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Demonstration Risk Assessment Form

SCIENCE IN SCHOOLS - COMMUNITY SHOW

This 45-60min long show and contains the following demonstrations:

1. Fire in Hand
2. CO_2 Candle Extinguisher AKA Stepped box
3. Flour fireball
4. Yellow pages pull apart AKA Tug of War
5. Tablecloth Trick
6. Fake eggs in an egg box
7. Can Crush
8. Film Canister Rockets
9. Lots of Canister Rockets
10. Butane Bubbles
11. Wire wool and Battery
12. E-match
13. Butane Rocket Launch

Likelihood		Severity of impact		Current risk	
Certain	5	Death or total destruction	5	**Multiply Likelihood and Severity of impact to get Current Risk rating**	
High	4	Major injury or damage	4		
Medium	3	Serious injury or damage	3		
Low	2	Minor injury or damage	2		
Very low	1	Negligible	1		

Action Rating	
10 and above	**The work is too dangerous and should not be undertaken**
8 or 9	The work is high risk. Those undertaking the work must be fully competent and experienced for the type of work, equipment to be used and fully understand all risks present.
5 or 6	Moderate risk Workers must be fully competent for the type of work and risks present, or under competent supervision.
4	Low risk. Those undertaking the work must be aware or be made aware of the risks and mitigation measures required.
2 or 3	Slight risk. Those undertaking the work should be aware or be made aware of the risks and mitigation measures required.
1	Insignificant risk. Activity suitable for all workers

ACTIONS NEEDED BY VENUE:

1. Isolate Smoke/ Fire Alarms in vicinity of demonstrations (if possible)
2. Ensure presenter knows Fire Evacuations procedure and locations of nearest ones
3. Ensure 1 x Fire Extinguisher is on Stand-by (only to be used in emergencies - should be either dry powder or carbon dioxide
4. To inform presenter/ Ri (at least 24hr prior to performance time) if any of the attendees suffer allergies to latex, eggs or tomatoes.

Risk assessed by: **Dan Plane**

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Date of last review: **March 2024**
Review date **February 2025**

Demonstration 1 : Fire in Hand

Method: Lighter fluid is added to cotton wool (enough to make it slightly damp) in a fire gadget. The lid is closed, and the gadget is held in the presenter's preferred hand. At the appropriate time the presenter flips the lid open in their hand, holds their hand out, palm up, and uses their thumb on the same hand to flick the flint, causing sparks, which ignite the lighter fluid. To extinguish the flames, the lid is flipped closed, snuffing the flames out.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Fire in hand presents burning risk	Presenter is trained and confident in how to use the equipment in such a way to keep their fingers in a safe position. Demonstration is only to be conducted by presenter.	1	2	2
Hot metal during and after the demonstration could burn hand	The demonstration should only be conducted for up to 5 seconds at a time	1	2	2
Cotton pad could fall out when flicking lid closed to attempt to extinguish the flame. This could start an unwanted fire	Presenters trained and practiced in proper use. A wire is stretched over the pad to keep it in place. Should the pad fall out, it is to be immediately extinguished. Oxygen restriction through smothering is the preferred method as fire extinguisher is likely to move the cotton pad around creating more of a hazard.	1	1	1

Flames present risk to eyes	Flames kept at arms-length by trained presenter. Presenter always in control of placement of flames. The fire is only 15cm high, so isolation of smoke alarms not needed unless they are particularly sensitive.	1	1	1
Incorrect use of Lighter Fluid can cause uncontrolled fires/explosions or toxicity Lighter fluid is a flammable liquid (UN1268) Safety data sheet can be found here: https://www.mssd14.org/UserFiles/Servers/Server_57364/File/SDS%20Materials/SDS%20Sheets/Ronsonol%20Lighter%20Fluid.pdf	When setting up the demo (dampening the cotton with lighter fluid), ensure it is being conducted in a well ventilated space. It should not be handled near any naked flames, unless during the demonstration. Hands should be washed after handling lighter fluid/the demo, with extra precautions being taken before eating or drinking. Lighter fluid fires should be extinguished using oxygen restriction, or in an emergency, dry powder or carbon dioxide extinguishers can be used.	1	2	2
Incorrect storage and transportation of lighter fluid can cause uncontrolled fire/explosion.	It will be stored in cool, dry conditions, and kept separate from any oxidizers. Lid is to be securely after use and for storage and transportation The fluid container should be inspected for visual signs of damage at regular intervals. When empty, the fluid container should not be pierced, but can be disposed of in the normal rubbish. If left unattended in a school, it should be left within a locked box.	1	2	2

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Demonstration 2: CO_2 candle extinguisher

Method: 3 tea lights are lit and placed onto a clear box with stepped shelves, one candle on each shelf. Then they pour approximately 200 ml of vinegar and 20g (one heaped teaspoon) of bicarb soda into a 3L jug. Stir quickly and leave to sit still while the reaction settles, and produces CO_2. The presenter then carefully lifts the jug and slowly pours the CO_2 onto the candles (aiming for the bottom step), taking care not to pour the liquid in the jug. The candles should go out, one at a time from the bottom to the top, as the CO_2 fills up the box.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Lighter can cause unwanted fires or burn injuries	Only presenter to use lighter. Lockable long handled lighter will be used where possible. Lighters to be stored away from flammables and oxidizers	1	1	1
Candles can cause unwanted fires or burn injuries	Only presenter to handle candles. Candles are not moved once lit and never left unattended. Ensure all candles are extinguished before moving on from the demo. Only use tealights with a stable base, and ensure the candle is upright and stable	1	1	1
Vinegar and/or bicarb can spill, causing a slip hazard	Presenter to be wary of slippery surfaces, and verbally warn any volunteers coming up on stage of potential hazard. Clean up at the earliest convenience.			

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Demonstration 3: Flour fireball

Method: A tablespoon or two of cornflour is placed in a funnel connected to a pipe. This cornflour is then blown upwards through the open flame of a blowtorch to create a short-lasting ball of fire. The blowtorch will be fuelled by butane or a butane/ propane mix

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact	Y	High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
The ball of flame may burn the face or hands of the presenter	Presenter must wear eye protection and a glove on the hand holding the funnel. They should also angle the shower head away from their face, step back as they blow into the tube.	1	3	3
The ball of flame presents a fire hazard to building, equipment and audience.	Ensure that the area around the demo is clear from all additional equipment and flammable objects. Ensure there is sufficient room (3m) above the flame without any overhanging objects. Presenter must not angle the funnel directly at the audience or other equipment.	1	4	4
Presenter blowing into the tube may result in risk of communicable diseases	Presenter to perform the demonstration with an exclusion zone from audience of at least 2m. Presenters to have their own mouthpiece, and not allow others to use the same equipment.	1	2	2

Cornflour on the floor after the demo may cause a slip hazard	Presenter to be wary of slippery surfaces, and warn any volunteers coming up on stage of potential hazard. Clean up at the earliest convenience. Limit the amount of cornflour being blown into the air.	1	3	3
The open flame of the blowtorch presents a fire hazard.	Presenter to ensure that if the blowtorch is placed on the table it is in a stable position. And also ensure that the flame is angled away from other equipment. The blowtorch must be turned off as soon as the demo is complete.	1	4	4
Incorrect use of butane and butane/propane mix can cause uncontrolled fire/explosion. The gas used will be from domestic canisters: UN 2037 Safety data sheets can be found here; Butane: http://www.farnell.com/datasheets/1801831.pdf Butane/ Propane mix: https://www.partinfo.co.uk/files/2500%20Cartridge.pdf	Goggles will be worn when using the blowtorch. When refilling blowtorch with butane, conduct in a well ventilated space. Blowtorch and butane will be sourced from a reputable supplier, but they should be inspected regularly for signs of damage Butane fires should be extinguished using oxygen restriction, or in an emergency, dry powder or carbon dioxide extinguishers can be used.	1	4	4
Incorrect storage and transportation of butane and butane/propane mix can cause uncontrolled fire/explosion.	It will be stored in a non-conductive box at a temperature below 50°C and away from sources of ignition. There will be a maximum of 8 canisters stored at one point, but mostly only 4, unless a high number of shows are needed. Due to the butane being domestic canisters and the small volume carried/ stored, no special license or labelling is needed. Ideally the box containing the butane will be lockable, so if left unattended the gas cannot be accessed by others.	1	3	3

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Demonstration 4: Friction books (Tug of War)

Method: Two large, thick books, with bolts attached to the spines, and chains coming off the metal bolts are interlaced. Ropes are attached to the chains and two volunteers attempt to pull the books apart, in the style of a tug-of-war, by taking a hold of the ropes. More volunteers come to help and pull on the ropes. The books will not separate.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Volunteers may sustain injury through falling during the tug-of-war, for instance, if a member of the other team suddenly lets go, or if a volunteer loses grip on the rope.	The presenter will be on hand to act as a 'catcher' in the event that any of the volunteers suddenly fall backwards. Volunteers are instructed to only start when cued by the presenter, and asked to stop pulling immediately once instructed by the presenter. Presenter to visually inspect that the pages are securely interlaced prior to the start of the demo. In addition, the volunteers will be instructed to not pull each other and to concentrate on working together rather than as if they are separate teams (i.e. the volunteers work together against the books). They will also be instructed to take a wide stance to minimise the probability that they will fall.	2	2	4
Friction burns from rope.	Presenter will instruct volunteers not to wrap the rope around their hands or arms.	2	2	4

Chains and clips present a finger trapping risk.	Volunteers closest to the book are instructed not to touch the metal parts and only hold the ropes.	1	1	1

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Demonstration 5: The tablecloth trick

Method: A silky/satin tablecloth is set with a variety of heavy objects, such as a cup and saucer, bowl etc. A volunteer is briefed on how to pull the tablecloth out (pull down, not out), leaving the objects on the table

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Flying crockery and cutlery may cause impact injury	Presenter will brief the volunteer and audience in the correct method in doing the demo (that is, rapidly remove the cloth with a snatch/fast movement rather than slow pull, downwards below the table height). Presenter will ensure the volunteers head is above the height of the table setting. Crockery and cutlery are heavy, and the tablecloth has a low friction coefficient, and as such the likelihood of flying items is minimal.	1	3	3
Crockery may fall on the ground and break, presenting a trip hazard, or injury	Presenter to ensure all broken crockery is to be picked up and disposed of as soon as possible.	1	2	2
Volunteers could injure hands on the table when pulling the table cloth hard	Volunteers instructed to keep hands below/away from the edge of the table so they do not hit their knuckles on the table in the downward motion	1	2	2

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Demonstration 6: Fake egg drop

Method: Fake eggs (rubber bouncy eggs) in an egg carton are shown to the audience and then 'accidentally' dropped on the floor

	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
Those at risk	Y		Y		

PPE Requirements

Item		Item		Item		Item	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	Mitigation	Likelihood	Severity of Impact	Current Risk
The fake eggs are made of hard rubber, are quite heavy and due to their shape their bounce is unpredictable, so could go into the audience, causing mild impact injury	Eggs are dropped, not thrown, to minimise force. Eggs are dropped a minimum of two metres away from the audience to minimise risk of them bouncing into them.	2	1	2

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Demonstration 7: Can crush

Method: An empty aluminium drink can is filled with 1-2cm of water and then heated using a blowtorch. When the water is boiling rapidly enough that the can must be filled with steam, the can is grabbed with tongs and immediately placed upside down (hole down) in a bowl of cold water, causing the steam to condense to water.
The difference in pressure between the inside and outside of the can allows the atmospheric pressure to crush the can.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact	Y	High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Touching the hot can or coming into contact with the hot water can cause burn injuries	Presenter to ensure they are trained in and are confident in performing the demo (holding the tongs that allow for easily turning the can upside down) The can is to be handled using the tongs. Do not touch the can immediately after the demonstration (unless using tongs or with heat proof gloves) Before the show, visually inspect the can for signs of puncture or other damage that could result in hot, boiling water leaking out. Ensure that the bowl of water (into which the can will be upturned) is nearby, with no obstructions, to minimize the risk of boiling water spilling. Can of boiling water should not be carried around the stage area.	1	4	4
Steam presents a risk of burns, especially to eyes	Eye protection must be worn	1	4	4

Spilt water can create a slip hazard	Presenter to be wary of slippery surfaces, and warn any volunteers coming up on stage of potential hazard. Clean up at the earliest convenience.	1	3	3
The open flame of the blowtorch presents a fire hazard and risk of burn injury	Presenter to ensure that if the blowtorch is placed on the table it is in a stable position. Ensure that the flame is angled away from other equipment, and no flammable items are nearby The blowtorch must be turned off as soon as the demo is complete.	1	4	4
Incorrect use of butane and butane/propane mix can cause uncontrolled fire/explosion. The gas used will be from domestic canisters: UN 2037 Safety data sheets can be found here; Butane: http://www.farnell.com/datasheets/1801831.pdf Butane/ Propane mix: https://www.partinfo.co.uk/files/2500%20Cartridge.pdf	Goggles will be worn when using the blowtorch. When refilling blowtorch with butane, conduct in a well ventilated space. Blowtorch and butane will be sourced from a reputable supplier, but they should be inspected regularly for signs of damage Butane fires should be extinguished using oxygen restriction, or in an emergency, dry powder or carbon dioxide extinguishers can be used.	1	4	4
Incorrect storage and transportation of butane and butane/propane mix can cause uncontrolled fire/explosion.	It will be stored in a non-conductive box at a temperature below 50°C and away from sources of ignition. There will be a maximum of 8 canisters stored at one point, but mostly only 4, unless a high number of shows are needed. Due to the butane being domestic canisters and the small volume carried/ stored, no special license or labelling is needed. Ideally the box containing the butane will be lockable, so if left unattended the gas cannot be accessed by others.	1	3	3

Demonstration 8 & 9: Film Cannister rocket(s)

Method – Film Canister Rocket: About 2cm of water is added to an empty film canister. Very quickly, a fizzy tablet (alka seltzer, aspro clear, steradent etc. but ideally clear) is dropped into the canister, the lid secured, the canister shaken and placed upside down on a flat surface. As the tablet dissolves, it releases CO_2, increasing the pressure inside. Eventually, the canister pops off the lid, releasing the pressure and sending the canister flying up like a rocket.

Method – Multiple Film Canister Rockets: Before the show, canisters with a small tube and platform are laid out in a tray. About 2cm of water is added to each canister, and half a fizzy tablet placed on the platform (note: ensure the water level is below the tablet – the tablet should not be touching any water at this stage). The lid is secured onto each canister and then the canister is placed on an upturned box lid, when all canisters are prepared, the box is placed over the canisters and fixed to the lid. To perform the demonstration, the whole box is flipped upside down onto the ground (or other suitable flat surface), and the lid taken away; the fizzy tablets inside the canisters should have come into contact with the water, and be reacting as in the first demo, with all canisters being contained in the box until they fly out. Each of the film canisters should pop off randomly.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection			

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**

As the canisters pop off with speed, they could hit someone, causing impact injury	Presenter is practiced and confident in performing the demo. When volunteers are involved, presenter gives clear instruction to perform the actions very quickly. Perform the demonstrations at least 1m away from audience. No one is to ever be above an 'armed' rocket to avoid being hit in the face with the canister. If a rocket does not pop off, carefully grab the canister by sliding hand along the surface it is on and uncapping lid – never grab the canister from above, even if the demo appears to have failed. Perform the demo with fewer rockets first, allowing audience to be prepared for multiple flying rockets.	1	2	2
Fizzy tablets could contain sodium bicarbonate, citric acid, aspirin and/or paracetamol. The acid may sting if the solution gets in eyes. Paracetamol and/or aspirin may cause allergic reaction.	If solution gets in eyes, rinse with water. Risk is low so goggles are not required, but can be worn by presenter if necessary. Presenter is to say what the tablet is, as a warning for audience members who may have an allergy.	1	2	2
Water spilt (from rocket launch or accidental spillage when filling the canister) may create a slip hazard	Perform the demo on a table, and keep the multiple film canister rocket in the box to contain the water Presenter to be wary of water on surfaces, and verbally warn any volunteers coming up on stage of potential hazard. Clean up spills at the earliest convenience	1	3	3

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Demonstration 10: Butane Bubbles

Method: A plastic bowl is half filled with water with a little bit of washing up liquid (Fairy Liquid is best). Butane is dispensed by pushing the can into the base of the bowl, from a domestic canister into that soapy water such that butane filled bubbles are created. These bubbles are lifted by a long handled frying scoop and set on fire using a long-handled gas lighter. A volunteer from the audience will be holding the frying scoop.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y	Y	Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact	Y	High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			Y
		Laboratory Coat	Y	Eye protection	Y		

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Intentional ignition of butane presents a risk of accidental fires and burns to people	The butane will be lit on a long handled frying scoop. It will not be lit overhanging the remaining butane bubbles. Flammables items will be placed at least 1m away from the bubbles. The headspace above the bubbles will be checked for flammable items, including the ceiling (3m clearance minimum). A fire extinguisher and blanket will be on standby. The smoke/ heat alarms should be isolated if present. In addition, the table on which this demonstration is performed will be covered in a fire blanket. The volunteer will be wearing a face shield and heat proof gloves. They will be verbally warned that the fire will be relatively long lasting and that they are to keep hold of the panel. If the venue ceiling is particularly low, then this demonstration can be performed with the fire blanket on the floor if necessary.	1	5	5

Butane fire can cause burn injury to persons	The presenter will wear goggles and perform the lighting with a long-handled lighter. The volunteer will wear a faceshield and heat proof gloves and will hold the paddle at arms' length. The presenter will be trained in how to hold the volunteer at the elbow/ hold the paddle to ensure that the volunteer does not move their arms during the demonstration. It will be ensured that the volunteer has no 'dangling' items such as scarf, ties or loose hair. If so, these will be removed or tied back before conducting the demonstration. Alternatively, the presenter's labcoat can be used on the volunteer.	2	2	4
Incorrect working with Butane can create fires and injury to persons The Butane used will be from domestic canisters: UN 2037 Safety data sheet can be found here; Butane: http://www.farnell.com/datasheets/1801831.pdf Butane/ Propane mix: https://www.partinfo.co.uk/files/2500%20Cartridge.pdf	The butane used is available domestically, it is used as a lighter refill, however it should still be treated with respect. It will be sourced from a reputable supplier and canisters inspected for damage before use. Goggles will be worn when using the blowtorch Butane can be extinguished using either dry powder or carbon dioxide extinguishers, though these will only be used in an emergency, with oxygen restriction being used as our preferred method.	1	4	4
Incorrect storage and Transportation of Butane can create fires and injury to persons	It will be stored in a non-conductive box at a temperature below 50^{o}C and away from sources of ignition. There will be a maximum of 8 canisters stored at one point, but mostly only 4, unless a high number of shows are needed. Due to the butane being domestic canisters and the small volume carried/ stored no special license or labelling is needed. Ideally the box containing the butane will be lockable, so if left unattended the gas cannot be accessed by others.	1	3	3

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Demonstration 11: Wire wool and battery

Method: Wire wool is teased out and placed in a Pyrex bowl and a 9V battery is held to the wire wool to intentionally short the battery and set wool on fire. Once the wire wool is alight, the battery is removed.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact	Y	High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
The demonstration may cause a risk of electrical injury	Presenter to visually inspect the battery for signs of leakage or damage. Only batteries in good condition are to be used. Presenter to be trained and confident in performing the demonstration. Only those trained are to perform the demonstration.	1	3	3
The demonstration may create unwanted fires, or become uncontrolled	Ensure the demonstration is performed on a sturdy surface, in a Pyrex bowl with no signs of stress or damage. The fire should be left to burn out, or extinguished with oxygen restriction. In an emergency, dry powder or carbon dioxide extinguishers can be used. Do not leave the fire unattended; presenter to ensure the fire is extinguished before moving on from the demonstration The wire wool and battery are to be stored separately in a cool, dry place.	2	2	4

Pieces of flaming steel or ash may cause eye injury	Presenter to wear eye protection. Do not perform the demo in very windy conditions	2	3	6
Bowl will become hot and create a risk of burns	If handling the bowl, gloves are to be worn	3	2	6

Demonstration 12: E-match

Method: an E-match is hooked up to a 9V battery, and their effect is demonstrated to the audience (small explosion with sparks)

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection		Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Sparks from E-match may cause burn or eye injury	Presenter to be trained and confident in performing the demonstration. Only those trained are to perform the demonstration. Presenter should angle the e-match away from their own face, but not directly towards the audience Goggles to be worn by presenter. Demonstration is to be performed at least 2 meters away from audience.	1	3	3

Incorrect handling of E-matches can create unwanted fires/explosions UN0454 Safety data sheet can be found here: https://respyro.com/wp-content/uploads/2018/01/Electric-Match-NPB.pdf	E-matches are electronic matches, categorized at 1.4s explosives. Goggles will be worn at all times when handling them. They are to be kept away from sources of ignition and static prior to lighting. Hands will be washed after handling and before eating. Advised fire fighting method is to flood with water if a small number of pieces are involved. Do not use the suffocation method as the e-matches contain an oxidizer. Once fired, the ematches can be disposed of in the normal rubbish. Good practice is to tie a knot in the e-match to denote it has been used.	2	3	6
Incorrect storage and transport of E-matches can create unwanted fires/explosions	As the law dictates they will be stored in their designated UN box, sealed with tape, away from members of the public. They will be kept away from heat and open flame and stored in a cool, dry place. A maximum of 100 e-matches will be stored at any one time. Although they are pyrotechnics, no licence is needed as the net explosive content (NEC) is well below the 5kg limit. They should not be left unattended when in public.	2	3	6

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Demonstration 13: Butane Rockets

Method: A 1ltr PET bottle has 50ml of butane gas placed inside it using a syringe and gas canister (invert push nozzle into the hub/tip of the syringe). This is then pushed tightly onto a cork that is gripped in a PTFE plastic T-junction and in turn held by a cork lined clamp on a retort stand. A small hole is drilled through the cork to allow an e-match to be inserted into the bottle - connected to a button to fire the rocket. A number of bottles can be set up to launch all at once.

Those at risk	Ri Staff	On-Stage Volunteers	Audience	Non-Ri Workers	Others
	Y		Y		

PPE Requirements

Item		**Item**		**Item**		**Item**	
Flameproof overalls		Gloves contact		High visibility		Waterproof clothing	
Hardhat		Dust Mask		Gloves chemical		Wellington boots	
Hearing protection	Y	Mask chemical vapour/mist		Safety shoes			
		Laboratory Coat		Eye protection	Y		

Hazards and risks	**Mitigation**	**Likelihood**	**Severity of Impact**	**Current Risk**
Lighting the butane or touching the bottle after firing could cause burn injury	Ignite the rocket remotely using an e-match, so that the presenter is not immediately next to the rocket when it fires. The bottles will not be aimed directly at the audience (to the side, or upwards) – this will allow the bottle to cool down by the time it falls towards the audience.	1	3	3
Sparks and flames from the rocket launch present a risk of injury to eyes	Demo to be performed a minimum 3m away from the audience. Presenter and volunteer to wear eye protection	1	4	4
Firing of the rocket may cause hearing damage	Presenter and any volunteers to wear hearing protection. Presenter to instruct audience to cover their ears.	2	2	4

Bottle as a projectile may cause impact injury	Bottle rocket will not be aimed directly at the audience The demonstration is to be performed at least 2m away from the audience. Presenter to ensure that the clamps are securely holding the T-junction in place.	1	2	2
The retort stand may fall, causing impact injury	The base of the retort stand must be secured to the table using clamps	1	2	2
Wires from the E-match can cause trip hazard	Presenter to ensure wires remain neat and not trail on the ground. Wires are to be picked up as soon as possible and not left on ground, in case people walking up to stage at the conclusion of the show does not trip on them.	1	2	2
Incorrect handling of E-matches can create unwanted fires/explosions UN0454 Safety data sheet can be found here: https://respyro.com/wp-content/uploads/2018/01/Electric-Match-NPB.pdf	E-matches are electronic matches, categorized at 1.4s explosives. Goggles will be worn at all times when handling them. They are to be kept away from sources of ignition and static prior to lighting. Hands will be washed after handling and before eating. Advised fire fighting method is to flood with water if a small number of pieces are involved. Do not use the suffocation method as the ematches contain an oxidizer. Once fired, the ematches can be disposed of in the normal rubbish. Good practice is to tie a knot in the e-match to denote it has been used.	2	3	6

Incorrect storage and transport of E-matches can create unwanted fires/explosions	As the law dictates they will be stored in their designated UN box, sealed with tape, away from members of the public. They will be kept away from heat and open flame and stored in a cool, dry place. A maximum of 100 e-matches will be stored at any one time. Although they are pyrotechnics, no licence is needed as the net explosive content (NEC) is well below the 5kg limit. They should not be left unattended when in public.	2	3	6
Incorrect use of butane and butane/propane mix can cause uncontrolled fire/explosion. The gas used will be from domestic canisters: UN 2037 Safety data sheets can be found here; Butane: http://www.farnell.com/datasheets/1801831.pdf Butane/ Propane mix: https://www.partinfo.co.uk/files/2500%20Cartridge.pdf	Butane will be sourced from a reputable supplier, but they should be inspected regularly for signs of damage The fire should be left to burn out. However, butane can be extinguished using oxygen restriction. In an emergency, dry powder or carbon dioxide extinguishers can be used.	1	4	4
Incorrect storage and transportation of butane and butane/propane mix can cause uncontrolled fire/explosion.	It will be stored in a non-conductive box at a temperature below 50°C and away from sources of ignition. There will be a maximum of 8 canisters stored at one point, but mostly only 4, unless a high number of shows are needed. Due to the butane being domestic canisters and the small volume carried/ stored, no special license or labelling is needed. Ideally the box containing the butane will be lockable, so if left unattended the gas cannot be accessed by others.	1	3	3