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STEM bulletin

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

Tracker revisited

The free, open-source Tracker software package, written by Doug Brown of Cabrillo College, has been a favourite of ours at SSERC for over a decade. Indeed, we first wrote about it in 2008 [1]. Tracker is many-faceted, but at its core is the ability to analyse video and still images. Students working at home could perform meaningful practical work using the application.

In this article we will cover the following:

- Uses of Tracker.
- How to run Tracker in a browser (including on a Chromebook).
- Alternatives to Tracker.
- Learning more about Tracker.

What we will not be doing is guiding you step-by-step through the package. We have material available online for that purpose. You can even take part in self-study professional learning on the topic.

Uses of Tracker

Linear motion analysis

Create motion graphs by following a moving object from frame to frame in a video (Figures 1a/b).

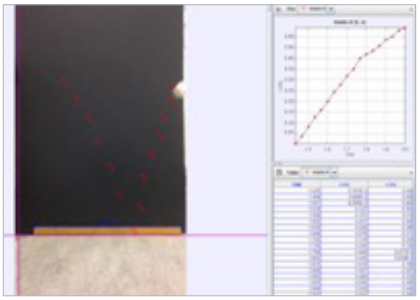

Figure 1a

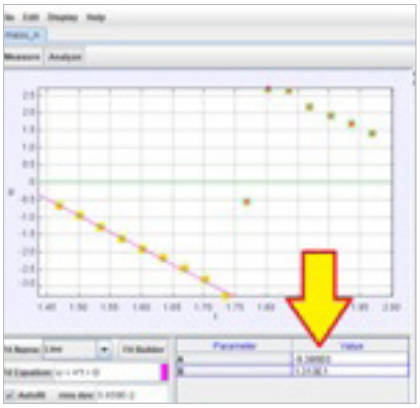

Figure 1b

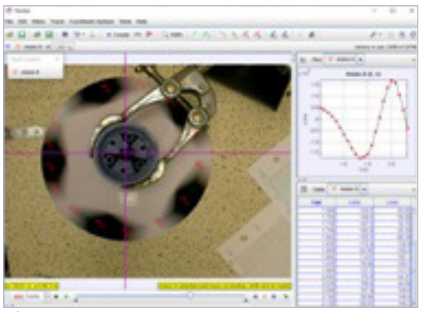

Figure 2a

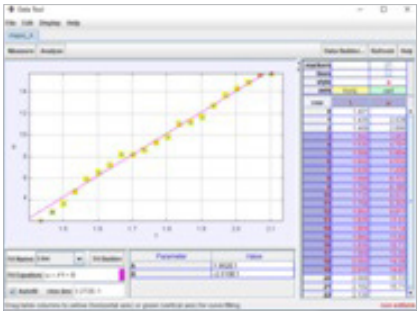

Figure 2b

You can replay the video and see the corresponding point on a graph highlight as the object moves.

Best fit lines can be plotted and gradients calculated.

Tracking can be performed automatically if the moving object is well-defined against the background (though where's the fun in that?).

Rotational motion analysis

Rotational motion can also be analysed. The experiment shown involves plotting angular velocity against time and subsequently finding the angular acceleration when various constant torques are applied (Figures 2a/b).

Line profiling

Here we have taken a still image of a double slit interference pattern and used Tracker's line profiling tool to scan the pixel intensity across the photograph. We see that the intensity of the light and dark bands is modulated by the envelope of a single slit diffraction pattern (Figures 3a/b).

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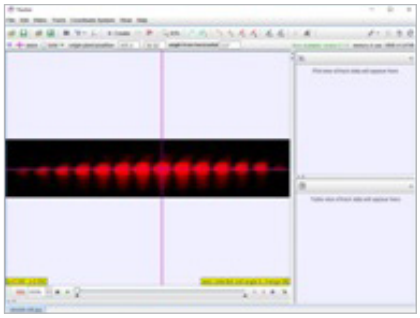

Figure 3a

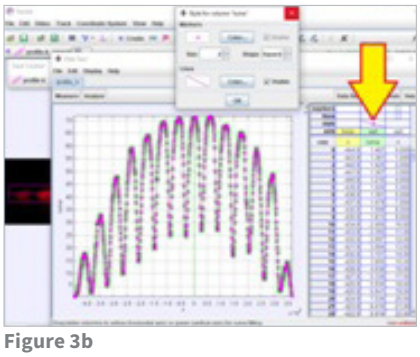

Figure 3b

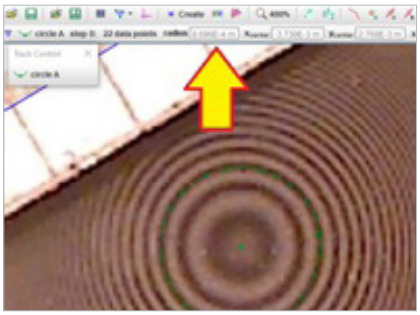

Figure 4a

Figure 4b

Radius of curvature
This is a Newton's Rings pattern photographed using a digital microscope. If we click on various points on a ring, tracker can fit a circle to it and work out the radius of curvature. We have also used it to work out the radius of curvature of the lens in the Newton's Rings apparatus (Figures 4a/b).

Figure 5a

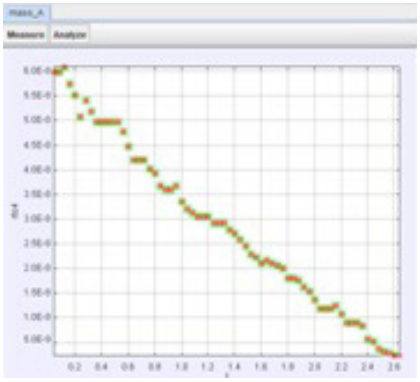

Figure 5b

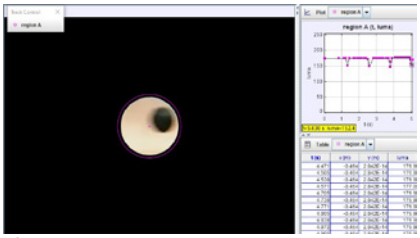

Figure 6a

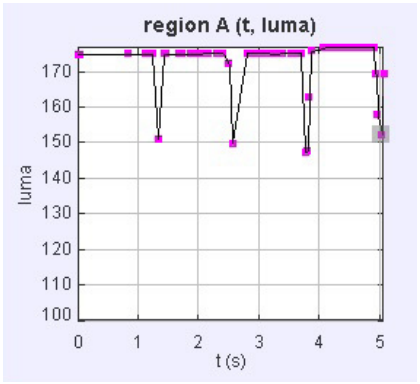

Figure 6b

Define your own variables
When a soap bubble deflates through a capillary tube, a graph of radius to the power 4 versus time should be a straight line (Figures 5a/b).

Tracker lets you define new variables such as 'rto4' in terms of existing quantities.

(This experiment can be used to determine the viscosity of air)

Modelling exoplanet detection
Here we have filmed the bob of a conical pendulum passing in front of a lamp (Figures 6a/b). When we analyse the variation of the brightness of a group of pixels with time we get a graph just like that obtained by the transit method of exoplanet detection [2].

How to run Tracker in a browser

There are versions of Tracker for Windows, OSX (Mac) and Linux [3]. At this point, we can almost feel the frustration emanating from some of you. We know that getting software installed on school computers can be difficult. We are aware of one department that took pendrives home and installed Tracker directly on to them. Tracker could then be run from the pendrives when they were inserted into school machines. This does not work for every school. Furthermore, many schools have now moved to Chromebooks (Figure 7).

The following solution may work for schools where either Chromebooks are in use or installing software on laptops and desktops is not possible. It has its limitations but we have had some success with it.

Visit the Rollapp website [4]. Rollapp allows certain applications to run in a browser, including Tracker and another physics education favourite, Audacity. If you opt for the free Rollapp service you will encounter the following limitations:

- You cannot save your work (surprisingly not such a big deal as far as Tracker is concerned, in our experience).
- Uploading files to analyse is a bit of a pain.

When you go to the Rollapp Tracker page you will see a button marked Launch Online (Figure 8).

You will now be taken to a screen that gives you the option of signing up or logging in. If you haven't signed up beforehand, you'll have to do that now. >>

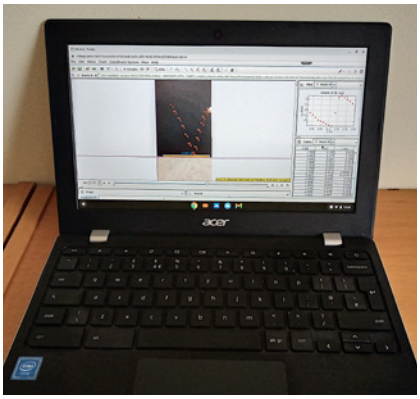

Figure 7 - Tracker on a Chromebook.

Figure 8 - Launch Online.

Once you have signed up and logged in you may be met with a screen that entices you to upgrade to a less limited version of Tracker. Ignore this and click on Launch Tracker with limited capabilities.

Normally, to analyse a video or image in Tracker you would go to the menu Video and select Import (Figure 9)

You would then navigate to that file on your computer. With Rollapp, you need to upload the file first.
When you select Import... you should see a pop-up (Figure 10).

Look for the wee dots (see the arrow in Figure 10) and hover your mouse pointer over them (Figure 11).

Select the icon indicated by the arrow in Figure 11.

You will then be able to navigate to the file on your computer that you would like to upload. Once uploaded, it is placed in the LocalSync folder. If it's an image rather than a video file, you may have to use the drop down arrow to the right of Files of Type: Video Files to see it. You can also link cloud storage such as Onedrive or Googledrive to your Rollapp account. We did so with Googledrive, but set up a bespoke account solely for use with Rollapp as the permissions the platform was asking for made us emit an abrupt squeak.

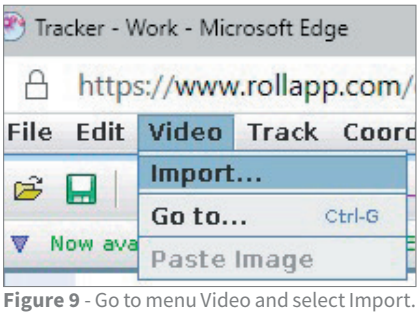

Figure 9 - Go to menu Video and select Import.

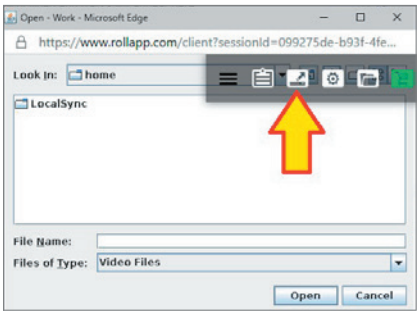

Figure 10 - Select Import to see the pop-up.

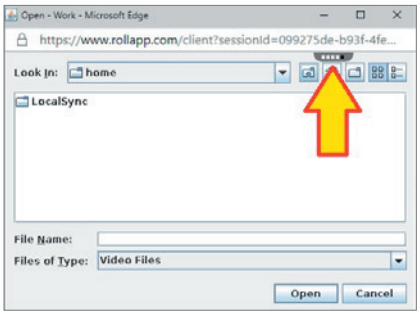

Figure 11 - Select the icon inidcated by arrow.

At the end of this article we will tell you how to find out more about using Tracker.

Alternatives to Tracker

If you have an Android tablet or phone, or can run Android apps on your Chromebook, you might like to check out a motion analysis app called Vidanalysis. It is not as sophisticated as Tracker but is still useful, especially if you can use a mouse or trackpad rather than a touch screen with your device.

For iPad users, there is Vernier Video Physics. This is a paid-for app that is reasonably slick. You can find out more in our apps guide [5] or by signing up to our Mobile Devices self-study course [6].

Learning more about Tracker

You can find out how to carry out many different activities by working through the documents on our Tracker section of the SSERC website [7] or you can sign up for a self-study course [8]. Feel free to share the materials with your students. Both the webpage and the course include sample videos and images. <<

References

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[3] https://physlets.org/tracker/ (accessed November 2020).
[4] https://www.rollapp.com/app/tracker (accessed November 2020).
[5] https://www.sserc.org.uk/wp-content/uploads/2013/07/All_apps_iOS_Droid.doc (accessed November 2020). Some of the apps, including the SSERC speed camera app, mentioned in this document are no longer on the Play Store. We may be able to help you obtain them. Please get in touch.
[6] https://www.sserc.org.uk/professional-learning/secondary-clpl/physics-clpl/mobile-devices-self-study/ (accessed November 2020).
[7] https://www.sserc.org.uk/subject-areas/physics/physics-higher/tracker-easy-motion-analysis-and-more/.
[8] https://www.sserc.org.uk/professional-learning/secondary-clpl/physics-clpl/tracker-self-study.

Studying animal cells at BGE using liver cells

The study of cells, including comparison between plant and animal cells, is a common feature of Broad General Education (BGE) science courses [1]. At this level in the curriculum practical activities would typically include the preparation of slides of onion cells and human cheek cells, each stained with iodine solution, and subsequent comparison of the cells as viewed under a microscope.

Figure 1 - Transfer the scraped tissue to a clean microscope slide.

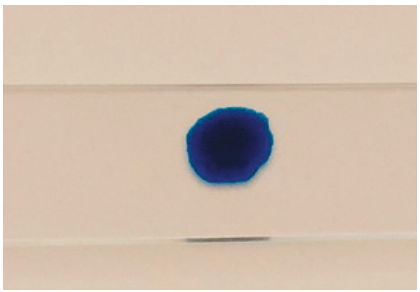

Figure 2 - Add a small drop of 0.1% methylene blue stain.

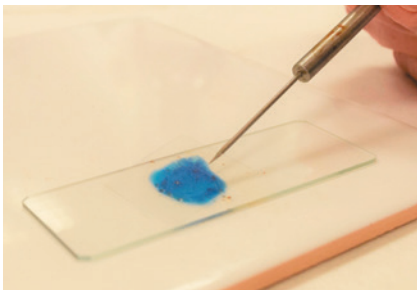

Figure 3 - Use the mounted needle or cocktail stick to carefully lower a coverslip over the stained tissue.

In this time of COVID-19, SSERC has received several enquiries from teachers and school technicians about the safety and desirability of carrying out cheek cell sampling for microscope work with BGE students. Our answer to these enquiries has been that as long as the guidance in the Code of Practice, Materials of Living Origin [2], is followed, and SSERC's general back-to-school guidance [3] is in place, it is safe for BGE students to do this. The main caveat to the guidance is that a teacher's risk assessment should take account of the ability of their learners to adhere strictly to the guidance.

However, all of that said, we appreciate that, in the current climate of enhanced hand and respiratory hygiene, some teachers might remain uncomfortable with carrying out this practical work with their classes.

Here we set out a protocol using fresh liver as a readily available and cheap source of animal cells suitable for microscopic examination by learners. Treated as follows, the cell membrane and nucleus of the cells are easily visible with a school microscope.

We are grateful to our colleagues at CLEAPSS [4] for sharing their protocol 'Staining and observing liver cells' which in turn is based on the work of Ian J. Burton [5].

For this activity we used fresh lamb's liver purchased from a butcher. Pig's liver is also suitable. Frozen liver and chicken liver are not suitable. The cells were stained with a 0.1% w/vol methylene blue aqueous solution. Methylene blue can be purchased in two forms: 1% solution which can be further diluted or solid powder which can be dissolved in water. The prices for each sourced from Scientific and Chemical [6], November 2020 (other suppliers are available) are:

- 100 cm^3 methylene blue solution - £2.58;
- 5 g methylene blue powder - £2.27.

Safety measures

- Learners should wash their hands before and after carrying out this work.
- There are no associated hazards with using small quantities of 0.1% methylene blue, therefore eye protection is unnecessary.
- Learners should be provided with a small pre-cut piece of fresh liver - 1-2 cm^3.
- Learners should be reminded of the fragility of coverslips and the care needed to avoid their breakage.
- Used slides and coverslips should be placed in a suitable disinfectant solution, e.g. *Virkon*, or 1% bleach, for several hours. Slides can then be rinsed and dried for re-use.

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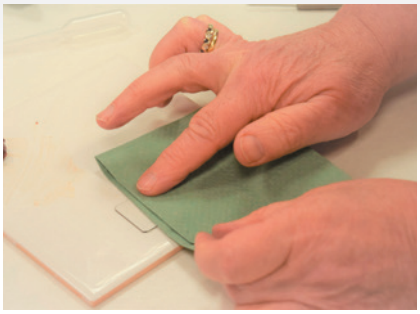

Figure 4 - Remove excess stain.

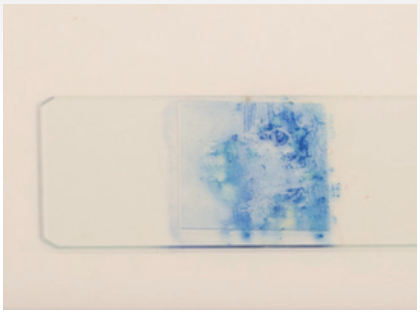

Figure 5 - The slide ready for viewing.

- Coverslips can be wrapped and disposed of via normal refuse, or placed in a broken glass bin.
- Liver can be bagged and disposed of via normal refuse.
- Work surfaces should be cleaned with detergent, or disinfectant solution on completion of this work.

SSERC 'Guidance for school Science & Technology coming out of lockdown' contains the following statement relating to microscopes. "Items that might come into direct contact with the face, such as microscope/spectroscope eyepieces should still be wiped with an antiseptic between users." [7]

Materials

- Microscope.
- Microscope slides and coverslips.
- Spatula or spoon.
- Mounted needle or cocktail stick.
- White tile.
- Small piece of liver.
- Dropping bottle containing 0.1% methylene blue.
- Paper towels.

Method

1) Scrape the cut surface of a small piece of fresh liver with a blunt instrument - spatula or small spoon.
2) Transfer the scraped tissue to a clean microscope slide and smear over a small area in the middle of the slide creating a thin layer (Figure 1).
3) Remove any obvious lumps using a mounted needle or cocktail stick.
4) Add a small drop of 0.1% methylene blue stain (Figure 2).
5) Mix the stain with the smeared liver tissue and leave for 1 minute.
6) Use the mounted needle or cocktail stick to carefully lower a coverslip over the stained tissue (Figure 3).
7) Fold a paper towel 2 or 3 times and place over the coverslip. Apply gentle pressure. This helps to spread the cells into a single layer and removes excess stain (Figure 4).
8) Carefully clean any excess stain from the surface and around the coverslip.
9) The slide is now ready for viewing under the microscope (Figure 5).

Figures 6 and 7 show images of liver cells as viewed under the microscope at magnifications of x100 and x400 respectively.

For the study of animal cells, this simple and straightforward technique would make a suitable alternative to sampling and staining cheek cells. <<

References

[1] *Curriculum for Excellence: Sciences experiences and outcomes* availabe at https://education.gov.scot/media/jcxpmwd5/sciences-eo.pdf (accessed November 2020).
[2] *Materials of Living Origin – Educational Uses A Code of Practice for Scottish Schools and Colleges* (SSERC 2018), Appendix 2 availabe at https://www.sserc.org.uk/health-safety/biology-health-safety/codes-of-practice/.
[3] Guidance for school Science & Technology coming out of lockdown availabe at https://www.sserc.org.uk/health-safety/covid-19-back-to-school/.
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[5] Ian J. Burton, *Journal of Biological Education,* (1999) 33(2).
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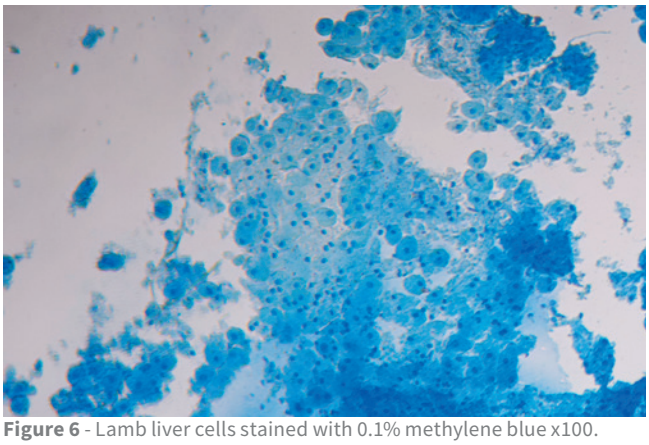


Figure 6 - Lamb liver cells stained with 0.1% methylene blue x100.

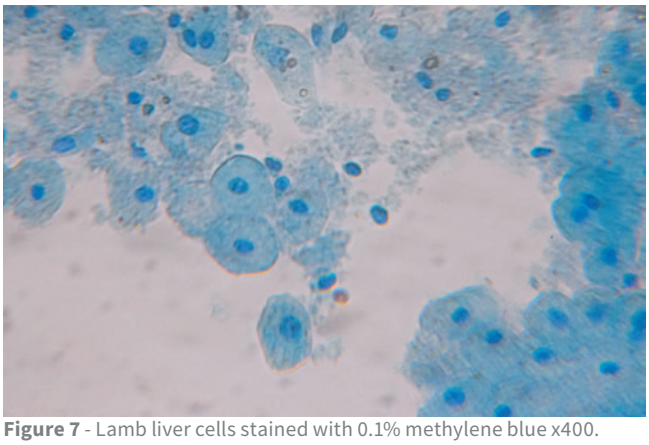


Figure 7 - Lamb liver cells stained with 0.1% methylene blue x400.

Determining the iodine value without Wijs

For some years now there has been an activity on the SSERC website about the synthesis and testing of biodiesel [1].

Biodiesels are derived from plant oils and can be used as a cleaner, non-toxic alternative to diesel, though not entirely free from environmental problems. An important property of biodiesel is its chemical stability as this determines how long it can safely be stored and how it might deteriorate under extreme conditions [2]. One measure of the chemical stability of a biodiesel is its Iodine Value. The Iodine Value is a measure of the degree of unsaturation in the fuel - the higher the Iodine Value, the greater the degree of unsaturation and the higher susceptibility to oxidation [3]. More detailed information about biodiesel can be found from an American organisation, Brevard Biodiesel [4].

Iodine value

A common method to establish the Iodine Value is to treat the oil with excess Wijs solution. This contains iodine monochloride dissolved in ethanoic acid and reacts with the unsaturated part of the oil or fat, adding iodine to the molecule.

The greater the number of double bonds, the greater the amount of unsaturation, the less iodine there is left over. The unreacted iodine can then be determined by titration with a standard solution of sodium thiosulphate.

This method is reliable but the solution is expensive to buy ready-made and synthesising it in on site is quite hazardous due to its toxicity.

At SSERC we have developed a simpler, quicker and safer method: add a mixture of ethanolic iodine solution and water to the oil. The iodine and water react with the unsaturated part of the oil, the double bonds, adding iodine and an alcohol group to the molecule [5].

Equipment needed

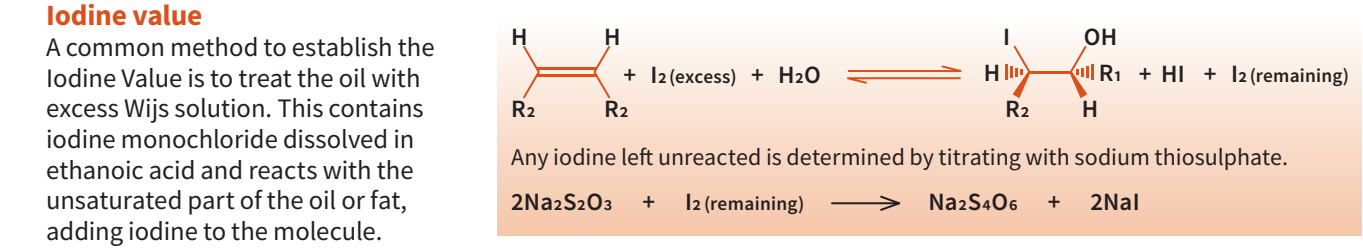
Each group requires the following, the reagents will be sufficient for about 25 titrations:

- Access to a 2 dp balance (3 dp or 4 dp balance would be even better).
- Burette.
- 400/500 cm³ conical flasks.
- 2 x 25 cm³ measuring cylinder.
- 1 x 250 cm³ measuring cylinder.
- Oil samples.
- 500 cm³ 96% Ethanol (IDA).
- 375 cm³ Propanol.
- 500 cm³ 0.1 mol l^{-1} Iodine solution in 96% ethanol.
- 1000 cm³ 0.1 mol l^{-1} sodium thiosulphate.*
- Freshly made 1% starch indicator solution.

*The thiosulphate solution should be standardised to determine the exact concentration.

Method

1) Prepare and titrate a blank solution as below but omit the oil. The blank titration only needs to be done once at the start of the experiment.
2) Accurately weigh 0.10-0.17 g of the oil sample into a clean 400 cm³ conical flask. >>



Any iodine left unreacted is determined by titrating with sodium thiosulphate.

$$2Na_2S_2O_3 + I_2\,(remaining) \longrightarrow Na_2S_4O_6 + 2NaI$$

3) Add 15 cm^3 propan-1-ol to the flask and allow the oil to dissolve.
4) Add 20 cm^3 Iodine solution.
5) Add 200 cm^3 cold water (~10°C).
6) Cover with a watch glass and swirl the flask gently for 3-5 minutes.
7) Titrate the solution to a pale yellow colour and then add 2 cm^3 starch solution. Continue titrating to the milky white endpoint ensuring that the flask is well shaken to remove all traces of colour.

Troubleshooting

After the addition of the water a small amount of iodine vapour can be seen in the flask. This can be minimized by using cooled water (~10°C) and only swirling the solution very gently. A watch glass should be used to cover the flask. Any iodine vapour present will disappear as soon as the titration is started. Ensure the conical flasks are completely dry before use – any presence of water will affect the solubility of the oils in the initial stage.

Although ideally a pipette should be used to dispense the iodine solution, the high volatility of the ethanol makes this problematic (ethanol evaporates in pipette, increasing the vapour pressure which forces the solution out of the pipette). In this case it is easier and probably as accurate to use a 25 cm^3 measuring cylinder.

Calculation of the iodine value

2 titrations are carried out, a titration with the oil (T) and a titration without the oil (the blank, B). The difference between the titres in the blank and in the test sample, (B-T), gives the amount of $S_2O_3^{2-}$ equivalent to the I_2 absorbed by the oil.

See equation in next column.

Iodine value equation

Using the equation below we can calculate the mass of I_2 that reacts with 1 cm^3 $S_2O_3^{2-}$.

i.e. 1 cm^3 sodium thiosulphate ≡ a known mass of I_2.

$$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$$

Number of moles of $S_2O_3^{2-}$ in 1 cm^3 0.1 mol l^{-1} solution is

1/1000 x 0.100 = 0.0001 moles $S_2O_3^{2-}$

From the equation

2 moles of $S_2O_3^{2-}$ reacts with 1 mole of I_2

Therefore

0.0001 moles of $S_2O_3^{2-}$ reacts with 0.0001/2 = 0.00005 mole of I_2

Mass of I_2 is given by

No of moles = mass I_2/molecular mass of I_2

mass I_2 = no of moles x molecular mass of I_2
= 0.00005 x 254= 0.0127 g

Therefore

1 cm^3 $S_2O_3^{2-}$ reacts with 0.0127g I2

Iodine Value is expressed as a number per 100 g oil

Iodine value = (B-T) x (0.0127) x 100/W

Where

B = blank titre of sodium thiosulphate solution (i.e. no oil present)

T= sample titre of sodium thiosulphate solution

((B-T) gives the amount of $S_2O_3^{2-}$ equivalent to the I_2 absorbed by the oil)
0.0127 is the calculated mass of iodine per cm^3 0.1 mol l^{-1} thiosulphate

W= mass in grams of sample of oil. 100 is used because the Iodine Value is expressed as a number per 100 g of the oil.

Results

Oil	Iodine Value Experimental	Iodine Value range
Olive	91	75-94 [8]
Rapeseed	117	105-126 [7]
Sunflower	129	118-141 [7]
Walnut	135	132-162 [9]

References

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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 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 with appropriate COVID processes and procedures in place, including social distancing.

Courses available for online booking include:

COURSE NAME	RESIDENTIAL?	DATES	CLOSING DATE	SECTOR
Chemical Handling	Face-to-face	16-17 February 2021	12 January 2021	Secondary Technicians
Practical Techniques for Recently Qualified Biologists*	Face-to-face	23 February 2021 & 25 May 2021	8 January 2021	Secondary Biology
Wood Turning*	Face-to-face	24-25 February 2021	8 January 2021	Secondary Teachers & Technicians
Working with Radioactive Sources	Online	1 & 8 March 2021	5 February 2021	Secondary Teachers & Technicians
Physics Blended Learning*	Online & Face-to-face	3, 10, 17, 24, 31 March & 12-13 May	22 January 2021	Secondary Physics
Electrical Safety and PAT	Face-to-face	10-11 March 2021	25 February 2021	Secondary Technicians
Centre Lathe Turning*	Face-to-face	24-25 March 2021	20 February 2021	Secondary Teachers & Technicians
Safety in Microbiology*	Face-to-face	21-23 April 2021	12 March 2021	Secondary Technicians
Welding Skills*	Face-to-face	6-7 May 2021	26 March 2021	Secondary Technology
Physics Summer School	Face-to-face	19-22 May 2021	16 April 2021	Secondary Physics
Welding Skills*	Face-to-face	20-21 May 2021	2 April 2021	Secondary Technology
RSB Annual Teachers' Meeting	Face-to-face	27 May 2021	23 April 2021	Secondary Biology
Chemistry Summer School*	Face-to-face	9-11 June 2021	7 May 2021	Secondary Chemistry
Wood Turning*	Face-to-face	16-17 June 2021	7 May 2021	Secondary Technology
Biology Summer School*	Face-to-face	22-24 June 2021	28 May 2021	Secondary Biology

*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 career long professional learning calendar.

Courses are available for online booking at **https://www.sserc.org.uk/course-online-booking-form/**
Courses may be postponed due to the COVID-19 situation.

The STEM Ambassador Programme in Scotland

STEM Ambassadors are volunteers from a wide range of science, technology, engineering and mathematics (STEM) related jobs and disciplines across the UK. They offer their time and enthusiasm to help bring STEM subjects to life and demonstrate the value of them in life and careers. STEM Ambassadors volunteer to support learning, such as by delivering a careers talk, running an activity, helping to deliver a demonstration or by providing a broader context to a STEM subject.

There are three STEM Ambassador Hubs in Scotland, each having specific responsibility for coordinating the activity in their region.

SSERC manages the STEM Ambassador Programme in Scotland, on behalf of STEM Learning.

North of Scotland

The North of Scotland STEM Ambassador Hub is coordinated by the newly renovated Aberdeen Science Centre (ASC). The Hub covers Aberdeen City, Aberdeenshire, Moray, Highlands, Eilan Siar, Orkney and Shetland local authorities. ASC have staff members spread across the region, along with fantastic links to education, employers and communities. For more information about requesting STEM Ambassadors, visiting the science centre and potential collaboration projects, visit https://aberdeensciencecentre.org.

A great example of STEM Ambassadors in action is their ability to show young people their workplace through video tours and live Q&A. This is what is happening with a number of STEM Ambassadors working in labs and an Aberdeenshire secondary school – ensuring that secondary students don't miss out on experiencing workplaces during the pandemic.

Contact
stemambassadors@asc.scot

East Scotland

SAE@SSERC manages the Hub in the East of Scotland and is based at SSERC HQ in Dunfermline. We support over 1,600 Ambassadors to deliver engaging STEM experiences for schools across 12 local authorities: Angus, Clackmannanshire, Dundee, Edinburgh City, East Lothian, Falkirk, Fife, Midlothian, Perth & Kinross, Scottish Borders, Stirling and West Lothian.

We have continued to support secondary schools during COVID by providing new ways for learners to engage with the programme. A great example is where we provided case studies and videos from STEM Ambassadors working in a lab skills field to Kinross High School's Lab Skills class who were unable to visit workplaces as a result of pandemic restrictions. We have also supported career pathway events, CREST Awards, mock interviews and digital work experience.

For more information about STEM Ambassador activity in the East of Scotland, visit https://www.saesserc.scot.

Contact
sae@sserc.scot

West Scotland

Science Connects manages the West of Scotland STEM Ambassador Hub and is based at the University of Glasgow. Covering 13 local authorities from Dumfries and Galloway to Argyll and Bute, >>

Science Connects has run the STEM Ambassador Programme since its inception in 2001 and has over 2,700 authorised STEM Ambassadors.

During the COVID pandemic they have been working with schools to assist with virtual careers events, either by providing pre-recorded videos of STEM Ambassadors discussing their careers or facilitating live sessions with Ambassadors.

They recently piloted a successful online evening engineering event with the DYW Co-ordinator at Boclair Academy in East Dunbartonshire for senior pupils and their families to hear from nine STEM Ambassadors in the engineering sector. Pupils were given the opportunity to pre-select the areas of engineering of interest to them and after a keynote presentation, they were allocated to breakout sessions to hear from STEM Ambassadors in their selected areas, rotating to different breakout sessions to hear from different STEM Ambassadors. In each session, pupils were able to ask questions of the STEM Ambassadors.

For more information about STEM Ambassador activity in the West of Scotland, visit https://www.gla.ac.uk/explore/scienceconnects/.

Contact
stem-ambassadors@glasgow.ac.uk

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IOP Teacher Award 2020
Dr Catherine Dunn

Anyone who has worked with Catherine knows how sharp, rigorous, humble, creative and talented she is.

What also quickly becomes apparent is that she really is dedicated to helping pupils, students, teachers and colleagues in any way she can – nothing is too much trouble for Catherine. She is always extremely generous with her support. Catherine's physics and maths ability can only be described as "incredible". She rigorously writes up all her experiments and results in her lab journal so that if any enquiries come in about the experiment she can back up her advice with typical results. She is quietly efficient; she knows what needs to be done and works quietly away before presenting her well thought out product or idea. Catherine is a very creative teacher. She is superb at combining ideas and resources and creating fantastic, novel teaching materials. Catherine is also just as happy making model cardboard houses for an energy topic so that she can share the template with other teachers.

All at SSERC were therefore delighted to learn that Catherine was a winner of the Institute of Physics Teacher of Physics Award 2020.

Catherine's citation for the award reads as follows:
In recent years Catherine has split her teaching between pupils at St Leonard's School in St Andrews and SSERC where she has supported the professional learning of teachers of physics. Catherine is a lovely, humble person but she has an extremely sharp mind. There can be few teachers who surpass her regarding intellectual ability and rigour. However, her creativity and empathy allow her to present difficult concepts in novel, accessible ways. Catherine has supported many pupils and teachers and her support is often bespoke, but she then shares these solutions with the wider community. As a result Catherine is well-known throughout the Scottish physics teaching community. She attends and presents at national events and is well-respected, and indeed well-loved, by the Scottish physics teaching community.

A very worthy recipient of the 2020 IOP Teacher of Physics award. Congratulations from all at SSERC Catherine.

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"Catherine pitched the music experience at a perfect level. It was very enjoyable and I can see how the experiences can be used and develop to engage with the children."

Treehouse - a fun digital solution to support mental health & wellbeing of pupils and staff

SSERC is please to support and endorse the Tree of Knowledge Treehouse platform. It's been an unprecedented and challenging year for school staff, teachers, pupils and parents. What is becoming evident is the knock-on effects of social isolation and the stresses of the continued change and uncertainty, on the mental health and wellbeing of school communities, due to COVID-19.

Treehouse is an online education platform full of interactive, inspirational and confidence-boosting modules to support schools, their teachers, and pupils to be the best version of themselves. Designed by the team of psychologists, teachers and motivation experts at Tree of Knowledge, Treehouse offers a unique, fun and flexible way to support the mental health and wellbeing of staff and pupils and increase motivation and creativity.

Treehouse has been designed to work alongside GLOW, Microsoft Teams, and other online platforms. So whether you are full time face-to-face schooling or operating with a blended learning approach, this intuitive platform can be used within a classroom or by pupils as home learning, homework or extra-curricular study.

treeofknowledge

TREEHOUSE FAQs

Who is Treehouse for?
Treehouse is for pupils and staff of primary schools, secondary schools and nurseries.

Does it support the curriculum?
Treehouse has been designed to support schools to deliver a wide range of the Curriculum for Excellence: Health and Wellbeing Experiences and Outcomes.

What themes does it cover?
Treehouse covers a range of topics, but focuses mainly on developing resilience, mental health & wellbeing, self-confidence, kindness & empathy, inspiration, motivation, creativity and nurture. It's a lot of fun, and we hope that it will help your pupils and staff rediscover that "wee piece of magic".

How does Treehouse work?
Treehouse is an online education platform which is built using a learning management system called Learn Dash. This system is used and trusted by companies, universities and training organisations all over the world. Once you sign up to Treehouse, there is a simple process to create log-ins for all of your staff and pupils. Your whole school will then have access to 50+ educational modules specifically designed to support the mental health, wellbeing and soft skills development of your pupils and staff. Better still, with new modules being added throughout the year, skills will just keep on developing. Modules will include a combination of video, reading and writing tasks. These can be used within lessons, set as homework, or form part of a blended learning approach.

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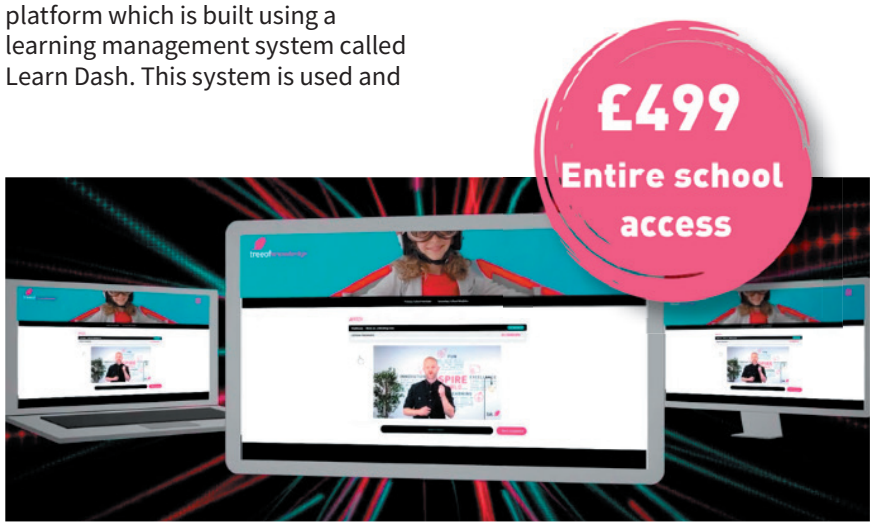

Can this be used in the classroom?
Yes. This has been designed with ultimate flexibility in mind. It can be beamed onto whiteboards or projected onto screens, as well as used on laptops or PCs. It can also be used for independent learning or in groups to stimulate discussion.

Can this be used for blended learning?
Yes. Like you, we're not sure what's going to happen over the next wee while, so this platform can be used at home, by pupils, and in the classroom. IT's been designed with ultimate flexibility in mind.

Does it track progress?
Yes. Each pupil will have their own log-ins and can be assigned to a "class", and teachers will be able to see how their pupils are progressing through the modules.

How much does it cost?
Treehouse starts at just £499 for the year for access for your entire school.

TREEHOUSE Use Cases

As we talk to schools, we're learning more about how TREEHOUSE is being used. We want to share ideas, to inspire you to get the most from it!

Classroom
Whether it's on individual screens, in small groups or projected onto a screen or board, TREEHOUSE can form parts or, or full lessons, hitting key topics from the Curriculum for Excellence: Health and Wellbeing Experiences and Outcomes. The activities can be done individually and then discussed within a group setting.


Photo: Max Fischer / Pexels.com

At home
TREEHOUSE can be used for homework or can be used from home as part of a blended learning approach. This can be done with the support of parents (for Primary) or independently (for Secondary). Teachers can set the work and track the progress of each pupil.

Dinner table
The activities on TREEHOUSE are actively encouraged to be used as dinner table discussions. Not only does this encourage opportunity for children and their parents to connect, but it also allows parents to see and be involved with their child's learning around mental health & wellbeing.


Photo: Julia M Cameron / Pexels.com

Peer-to-peer
TREEHOUSE can be used as a resource to be delivered by Mental Health Ambassadors to other pupils. All of the modules include an introduction, an activity, and a discussion - they're a great resource to help pupils build confidence in delivering content and facilitating discussion.

Self isolating
For self-isolating or vulnerable pupils, TREEHOUSE can be a lifeline and crucial support for mental health to combat loneliness. Teachers can set the work and track the progress of each pupil, plus it's a great way to start difficult conversations with pupils who may be struggling.

Staff wellbeing
TREEHOUSE directly addresses the current need for support for staff wellbeing during this unprecedented time. Staff modules offer time for reflection, gratitude and reignite the passion. It will also help them to unpick stress and anxiety, to help them to understand and handle negative emotions. <<

Exclusive 10% SSERC discount. Use code SSERC10 at checkout.

Jayne Hamilton - Winner of ENTHUSE Award, Excellence in STEM Teaching (Secondary)

At the start of the 2019 academic year, I was appointed as PT Positive Destinations for Bannockburn High School. Having worked alongside fantastic colleagues in the DYW working group, this opportunity was a real springboard to start embedding STEM learning into wider achievement opportunities and support our young people and their parents when it came time to make subject choices.

At this point I had also embedded an alternative vocational curriculum pathway for the young people at Bannockburn High School to include Level 5 Lab Skills and Level 6 NPA.

Through SSERC's STEM Engagement Offer, I was able to access a Grand Challenge ENTHUSE Teacher Placement. I along with colleagues from across the central belt spent two days at Canon Medical in Edinburgh and one day at The Imaging Centre of Excellence at the Queen Elizabeth University Hospital, Glasgow. This opportunity provided valuable insights and networking opportunities that would go on to benefit my own practice and provide unique learning opportunities for pupils at Bannockburn High.

In November, I took part in another 3-day Teacher Placement funded by the Biochemical Society at Glasgow University. Once again, an opportunity for networking and making connections and speaking directly to lecturers and employers on what they are looking for in young people coming to university.

Armed with a new vision of inclusivity and opportunities for all, I organized a Women in Medicine event at my school. This was supported by Canon Medical staff, a past pupil who is now a qualified doctor, a local business owner and a vet. This provided a springboard for young female students to hear from inspiring women in their respective fields and the challenges and successes they have encountered. This then led to pupils setting up a Medic Society and Bannockburn High now have a partnership with Medic Mentors and You can be a Doctor.

I organised our Future Pathways and Wider Horizons events for S4/5/6 and S2 respectively. This involved over 30 partners from a range of colleges, universities, apprenticeship providers and employers in school over two days to share information with parents and pupils. Through the two placements, I also received funding to put on a full two day Wider Horizons event for S2 pupils including a STEM Extravaganza. With activities including building a suspension bridge, milking a (fake) cow, meeting STEM Ambassadors, filtering scat samples to identify organisms, Lego Coding, and Robotics, pupils were armed with a knowledge and insight they would not have had before when choosing subjects. The engagement with parents was significantly improved and many felt more secure in their child's future pathway.

With encouragement from colleagues, I put in an application for an Enthuse Award. This happened in March 2020 pre-lockdown, pre-COVID and what feels like another reality. As the thoughts of awards slipped out of my head and were replaced with blended learning and the world of Google Meet, I never considered the possibility of winning. The shock and pride felt in equal measure when I opened the email will not go unforgotten, neither will the memories that I and the pupils I work with shared in life before lockdown. I feel hugely privileged to have received this recognition award for Excellence in STEM Teaching. <<

A Young STEM Leader case study:

Building STEM capital in Turnbull High School

Turnbull High School in Bishopbriggs, East Dunbartonshire has been delivering the Young STEM Leader Programme (YSLP) for the last two years. Delivering YSLP in a secondary setting is a great way to add value to existing STEM engagement activities, helping to build and maintain a STEM learning community led by positive role models.

YSLs at Turnbull High School delivering gameshow style STEM activities to younger pupils.

Jacqueline O'Kane is a maths teacher in Turnbull High School, Bishopbriggs. As Principal Teacher of STEM she works with STEM departments and S6 pupils to create a vibrant STEM culture in their community. She leads the School STEM Action Group, which consists of members of staff from across the STEM departments. They meet at least once per term for a planning and update meeting to take forward the STEM agenda. Jacqueline is a Tutor Assessor for the Young STEM Leader Programme and has been delivering the award at Turnbull High School since 2019.

Tell us about your Young STEM Leaders

This year eight pupils have decided to participate in the YSL6 award. Each year we appoint two STEM captains and two Numeracy Captains, who lead a group of S6 pupils to support all STEM departments. These captains along with the other S6 pupils have a team meeting on a fortnightly basis to catch up and plan future events and work. The pupils are great fun to work with and are enthusiastic about STEM and working with the younger year groups.

What made you start running YSLP?

Like most schools, we have had S6 leading and delivering aspects of the curriculum, supporting staff in clubs and activities within STEM subjects for many years. This programme has given us the opportunity to formally certificate pupils for the tremendous work that they are doing to enthuse, engage and stimulate the younger pupils in STEM subjects and careers.

How long did it take?

It did not take long to set up as we have an established programme of S6 working across the school. The support from SSERC has allowed us to present the award with ease.

Was it worth it?

It has definitely been worth it. Last year we presented pupils at YSL6 and we are hoping to repeat this process this year. As pupils are required to participate, lead or create three STEM experiences we have a vibrant and growing STEM community.

What did the pupils think?

Pupils are enjoying the experience, working and supporting pupils and departments. It gives them a platform to display their leadership and creativity. The feedback from the younger pupils has been fantastic.

How are you running the award in its second year?

This year we are building on the success and ideas from our previous YSLs. I meet with the STEM Captains every two weeks and the Numeracy Captains meet with a maths teacher on a regular basis. The captains meet with the other YSLs on a weekly basis and report to me on their progress.

In previous years we have run events and workshops supported by STEM Ambassadors but due to COVID we have had to 'think outside the box' to ensure that we are able to make an impact with the younger pupils. This has resulted in more virtual engagements.

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Examples of some activities, events and interactions developed by the YSLs are forensic workshops, monthly Numeracy Challenges and adapted gameshows such as The Chase, Kahoot quizzes to support STEM learning and Careers Information PowerPoints. For support in the Senior Phase, YSLs have produced presentations, tutorial work for subjects and Kahoot quizzes too.

S6 pupils Cara and Emma are both Young STEM Leaders at Turnbull High School.

What's the best thing about being a Young STEM Leader?

Cara and Emma: As Young STEM Leaders we have been actively involved in engaging with our peers within science. It has provided us opportunities to engage with staff and younger pupils too. It has been great fun so far and we really enjoy having responsibilities to deliver exciting and worthwhile experiences for pupils.

Tell us about the activities, events and interactions you are delivering

Emma: I have contributed to the presentation of Higher Human Biology by running supported study sessions to aid pupils with their knowledge and motivate them to succeed. I also organised experiment demonstrations for S1 pupils to ignite their interest in science and encourage them to continue their academic career within STEM.

I have created Kahoots and Numeracy work for Halloween and Bonfire Night for S1 which the maths department has been using in first and second year.

Cara: I have organised supported study in Physics to support pupils in their learning. I helped create a STEM Careers PowerPoint for the BGE and I am currently promoting a STEM competition from Shell. I have created Kahoots for the Science department. One of my other roles is to engage regularly with the other YSLs to give Ms O'Kane an update on our activities.

How has Young STEM Leader helped you to improve your skills in leadership, communication and teamwork?

Cara: I have immensely improved my confidence as a leader. The experience has pushed me outside my comfort zone and encouraged me to take initiative and organise events for my school. I think it is important to provide a positive platform for STEM within school and raise awareness of the lack of female representation in the sector. As such, along with other Young STEM Leaders, I have been involved in 'Stay in STEM' events and supported learning programmes to help and encourage pupils to pursue a career in STEM. The Log and written work we are completing helps me to identify my strengths and areas for improvement and this was very valuable as I have since been able to improve myself.

Emma: I worked closely with other Young STEM Leaders to organise and carry out these tasks and

The YSLs at Turnbull High School received training from Education Scotland about gender stereotypes and unconscious bias, helping them to address these issues through delivering STEM activities, events and interactions.

this required me to work to strict timescales and be effective in a team environment. This opportunity has allowed me to improve my interpersonal skills and develop my leadership qualities, skills all applicable to the world of work and university.

What would be your advice to people thinking about becoming a Young STEM Leader?

Cara and Emma: As a group of S6 we are enjoying having a lead role in the school. It is definitely worth doing, and it is not too time consuming. Overall, we are very grateful to take part in this experience and the skills we have gained will be applicable to our daily lives and further education. It is also good for our UCAS Personal Statements.

It is fun….do it! <<

Find out more...

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

Coronavirus and the cleaning of equipment

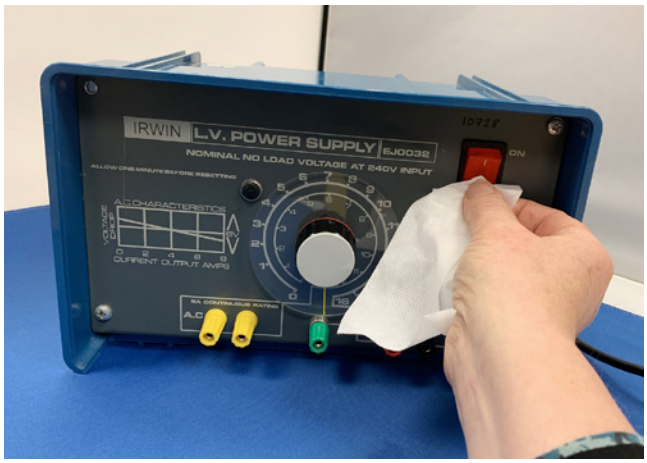
From the beginning of the coronavirus outbreak, quite an emphasis was placed on the cleaning/sanitising of hands and surfaces. This was for perfectly good reasons: more familiar viruses, especially flu, are definitely transmitted this way and some early research in April [1] showed that the virus could last for some considerable time on surfaces. As a result, looking at this and other advice from the Scottish Government, we suggested that shared science equipment should be either disinfected between uses or, where that wasn't possible, left for 72 hours or longer to quarantine.

But science changes, particularly when dealing with something new. In July, a paper in The Lancet Infectious Diseases [2] suggested that the previous research overstated the case as it had involved 'infecting' the surfaces with quantities of virus that were far larger than would be likely to occur in real-life situations. They did say, however, that no actual tests had been done to see if this was in fact the case. Recently though, such a study has indeed been carried out and published in the same journal [3]. The researchers conclude that:

> "Our findings suggest that environmental contamination leading to SARS-CoV-2 transmission is unlikely to occur in real-life conditions, provided that standard cleaning procedures and precautions are enforced."

As a result of this, and other, research, the Scottish Government has changed some of its advice in the latest update to its guidance for schools. It says:

> Careful hand washing with soap and warm water/use of alcohol-based hand sanitiser before and after handling text books, jotters (or other pieces of equipment) mitigates the need for quarantine for 72 hours before, and 72 hours after.



SSERC's interpretation is that this can also be applied to equipment used in science and technology. It is important to note that this does NOT mean a return to normality. The virus is still here and all possible measures should still be taken to prevent its spread. In health and safety matters, we often use the concept of 'so far as is reasonably practicable'. This means that when we consider a safety measure, we weigh the possible gains against the costs, not just financial but also in terms of time and convenience and indeed the possible impact on learning. Given the increasing evidence that with good hand hygiene, the risk of picking up coronavirus from touching a surface is low, we think that in normal conditions there may not be an absolute requirement to disinfect/quarantine equipment between classes – provided that:

a) Disinfecting/quarantining of the equipment is difficult or time-consuming to the point where practical activities are reduced or not taking place and learners' education is affected. For example, whilst it is practicable to wipe down the rotary control on a physics power supply every time it is used, sanitising or quarantining connecting leads and small components is far less so.

b) An effective system is in place for careful hand sanitising with soap and warm water/use of alcohol-based hand sanitiser before and after handling items.

c) Users of such equipment, teachers as well as learners, should avoid touching their faces. If they do so then they should re-clean their hands before touching the equipment.

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d) If there is an event that could potentially lead to greater contamination – such as someone coughing or sneezing on equipment then the item should be cleaned or quarantined before another user touches it. (The chances of this being an issue are greatly lessened in situations where the user is wearing a face covering).

e) Items that might come into direct contact with the face, such as microscope/spectroscope eyepieces should still be wiped with an antiseptic between users.

PPE such as eye protection should still continue to be disinfected in the same way as before as it is in direct contact with the face.

Note that this is between classes – sharing of equipment between individuals in the same class should still be kept to an absolute minimum. In the same way that evidence suggests surface transmission is less important, it is also suggesting that transmission by droplets and aerosols is more important. The sharing of equipment at the same time in a group will inevitably mean they are in close proximity and maximising distance is thus an important factor in minimising the spread of the virus. <<

References
[1] https://doi.org/10.1016/S2666-5247(20)30003-3
[2] https://doi.org/10.1016/S1473-3099(20)30561-2
[3] https://doi.org/10.1016/S1473-3099(20)30561-2

Update of chemistry risk assessments

Any chemistry teacher will no doubt be aware that all of the many chemistry activities listed on our website come with their own model risk assessment that you can customise for your own use.

Over the past few weeks all of these have been reviewed, updated to take account of any changes in procedure and classification since they were last reviewed and converted to an updated format.

All the links on the pages for the chemistry activities have been updated to point to the revised versions and anyone who wishes to download all of them in a single zip file can do so here:

https://www.sserc.org.uk/wp-content/uploads/2020/12/01-Chemistry-Risk-Assessments-2020.zip

Sealed radioactive source disposal

When the Environmental Authorisations (Scotland) Regulations (EASR 2018) were introduced, there was a subtle but important change to legislation permitting dustbin disposal of sealed radioactive sources with activities of 200 kBq or below. Dustbin disposal was still permitted, provided that waste went directly to landfill. One reason for this is that a lot of waste is now processed to make refuse-derived fuel (RDF). Black bag waste is shredded and electromagnetic induction is used to remove metal waste for recycling. The rest is burned in power plants. Scotland's environmental agency, SEPA, does not want radioactive material ending up in the scrap metal chain. With many councils adopting a 'zero waste to landfill policy', what should a school do if it wishes to dispose of a source?

Firstly, no school should dispose of anything radioactive without consulting SSERC via rpa@sserc.scot. If you want to dispose of your source because you don't want to have radioactive sources any longer, we'll try to talk you round. Perhaps you have a misconception regarding safety or the difficulty of procedures such as leak testing [1]. If we really can't talk you into keeping a resource that supports the teaching of a fascinating topic and that would cost hundreds of pounds to replace, we'll work with you to either dispose of the source if possible, or to rehome it to another school. The worst-case scenario is that you will have to pay for a 'direct to landfill' uplift from your usual waste contractor, or to pay for an uplift from a specialist company which could be very expensive. We are engaging with legislators and have tried to work with the trade to make this easier. To be candid, the whole business of disposal has been a game of 'whack-a-mole' for around a decade. Just when one policy or piece of legislation that is a barrier to disposal is modified, another pops up.

Fortunately, the vast majority of schools see the value in keeping their sources. Our courses [2], some of them free of charge, bust the myths about the risks and difficulties. There is, however, one sealed source that even the most enthusiastic schools want to get rid of. This is the cobalt-60 gamma source, though they only wish to dispose of it if it is 25 years old or more. This is because the half life of cobalt-60 is only 5 years. A source with an initial activity of 180 kBq will have an activity of 90 kBq 5 years after purchase, 45 kBq after 10 years and so on. Many cobalt-60 sources in schools are effectively spent. They are no use for experiments. Or are they? Whilst we would be happy to assist a school in disposing of an old cobalt-60 source, if this proved to be expensive we are happy that you are justified in keeping it to demonstrate how a once-active source can have an activity barely above background level after a few years. Keeping the source is subject to it continuing to pass its annual leak test. In the last decade, no sources like the one in Figure 1 have failed a leak test in Scotland.

Figure 1 - A source undergoing a leak test.

If you don't have any sources just now and would be prepared to adopt one from another school, please let us know. <<

References

[1] https://www.sserc.org.uk/wp-content/uploads/Publications/Bulletins/263/SSERC-bulletin-263p11_13.pdf.
[2] https://www.sserc.org.uk/professional-learning/secondary-clpl/health-safety-clpl/online-radiation-protection-refresher/.

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