between an economy flight and a regular fare can amount to hundreds of pounds for one return journey.
7. The reasonable cost of meals actually taken while on Institute business will be reimbursed.
8. The cost of essential overnight accommodation will also be reimbursed and travellers making their own arrangements for such accommodation are requested to exercise restraint in the choice of hotel so as to minimise the costs.
9. In order to maintain flexibility no maximum amounts are laid down for subsistence and overnight accommodation but claimants may be asked to justify amounts claimed before reimbursement if their claims appear to be excessive.
10. The travel costs of accompanying partners or family members are not paid for by the Institute. If special circumstances apply whereby reimbursement of such costs is required, travellers must obtain prior written agreement from the relevant director of the Institute.
11. The Institute will reimburse reasonable expenses incurred by Branch, Group and Division committee members while on Institute business (e.g postage, printing, telephone), on production of authorisation from an Honorary Officer of the committee who is not the claimant.
12. Expenses should be claimed by completing an expenses form obtainable from the secretary of the meeting or other attendant member of the Institute's staff. Forms are also available direct from the finance department. Receipts covering amounts claimed must be attached to the claim form. Completed forms should be returned to the secretary or other attendant member of the Institute staff.

Guidelines on DBS checks

The Disclosure and Barring Service (DBS) helps employers make safer recruitment decisions and prevent unsuitable people from working with vulnerable groups, including children. It replaces the Criminal Records Bureau (CRB) and Independent Safeguarding Authority (ISA).

In Scotland a disclosure check under the Protecting Vunerable Groups (PVG) scheme is the equivalent of a DBS.

www.gov.uk/government/organisations/disclosure-and-barring-service

www.mygov.scot/pvg-scheme/

Introduction

The Institute participates in a large number of outreach and public-engagement activities each year, either organised via staff members or local branch volunteers. The following guidelines have been produced following a number of enquiries regarding DBS checks for individuals delivering outreach activities.

Recommendations

- **Public spaces**
  All outreach activities should take place in public spaces. This doesn't limit the number of places in which activities can take place, and can, for example, include festivals, parks, shopping centres and town halls – but shouldn't involve sessions where a volunteer or staff member will be alone with a participant.
- **Avoid being sole supervisor**
  No staff or volunteers should be alone with young people under 18, or with vulnerable adults. If there's any doubt about a person's age then volunteers should assume that they are under 18. In the case of activities such as light painting, where participants need to enter an enclosed space to take part in the activity, two members of staff/volunteers should be present at all times and parent/carer supervision is required.
- **Parent/carer supervision**
  Young people under 18 and vulnerable adults should be supervised at all times by their parents/carers when taking part in outreach activities. Responsibility for their supervision does not lie with Institute staff or volunteers.
- **Supervision by school staff**
  In the case of school outreach, teachers should not leave staff or volunteers alone with students during the visit. Students should be supervised by school staff at all times.
- **Obtaining DBS checks**
  Unless a person has specifically registered for the DBS update service, DBS checks obtained through other organisations and roles are not valid for IOP outreach activities. The exception to this is if a volunteer is a registered STEM Ambassador and holds a current DBS check through STEMNET.
- **DBS checks for all staff**
  All Institute staff arranging and participating in outreach activities as part of their role require a DBS check.
- **Volunteers may not require DBS checks**
  Provided the guidelines above are followed, it is not essential for all volunteers to obtain a DBS check.

Promote safeguarding culture

Event organisers and schools should be aware that we don't require all volunteers to complete the DBS check process, but promote a safeguarding culture within our outreach activities.

Because of these guidelines, event organisers should be aware of the following:

- **IOP Staff may not always be present**
  As an organisation we aim to give our volunteers the necessary skills and support to organise outreach activities themselves, and staff may not always be present at outreach events.
- **Events with volunteers who have not been DBS checked**
  There may be situations when none of the volunteers organising and participating at events have a DBS check.
- **DBS checks and the law**
  It is a criminal offence to knowingly employ an individual barred by the DBS to work in regulated activity with children (under 18) or with adults in vulnerable situations. For working with children, this will generally be unsupervised teaching, training, instructing, caring for or supervising, on a frequent (one a week or more) or intensive (four or more days in a 30-day period) basis.

John Smith
Client Advisor

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To Whom It May Concern

02 February 2018

Dear Sirs,

CONFIRMATION OF INSURANCE – The Institute of Physics

As requested by the above client, we are writing to confirm that we act as Insurance Brokers to the client and that we have arranged insurance(s) on its behalf as detailed below:

Public Liability

INSURER	Aviva Insurance UK Limited
POLICY NUMBER	25148997CCI
PERIOD OF INSURANCE	31 January 2018 to 30 January 2019
PRINCIPAL LIMIT OF INDEMNITY	GBP 15,000,000 any one occurrence

We have placed the insurance which is the subject of this letter after consultation with the client and based upon the client's instructions only. Terms of coverage, including limits and deductibles, are based upon information furnished to us by the client, which information we have not independently verified.

This letter is issued as a matter of information only and confers no right upon you other than those provided by the policy. This letter does not amend, extend or alter the coverage afforded by the policies described herein. Notwithstanding any requirement, term or condition of any contract or other document with respect to which this letter may be issued or pertain, the insurance afforded by the policy described herein is subject to all terms, conditions, limitations, exclusions and cancellation provisions and may also be subject to warranties. Limits shown may have been reduced by paid claims.

We express no view and assume no liability with respect to the solvency or future ability to pay of any of the insurance companies which have issued the insurance(s).

We assume no obligation to advise yourselves of any developments regarding the insurance(s) subsequent to the date hereof. This letter is given on the condition that you forever waive any liability against us based upon the placement of the insurance(s) and/or the statements made herein with the exception only of wilful default, recklessness or fraud.

This letter may not be reproduced by you or used for any other purpose without our prior written consent.

This letter shall be governed by and shall be construed in accordance with English law.

Yours faithfully,

John Smith ACII, CIRM
Client Advisor
Marsh Ltd

Use of images of young people under the age of 18

Ten golden rules to remember

1 All young people featured in recordings must be appropriately dressed with outer clothing garments covering their torso from at least the bottom of their neck to their thighs, (i.e., a minimum of vest/shirt and shorts).

2 Photography or recording will focus on the activity being carried out, not on a particular young person.

3 Images should focus on small groups rather than individuals.

4 The names of young people (first names or surnames) will not be used in photograph captions.

5 Images of a young person who is known to be under a court order will not be used.

6 Personal details about a young person will never be revealed intentionally.

7 We endeavour to use photographs that represent the broad range of young people that participate in Institute related activities.

8 All people taking photographs or recording footage at an event should be associated with the Institute.

9 Any instances of the use of inappropriate images may be reported to the NSPCC Helpline or the Internet Watch Foundation (IWF).

10 We have a Children and Vulnerable Adults Policy to which we require all our employees to adhere. A copy of this policy is available on request from the Institute.

For further general information or advice please contact:

The NSPCC Helpline

Tel: 0808 800 5000
www.nspcc.org.uk

This is a 24-hour free and confidential telephone Helpline that provides counselling, information and advice to anyone concerned about a child at risk of ill treatment or abuse.

Internet Watch Foundation

To report potentially illegal material on the Internet, please contact the IWF:
https://www.iwf.org.uk/report

The IWF was set up to address the issue of illegal material on the Internet, with particular reference to child pornography.

Evaluation: A step-by-step guide

Evaluation is an essential part of any public engagement activity – it allows you to see what has been successful and what can be improved on next time.

iop.org/evaluation

Introduction

Evaluation is much more than simply asking participants to tick a few boxes on whether they enjoyed the event. A good evaluation will be an integral part of your activity, and will assess the reach, quality and impact of your project as well as ways in which you can improve future projects.

By working through the following steps in order you should be able to put together a well-thought-through evaluation that measures your activity against what it is trying to achieve.

Step by step

1. State the overall aims of the programme or activity

- Why am I doing this? What do I want to achieve?

Eg an attempt to increase the number of girls taking A-level physics

2. A description of the activity

- What it is and what is the target audience?

Eg a series of workshops to increase the confidence and resilience of girls in years 9 and 10.

3. What is the rationale

- Why do you think the activity or the programme of activities will lead to the outcome you desire?

Eg a known barrier to girls choosing physics is their fear of failure and their lack of confidence in their own ability. This programme aims to build their confidence in their own ability and their ability to cope with failure.

4. Identify your objectives

- What are the specific objectives of the particular activity?
- The objectives should be measurable and specific to the activity – aim for them to be SMART: specific, measurable, attainable realistic and time-bound.

Eg the objective would be that the girls do feel more confident in themselves.

5. Assessing objectives

- Relate back to project aims and objectives.
- What do you want to find out? Ensure the previous steps are completed before thinking about methods of evaluation.
- How much time, money and staff do you have?
- What type of audience do you need to sample? What challenges will they present?
- Don't just collect evidence of success!

In general, there should be two types of question:

- Questions that refer to operational issues. These are generally straightforward but specific. These may be addressed to teachers, students or both.
- Questions that refer to the specific objectives of the activity. These questions can be straightforward but they offer the opportunity to be more subtle. For example, instead of asking whether a student is more likely to choose physics at A-level as a result of the activity (a question known to be of very limited worth), one could ask them questions related to how they rate various careers or certain stereotypes. There may be some value in arranging for some or all of the feedback to be provided a few days after the event, since that is likely to be more objective in that the students will be less likely to offer answers they think the presenter would like.

Eg at the programme level, the ultimate data is the number of girls choosing A-level physics. At the activity level, the organisational questions can refer to the room, the clarity of the activity, levels of engagement, etc. For a series of identical workshops we wouldn't expect each one to be evaluated. In terms of the objectives, questions would be designed in partnership with psychologists and/or social scientists to tease out improvements in confidence levels.

6. Programme evaluation

- Periodic evaluation to consider whether the individual activities are delivering their objectives and to compare progress against the aims.
- What does progress along the way look like?

Eg after a few years, the results of the work at the programme level should begin to show in the figures on progression to A-level. Before then, the outcomes from the workshops can be assessed in terms of their effect on the girls' confidence levels. This process might lead to adjustments in the workshops or even the evaluation questionnaires.

7. Disseminate your evaluation

- Think about who the evaluation should be shared with – both within your branch and more widely in the IOP or with other organisations.
- Consider what lessons others would find useful.
- Evaluations can be shared via a number of different platforms, including an evaluation bank such as the British Science Association's Collective Memory, relevant mailing lists, at conferences or events, through outreach networks, and more informally with other practitioners.

A few ways of collecting information for evaluation

- **Count the number of participants**
  Stickers can help with drop-in activities that have a lot of visitors (keep the empty sheets and count the blanks) or use a tally counter.
- **Graffiti board**
  A graffiti board can help gather comments about the activity. Pin up a question or two to give some guidance on what you're after.
- **Timing interactions**
  For a drop-in activity, try timing how long people interact with you, or note whether you have repeat visitors. This is best done by a designated observer.
- **Voting**
  Use voting buttons or a show of hands to assess attitudes during a talk or workshop (you might even be able to see a change if you ask questions at the start and near the end of the activity).
- **Buckets of emotion**
  Very young participants can put a ball in a happy bucket or a sad bucket on their way out.
- **Observations**
  Get someone to subtly observe the participants during the activity and note down reactions and comments.
- **Questionnaire**
  Have participants fill out a questionnaire at the end of the activity. Sometimes an incentive (a giveaway or prize) can help get a good return rate – but be aware that people often tell you what they think you want to hear.
- **Online questionnaire**
  Give out postcards that direct participants to an online questionnaire with prizes.
- **Evaluation**
  Include the evaluation as part of the activity, for example, during a workshop with young children, you might get them to draw something related to the topic.
- **Data-mine**
  Data-mine information you already have for useful insights, for example, how many people shared your event on Twitter or asked a question on Facebook.
- **Something new**
  Use your imagination and don't be afraid to try something new – just remember to keep it linked with your aims.

For more evaluation guidance and reading we have collected together some useful resources at **iop. org/evaluation**

To find more about outreach, please contact the Outreach and Engagement team at:

Email: engagement@iop.org

Tel: +44 (0)20 7470 4800

Or find us online at: **iop.org**

WARNING

Some of our experiments use ingredients containing allergens. Please speak to an IOP demonstrator for further information if you have an allergy.

Some of our experiments use small parts, so please supervise small children.