



Demonstration Risk Assessment Form

SCIENCE IN SCHOOLS- FEEL THE POWER SHOW

JUNE 2019

Demonstrations include:

1. Carbon Arc Lamp
2. Electrocuting a Gherkin
3. Electron Atom Demo
4. Hand generator with Microdet
5. Large electromagnet
6. Small electromagnet
7. Static electricity
8. Wire Wool
9. Van de Graaf Generator

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
2. Ensure 1 x Fire Extinguisher is on Stand-by (only to be used in emergencies - should be either dry powder, carbon dioxide or water spray (not jet))
3. Ensure presenter knows Fire Evacuations procedures
4. Ensure presenter know location of nearest fire extinguishers

Risk assessed by: Fran Scott
Date of last review: 06/06/2019
Review date: 05/06/2020



General Risks Throughout the Show

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Activity	Hazards	Mitigation	L i k e l i h o o d	S e v e r i t y o f i m p a c t	Current Risk
	Electrical hazards The show uses a variety of electric items; some off-the-shelf, some not.	All electrical items will be visually inspected prior to the shows. Where appropriate the items will also be PAT tested	1	4	4
	Manual handling	Some of the apparatus used in this show is heavy, and hence correct lifting procedures (bending at the knees) should be used at all times.	1	3	3
	Tiredness (particularly driving) As the presenting will be driving to and from the venue there is risk of driving whilst tired.	The Ri will ensure that the presenter's schedule is such that they are not tired whilst on the drive to or from the venue. The presenters are actively encouraged to take a break before the return journey if needed.	1	4	4

Demonstration: Carbon Arc Lamp

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
<p>The mains electricity supply will be passed across the gap between two carbon electrodes, creating an electrical arc which will emit lots of light.</p> <p>There are two slight variations of this apparatus; one which uses DC, the other AC. They both operate in similar ways (the difference is due to slight difference in the carbon rods used. Older rods = AC, Newer rods= DC).</p>	<p>By necessity for the demonstration, there will be surfaces/contacts electrified to mains voltage, which are either completely exposed or not insulated/enclosed to the standard required by electrical regulations.</p> <p>This creates a significantly enhanced risk of mains electric shock to users of the apparatus and those nearby, which could cause injury or even death.</p>	<p>The apparatus will be unplugged and stored away from access at all times, other than immediately as being demonstrated. Only the presenter and assistants will handle the apparatus, or go near it while any plugged in. The presenter must have experience with the apparatus and know how to handle it. He or she will immediately unplug it and make it safe after presenting it.</p> <p>This demonstration will be performed at a minimum distance of 2m away from the public.</p>	2	4	8
	<p>The electric arc will emit a small amount of UV radiation, which may be harmful to eyes with prolonged (yet short) exposure.</p>	<p>The arc will only be displayed briefly, so exposure to UV radiation will be slight. Nevertheless a polycarbonate safety screen will shield the apparatus, which will absorb the majority of the radiation.</p> <p>Audience will also be warned about the brightness, and asked not to stare at the arc.</p> <p>The presenter will wear welding goggles and a long sleeved top or sunscreen (as they endure repeated exposure).</p>	5	1	5
	<p>Accidentally operation and therefore risk of electrocution.</p>	<p>The apparatus is controlled by a foot pedal, with the apparatus only being able to operate when this pedal is pressed. An led light will indicate when the apparatus is 'live'.</p> <p>The apparatus will not be left plugged in whilst unattended.</p>	5	1	5



		If unattended the foot pedal will be placed in a different area so that passers-by cannot operate the apparatus.			
	Non-standard electrical device. As this is a specially designed piece of apparatus there is risk (as will all electrical items) that is could provide an electrical hazard.	<p>Apparatus will be inspected for damage before each use, with all damages being reported and the apparatus not used if deemed damaged or there are pieces missing.</p> <p>The apparatus will never be left unattended with the power lead connected. If the apparatus will be unattended for any length of time remove the power will be removed completely. The apparatus will not be worked on (including fitting the electrodes) with the power lead connected.</p> <p>A fan heater is used as a current sink to ensure the correct current is fed to the apparatus.</p> <p>It will be ensured that the apparatus is placed on a stable surface.</p>	4	1	4
	The carbon rods and the arc will be very hot to the touch	Under NO circumstances is the operator touch the arc during operation, and in addition the carbon rods will not be touched for at least 10mins after operation has ceased.	3	1	3
	Igniting surrounding flammables	As this demonstration is performed as part of a show which contains flammables items, accidental ignition could occur. Therefore the apparatus will be operated a minimum of 1m away from flammable items.	5	1	5

PPE Requirements

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

Demonstration: Electrocuting a Gherkin

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
<p>A gherkin will be subjected to mains voltage, resulting in a strong electrical discharge through the body of the gherkin.</p>	<p>By necessity for the demonstration, there will be surfaces/contacts electrified to mains voltage, which are either completely exposed or not insulated/enclosed to the standard required by electrical regulations.</p> <p>This creates a significantly enhanced risk of mains electric shock to users of the apparatus and those nearby, which could cause injury or even death.</p>	<p>The electric circuit will contain two push-to-make switches which independently break the supply of the live phase – ie both switches need to be held down in order to electrify any exposed contacts.</p> <p>The risk to people other than a single user of the apparatus is partly mitigated by these switches, in that they ensure that the circuit is only made when wanted, and is very unlikely to be accidentally or inadvertently connected. However, someone unaware of the hazard, could in principle try to touch the apparatus while in use. All present should therefore be made aware that they are not to approach the demonstration while it is in use.</p> <p>This demonstration must only be performed by presenters experienced with the apparatus,</p>	2	3	6



		and who completely understand all the risks. When unattended the power lead will be removed from the apparatus.			
	It is not easy to determine how much current may be drawn by the apparatus while in use. This creates the possibility of blowing fuses or tripping RCDs in the mains supply.	The possibility of an excessively high current being drawn will be eliminated by using a resistor wired in series with the rest of the circuit. This resistor will be in the form of a domestic appliance, such as kettle – which is ideal in that it will pass a high enough current for the demonstration to work well, but cannot not pass any more than it would in normal operation, and will also dissipate any excess heat very effectively.	2	2	4
	The demonstration may give off some smoke.	Smoke detectors in the vicinity of the demonstration should be turned off where possible, or other steps taken to ensure that the fire/ smoke alarms are not activated by smoke. This demonstration should not be performed within a small, confined space.	4	1	4

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		Sun screen	
		Laboratory Coat		Eye protection	Y		

Demonstration: Electron Atom Demo

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
One teacher and four children recreate the movement of the electrons in an atom.	Volunteers may trip as they walk around stage area or bang into demonstrations on stage.	Presenter must ensure all demonstrations and apparatus are safely and securely placed on tables and all floor space leading to and including activity is clear of trip hazards.	2	2	4
	May trip on plastic balls used during demonstration.	All balls to be picked up from the floor as soon as this demonstration is finished.	2	3	6

Demonstration: Hand Generator with Microdet

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
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Hand cranked generator is used to build up a voltage which ignites a squib (microdet). This ignition of this microdet (an off-the-shelf pyrotechnic) causes a loud bang.	Strong Magnets: The magnet used here is extremely powerful. It will attract ferromagnetic objects very strongly, sufficiently to cause injury to body parts caught in the way. This can happen very suddenly and very rapidly. If two such magnets are allowed to come together, they may cause severe crushing injuries, especially to fingers, which may even be severed. Even if they fly together without trapping fingers they may shatter from the impact and project shards of magnet through the air.	<p>The generator has been built by a respected prop builder and supplied to us with a full users' guide.</p> <p>During transport, storage and when not in use, the magnet will be aligned with the end plates which form the structure of the generator. That way they will stay in place and attract minimal extraneous material.</p> <p>It will also be ensured that the operator of the generator (presenter or volunteer) does not have any medical equipment on them that will be affected by strong magnetic fields. Others will be kept at a distance of 2m.</p>	3	3	9
	Impact Injury: As the generator is weighty, it could cause damage is it falls	The generator will always be placed on a stable table away from the edge	1	4	4
	Lifting Injury: As the generator is weighty, lifting it could cause damage is not undertaken correctly	It will only be lifted by our presenters, all of which are trained in the correct (bending the knees) procedure.	1	3	3
	Squib (microdet) creates loud explosive noise and amount of shrapnel on ignition	All audience to be advised to cover their ears ahead of explosion. Those with sensitive hearing to be advised to leave the room. Presenter to wear ear defenders. Protective shield to go in front of squib to protect audience from cardboard pieces released from the shell. Audience to be at a minimum of 3 meters distance from squib.	2	4	8



	<p>Working with Microdets (pyrotechnics):</p> <p>Microdets (also known as squibs) are small pyrotechnics. Classification 1.4G (UN0431)</p> <p>http://www.lemaitreltd.com/p/Microdets/0zzjc%5B%5DyA98g</p> <p>http://www.lemaitreltd.com/_includes/images/uploads/ecommerce/documents/SDS%20Flash%20Reports,%20Miroons%20and%20Microdets%20(2017)%20-%20u5n52btf.ksd.pdf</p> <p>They are small cardboard tubes filled with aluminium powder, magnesium powder and an oxidizer with a remote igniter.</p>	<p>Microdets to be sourced from a reputable supplier (Le Maitre). When handling Microdets, goggles are to be worn at all times and there will be no naked flames, smoking or eating within the immediate area.</p>	2	4	8
	<p>Storage and Transporting Microdets:</p> <p>As microdets are classified as a pyrotechnics there are rules and regulations governing their storage and transport.</p> <p>http://www.legislation.gov.uk/ukxi/2014/1638/content/made</p>	<p>Microdets are classified as category 1.4G (the second lowest – safest- there is).</p> <p>The law states that if NEC (net explosive content) is lower than 5kg then no licence is needed. We will always ensure that the NEC is well below this limit. Each microdet has a NEC of 0.15g, therefore we could need to carry over 30,000 of them to exceed this limit (we normally carry 24 as a maximum)</p> <p>Microdets will always be stored and transported within a corrected labelled (1.4G) UN box. They will be kept in a cool, dry location, away high temperatures, shock, static discharge, vibrations or other physical stresses that might result in a hazardous situation.</p>	2	4	8



	<p>Non-Standard Ignition System:</p> <p>As we are using a non-standard ignition system we need to take care to avoid premature ignition.</p>	<p>Premature ignition will be negated with the use of a 'circuit connecting system'. Until the button is pressed on this 'circuit connecting system', no connection will be made between the generator and the microdets and so no ignition will occur.</p> <p>IN THE EVENT OF A MISFIRE the following procedure will be followed:</p> <ol style="list-style-type: none">1. The audience will be instructed to keep their hands over their overs.2. One wire from the microdets will be disconnected from the generator.3. Audience can stand at ease4. Another microdet will be loaded on the laboratory stand.5. And the normal procedure then followed.	2	4	8
	<p>Disposing of Microdets</p>	<p>Once fired the microdets can be disposed of in the normal rubbish.</p> <p>If a misfire occurs and the microdet doesn't fire, it will be disposed of according to advice from the supplier. Therefore it will be immersed in water for 24 hours (ensuring that they are sunk under the surface of the water) and that any paper tops so should be pieced so that the water can easily permeate the device. After which they can be disposed of in the normal rubbish.</p>	1	2	2

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		

Demonstration: Large electromagnet

Those at risk	Ri Staff	Contractors	Tenants	Visitors	Others
(please tick)	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
An off-the-shelf large electromagnet is connected to power supply. Two volunteers attempt to separate the electromagnet. While it is switched on.	As a 9v battery is used for the demonstration with delicate wires, there is risk of a small electric shock.	Only the presenter will handle the battery and place it into the electromagnet. The device is powered simply by a 9V battery, therefore if a shock does occur, it will be uncomfortable rather than dangerous.	1	2	2
	The volunteers may fall over once the electromagnet is turned off, or if the battery fails during operation	The volunteers will be warned that the apparatus may separate, and advised to take the appropriate stance. The presenter will position the volunteers in such an area of the stage such that if they do fall, they will do so in	2	2	4



		an area clear of obstacles.			
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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			

Demonstration: Small Electro Magnet

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
Electricity will be run through a wire via either a power pack or from a battery. This wire is wrapped around a nail. This induces a magnetic field in the nail which can be used to pick up smaller nails/paperclips.	Sharp edges	The nail(s) used will be blunted using sandpaper if necessary.	1	1	1

PPE Requirements

Item		Item		Item		Item	
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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			

Demonstration: Static electricity

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
Two volunteers use plastic rods and combs to build up a static charge to attract balloons and pieces of paper to the plastic rods.	Volunteers could poke themselves using the rod or comb.	Show volunteers how to correctly rub the rod/comb. Supervise the volunteers rubbing.	2	1	2
	Volunteers could receive a small shock from the static charge	The spark felt will be uncomfortable rather than at all dangerous.	2	1	3

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			

Demonstration: Wire Wool

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	



Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
Wire wool is held across the terminals of a battery to intentional short circuit the battery. As the electricity flow through the wire wool, the resistance is enough to cause the wire wool to catch light.	By necessity for the demonstration, there will be contacts electrified to battery voltage. There is a risk of electric shock to presenter.	This demonstration will only be performed by the presenter. In addition it will be a 9V battery used, therefore any shock will uncomfortable rather than dangerous.	3	1	3
	Fire spreading	This demonstration will be conducted either with a small piece of wire wool, or on a larger piece contained within a pyrex bowl. Either way the area in the immediate vicinity of the performance of his demonstration (1m) will be clear of other flammables. The fire/ smoke alarms should be isolated.	2	2	4
	Accidental ignition	The battery will be stored in a non-conductive box away from the wire and only positioned next to it during this demonstration.	1	4	4
	Shorting a battery In this demonstration, the battery is deliberate shorted. This could cause the battery to get hot.	The battery only need to be shorted for a very short period of time (1-2seconds). This short time is not enough to cause serious heating of the battery. However, before conducting the demonstration the battery used will be visually inspected to ensure that it is not damaged in any way.	2	2	4

PPE Requirements

Item		Item		Item		Item	
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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			

Demonstration: Van De Graaff Generator

Those at risk (please tick)	Ri Staff	Contractors	Tenants	Visitors	Others
	Y			Y	

Method Statement	Hazards	Mitigation	Likelihood	Severity of impact	Current Risk
<p>A van de graaf generator is used by the presenter to create some sparks. Then some (approx. an 8cm high pile) small metal pie dishes are placed on the large dome of the van de graaf generator and so when the van de graaf is switched on the pie dishes will all gracefully fly off.</p> <p>In addition a toy doll will be placed on top of the dome of the van de graaf generator, with their hair raising into the air once the device is switched on.</p>	Electrical fault	Ensure van de Graaff is in fully working order. The Van de Graaff will either be brand new (less than 6months old), or will be PAT tested.	1	1	1
	Trip hazard	If the wires are trailing over the stage they will be secured with gaffer tape.	1	1	1
	Static Shock	Only the presenter will be on stage when the Van de Graaf is switched on. All the presenters are fully trained in how to use a Van de Graaff generator and will ensure that the earthing globe/ earthing wires are used when necessary. They have no heart conditions that prevent them from using such equipment.	3	1	3
	Working with High Voltage Apparatus	As this machine uses high voltage it should not be used near those with pace makers or other electrical based health monitors, therefore the audience will be warned that if they do have a pacemaker to stand back at least 3metres from the apparatus.	1	5	5

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	



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