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# STEM bulletin

Supporting STEM for all Local Authorities through advice, ideas and inspiration

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# Our Growing Brain

**The GTCS Professional Standards outline our responsibility to support Scotland's young people to "develop skills for learning, life and work". At SSERC, our three strands of activity (professional learning, the advisory service and wider STEM engagement) can link together to create learning opportunities that celebrates this vision for education.**

In celebration of British Science Week (BSW) 2022, the professional learning and STEM Ambassadors in Scotland (SAiS) teams worked together to create an online event called "Our Growing Brain", embracing this year's theme of "growth". Teachers representing many local authority areas across Scotland engaged with the event, which boasted a panel of STEM Ambassadors who shared their experiences working within their respective sectors.

## Online SSERC Meet

Erin Cowley (University of Dundee) shared classroom resources she developed on Motor Neuron Disease (MND), supported by the University of Dundee and MND Scotland. Michael Stringer, from the Centre for Clinical Brain Sciences at the University of Edinburgh, explored the development of magnetic resonance imaging (MRI) for the diagnosis and treatment of disease and for understanding the impact of ageing on brain structure and function. Finally, John Morgan, a PhD student from the University of Strathclyde, supported aspects of the Higher Human Biology curriculum by sharing new research into cholesterol-targeted drug treatments for brain tumours. The event was recorded and presenter resources are available for download [1]. These fabulous STEM Ambassadors form part of a growing community of professionals who love to support classroom activities. Visit the SAiS website [2] for more information.

## Our Growing Brain resource pack

A resource pack [3] was developed by SSERC featuring six curriculum-linked activities, suitable to support CfE Third and Fourth Level Science Experiences and Outcomes (e.g. *SCN 3-12a*), and National 5 and Higher Human Biology in their respective key areas on the nervous system.

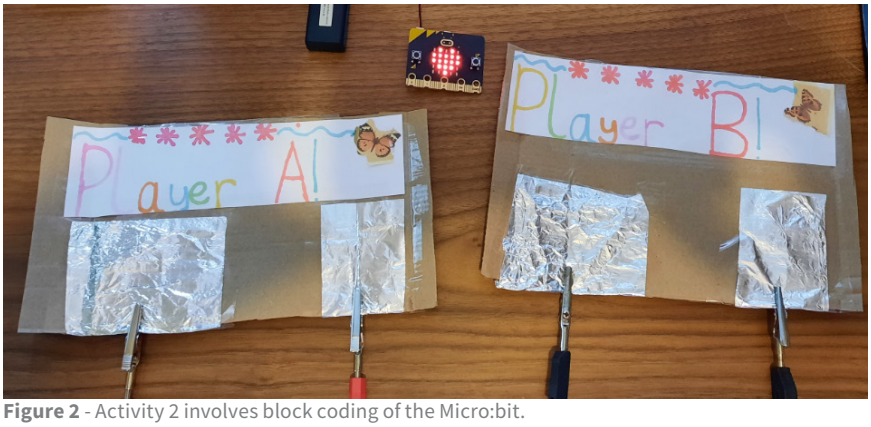



**Figure 2** - Activity 2 involves block coding of the Micro:bit.

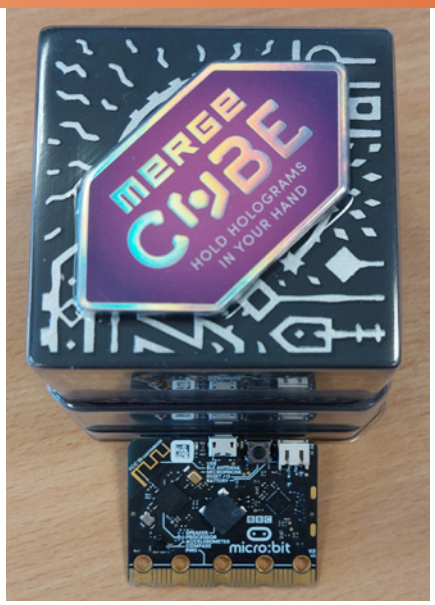



**Figure 1** - Merge Cube and Micro:bit.

## Activity 1 & 2
## Use of digital technology

In December 2021, Sarah Clark from Queen Anne High School in Dunfermline led a SSERC Meet on the use of digital technologies in the classroom. Inspired by her practice, SSERC developed two activities using Merge Cubes and Micro:bits (Figure 1) to support exploration of the human brain using digital technologies.

Using a Micro:bit, activity 2 offers a digital approach to the classic "ruler drop" reaction test. This 2-player activity is an entertaining and competitive alternative that involves block coding before game-play can commence. The resource includes a "how-to" video and text instructions for coding the Micro:bit and constructing the game boards. As shown in Figure 2, the coding instructs the Micro:bit to display a heart within a specified time frame; the first player to touch their left "button" in response to the heart display wins the point. In 2016, every S1 learner attending a Scottish secondary school was issued with a Micro:bit. Many schools have a supply of these so it is worth investigating if there is a rogue box lying dormant somewhere. Alternatively, Kitronik are a reputable supplier and the Digital Xtra Fund welcomes applications for funding of specific projects. >>

### Activity 3
### Can our brain make us do things we didn't mean to?

Education Scotland's Science benchmark document outlines our responsibility to support young people develop informed opinions on STEM issues. Here, learners consider the impact of brain injury or damage on an individual's behaviour and challenges the idea of responsibility and free will. The activity follows the story of Charles Whitman who, in 1966 murdered several people. The disturbing content of the story could make this more appropriate to senior classes and consideration of videos should be made prior to showing learners.

### Activity 4
### Explore the effect of sleep on our memory

Memory is a key area of the Higher Human Biology curriculum and activity 4 explores the link between sleep duration and short-term memory span – perhaps an interesting experiment to do from a health and wellbeing point of view with your teenage, sleep-deprived learners too. Ethical considerations central to a human study, as featured within the AH Biology curriculum, and appropriate sampling strategies are explored. Learners can make their own copy of a sample "Participation Form", covering themes of "informed consent", "confidentiality", and the "ability to withdraw", and a link to a suitable online memory test. Once learners have conducted their study, a Google Sheet is available to record their data and draw conclusions, while considering the principles of causality versus correlation (Figure 3).

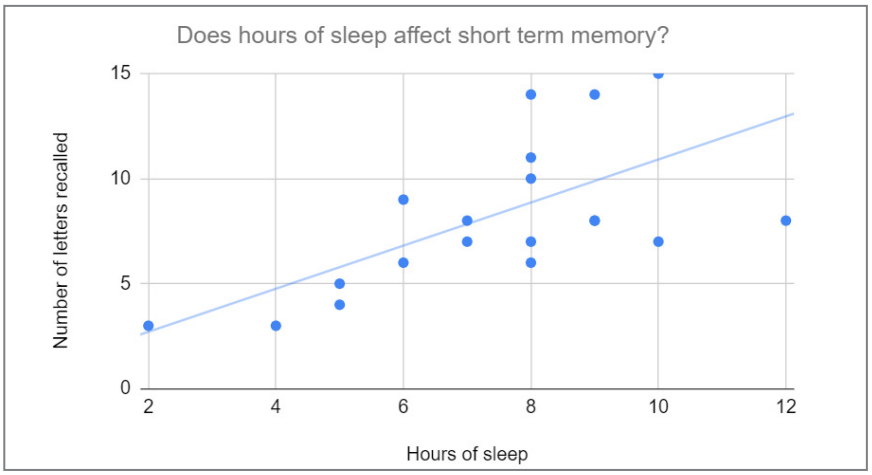
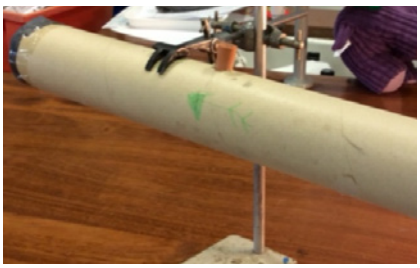



**Figure 3** - Activity 4 investigates a possible link between sleep duration and short-term memory.

### Activity 5
### Are certain behaviours hard-wired in our growing brain

Working with organisms in the classroom can be a rare but exciting opportunity for learners. Prior to any investigative work, you should carry out a risk assessment using the SSERC Code of Practice, "Materials of Living Origin" [4]. This investigation explores the effect of light on maggot behavioural rules using choice choobs (see Figure 4), a simple and easy-to-produce piece of apparatus. Consideration of the "3Rs" in scientific ethics are reinforced and digital templates for presentation of data are provided.



### Activity 6
### Explore the role of our growing brain when we exercise

Adapted from the Wellcome Trust "In the Zone – I've got the power" resource pack [5], this activity involves learners using a respirometer containing an indicator responsive to carbon dioxide concentration. The respirometer can be used before and after exercise and the number of breaths required to change the colour of the indicator can be recorded. Health and safety precautions are explained, including the requirement to fit a 1-way valve in the respirometer.

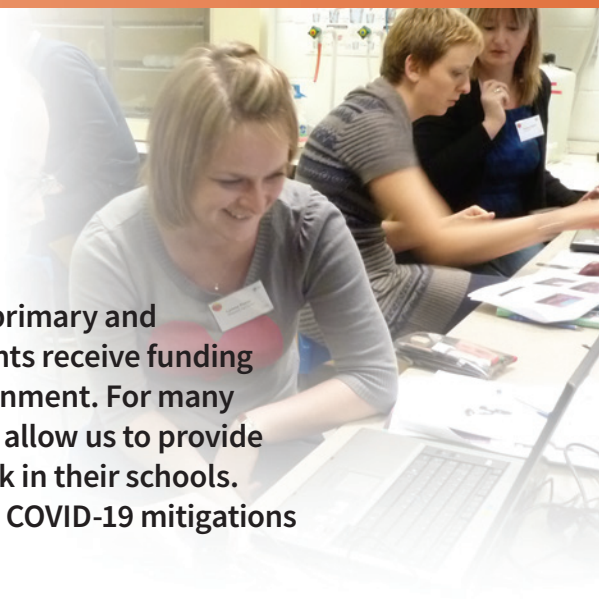
The resource concludes with a suggested activity for incorporating the Young STEM Leader programme into the classroom under the broad theme of "our growing brain". <<

**Figure 4** - A choice choob set up to support activity 5 (image courtesy of Association for the Study of Animal Behaviour).

**References**

[1] SSERC (2022a), Our Growing Brain SSERC Meet resources, available at https://sserccltd-my.sharepoint.com/:f:/g/personal/enquiries_sserc_scot/EtS_yZb0W3pOmv4sOZ2e6qYBLafmnMgvJDj5LJU4al_4aw?e=dIzsrF.
[2] STEM Ambassadors in Scotland, available at https://www.stemambassadors.scot/.
[3] SSERC (2022b), Our Growing Brain website, available at https://sites.google.com/view/our-growing-brain/home.
[4] SSERC (2018), Materials of Living Origin – Educational Uses, A Code of Practice for Scottish secondary schools and colleges, available at https://www.sserc.org.uk/wp-content/uploads/2018/06/SSERC-Materials_of_Living_Origin_Code_of_Practice.pdf.
[5] Wellcome Trust (2012), In the Zone, Pearson Education Ltd and Guardian Professional.

# SSERC professional learning courses



**We offer professional learning events for teachers in both the primary and secondary sectors and for school technicians. Many of our events receive funding from the ENTHUSE Bursary scheme or from the Scottish Government. For many courses, bursaries will help towards covering course costs and allow us to provide delegates with resources to support learning and teaching back in their schools. Face-to-face courses will take place at SSERC with appropriate COVID-19 mitigations and social distancing in place.**

Courses available for online booking include:

| COURSE NAME | RESIDENTIAL? | DATES | CLOSING DATE | SECTOR |
|---|---|---|---|---|
| **Biology SSERC Meet** | Online | 19 May 2022 | 13 May 2022 | Secondary Biology |
| ***Welding Skills** | Face-to-face | 23-24 May 2022 | 18 April 2022 | Secondary Technology |
| ***Physics Summer School** | Face-to-face | 25-28 May 2022 | 18 April 2022 | Secondary Physics |
| **RSB Annual Teachers Meeting** | Face-to-face | 26 May 2022 | 29 April 2022 | Secondary Biology |
| **Intermediate Physics** | Face-to-face | 8-9 June 2022 | 13 May 2022 | Secondary Physics |
| **Safe Use of Fixed Workshop Machinery** | Face-to-face | 8-9 June 2022 | 6 May 2022 | Secondary Technicians |
| ***Microscale Chemistry Summer School** | Face-to-face | 14-16 June 2022 | 13 May 2022 | Secondary Chemistry |
| ***Biology Summer School** | Face-to-face | 21-23 June 2022 | 13 May 2022 | Secondary Biology |
| **Safe Use of Fixed Workshop Machinery (Refresher)** | Face-to-face | 24 June 2022 | 27 May 2022 | Secondary Technicians |
| **Safe Use of Fixed Workshop Machinery** | Face-to-face | 24-25 August 2022 | 27 May 2022 | Secondary Technicians |
| **Working with Radioactive Sources** | Face-to-face | 25 August 2022 | 10 June 2022 | Secondary Physics |
| **Physics Blended Learning** | Online & face-to-face | September & December 2022 | 3 June 2022 | Secondary Physics |
| **Safe Use of Fixed Workshop Machinery (Refresher)** | Face-to-face | 2 September 2022 | 10 June 2022 | Secondary Technicians |
| **Chemical Handling** | Face-to-face | 6-7 September 2022 | 10 June 2022 | Secondary Technicians |
| **Biology SSERC Meet** | Online | 8 September 2022 | 2 September 2022 | Secondary Biology |
| **Electrical Safety and PAT Testing** | Face-to-face | 8-9 September 2022 | 10 June 2022 | Secondary Technicians |
| ***Support for Practical Activities in Advanced Higher Physics** | Face-to-face | 15-16 September 22 | 17 June 2022 | Secondary Physics |
| ***Environmental Science** | Face-to-face | 20-21 September 22 | 26 August 2022 | Secondary Science |
| **Safe Use of Fixed Workshop Machinery** | Face-to-face | 4-5 October 2022 | 31 August 2022 | Secondary Technicians |
| **Science Probationers Residential** | Face-to-face | 4-5 October 2022 | 31 August 2022 | Secondary Science |
| **Biology SSERC Meet** | Online | 6 October 2022 | 30 September 2022 | Secondary Biology |
| ***Investigations for Advanced Higher Biology** | Face-to-face | 25-27 October 2022 | 2 September 2022 | Secondary Biology |
| ***Wood Turning** | Face-to-face | 27-28 October 2022 | 2 September 2022 | Secondary Technology |
| **Introductory Physics** | Face-to-face | 2-3 November 2022 | 16 September 2022 | Secondary Technicians |

*This course attracts ENTHUSE funding which offsets the course fee.

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| COURSE NAME | RESIDENTIAL? | DATES | CLOSING DATE | SECTOR |
|---|---|---|---|---|
| **Health and Safety (Online)** | Online | 7, 14 & 21 November 2022 | 23 September 2022 | Secondary H&S |
| ***Safety in Microbiology for Schools** | Face-to-face | 8-10 November 2022 | 30 September 2022 | Secondary Technicians |
| **Technology Probationers Residential** | Face-to-face | 10-11 November 22 | 30 September 2022 | Secondary Technology |
| ***Hot & Cold Metal Forming** | Face-to-face | 17-18 November 22 | 21 October 2022 | Secondary Technology |
| ***Laboratory Science Nat 5** | Face-to-face | 23-25 November 22 | 21 October 2022 | Secondary Science |
| **Science Probationers Residential** | Face-to-face | 2-3 December 2022 | 21 October 2022 | Secondary Science |
| **Science Probationers Residential** | Face-to-face | 13-14 December 22 | 11 November 2022 | Secondary Science |
| **Science Probationers Residential** | Face-to-face | 11-12 January 2022 | 11 November 2022 | Secondary Science |
| ***BGE Biology for Non-Specialists** | Face-to-face | 17-18 January 2022 | 1 December 2022 | Secondary Biology |
| **Science Probationers Residential** | Face-to-face | 25-26 January 2022 | 1 December 2022 | Secondary Science |
| ***BGE Physics for Non-Specialists** | Face-to-face | 1-2 February 2022 | 9 December 2022 | Secondary Physics |

*This course attracts ENTHUSE funding which offsets the course fee.

Please check our website pages at **https://www.sserc.org.uk/professional-learning/calendar/** for the most up-to-date details on our professional learning calendar. **Courses may be subject to change or cancellation due to COVID-19.**

# New professional learning offers for 2022/2023

### Biology SSERC Meets
A series of 5 online twilight courses for Biology teachers with supporting content from invited guest experts in the subject.

### BGE Biology/Chemistry/Physics for non-specialists
A 2-day face-to-face course targeted at Biology/ Chemistry/Physics Teachers to support their delivery of BGE science content outwith their specialism.

### Investigations for Advanced Higher Biology
A 3-day face to face course supporting teachers to deliver high quality practical learning.

### Support for Practical Activities in Advanced Higher Physics
A 2-day face-to-face course supporting teachers to deliver high quality practical learning across the certificate levels of Physics, focussing on SCQF Levels 6 and 7.

### Science Probationers Residential
A 2-day residential course to support NQTs in the delivery of safe, high quality, hands-on practical STEM learning in the Science classroom.

### Technology Probationers Residential
A 2-day residential course to support NQTs in the delivery of safe, high quality, hands-on practical STEM learning in the Technical workshop.

# High and dry

**There are times in the laboratory where it is desirable to ensure that a chemical is either dried completely or remains dehydrated once it has been dried out. Both these functions can be carried out by a desiccator.**

The most common type of desiccator found in schools consist of a dome-shaped container made of thick glass. It has a main body and a heavy lid. The lid has a ground-glass edge which is coated with a thin layer of a suitable lubricant to ensure an airtight seal.

The interior of the desiccator is usually separated in two by a mesh platform. The desiccating agent is placed in the bottom and the material to be dried is placed on the mesh platform. The lid is then replaced and the drying agent left to do its work.

A common variant of this design is the Vacuum desiccator- as shown in Figure 1: this is very similar to the basic design but, they also have a valve on the top of the lid that allows the connection of a vacuum pump. This design allows for faster drying – and also stronger drying.

If you need a vacuum desiccator then there is no real alternative but to buy one. However, then non-vacuum type can be easily replaced by a DIY version.

**Figure 2** - A DIY desiccator.

You can easily make your own simple desiccator from an air-tight plastic container, like an ice-cream container (Figure 2). You place the drying agent in an open container like an evaporating basin, and the material to be dried can be placed near it, in a separate open container, like a watch glass or another evaporating basin.

You can also make a version from resealable bag. In exactly the same way as above – though you will need to make sure there are no holes in the bag. In fact, it is probably preferable to place one bag inside another.

Placing a smaller desiccator in a bigger one may not always be required, though it will improve performance.

Table 1 below shows the results a quick test: two samples of potassium hydroxide (KOH) pearls were put on watch glasses and weighed. One was put in a DIY desiccator with some silica gel in as shown and the other left on the bench. 90 minutes later they were both weighed again.

The sample in the desiccator clearly absorbed less water and as time goes on this difference will increase as there is initially a certain amount of water vapour in the air inside the desiccator that can be absorbed but, once that is gone, the seal prevents any significant ingress of any more.

**Figure 1** - A vacuum desiccator. Image by Cjp24 on Wikimedia Commons under a Creative Commons License.

Whatever their design, whenever the desiccator is opened, the contents are exposed to moisture in the air. They also take quite some time to achieve a sufficiently low level of humidity so they are not for fast drying. They are, however, quite effective at either a final drying or for keeping already dry materials dehydrated.

It is important to note that desiccators don't work well for materials that are very highly hygroscopic.

## Desiccating agents

There are many different chemicals that can be used in desiccators. A few commonly used ones are:

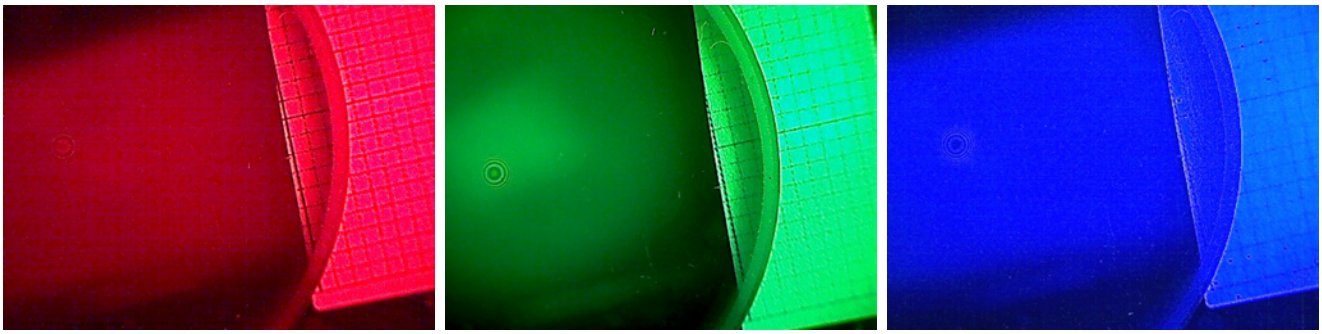
- Various anhydrous salts such as anhydrous calcium chloride, anhydrous calcium sulphate (drierite), anhydrous magnesium sulphate.
- Silica gel (this usually has a small amount of cobalt indicator added which turns from blue to pink on absorption of moisture. This lets you know when to regenerate the desiccant.
- Potassium or sodium hydroxide.
- Concentrated sulphuric acid. <<

| | In desiccator | On bench |
|---|---|---|
| Mass of KOH (g) | 1.725 | 1.775 |
| Total mass – start (g) (T=0) | 12.702 | 10.341 |
| Total mass - finish (g) (T-90) | 12.734 | 10.435 |
| Difference | -0.032 | -0.094 |
| **% change** | **1.86%** | **5.30%** |

**Table 1** - Effectiveness of a DIY desiccator.

# Newton's Rings experiment with a LED light source

**We've had quite a few enquiries from schools recently asking where they can source a low pressure sodium light source to use in the Newton's Rings experiment in Advanced Higher Physics. The short answer is that these low-pressure sodium lamps are no longer available.**



**Figures 1, 2 & 3** - Newton's rings using a £6 RGB raybox.

Our first approach was to use a £6 RGB LED raybox [1] borrowed from our Early Years and Primary colleagues. We were able to produce rings using Newton's Rings Apparatus (A46229) by Philip Harris (see Figures 1, 2 & 3). We then set about making a simple yellow LED lamp and trying this out in the Newton's rings experiment.

We decided to use 20 yellow LED's to provide around the same brightness as our 18W Sodium Lamp.

Designed to be used with a smoothed 5V low voltage power supply, our design was simple and the circuit diagram is shown in Figure 4 below.

We constructed this on stripboard as shown in Figure 5. In use we used the white top of a margarine tub as a diffuser (see Figure 6).

We used the LED's shown in Figure 7 but with minor alterations to the circuit other yellow LED's would work.

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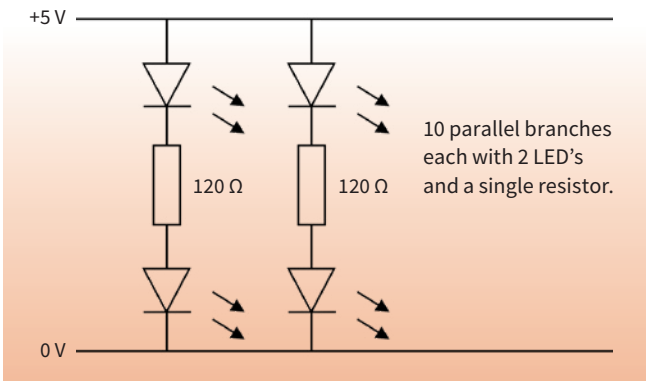


**Figure 4** - Circuit diagram of the LED light source.

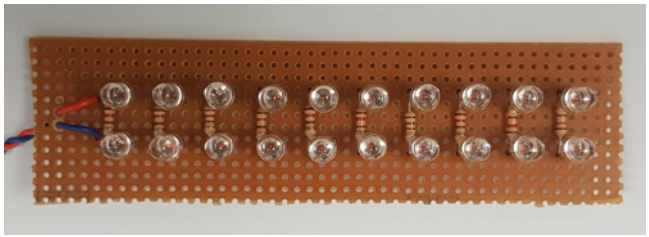

**Figure 5** - Circuit constructed on stripboard.

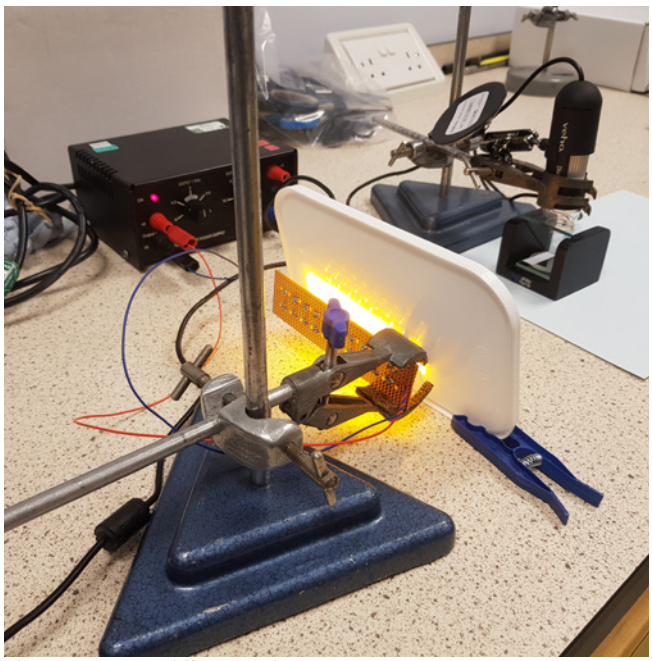

**Figure 6** - In use - diffuser in place.


**Figure 7** - Pack of 25 yellow LED's as used for the LED light source.

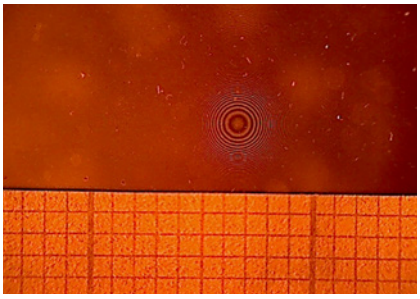

**Figure 8** - LED light source.

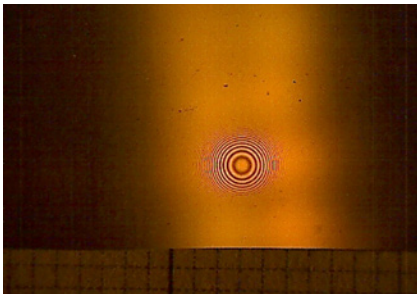

**Figure 9** - Sodium Lamp light source.

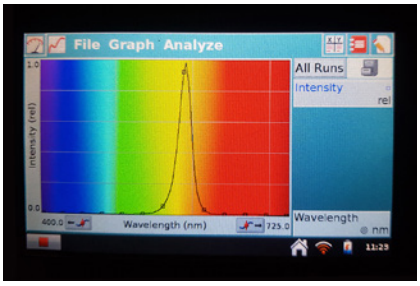


**Figure 10** - LED light source.

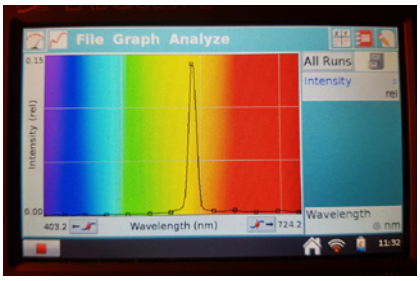


**Figure 11** - Sodium light source.

## So how did the LED lamp perform?

Figure 8 (LED light source) and Figure 9 (Sodium light source) show how the LED source compares with the Sodium light source.

We then compared the spectra from each light source using a spectrometer (Figures 10 & 11).

As expected both the λ and the FWHM (Full Width Half Maximum) values differ. The FWHM value is a measure of the width of a shape at half of its maximum height. It can be seen that the LED spectral response curve in Figure 10 looks 'broader' than the Sodium spectral response curve in Figure 11 (although the peak values differ) [2].

A larger FWHM would likely lead to a greater uncertainty in calculated results. Figures 12 and 13 show the (differing) calculated results for the radius of curvature for the same lens. Figure 12 includes calculations for the stated LED max, min and typical λ.

We believe that a 'yellow LED' lamp is a suitable alternative to a now hard to find low pressure sodium lamp to show Newton's rings.

A cautionary note. We have not, as yet, been successful in using the LED lamp to show air fringes. This may be because of the 'broader' output spectrum of the LED. <<

**References**

[1] https://www.scichem.com/product/3-colour-led-light-source-set
[2] https://en.wikipedia.org/wiki/Full_width_at_half_maximum

| m | r | r^2 | | Lambda | 5.92E-07 | 5.88E-07 | 5.94E-07 |
|---|---|---|---|---|---|---|---|
| 0 | 0.3448 | 0.118887 | | m | 0.2774 | 0.2774 | 0.2774 |
| 1 | 0.6379 | 0.406916 | | | | | |
| 2 | 0.8103 | 0.656586 | | R | 4.69E-01 | 4.72E-01 | 4.67E-01 |
| 3 | 0.9655 | 0.93219 | | | | | |
| 4 | 1.1034 | 1.217492 | | | | | |
| 5 | 1.2069 | 1.456608 | | | | | |
| 6 | 1.327 | 1.760929 | | | | | |
| 7 | 1.448 | 2.096704 | | | | | |

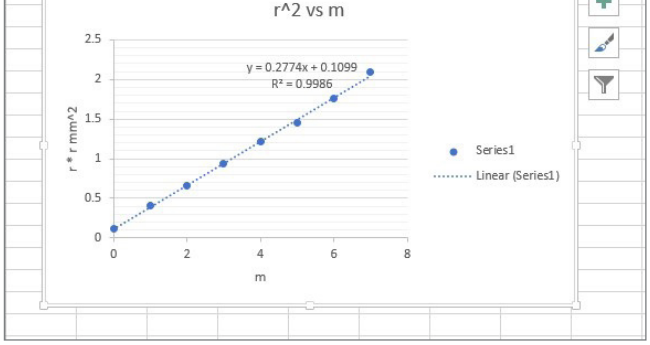


**Figure 12** - LED results from image in Figure 8.

| m | r | r^2 | | Lambda | 5.89E-07 |
|---|---|---|---|---|---|
| 0 | 0.385 | 0.148225 | | m | 0.2854 |
| 1 | 0.6468 | 0.41835 | | | |
| 2 | 0.8391 | 0.704089 | | R | 4.85E-01 |
| 3 | 0.9965 | 0.993012 | | | |
| 4 | 1.1363 | 1.291178 | | | |
| 5 | 1.2762 | 1.628686 | | | |
| 6 | 1.3636 | 1.859405 | | | |
| 7 | 1.451 | 2.105401 | | | |

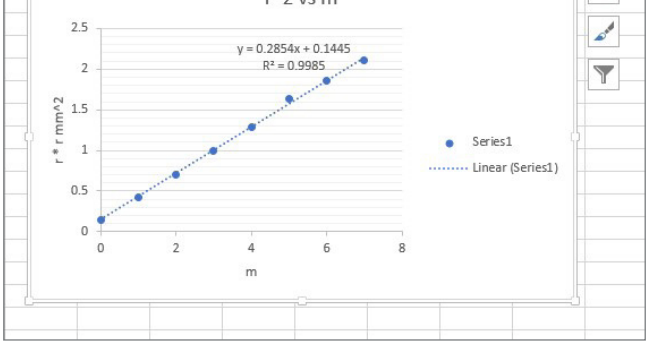


**Figure 13** - Sodium results from image in Figure 9.

# Q = C V capacitor experiment using an LM334Z current source

**We like the usual capacitor experiment where we manually change the value of a series variable resistor in order to try maintain a constant charging current. There is educational merit in trying to vary the resistor at noticeably different rates and reaching a point where this is no longer possible. Noting this current, the time and the voltage across the capacitor allows the calculation of Q, the charge, from Q = It where I is the constant charging current, and enables a graph of Voltage v Charge to be plotted. The gradient of this graph, Q/V, is the value of the capacitance of the capacitor being charged.**

We received a query about the construction of a constant current circuit for use in the above experiment. We had previously used a single, silicon, NPN transistor constant current circuit successfully.

As the enquiry was about the use of an LM334Z integrated circuit we ordered some [1] and set about doing the experiment.

The LM334Z is a three pin device, it comes in a TO92 style package, and has a maximum device current of 10 mA.

In the most basic configuration the addition of a single resistor is all that is needed to set the value of the constant current (Figure 2). Online information states that the value of this resistor can be calculated using the equation: $R_{set} = 67.7\ mV / I_{set}$. $I_{set}$ is the desired constant current and $R_{set}$ is the total value of resistance between the R and V- pins of the LM334Z.

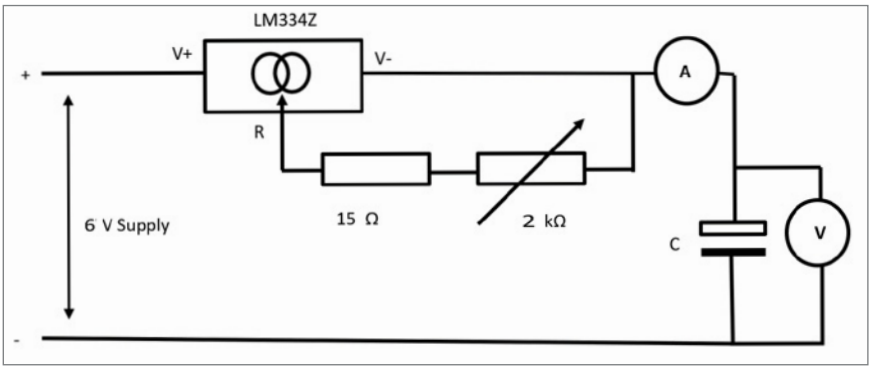


**Figure 1** - The circuit diagram of the LM334Z constant current source in the capacitor experiment.

A 68 Ω resistor would give a current of approximately 1 mA, 136 Ω would give about 0.5 mA.

Instead of using a single fixed value resistor we used a combination of a fixed resistor (15 Ω to limit the max value of current to just under 5 mA, well under the device's max current) in series with a 2000 Ω multi-turn preset resistor (Figure 1 and 4). This allowed us to vary the value of the current but not exceed its maximum

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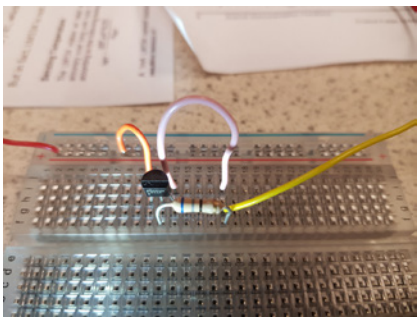


**Figure 2** - The LM334Z prototype circuit with 15 Ω resistor giving a constant current of 0.98 mA.

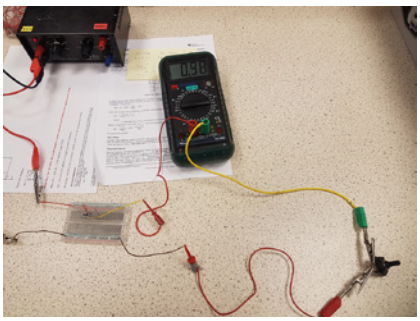


**Figure 3** - Using a 500 Ω variable resistor to confirm constant current over a range of load resistances.

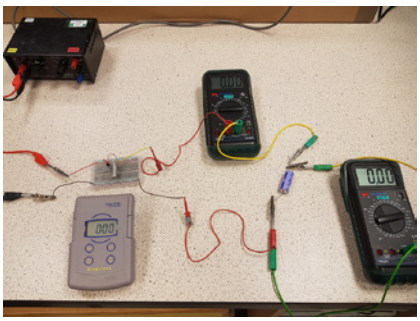


**Figure 4** - The capacitor experiment as shown in Figure 1.

current capability. The ammeter is only required when setting the current. Circuit diagram - For the datasheet and pinout information see [2].

To set the value of the current use a 500 Ω variable load resistor (in place of the capacitor) and an ammeter (Figure 3). Adjust the multiturn preset resistor until the ammeter displays the desired current.

## Results

The spreadsheet in Figure 5 shows typical results using a 2200 µF electrolytic capacitor with the current set to 0.1 mA. The Voltages on the Voltmeter were noted every 5 s. The calculated value of capacitance was 2501 µF. Electrolytic capacitors have a wide tolerance range, typically +/- 20%!

The area under the best fit straight line (calculated from the integral of the equation of best fit) is also compared to the Energy (½ Q V) stored in the capacitor.

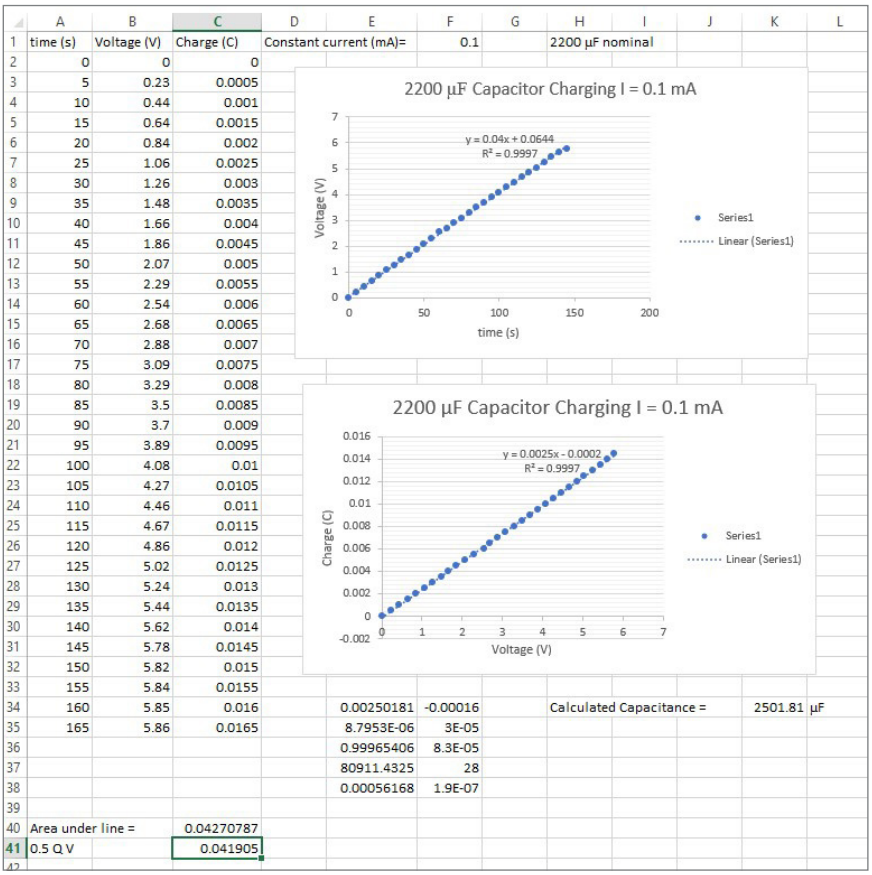



**Figure 5** - Typical results for a 2200µF capacitor.


**References**

[1] https://www.bitsbox.co.uk/

[2] https://www.ti.com/lit/ds/symlink/lm334.pdf?ts=1649740909939&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FLM334%253Futm_source%253Dgoogle%2526utm_medium%253Dcpc%2526utm_campaign%253Dapp-null-null-GPN_EN-cpc-pf-google-eu%2526utm_content%253DLM334%2526ds_ k%253DLM334%2526DCM%253Dyes%2526gclsrc%253 Daw.ds%2526gclid%253DCjwKCAjwo8-SBhAlEiwAopc9W1WoVoWYhAnz10DA6VQCNQejUXWUIa WVIHY9eV5p6_AfOw-IiUMKzBoCOD0QAvD_BwE

YOUNG STEM leader led by sserc

# Five activities for Young STEM Leaders to lead in Technologies

## by Angela Barclay

**The Young STEM Leader Programme is an exciting opportunity for learners to take the lead in delivering activities, events or interactions to engage not only their peers, but also teachers and families too.**

If you are looking for interesting ways to support Young STEM Leaders (YSLs) in Technologies you are in the right place! Here is a summary of five activities which have proven very effective and engaging, with links to resources where appropriate.

### F1 In Schools

F1 In Schools is our main vehicle for YSLs, and with the introduction of the Auto-Award (meaning any young learner who competes in F1 in Schools can also have their work submitted to gain a Young STEM Leader Award) the two elements go hand-in-hand. Although our F1 YSLs do not need to plan additional STEM activities, they always want to, particularly when it involves encouraging younger learners to become passionate about their topic. Teams have designed their own sessions from creating presentations to explain the fundamentals of aerodynamics, to workshops to make model cars, and delivered these to both small and large groups at the Angus annual STEM Event, "Mission Possible".

F1 in Schools have now released a new Primary project and the resources are excellent:

- F1 in Schools Primary Class - F1 in Schools UK.

There are six units which YSLs can easily deliver aspects of, and there are also free worksheets that can be used for shorter or stand-alone activities. Some of these are also suitable for learners in S1.

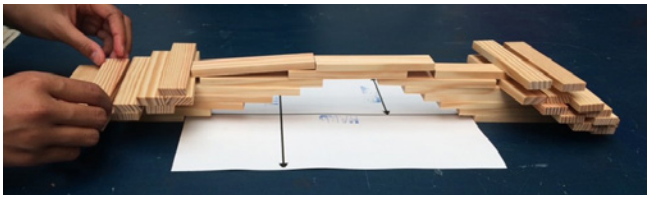
If you are at the beginning of your Young STEM Leader journey and getting involved in F1 in Schools seems a bit overwhelming, don't panic. The following four recommendations are definitely within reach!

Angela Barclay- Associate Regional Trainer and Verifier (ARTAV).PT Technologies/DYW at Monifieth High School (Currently seconded to Angus Virtual School).

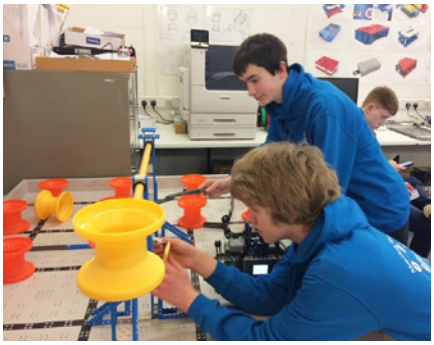
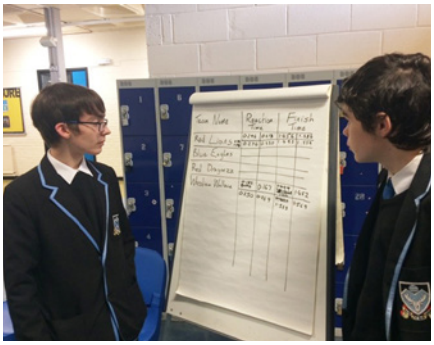
### Kapla Bridge Building

This practical engineering activity is equally exciting and frustrating, as young people try to figure out what initially seems like an >>


Young STEM Leaders taking part in F1 in Schools as part of their Young STEM Leader award.



Kapla Bridge Building.



YSLs leading robotics challenges.

impossible task. As well as learning about counterbalance, participants develop skills such as team working, communication, planning and resilience.

**Audience**
This activity works well with learners of all ages (staff loved it too), working in groups of 3-5, and our YSLs have enjoyed using it during transition.

**Equipment**
- Kapla Blocks (40 per group)
- A4 Paper (5 sheets per group)

Other blocks can be used providing your YSLs check the challenge is possible!

**Planning**
The YSLs set up the blocks in advance- an equal number to each group, and hand out the paper. They can prepare a short Powerpoint, or just talk the groups through the challenge.

**Challenge**
1) Design and build a bridge which spans the A4 paper widthways.
2) Design and build a bridge which spans the A4 paper lengthways.
3) Repeat the previous challenges using the minimal number of blocks.

This activity normally lasts around 50 minutes, but it could easily go on longer or for more than one session. The bridge building can be replaced with building the tallest tower, or something more creative!

## Robotics

This robotics activity involves learning simple coding, working systematically and learning from mistakes.

**Audience**
This activity works well with primary and secondary aged learners, staff and families, working individually or in pairs. It has been used in classes, primary visits and at community events.

**Equipment**
- Lego Mindstorm, VEX Robot or similar (one will do, but the more the merrier!)
- Appropriate IT Equipment
- Timer
- Tape/Cardboard etc. to create the course
- Flip Chart or similar

Other Robots can be used providing your YSLs check the challenge they design is possible!

**Planning**
The YSLs set up the Robot and design the task in advance. They can prepare a short Powerpoint, or just talk the groups through the challenge. YSLs can decide whether it's appropriate to expect participants to do any coding, or simply try to complete the task.

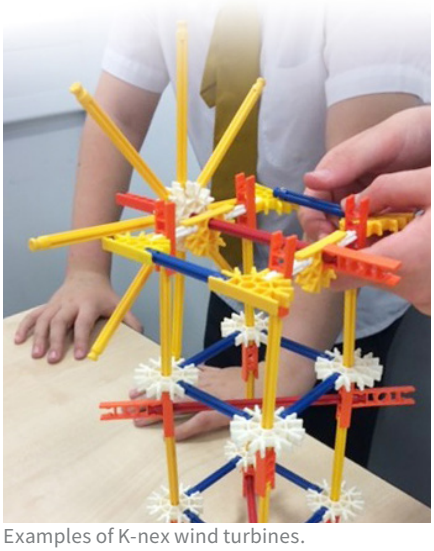
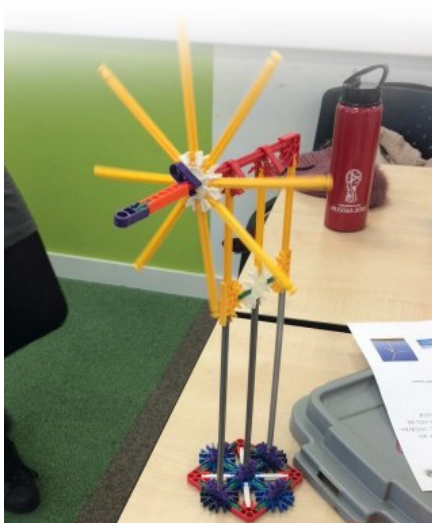
**Challenge**
1) Participants listen to instructions.
2) Participants take turns to control/code the robot through a marked route in the shortest time while others spectate.
3) YSLs operate timer and keep track of the leaderboard on the flipchart.

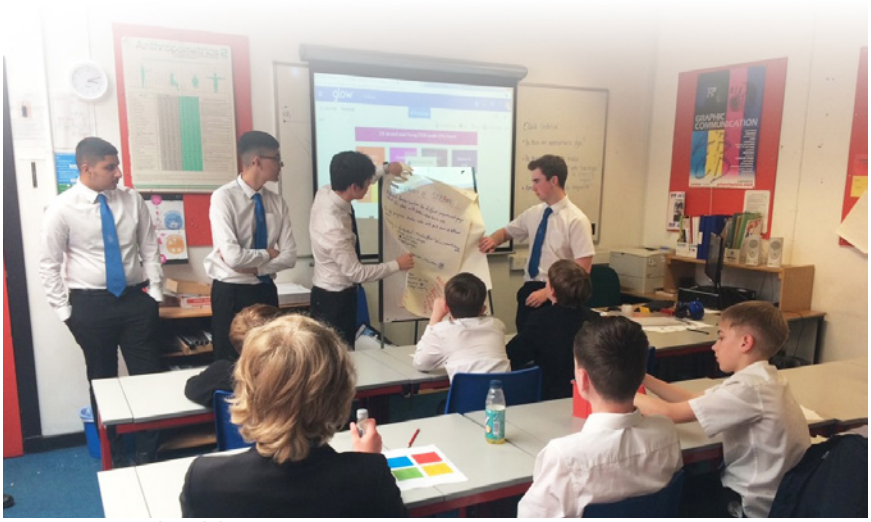
This activity lasts as long as you want, as it can become very competitive.

**TOP TIP**
This activity can be used to raise funds for charity by charging per turn - be prepared, you might have lots of repeat customers!

## K'Nex wind-turbine design

This is another hands-on activity, which involves more planning and typically lasts around three 50 minute sessions, perfect for the extended leadership required in the Formal levels of YSLP. The learning input is around motion and structures, and participants also develop their planning, team working, communication, and resilience. >>



Examples of K-nex wind turbines.



Young STEM Leaders delivering a presentation.

**Audience**
This activity has been used during transition, and also with young people in S2, working in groups of 3-5.

**Equipment**
- K'Nex Kits (at least one between three teams, one between two teams is best)
- A4 Paper (4 sheets per group)
- A3 Paper (2 sheets per group)

**Planning**
YSLs should sort the K'Nex into the different pieces and divide them equally between the teams, and hand out the paper. Again, they can prepare a short Powerpoint, or just talk the groups through the theory about different types of motion and the challenge.

**Challenge**
1) Design a Wind Turbine individually on A4 paper- this should turn easily and be a minimum height.
2) Discuss and develop a team design on A3 paper, indicating which pieces you will use.
3) Negotiate with other teams if you wish to swap any pieces.
4) Build and test your Wind Turbine, using a fan or hairdryer.

This normally takes 3 x 50 minute lessons, and can be adapted to develop a Fairground Ride or a Bridge for variety.

**TOP TIP**
YSLs should be prepared to photograph final models to record them, so that groups can then dismantle and assist in reorganising all the pieces!

## Cardboard chair design

This practical design activity is very collaborative and exciting. As well as learning about construction and ergonomics, participants develop skills such as team working, communication, planning and resilience.

**Audience:**
This activity has worked well with S3 learners, and can probably be adapted to suit most ages, working in groups of 3-4.

Cardboard chairs don't often last for very long!

**Equipment**
- Cardboard (minimum of two large boxes/sheets per group- we used PC and Monitor boxes after a school IT refresh, and food packaging from the dinner hall)
- Wide Sticky Tape
- A4 Paper (4 sheets per group)
- A3 Paper (1 sheet per group)

*Other materials can also be used providing your YSLs check the challenge is possible!*

**Planning**
The YSLs set up the materials in advance - an equal number to each group - and hand out the paper. They can prepare a short PowerPoint, or just talk the groups through the challenge.

**Challenge**
1) Individually design a chair from the given materials on A4 paper.
2) Collaborate and agree a team design on A3 paper, showing construction methods. (This can also be done using CAD)
3) Build a chair which supports the weight of one team member.
4) The chair must seat the user at least 300 mm from the ground.
5) The chair must be a good fit for the user's body.
6) Bonus points if the chair is aesthetically pleasing!

This activity normally lasts around three 50 minute sessions, and YSLs can adapt the specification to best suit the materials available.

**TOP TIP**
For a shorter, simpler activity, all materials can be replaced with balloons and string, and a time limit of 30 minutes. This is best done on a soft surface- possibly outdoors on grass, as the balloons do sometimes pop during testing!

>>

In addition to the activities described above, our YSLs have presented at parent's evenings and community events, judged junior learner competitions, and our Senior YSLs supported our Junior YSLs in setting up working groups to drive forward our school STEM agenda.

### Young STEM Leaders delivering a presentation

I think that covers most of our YSLs leadership in Technologies, but I'm sure yours will come up with many more ideas of their own. If you would like to run anything by me, or if you would like some examples of YSLs in DYW activities such as Barista or Nail Bar, please get in touch. I hope you find your involvement in the Young STEM Leader Award as rewarding as I have - good luck!

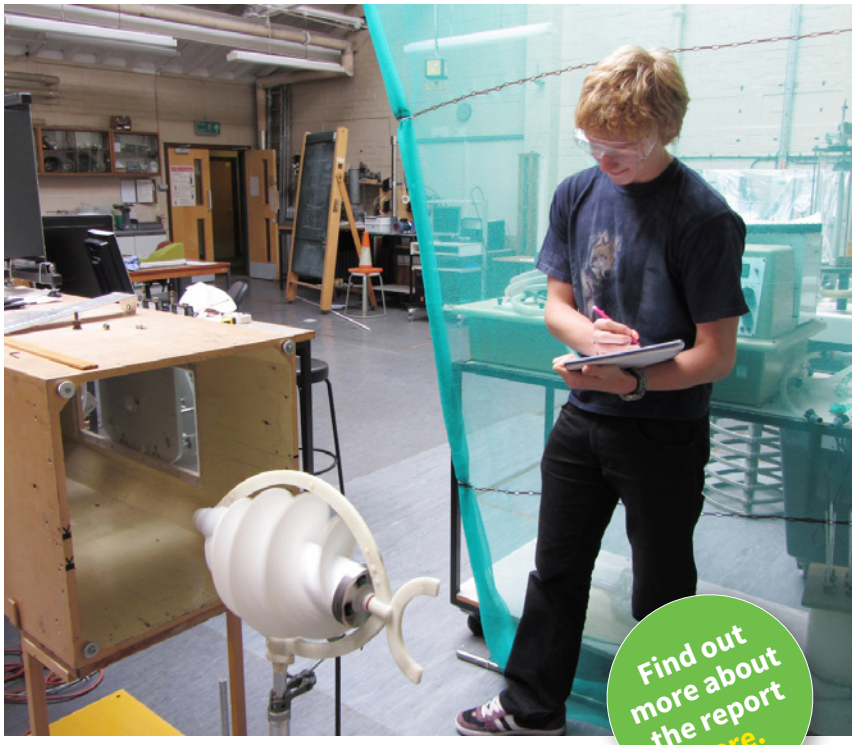
You can reach Angela by emailing Angela.Barclay@sserc.scot

## Find out more...

To learn more about the Young STEM Leader programme and start delivering it in your school community or youth group, visit **www.youngstemleader.scot**, email us **youngstemleader@sserc.scot** or check out our **@YoungSTEMLeader**.

# Nuffield Research Placements

**SSERC's coordination of the Nuffield Research Placements Programme in Scotland is now well under way. We have begun matching learners with their placement supervisors and will be in touch with successful candidates soon to let them know where they've been placed.**




The Evaluation of the 2021 Nuffield Research Placements Cycle report has now been released. Learners who took part in last year's cycle found the experience really valuable, with 98% finding that their experience had supported their higher education or job applications and 93% saying they would recommend it to other learners.

*"I was a real researcher carrying out valuable research. I was able to do so many new things and widen my knowledge of topics I had previous knowledge of."*

If you are a young person or teacher interested in placements, or an educational institute or employer looking to host a placement, please get in touch: **nuffieldresearchplacements@sserc.scot**

# Spotlight on STEM Ambassadors

STEM AMBASSADOR HUB
STEM AMBASSADORS IN SCOTLAND

**STEM Ambassadors are employees and students working in STEM focused roles who volunteer their time to help engage and inspire the next generation of learners.**


View all our STEM Ambassador Spotlights

Whether it's running a workshop, judging a STEM competition, or giving a careers presentation or Q&A, they are there to help bring STEM to life in the classroom.

We have thousands of ambassadors available throughout Scotland, specialising in all areas of STEM.

To give you an idea of just some of the people you and your learners could engage with we regularly spotlight ambassadors on our website, highlighting their day-to-day jobs and the paths they took to a career in STEM.

Not only do these articles give an idea of the ambassadors that we have on board, they can be used as a tool to discuss career options with learners.

Our latest spotlight Emily Southworth is a PhD Student at the Edinburgh University Institute of Genetics and Cancer.

## Arrange a STEM Ambassador visit online or face-to-face

If you would like a STEM Ambassador to be involved in your setting here is how it works.

Login or register on the STEM database at www.stem.org.uk and add an activity giving as much detail as possible about what you would like the ambassadors to do and we will do the rest.

When you add an activity ambassadors can get in touch to register their interest, we also promote the activities through our communications with our volunteers to help you get the right person for your request.

More information on requesting ambassadors can be found in our Teachers Guide to STEM Ambassadors.

More information on requesting Ambassadors can be found in our Teachers Guide to STEM Ambassadors.

## Ambassador offers

Not sure how you would like a STEM Ambassador to help? Why not browse our ambassador offers.

Many of our ambassadors have created examples of presentations or workshops they are willing to deliver to help you engage with them.

From marine mammal presentations to an insight into a career in clinical research there is something for everyone.

To browse our offers and get in touch with the ambassadors offering them log in to website and visit browse offers.


Contact us

You can contact us by email or follow us on

# STEM Engagement calendar

**SSERC offers a wide range of STEM engagement and enrichment programmes to further increase access to, and participation in STEM, well beyond the classroom setting. There are leadership opportunities for young people with the Young STEM Leader Programme as well as programmes to link educators in all sectors with industry partners and STEM Ambassadors to create enhanced STEM learning events for young people in Scotland.**

## Upcoming events

| EVENT | TYPE | DATE | DETAILS |
|---|---|---|---|
| **SSERC & STEM Learning: Teaching and Inspiration Awards Scotland** | Awards Ceremony | Friday 20th May (by invitation) | Celebrating the inspirational educators and role models in STEM education in Scotland. |
| **Young STEM Leader Tutor Assessor Training – All Levels** | Online training session | Tuesday 24th May, 4pm – 6pm | Become a certified Tutor Assessor to deliver the Young STEM Leader Programme in your centre. |
| **Young STEM Leader Tutor Assessor Training – Non-formal levels** | Online training session | Thursday 26th May, 4pm – 6pm | Become a certified Tutor Assessor to deliver non-formal levels of the Young STEM Leader Programme in your centre. |
| **Young STEM Leader Kickstart Session** | Online training session | Tuesday 31st May, 4pm – 5pm | Trained to be a Tutor Assessor but not quite got the Young STEM Leader Programme up and running in your centre? Kickstart your YSLP journey with this session. |
| **Young STEM Leader Programme Information Session** | Online session | Wednesday 1st June, 4pm - 5pm | Find out more about the Young STEM Leader Programme and how you can deliver it in your centre. |
| **Tutor Assessor Connections - Space** | Online session | Tuesday 7th June, 4pm – 5pm | Networking and professional learning session for Young STEM Leader Tutor Assessors to share experiences of delivering YSLP activities on the theme of space. |
| **Young STEM Leader Tutor Assessor Training – All Levels** | Online training session | Wednesday 15th June, 4pm – 6pm | Become a certified Tutor Assessor to deliver the Young STEM Leader Programme in your centre. |
| **Celebration and Showcase Event Jacobs, Leidos and SSERC Enthuse and Education Industry Partnerships** | Showcase event | Thursday 16th June (by invitation) | Invited guests and key stakeholders within the Enthuse and Education Industry Partnerships led by SSERC will join partner schools and their learners to celebrate the impact and outcomes of their journey. |
| **Young STEM Leader Tutor Assessor Training – Non-formal levels** | Online training session | Thursday 16th June, 4pm – 6pm | Become a certified Tutor Assessor to deliver non-formal levels of the Young STEM Leader Programme in your centre. |

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Nuffield Research Placements

STEM AMBASSADOR HUB
STEM AMBASSADORS IN SCOTLAND

# Breaking glass

**The biggest problem with glass from a health and safety point of view is linked to its biggest drawback – the fact that it is brittle and likely to break. But there are a few lesser issues as well.**

## Cuts

The edge of a piece of broken glass can be phenomenally sharp. It is possible to obtain scalpel blades made from glass what are many times sharper than steel with an edge only 3 nm or so thick!

Clearly then any broken glass should be handled with care. It is usually easy to see when glass is broken and pick or sweep them up carefully with appropriate precautions. Beware of tiny slivers than can sometimes be missed. If it is not easy to sweep these up, you can use a piece of blu-tac to pick them up.

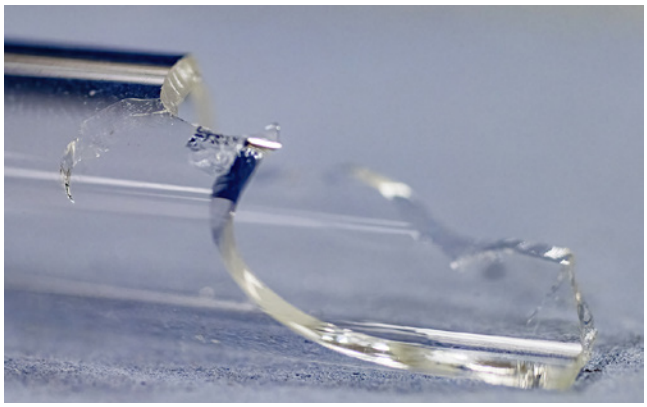
You need to particularly beware of glassware piled in a washing up bowl. It is always wise to check it before filling with water and detergent. Once it is full, you will not be able to tell if there is broken glass there and can easily give yourself a serious cut.

Another potential cause of nasty cuts is inserting glass tubing into bungs or corks. It is important to use the correct technique for this to avoid injury:

- Insert a cork borer, wide enough for the glass tube to fit through, into the hole in the bung. You can use propan-1,2,3-triol (glycerol) as a lubricant for this.
- Insert the glass tube through the cork borer.
- Remove the cork borer, leaving the glass tubing in place.

Inserting pipettes into fillers can also be a hazard. To avoid breakage and stabbing themselves, learners should be taught to hold the pipette only a centimetre or two from the end and not to push too hard.

A shard of glass.



A broken test tube.

## Burns

Glass can get extremely hot and looks no different from cold glass. Moreover, it has quite a high specific heat capacity and so will stay hot for a long time. So be very careful before picking up any glass item that has been strongly heated.

## Spillage

Another problem with the brittle nature of glass is that if it breaks the contents will spill out, and these could be hazardous. In addition to the normal precautions you would take with any container: watch out for cracks – a crack, even a hairline one, in glass can lead to sudden failure particularly when heated.

## Stuck stoppers

Stoppers, particularly in storage bottles, can become stuck in place. This is most common with ground glass stoppers. These should be avoided for bottles containing sodium hydroxide or other alkaline solutions as the alkalis can react with the glass and cement the stopper in place.

Similarly, alkaline solutions should not be left in burettes or pipettes as they will cement the jets closed.

Gentle tapping or warming can sometimes loosen them but even if not then it is usually no more than an annoyance.

Sometimes, however, the chemical inside the bottle can release gases that produce an increase in pressure that can cause the bottle to explode. Silicon tetrachloride is known for this. <<

# Working with radioactive materials - HSE inspections

**The Health and Safety Executive's Field Operations Division has contacted SSERC (and CLEAPSS for the rest of the UK) to explain it is undertaking a programme of inspections across England, Wales and Scotland to see how schools manage the safe use and storage of the radioactive sources used in science teaching.**

An inspection programme may come as a surprise to some when you consider the relatively low risk of these sources compared to those used in universities and hospitals. But low risk does not mean exemption from inspection.

Ahead of the inspection programme, our advice for Scottish schools with radioactive materials is to log in to our website and read the document Working With Radioactive Materials in Schools, which is downloadable from our **Ionising Radiation webpage**.

We are not the radiation protection police at SSERC, nor do we carry out inspections. If we did do so, we'd expect to be introduced to a member of staff who had taken responsibility for ensuring that the science department's procedures for working with radioactive materials were both safe and compliant with the law. Have a look at the following checklist. Can your school tick all the boxes?

If you can't at the moment, make sure that you address the weak areas. You are not on your own – the team at SSERC will work with you. Contact us on **rpa@sserc.scot**.

We also run courses on working with radioactive materials. We'd love to see you at our face-to-face course that will next run in August, but we appreciate that not everyone who wants to will be able to come. We will also run an online course in March 2023 and are soon to launch a self-study course. Details of all courses can be found on our **website**. Keep checking for new courses!

At the time of writing, we don't know how many schools in Scotland HSE intends to inspect or when they will be inspecting them. We are however confident that all schools who keep and use radioactive materials should be able to work with SSERC to be in a position where they have nothing to fear from an HSE inspection. <<

## This is a checklist

| Item | Comments |
|---|---|
| **SSERC poster with basic safety rules displayed, customised to have your own 'radiation casualty' hospital listed, and supervisory teacher identified.** | Editable version downloadable from our **Ionising Radiation webpage**. |
| **Stocklist present** | Editable version downloadable from our **Ionising Radiation webpage**. |
| **Log of usage maintained** | Editable version downloadable from our **Ionising Radiation webpage**. |
| **Monthly stock checks take place (except for summer holidays) and are recorded in log** | |
| **Only approved sources used** | See document *Working with Radioactive Materials in Schools* for a photo guide. |
| **Contingency plans available** | Customisable plans available in document *Working with Radioactive Materials in Schools.* |
| **Plans covering less serious incidents available** | Customisable plans available in document *Working with Radioactive Materials in Schools.* |
| **Activities risk-assessed, control measures communicated to users** | Generic risk assessments available for adaptation from our **Ionising Radiation webpage**. |
| **All staff who work with radioactive materials given appropriate training** | We run training courses, details on our **website** or inhouse training can be provided by a competent person e.g. thesupervisory teacher. |
| **No work with radioactive materials by learners if under 16s in the class** | |
| **Training and supervision of older learners if they are to use radioactive materials** | |
| **Appropriate secure storage** | See document *Working with Radioactive Materials in Schools*. |
| **Leak testing carried out and recorded** | See document *Working with Radioactive Materials in Schools* and spreadsheet downloadable from our **Ionising Radiation webpage**. |

# Chemicals in Early Years settings and Primary schools

**The connections between secondary schools and their cluster primary schools are important and of benefit to all. However, recent enquiries to SSERC have highlighted that there are some aspects of Health and Safety, where some extra consideration is called for.**

It is not uncommon for secondary schools to help with the provision of equipment or chemicals for use in Early Years and Primary science and technology. In principle, this is not a problem but there are important points to consider. There is also the possibility that a primary teacher is likely to be less familiar with their safe use. Restrictions in Early Years and Primary settings due to health and safety are not the same as in a secondary school. Regarding chemicals for instance, there are greater restrictions on the type and concentration of chemicals that younger learners can use or be exposed to.

The best guide for Health and Safety in Science and Technology in Early Years and Primary is the Association for Science Education's "Be Safe!" (Fourth Edition).

In general, arrangements work well and safely but we recently heard of a situation where a primary teacher was looking to source some chemicals from a secondary school of a higher concentration than would be safe even in a secondary classroom. This is not a common event but it was only flagged up because the teacher went through the secondary school. Had they managed to source the substance from a supplier there could have been a significant risk.

You should also be aware that, if you are considering delivering materials or equipment to an Early Years or Primary setting, there are legal restrictions on the transportation of hazardous chemicals by road (although the fact that they ought to be of low hazard should mitigate any problems).

Where secondary age learners are leading activities in Early Years or Primary settings, for example as part of the Young STEM Leader Programme, risk assessments must take the above advice into account.

As usual, if there is any doubt, contact SSERC for advice. Specific advice from the Early Years and Primary Team at SSERC can be obtained by emailing primary@sserc.scot.

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