SSERC Bulletin

Ideas and inspiration supporting science and technology for all Local Authorities

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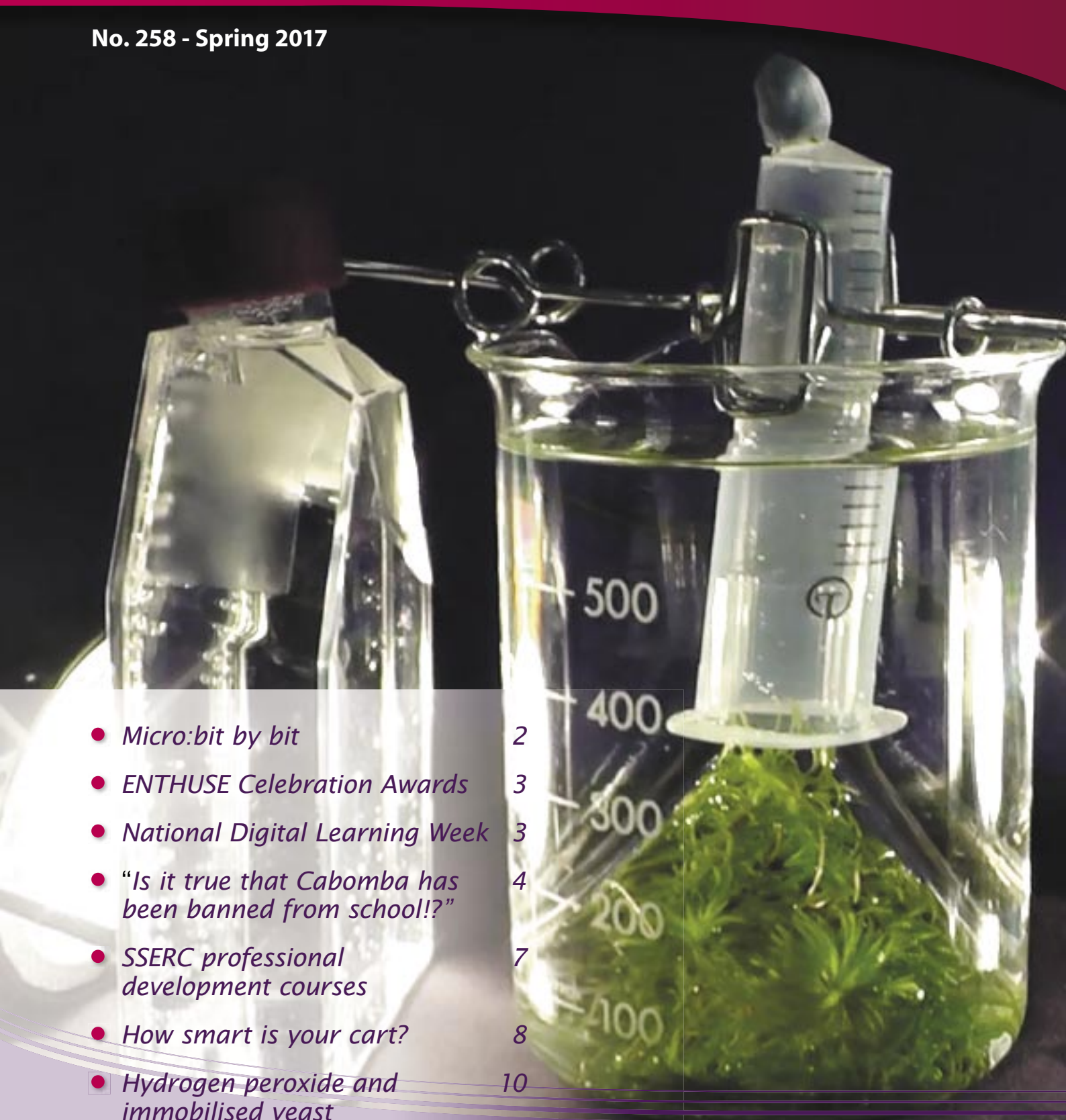

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Micro:bit by bit

In August 2016, on the back of the BBC's gift of a BBC micro:bit to schools for every S1 student, every Design and Technology department in Scotland was sent a Kitronik Inventor's Kit for the BBC micro:bit courtesy of SSERC. This kit is a great way to get started with programming and hardware interaction. This Inventor's Kit contains everything needed to complete 10 experiments including using LEDs, motors, LDRs and capacitors.

For those unsure of where to start with coding or electronic construction, Kitronik have included a tutorial book which guides you through programming the BBC micro:bit and constructing circuits. The micro:bit aims to give children an engaging introduction to coding and put a new generation back in control of technology. The micro:bit project builds on the legacy of the seminal BBC Micro, which was put into many schools in the 1980s and was instrumental in the careers of some of today's technology pioneers. Computing and digital technology has become ubiquitous since then but for many the emphasis has shifted from creation to consumption. The micro:bit, and the wider BBC Make IT Digital initiative, aims to help redress the balance.

The BBC, with a number of partners, have designed the BBC micro:bit to be a powerful, fully programmable computer to encourage children to get actively involved in writing software and building new things that will be controlled by it. Code is written using one of the easy to use editors provided on the BBC micro:bit website. The BBC micro:bit is connected to a computer via USB and then the downloaded files are dropped directly onto your device. There is also an app for Android and Apple devices.

The micro:bit is designed to be a starting point to get younger children interesting in coding so they can move onto other, more complex devices in future. The micro:bit can connect and communicate with other devices, including Arduino, Galileo, Kano and Raspberry Pi, as well as other micro:bits. This helps a child's natural learning progression and gives them even more ways of expressing their creativity.
The Kitronik Inventor's Kit for the BBC micro:bit provides a fantastic way of learning how to construct and control electronic circuits. The BBC micro:bit has a selection of pins that are located on the bottom edge of its PCB. By using the

specially designed Edge Connector Board for the BBC micro:bit in conjunction with the breadboard, it is easy to use these pins to connect additional components to the BBC micro:bit. Electronic circuits can be built without the need to solder, making activities more immediately engaging.

We tried out the Inventor's Kit on our recent Physics and Technology Diamond School. We found that the first four activities gave quick successes before moving on to more challenging tasks. These activities used a colour coded block editor which made coding very straightforward. Later tasks use more advanced editors and had the option to use touchscreen technology. We found Activity 5 particularly challenging, but found support at https://www.kitronik.co.uk/blog/inventors-kit-experiment-5-further-help.

Early feedback from teachers said that it "allowed me to build confidence in coding", "gave a simple set of activities in a very approachable format" and "had good projects to try with classes".

Further kits can be purchased via the Kitronik website [1].

Reference

[1] http://bit.ly/2hQbYxk (accessed 21st December 2016), or from Scientific and Chemical, and Timstar.

ENTHUSE Celebration Awards

If you or a colleague attended a professional development course during the academic year 2015-16 which qualified for ENTHUSE funding (through the National STEM Learning Centre), then you are eligible to apply for recognition via the ENTHUSE Celebration Awards.

The awards are presented each year to recognise the impact that teachers, technicians, and support staff have on their students, colleagues, schools, colleges, and peers, as a result of ENTHUSE-supported professional development. Successful applicants, whether individuals or institutions, enrich STEM subjects within the institution, and extend the impact of their work into wider communities.

The categories of Award are:

Individual

- ENTHUSE Award for Excellence in STEM teaching - Primary.
- ENTHUSE Award for Excellence in STEM teaching - Secondary.
- ENTHUSE Award for Excellence in STEM teaching - FE.
- ENTHUSE Award for Excellence in STEM teaching - Technicians and support staff.

Organisational

- ENTHUSE Award for STEM Primary School of the Year.
- ENTHUSE Award for STEM Secondary School of the Year.
- ENTHUSE Award for STEM FE College of the Year.

Further details about the awards can be found at the STEM website [1].

Reference

[1] www.stem.org.uk/enthuse-celebration-awards.

Applications are now open until 5th March 2017.

NDLW 2017

The 2017 National Digital Learning Week (NDLW 17) will take place from 15-19 May.

This year the theme of the week will be 'Digital Difference' and throughout the week there will be opportunities to share and celebrate the digital approaches which make a positive impact on classroom practice. The week will be packed with inspiring case studies from Early Learning and Childcare through to Senior Phase and beyond showcasing how digital makes a difference throughout the entire learner journey equipping young people for work.

Visit www.digilearn.scot for more information.

"Is it true that *Cabomba* has been

Most teachers of biology who attend SSERC courses will be familiar with the suite of activities entitled '*Fun with Cabomba*'. These activities, which can be downloaded from the SSERC website [1], were developed to support the learning outcomes which relate to understanding photosynthesis at level 3 in the *CfE* curriculum [2].

I have collaborated on investigations into the process of photosynthesis and I can demonstrate my understanding of why plants are vital to sustaining life on Earth - *SCN 3-02a*.

The first activity [1], whose purpose is to help pupils gain an understanding of carbon dioxide uptake and/or release by plants in light and dark, makes use of an aquatic plant and hydrogencarbonate indicator along with apparatus readily available in school laboratories.

The second activity makes use of an aquatic plant and sodium hydrogencarbonate, again with apparatus readily available in school laboratories, to investigate oxygen evolution in plants in light and dark conditions. By using and/or adapting the basic techniques, pupils can design their own practical work/investigations.

Until recently SSERC recommended the use of *Cabomba caroliniana* (Figure 1) for these simple photosynthesis experiments. *Cabomba* is an aquatic plant, non-native to the UK which has been available for some time from aquarium suppliers as an aquarium oxygenator. In bright light it readily releases bubbles of oxygen-rich gas and the rate of bubbling can be varied very easily by altering the lighting conditions (Figure 2). However, in 2016 *Cabomba*, along with various other plant species, was placed on the EU list of invasive alien species [4]. As current stocks are used up it will become increasingly difficult to source *Cabomba* and ultimately it will be an offence to keep, or supply it [4].

At SSERC we have identified another aquarium oxygenator, also non-native which, to date, is still available to buy. *Egeria najas* (Figure 3) performs just as well as *Cabomba* in these simple classroom photosynthesis experiments (Figure 4).

Egeria najas can be substituted for *Cabomba* and in bright light will give a stream of bubbles from a cut end of stem (Figure 5) and will bring about colour changes in hydrogencarbonate indicator from orange to purple within about 20 minutes in bright light, and to yellow in darkness within about 30 minutes (Figure 6).

We have also used *Egeria najas* as a successful substitute in our '*Cabomba* towers' [5] (Figure 7) and have found that it is sturdy and more easy handled than *Cabomba*,

Figure 1 *- Cabomba caroliniana.*

Figure 2 *- Cabomba caroliniana in bright light releasing oxygen-rich bubbles.*

Figure 3 *- Egeria najas.*

banned from schools!?”

Figure 4 *- Egeria najas in bright light releasing oxygen-rich bubbles.*

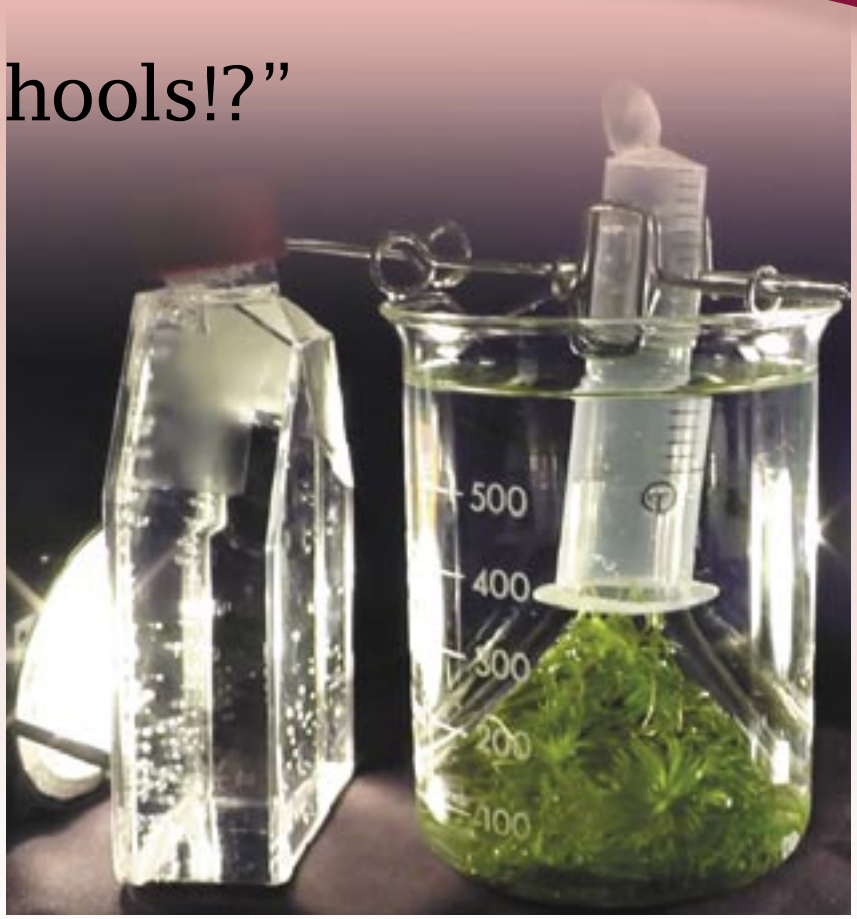


Figure 5 *- Collecting oxygen-rich bubbles of gas produced by Egeria najas in bright light.*

Egeria densa and *Elodea* when it is out of water.

A suite of activities called ‘Fun with photosynthesis’ using *Egeria najas* and comprising protocols for the classroom activities, a technical guide and an accompanying PowerPoint will be available to download from the SSERC website.

We have sourced *Egeria najas* from a variety of suppliers including our local Dobbies Garden Centre [6] and on-line from Urmston Aquatics [7].

If you are going to purchase *Egeria najas* you should note that in our experience even suppliers sometimes confuse it with *Egeria densa* and with *Elodea canadensis*. This is partly because all of these species have common names, including *Elodea densa*, Brazilian elodea and so on. It might help to take a picture with you and to note that compared to *Egeria densa* and *Elodea canadensis*, *Egeria najas* has narrow serrated leaves and compared to *Egeria densa* it has a narrow stem (Figures 8-10).

Since *Egeria najas*, is a non-native species, it may yet join *Cabomba caroliniana* on the EU list of invasive alien species not to be kept or supplied, the Biology Team within SSERC will continue the quest for a native substitute aquatic oxygenator with which to have photosynthetic fun. In the

Figure 6 *- Egeria najas and hydrogencarbonate indicator:*
1) In bright light for 30 minutes;
2) In darkness for 30 minutes;
3) Hydrogencarbonate indicator.

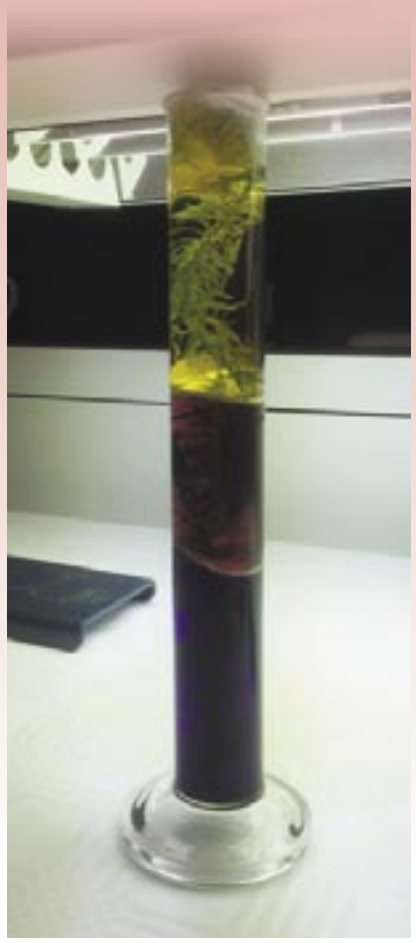


Figure 8 *- Egeria najas.*

meantime *Egeria najas* will serve the purpose, but it should be used on the understanding that care should be taken not to release it to the environment. This is also a point to be highlighted to students. The Code of Practice, *Materials of Living Origin* [8] (Figure 10) states in

Figure 7 *- Effect of irradiation (4 hours) on Egeria densa/hydrogencarbonate mixtures (Figure 7). Prior to irradiation the pH was measured to be 7.4. (i) Upper portion of cylinder covered with black paper during irradiation, (ii) middle portion of cylinder covered with 50% neutral density filter during irradiation, and (iii) lower portion of cylinder uncovered during irradiation after 4 hours irradiation.*

Figure 9 *- Egeria densa.*

Section 3 that using materials from the environment for investigation with care and respect will foster in students an appreciation of living things and "...illustrate the practical need for conservation and thus contribute to their development as responsible citizens and effective contributors to environmental concerns."

Figure 10 *- Materials of Living Origin: A Code of Practice for Scottish Schools and Colleges [8].*

References

[1] http://www.sserc.org.uk/resources/sciences-by-organiser/1355-sciences-biology-levels-3-4/3804-photosynthesis?highlight=WyJwaG90b3N5bnRoZXNpcyJd.

[2] *Curriculum for Excellence: Sciences Experiences and Outcomes* available at https://www.education.gov.scot/Documents/sciences-eo.pdf.

[3] http://ec.europa.eu/environment/nature/invasivealien/index_en.htm.

[4] http://www.plantlife.org.uk/uploads/documents/Banned_Plants_2016.pdf.

[5] http://www.sserc.org.uk/images/Biology/Photosynthesis_Nat4/1-4_Cabomba_Tricolour.pdf.

[6] Dobbies Garden Centre available at http://www.dobbies.com/home.aspx.

[7] Urmston Aquatics, 20 The Circle, Barton Road, Lostock, Manchester, M32 9TR. Available at http://www.urmstonaquatics.com/, telephone 0161-748-9086.

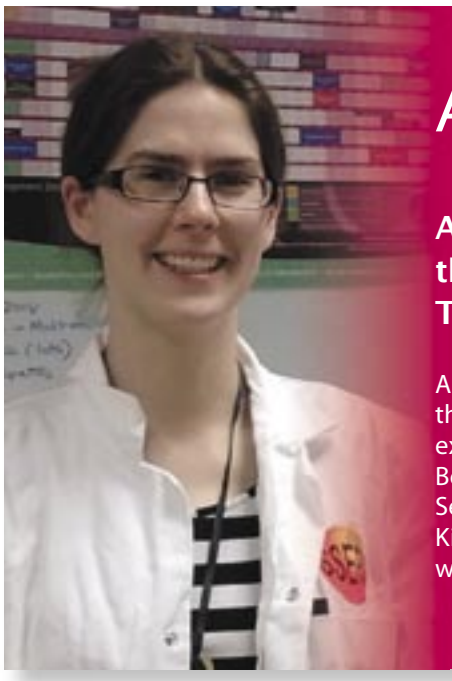
[8] *Materials of Living Origin - Educational Uses: A Code of Practice for Scottish Schools and Colleges*, SSERC, 2012. Available from the SSERC website at http://www.sserc.org.uk/biology-2/health-a-safety-home151.

SSERC professional development courses

Our professional development courses range from twilight events, day-courses through to residential meetings lasting up to 6 days in total. Our curriculum coverage spans both primary and secondary sectors and we offer events for teachers as part of their career long professional learning, newly qualified teachers and technicians. Many of our events receive funding from the ENTHUSE awards scheme or the Scottish Government.

Courses available for online booking at this time include:

COURSE NAME	RESIDENTIAL?	DATES	CLOSING DATE	SECTOR
Physics Summer School	Yes	24-27 May 2017	31 March 2017	Secondary
Science for Curriculum Leaders and Heads of Faculty	Yes	2-3 June 2017 and 15-16 December 2017	28 April 2017	Secondary
Chemistry Summer School	Yes	14-16 June 2017	08 May 2017	Secondary
Safe Use of Fixed Workshop Machinery	No	20-21 June 2017		Secondary
Biology Summer School	Yes	27-29 June 2017	26 May 2017	Secondary
Primary Summer School	Yes	4-5 July 2017	31 May 2017	Primary
Early Level Science Day	No	1 September 2017	9 June 2017	Primary



Anja Armstrong

Anja Armstrong is the new Senior Technician at SSERC.

Anja is really pleased to be joining the team as she has had great experiences of SSERC over the years. Before joining SSERC Anja was a Senior Technician with Perth and Kinross Council. Prior to that Anja worked as a fish geneticist with Marine Scotland and the University of St Andrews. "Although my training came in handy, NOTHING can prepare you for the diverse range of requests that land on the desk of a school technician, so I've been learning something new each day ever since." Anja works part time at SSERC and spends the remainder of her week running around with her 2 year old daughter.

How smart is

A car like the Triumph Herald (Figure 1) probably had around 50 m of wiring in it and nothing that would be identifiable as a computer on board.

Modern cars may have a kilometre of wiring and more computer memory dedicated to stopping a CD from jumping than was used in an Apollo space capsule. Whilst car technology developed radically over the last three decades, the humble dynamics cart resolutely stuck to a formula of "box with three or four wheels and maybe a spring-loaded plunger". Recently, things have begun to change. Welcome to the Tesla Model-X of physics trolleys, the Pasco Smart Cart (Figure 2).

Figure 1 *- Triumph Herald.*

Like a Tesla, the Smart Cart needs to be charged, though not in this case to make it move. Its internal battery powers accelerometers, gyros, a force sensor, a position sensor linked to the wheels and the circuitry to enable it to connect wirelessly to a Bluetooth-enabled PC or tablet. Our investigations were carried out using iPads and Android tablets running the free Sparkvue app.

Figure 3 shows a Smart Cart on a slope, attached to a spring. We logged position (from the wheel sensor) and acceleration (from the on board accelerometer) versus time (Figure 4).

The data shows that displacement and acceleration are 180 degrees out of phase. You may be wondering why acceleration is centred around 2.0 ms^{-2} and not zero. This is because accelerometers will measure a component of gravitational acceleration that offsets all readings unless the software is set to remove it.

More than one Smart Cart at a time can be connected to a tablet. This makes momentum investigations easy. Figure 5 shows the velocities during a collision between a Smart Cart and an initially stationary less massive trolley (you can work out the ratio of masses from the plot).

Sparkvue can also access your tablet's internal sensors. We exploited this feature by placing a tablet on top of a Smart Cart and moving it in front of two laptop speakers that were fed from another tablet that was running a signal generator app. We were able to plot maxima and minima caused by the interference of the sound from each speaker (Figure 6) by graphing sound intensity versus position.

Pasco also has a device called an Airlink that allows other sensors to connect to a tablet via Bluetooth. We were able to investigate the inverse square law for light using a light sensor mounted on the cart and its inbuilt position sensor.

Crumple zone experiments were also tried. These require a fast data capture rate - 100 readings per second is about as low as you can go. Whilst we were able to carry out some investigations, older Android tablets baulked at the task.

Figure 2 *- A brace of Pasco Smart Carts.*

your cart?

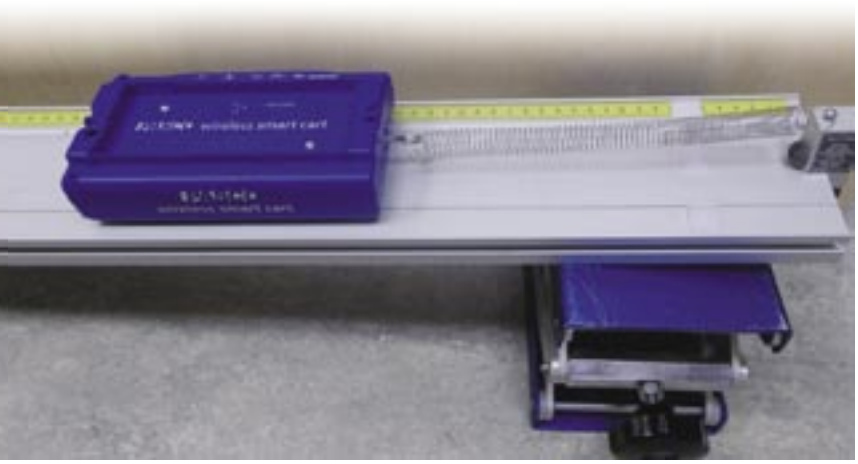


Figure 3 *- Smart Cart set up to investigate simple harmonic motion.*

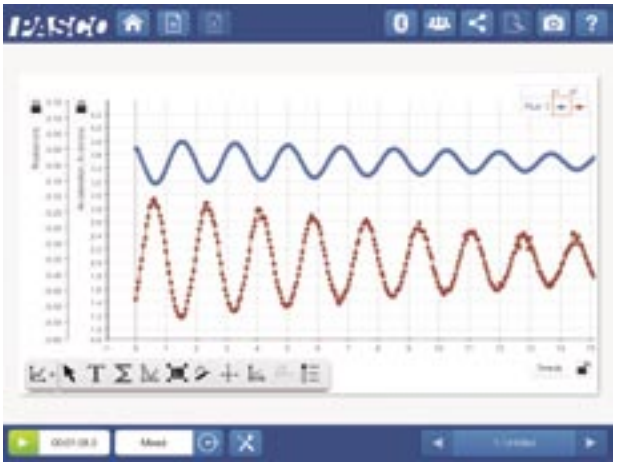


Figure 4 *- Position (blue) and acceleration (red) versus time.*

When we demonstrated the Smart Carts at a course, one participant was unhappy. He felt that the cart and software were performing some of the tasks students should be doing themselves, for example graph plotting. It is certainly possible to use this technology badly. Tongue in cheek, we posted on our social media outlets an inverse square law experiment that produced a linear plot in 11 seconds as the cart and light sensor was moved back from a lamp. Such a demonstration would be of little educational value without explanation, but if the inverse square law had been established with students, it could be a quick way of investigating whether the light source behaved as a point at close distances. Plotting a velocity/time graph of a cart running down a slope does not teach a pupil to plot a graph, let alone calculate a velocity. However, when these skills have been developed, this equipment makes it very easy to investigate the effects of changes to conditions. What change would we expect in the gradient of the velocity time graph if we made the slope steeper? What would be the effect of increasing friction? Predict what the sound intensity graph would look like if we used sound of a higher frequency, and so on.

At the time of writing, Smart Carts cost a little under £150 each, excluding VAT. They are sold by Scientific and Chemical, who are distributors for Pasco kit in the UK. ◀

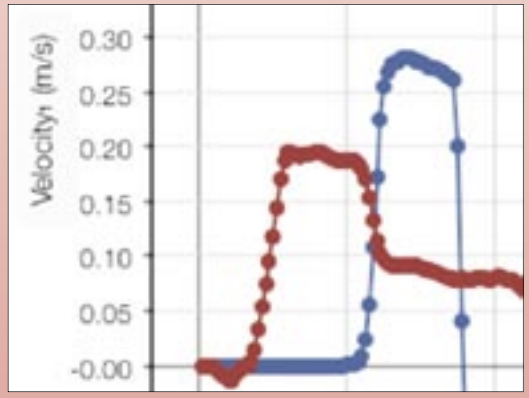


Figure 5 *- Collision analysis.*

Figure 6 *- Sound interference.*

Figure 1 - Experimental set-up for producing immobilised yeast balls.

Hydrogen peroxide and

Have you ever had that thought which broadly goes 'Now why didn't I think of that'? That was the response of at least one member of the SSERC Biology team when we read an article recently published in the journal *Science Teacher* [1]. The article offers a thought-provoking and, as we hope to show here, a fun approach to measuring catalase levels in yeast.

Background

Several years ago we published [2] a protocol (based on previous work by Roger Delpech [3]) in which catalase activity is measured. The enzyme catalase is found in nearly all aerobic cells (animals, plants and microbes). The function of catalase is to protect the cell from the harmful effects of hydrogen peroxide which is generated as a by product of cell metabolism. Catalase speeds up the breakdown of hydrogen peroxide into molecular oxygen and water:

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

Briefly the whole reaction can be carried out on a very small scale - in SSERC we tend to use Universal bottles but, as they say, other containers are available. An 'enzyme extract' is adsorbed on to filter-paper discs. These discs initially sink in a hydrogen peroxide solution, but then float to the surface as the oxygen that is produced is trapped in the fibres of the paper. The time taken for the disc to rise to the surface is measured and can be related to catalase activity. The 'enzyme extract' might be taken from a variety of sources including fruit, vegetables etc. although consistency of volume applied is a problem.

One of the extension activities which we recommend is to test the catalase activity of yeast by adding known (small) volumes of a yeast suspension to filter paper discs and testing the time taken for the discs to rise to the surface. Yeast concentration can be varied by making a serial dilution of the yeast suspension. One of the challenges of this extension activity is making sure that the number of yeast cells added is done in a consistent fashion and that the cells remain adhered to the filter paper. Despite these challenges we are aware that student investigations have successfully yielded semi-quantitative and in some cases quantitative results.

In SSERC, we continue to be great advocates of using immobilisation techniques in a variety of experimental systems most notably using algae [4] and adopting an assay from the National Centre for Biotechnology Education [5] for immobilising lactase.

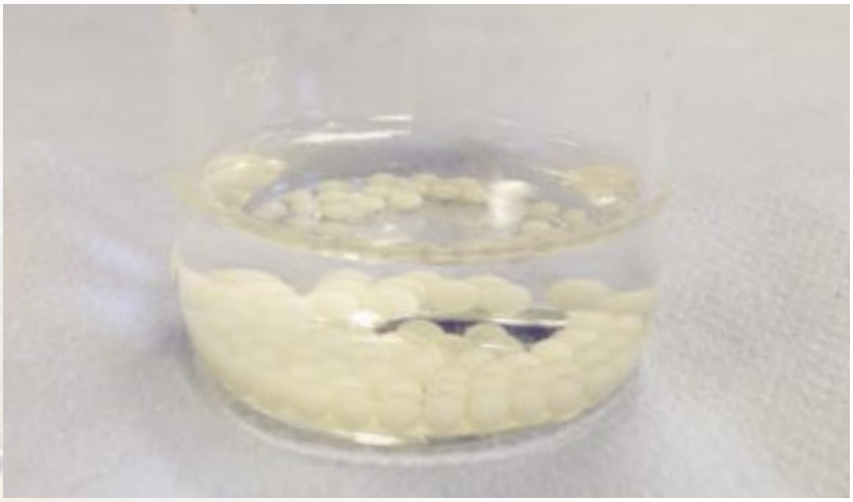


Figure 2 - Immobilised yeast balls.

immobilised yeast

Imagine our surprise/delight (and just a tad of jealousy) when the paper [1] by Bryer appeared. What the author has done is to immobilise yeast suspensions thereby producing 'yeast balls' and she uses these in solutions of hydrogen peroxide to test for catalase activity. In principle the advantages of such an approach include:

- consistent numbers of yeast cells can be trapped/immobilised;
- the number of yeast cells in a single yeast ball can be estimated using a haemocytometer;
- varying the concentration of the yeast cells in the stock solution is straightforward and immobilised balls with varying numbers of yeast cells can be produced;
- the opportunities for investigations are increased.

The experiments which follow are, then, largely based on Bryer's work [1] but we have adapted them to use the same apparatus as we would utilise for producing immobilised algae [6]. In due course our detailed protocols will appear on the SSERC website (www.sserc.org.uk).

Procedure

The basic protocol which we have adopted will be familiar to those of you who routinely immobilise algae for use in photosynthesis/respiration experiments follows below.

1) Prepare a 10% stock solution of dried yeast (typically we use Allison's™ Baker's Yeast).
2) Add aliquots (2 cm^3) of the stock yeast solution to a solution of sodium alginate (2%, 2 cm^3) and mix thoroughly.
3) Place the yeast/alginate mixture into a syringe positioned above a solution of 2% $CaCl_2$ (Figure 1).

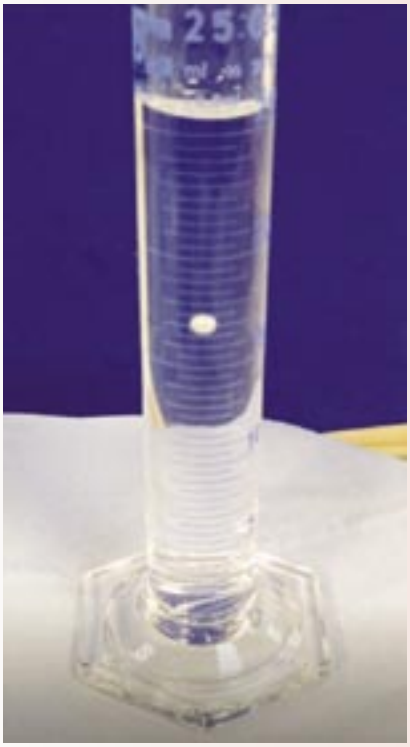


Figure 3 *- Immobilised yeast ball in hydrogen peroxide solution.*

4) Allow the liquid to flow, the drops form balls of immobilised yeast which are left in the $CaCl_2$ solution for about 5 minutes (Figure 2) and then washed gently under running cold water followed by a final rinse with distilled water. We store the balls in distilled water until used in the experiments which follow.

Results

The experimental set-up for measuring catalase activity is shown in Figure 3. A stock solution of hydrogen peroxide (10 vol) is prepared (see hydrogen peroxide entry in Hazardous Chemicals Database for instructions on doing this safely) and stored in the fridge when not in use. Dilutions of this hydrogen peroxide stock are prepared and added to a measuring cylinder (for convenience we use one with a 25 cm^3 capacity).

A single immobilised ball of yeast is placed in the cylinder and the time taken for the ball to sink to the bottom and then rise to the surface is recorded (Figure 3). Provided the ball is removed promptly once it has reached the surface then the change in hydrogen peroxide concentration in the cylinder is minimal and it is easy, therefore, to make repeat measurements with fresh balls using the same hydrogen peroxide solution. Typical results for immobilised yeast balls are shown in Table 1.

As one might have predicted, lowering the concentration of hydrogen peroxide leads to an increase in the time taken for the fall and rise of the ball.

Concentration of H_2O_2 in measuring cylinder	Temperature*	Time taken to fall and then rise to the surface (s)
1 vol	19°C	9, 9, 10, 11, 11
0.2 vol	19°C	24, 25, 26, 26, 27
1 vol	4°C	15, 16, 17, 17, 18

Table 1 *- Time taken for immbolised balls of yeast to fall and rise in solutions of hydrogen peroxide.*

** For experiments at 4°C a stock solution of 10 vol H_2O_2 was left in a fridge overnight and diluted to the final concentration using distilled water also stored at 4°C. Balls of immobilised yeast were covered with distilled water and stored in a fridge at 4°C for one hour prior to use.*

This observation opens up the possibility of investigating the [substrate] on the rate of reaction.

A decrease in temperature from 19°C to 4°C leads to an increase in the time taken for the fall and rise of the ball and this offers up the intriguing possibility of an investigation to measure the effect of temperature on catalase activity. We have not yet tried to study the effect of pH but in principle this would be a relatively straightforward set of experiments.

Material (g)	Volume of water added (cm^3)	Time taken to fall and then rise to the surface (s) [Mean of 5 measurements, rounded to nearest 5 seconds]
Potato	75	75
Banana	75	175
Cucumber	75	75
Blueberry	50	> 180
Frozen peas	100	> 180

***Table 2** - Time taken for immobilised balls of immobilised extracts from fruit/vegetable to fall and rise to the surface in a measuring cylinder (25 cm^3) containing 1 vol (25 cm^3) H_2O_2 at room temperature.*

In an attempt to extend the range of materials which are immobilsed and tested for catalase activity we have tested a number of different materials. For the list which follows we made a crude extract by adding a given mass of the material with some distilled water and subjected the mixture to homogenisation using a hand-held blender. The resulting suspension was centrifuged in microfuge tubes (approximately 8500 g) and portions (2 cm^3) of the supernatant were added to sodium alginate solution as in step 2 above. The resulting immobilised fruit/vegetable balls were then tested for catalase activity. Results are summarised in Table 2.

***Figure 4** - Innocent Smoothies™.*

We also tried out some immobilised algae which had been stored under distilled water in the fridge for some 6 months. We allowed the algal balls to come to room temperature and then added them to a measuring cylinder containing 1 vol H_2O_2; on average the algal balls took around 75 seconds to fall and rise to the surface. Given the length of time we had kept these immobilised algae we were quite surprised when we found that they retained catalase activity.

We were very excited when one of the Biology team spotted the list of ingredients on 'Innocent Smoothies™' (Figure 4). So, for example the 'Invigorate' bottle lists:

- 4 pressed apples
- 18 white grapes
- 1.5 mashed bananas
- 0.5 crushed mango
- 0.5 crushed kiwi
- some squeezed cucumber juice
- a dash of spirulina extract
- some milled flax seeds
- a squeeze of lime juice
- a dash of safflower extract
- a dash of matcha green tea infusion
- some milled wheatgrass
- some vitamins (B1, B2, B3, B6 and E)

Having centrifuged a sample and immobilised the supernatant we discovered that there was little or no catalase activity. Given the list of ingredients this was a bit of a surprise until we read the 'small print' only to discover that such smoothies are gently pastuerised as part of the manufacturing process and presumably all catalase is inactivated at that point.

Conclusions

We think the methods described here, based on the work of Bryer [1], offer lots of opportunities for student investigations. Much of our work is at the 'proof of concept' stage and we will undertake further experiments over the coming months and hope to report on those in future issues of the Bulletin. We make one observation here in respect of possible control experiments which might be undertaken. In principle 'pure' catalase could be immobilised and comparisons drawn with the extracts containing catalase described above. Such an approach might yield interesting data. However, we note from studies by Cheetham and Bucke [7] that immobilised catalase slowly loses activity (over a period of several hours) and this is explained by slow diffusion of the enzyme out of the immobilisation matrix. Other enzymes e.g. glucose oxidase do not appear to diffuse out of the matrix [7]. Such differences cannot easily be explained on the basis of molecular mass (glucose oxidase = 160 kDa and catalase = 232 kDa) since we might expect larger molecules to diffuse out of the matrix more slowly. Clearly we do not yet have all the answers...

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Evelyn Lee

Evelyn Lee joined the SSERC technician team on a part time, temporary basis in January.

Having worked at SSERC on various occasions in the past Evelyn is very happy to be returning to a place she knows and loves!

Evelyn's first job as a technician was at Stewart's Melville College in Edinburgh where she spent several happy years in the physics department. While at Stewart's Melville, Evelyn was seconded to SSERC and re-joined the staff when she was ready to return to work after starting her family. Leaving again to have another baby and spend some extended time with her young children Evelyn is delighted to be back "I have now been lucky enough to be welcomed back for a third time. It would seem they can't get rid of me!"

Duncan Lamb

We now have a new Technology team in place within SSERC. Duncan Lamb has recently taken up the post the of Development Officer for Technology.

Duncan started his teaching career at Duncanrig Secondary School in East Kilbride following a postgraduate course at the University of Strathclyde back in 2008. He then spent several years working across South Lanarkshire schools in a variety roles before moving over to Glasgow City Council.

Duncan also spent a few years working as a Technology Technician supporting teaching staff and providing machine maintenance. Duncan lives in North Lanarkshire with his wife, Sheryl (Duncan and Sheryl recently got married, and had a fantastic honeymoon travelling across Canada) Duncan spends any free time he has restoring classic cars or working on various wood/metal based projects.

Duncan is delighted to join the team and is looking forward to developing new CPD opportunities for Technology teachers. If anyone has any queries relating to Technology then Duncan can be contacted via duncan.lamb@sserc.org.uk.

Information can also be found on the SSERC website www.sserc.org.uk/technology-home.

Chris Kerr

SSERC is delighted to welcome Chris Kerr as our new Technology Technician. Aged 19, Chris became a qualified bench joiner and has had many wide and varied jobs within construction.

Chris moved from workshop based joinery into site work, mainly in the construction and finishing of new build homes while completing an apprenticeship in pressure washer engineering.

After gaining football coaching badges, Chris worked for SFA East Dunbartonshire Football Development and this ignited the spark to want to work in an education environment. Chris' first school post was at Paisley Grammar School as a whole school Technician, where he spent 4 years learning the ropes. More recently, Chris moved on to Turnbull High School in Bishopbriggs before joining SSERC on a year long secondment.

Chris is hoping to bring some Hollywood glamour to SSERC after building sets for both Outlander and Starz TV. Chris started with SSERC on the 5th of January 2017 and is looking forward to the challenges and experiences that lie ahead.

Trouble in store

You can scarcely have managed to avoid the pre-Christmas furore that was caused by 2016's chemical of the year, 2,4-dinitrophenylhydrazine. The hazards of this substance were, it must be said, rather over-hyped by the media and it is a tribute to the professionalism and good sense of teachers, technicians and school management, as well as Local Authorities, that EOD (the 'Bomb Squad') have been conspicuous by their absence from Scottish schools.

It has, however, been a useful opportunity to look again at how we manage the storage of chemicals: the whole 2,4-DNPH issue did, after all, only arise where the substance might not have been stored appropriately.

Before going on to discuss any specific substances, there are a few general matters that should be considered to ensure safe storage.

Date Marking - It is good practice to mark the arrival date on all the chemicals that come in to your school. That way you can ensure that older stock is used up first and minimise waste. In the case of chemicals that have safe shelf lives, it is even more important so you know when things need to be disposed of.

Stock check - You should aim to carry out an inventory of your chemicals on an annual basis. Knowing how much of any particular chemical you have, and how much it has changed, will allow you to rationalise your ordering and not overbuy - a common reason for overcrowded chemical stores.

Record keeping and communication - a big part of the problem with 2,4-DNPH was that there were many schools that had stocks but no one knew anything about how it had been stored. Many technicians will have a perfectly good working knowledge of everything that needs doing and be going about their business in an organised and effective way but if records are not kept then a change of personnel can 'throw a spanner in the works'. If you have kept your 2,4-DNPH well hydrated but have no record of it and then leave, a new teacher or technician might look at a bottle that is 10 years old and, in the absence of any other information, quite reasonably err on the side of caution and assume it may have dried out. So, there should be a check list of the various checks carried out over and above the stock check.

As far as individual substances go, it should be said that the vast majority of chemicals have no specific storage requirements at all and can just be left on the shelf in the chemical store quite happily between stock checks. There are a few chemicals, however, that perhaps need to be examined more frequently and certainly more carefully. These might include:

Termly

2,4-DNPH (and also 2,4-dinitrophenol and 2,4,6-trinitrophenol (picric acid)) - these three substances can all become hazardous in varying degrees if they are allowed to dry out. They are supplied wet so addition of a few cm^3 of distilled/deionised water should maintain this situation as long as the lid is sealed properly. (If it is clearly wet then there is no need to add extra water). You should also wipe down the lids, particularly any screw threads, after using, to ensure none is caught there where it could dry out.

Potassium metal - all the alkali metals (sodium potassium and lithium) as well as barium should be checked regularly to make sure there is still a sufficient covering of oil and topped up if need be. In addition, potassium has a tendency to form a coating of potentially explosive superoxide and thus has a safe shelf life of only 2 years. A termly check of potassium will ensure no potential problems. Any potassium which has developed a yellowish crust should be taken out of service and disposed of at the next uplift.

Bromine - if bought and stored in ampoules there are no issues but if you have a bottle of liquid bromine, it has a tendency to corrode the seal on the cap, allowing bromine fumes into the store. A regular check on the integrity of the seal, replacing the cap if necessary, will prevent this.

Water reactives such as aluminium chloride, phosphorus halides and silicon tetrachloride - these can react with water in the atmosphere and cause a build-up of pressure inside the container. Carefully opening these for a second to release any pressure build up will prevent the issue becoming dangerous.

Annually

Along with the annual stock check, there are a few other checks that should be carried out.

Check the dates - on any chemicals with a **safe** shelf life and dispose as needed.

Damaged containers (or lids) - should be replaced. Susceptible solvents - such as ethoxyethane and propan-2-ol should be checked to see if they are developing peroxides.

Segregation - Make sure that incompatible chemicals are still properly segregated: in a busy chemical store with chemicals going in and out as well as new ones coming in, they sometimes get placed where it is most convenient rather than in necessarily the best position.

It should be emphasised again that the vast majority of chemicals in the vast majority of stores are being kept perfectly well. But this extra set of measures should ensure an even greater level of safety without a great deal of extra work.

Safety alert! The use of caffeine on human subjects in school projects

The Biology Team at SSERC has, for some time, been uneasy about students administering caffeine in various forms to other students in school/college for the purposes of investigating caffeine's cognitive and physiological effects. While we are aware that protocols exist 'out there' for ways in which such investigations may be carried out in schools, our misgivings have remained.

Over time we have received enquiries from various schools/colleges about investigations proposing the delivery of caffeine via cups of coffee, 'energy drinks' and in tablet form. Some proposed investigations have related to senior students giving their peers caffeine, some have alarmingly proposed giving caffeine to younger groups of students, for example, to 'the whole of second year' and then measuring how fast they can run. We have advised that these investigations should not be done. Having ourselves sought the advice of a consultant toxicologist on this matter, we are reassured that our advice is sound.

We recently posted the following statement on the teachers' discussion forum, SYNAPSE:

At SSERC we are aware that protocols do exist for carrying out investigations into the effects of caffeine on human subjects. However, following recent discussions with a consultant toxicologist, it is our advice that such investigations should not be carried out in school.

Caffeine can promote a range of physiological changes in the body, some of which may be adverse in certain individuals.

Caffeine is addictive and stopping taking it after a period of use may cause symptoms in some people.

Caffeine may also react adversely with some prescription drugs.

Our current advice is that a substance known to have physiological effects on the subjects who consume it should not be administered in school for the purpose of investigation.

Additionally, we would make the point, relating to investigation design, that uncontrollable confounding variables in such an investigation make the generation of meaningful data difficult.

You should note that SSERC is the specialist Science and Technology Health and Safety Adviser for local authorities, and for independent schools who are members of SSERC. Should you wish to carry out investigations on human subjects using caffeine you would need to carry out a detailed risk assessment and seek your employer's permission to proceed.

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