SSERC Bulletin

Ideas and inspiration supporting science and technology for all Local Authorities

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A present for everyone

SSERC has been able to source two substantial pieces of scientific equipment to give out to local authorities on permanent loan.

Figure 1 - Spectrophotometer.

Item one is a spectrophotometer [1] and datalogger [2]. The spectrophotometer allows teachers to examine the absorption and transmission of light passing through substances. When connected to the datalogger, clear graphs are displayed and data can be analysed using a variety of built-in tools. Whilst this equipment is possibly of greatest use at National 5 and beyond in biology and chemistry, there is scope for forensic-style investigations during Broad General Education. The datalogger is state-of-the art and users with Wifi-equipped computers, tablets and smartphones can access data and control its acquisition using a compatible browser. These devices are not, however, essential for its function.

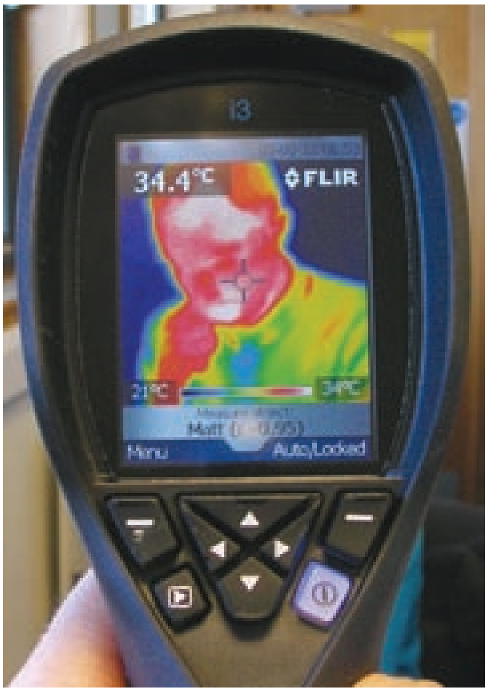


Figure 2 - Infrared camera.

The second item is a thermal imaging camera [3]. This picks up the invisible heat radiation from an object, including a human being. Not so long ago, supplying a device like this would have been inconceivable but there is now a well-made budget infrared camera on the market. Whilst its price is out of the range of most school science departments, we have been able to supply it as a resource for schools to share. The camera supports all stages of the science curriculum from upper primary onwards. Pupils can study heat loss from models or from actual buildings. They can investigate friction heating and energy loss in cars. Thermal imaging cameras are used to find victims who have become trapped after disasters such as earthquakes. This can be modelled using your camera. A memory card is supplied so that pupils can take pictures and transfer them to a computer to view or to include in reports or presentations.

We have contacted your local authority about this. They will decide whether to hold the equipment in a resource centre or a nominated school. Teachers and technicians from independent schools that are SSERC members should contact us directly regarding the borrowing of apparatus.

References

[1] SSERC Bulletin 228 http://www.sserc.org.uk/index.php/bulletins226/2009/228-summer-2009/1182-spectrophotometers-for-schools (older model).

[2] SSERC Bulletin 243 http://www.sserc.org.uk/images/Bulletins/243/SSERC%20bulletin%20243%20p12.pdf.

[3] SSERC Bulletin 245 http://www.sserc.org.uk/images/Bulletins/245/SSERC%20bulletin%20245_p8-9.pdf.

So, what is a 'circular economy'?

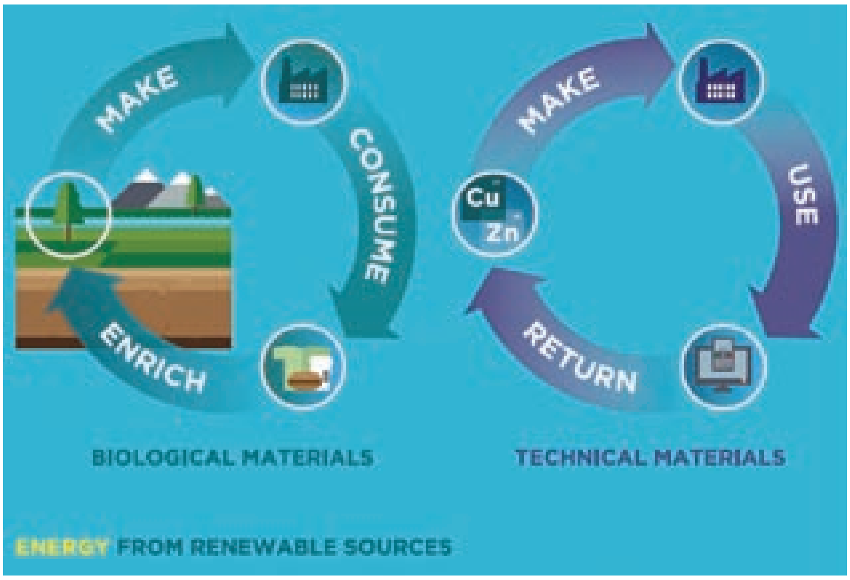
This is a short introduction to the circular economy, written by Colin Webster, to whet the appetite for a forthcoming interdisciplinary opportunity run by the Ellen MacArthur Foundation and SSERC.

From today to tomorrow

Businesses today follow a pattern of production that could be described as linear. They take resources out of the ground, process them to create products, sell them, and then we discard them. Take-make-dispose. It could be argued that this design for obsolescence approach makes business sense when materials and energy are cheap, and when the public has a plentiful supply of credit, but what happens when those conditions are no longer in place?

We are now in an era where commodity prices - that's everything from soy to oil, from copper to plastic - are high and volatile, and they are predicted to remain so for the foreseeable future. An intelligent company would ask themselves how they could ensure a prosperous long-term future in such an environment. Mainstream ideas, like asking people to 'use less', only delay the inevitable. Surely the goal should be to be able to use things without using them up, creating value at every turn, growing employment, whilst regenerating the biosphere, ready for the next cycle?

The circular economy offers a potential route out of the challenges described, and it offers a fundamental challenge to how we produce, use and consume. In a circular economy, biological materials flow effectively through the system before being returned to the biosphere where they add value for another cycle. That's how nature works - nothing is wasted, everything is 'food' for another cycle. Technical materials - metals, polymers and alloys - are made to be made again; designed for durability and reuse. In practice this means designing goods for repair, for upgrade, for remanufacturing; never losing the materials or the material integrity, whilst making use of embedded energy. To put the circular economy into practice we need to rethink design principles, rethink materials, and rethink business models.



So... is there any money in this?

Yes. The economic reports of the Ellen MacArthur Foundation and the global management company, McKinsey and Company, conclude there are worldwide savings of at least USD$1 trillion to be made every year by adopting this approach. The Ellen MacArthur Foundation now works closely with the World Economic Forum, the EU and many major companies on supporting the transition to a circular economy. The Scottish Government became a member of the Foundation's Circular Economy 100 group in 2013 and they are now actively educating businesses in Scotland about the economic potential of a circular economy.

But this isn't just about companies making a saving: many have noted the social advantages of a circular economy, such as increased employment, access to higher quality goods at a lower cost than today, and the multitude of advantages in taking a regenerative approach to the biosphere.

Is this all about recycling?

No. Most recycled material suffers a reduction in quality - it is 'downcycled' - into something of inferior value, then eventually lost The crucial thing about a circular economy is effective material flows We need to find a way to ensure material quality is maintained, and we have seen many examples of companies choosing not to recycle their goods, but to remanufacture products designed at high quality. This not only reduces their eventual materials bill, but saves a significant amount on their energy bill, too. Renault, for example, reduced their energy bills by 80% when remanufacturing old car engines and gear boxes.

Energy and the circular economy

Meeting the energy demands of the future will require significant changes to production and use.The circular economy has shown some very encouraging signs of reducing the energy demand of one of our most energy-hungry sectors: industry. The economics favour a switch to renewables ($72 per watt for solar in 1972, but only $1 per watt today), but the really crucial questions are over design and effective energy use. We are interested in how emerging technology, such as smart meters, LED lighting and a distributed energy network can combine with clever design to reduce energy demand.

Business models for a new economy

It is no fluke that the sharing economy has emerged at this time of powerful and ubiquitous mobile computer devices: services such as Park in my Drive, AirBnB and Car Clubs rely upon the mobile internet, and people are using these services in rapidly growing numbers. Now reflect on what it means to see the death of long-term businesses such as HMV and Kodak, while Netflix and Instagram thrive. There has been a switch away from ownership of products to access, perhaps brought about by prevailing economic circumstances, particularly for the 20-something generation.

Sensing these changes, Renault have already stated they are moving away from being a company that sells cars to become a company that sells mobility, while B&Q have announced their plans to launch 1000 products fit for a circular economy; products that B&Q would retain ownership of, while the customer would enjoy their use for a defined time period. Philips now lease lumens, rather than sell lights. In a world of high and volatile commodity prices, businesses will find it hard to plan for a long-term future by selling their materials, or so the theory goes.

Design implications

One thing we will certainly need to change is the way we design stuff. A move away from planned obsolescence is required, towards product durability, product upgrades, simple repair work and remanufacturing. Think 'design for disassembly', smart screws, soluble adhesives, standardised fittings and repair manuals. This approach requires new design skills and, crucially, a new design mentality around a whole systems approach so we can maximize the possibilities a regenerative approach offers. In addition, the demand for Material Scientists is likely to grow as companies seek durables as well as bio-based alternatives.

Where is the circular economy relevant to the curriculum?

Any idea as complex as the circular economy requires an interdisciplinary approach. It simply cannot be taught in just, say, a Business Management class. The implications of changing our development model are far-reaching - beyond energy and materials to the money system, geopolitics, globalization, emerging technologies and more.The relevance of teaching the circular economy can be seen in the following subjects, from N4 to Advanced Higher:

Design and Manufacture
- Design and Manufacture
- Materials and Manufacturing

Engineering Science
- Engineering Contexts and Challenges
- Electronics and Control
- Mechanisms and Structures

Economics
- Economics of the Market
- UK Economic Activity
- Global Economic Activity

Business Management
- Management of People and Finance
- Understanding Business

Physics
- Electricity and Energy
- Dynamics and Space

Biology
- Cell biology
- Multicellular Organisms
- Life on Earth
- Sustainability and Interdependence Chemistry
- Chemical Changes and Structure
- Nature's Chemistry
- Chemistry in Society
- Researching Chemistry

Environmental Science
- Living Environment
- Earth's Resources
- Sustainability

Textiles and Fashion Design
- Fashion and Textile Technology
- Fashion/Textile Item Development
- Fashion and Textile Choices
- Making a Fashion/Textile Item

Geography
- Global Issues

Modern Studies
- International Issues

Computing Science
- Software Design and Development
- Information System Design and Development

Want to learn more?

Then sign up to the interdisciplinary CPD event run by the Ellen MacArthur Foundation and SSERC on 17th September 2014. At the event, you will learn more about the circular economy and begin to develop an interdisciplinary project for your school. Find out more about this opportunity at http://www.sserc.org.uk/index.php/cpd-sserc/cpd-courses-sserc32.

Time flies

If you have recently attended a residential SSERC CPD course you may well be familiar with the Veho VMS-001 USB digital microscope [1, 2] (Figure 1).

Figure 1 - The Veho VMS-001 USB microscope.

In terms of versatility and value for money, the Veho is difficult to beat - see SSERC Primary Bulletin 61 [3]. We have been putting this useful little magnifier to further use lately - this time experimenting with time lapse photography.

Observation is one of the key skills in Science inquiry, and is described in the Curriculum for Excellence Sciences: principles and practice document [4] "Observing and exploring involves careful observation of how something behaves, looking for changes over time and exploring 'what happens if...?' and 'how could I...?' questions."

Observing changes over time forms an integral part of exploring the world around us and learners will be very familiar with time lapse techniques used in many documentaries and TV programmes. Here at SSERC we have been exploring a simple and easy way to produce very effective time lapse films in the classroom. Using Webcam Timelapse 2.0, a free software package from TNL Soft Solutions [5] we have been able to record various events and phenomena and present them in a time condensed manner, meaning that even the shortest attention span is no impediment to observation over time.

The program requires a digital camera to be attached to the computer and it recognises the Veho as such a device. The finished videos are made from a series of still images, like a digital flick-book. The advantage of this mechanism is that clips can be created without having to make use of the video function of the MicroCapture software that comes with the magnifier. In the past we have had difficulty extracting video clips of greater than 30 seconds from MicroCapture - due to the large file size - but with Webcam Timelapse 2.0 this is no longer a consideration.

Given that the Veho can be used to view objects and organisms at up to x200 magnification a broad range of filming opportunities exists. Among other projects, we have observed the germination of seeds and growth of plants over the course of several days, we have filmed ice gardens melt over the course of a few hours and even set up a Veho to film a "Forces Funtime" session at one of our Primary Residential courses in May 2013 - we then marvelled at the speed and intensity of our delegates as they moved around the various activities! All of these events were condensed into snappy videos lasting less than 20 seconds.

Time lapse video has proved to be an engaging way to approach science inquiry from a different angle, and this free software download adds another dimension to the already multi-talented Veho microscope.

A set of instructions for Webcam Timelapse 2.0 is available on request from SSERC [6].

References

[1] http://www.misco.co.uk/ (accessed 25th April 2014).
[2] http://www.amazon.co.uk (accessed 25th April 2014).
[3] http://tinyurl.com/Primary-61 (accessed 25th April 2014).
[4] http://www.educationscotland.gov.uk/learningteachingandassessment/curriculumareas/sciences/principlesandpractice/index.asp (accessed 25th April 2014).
[5] http://www.tnlsoftsolutions.com/timelapsehome.php (accessed 25th April 2014).
[6] Contact sts@sserc.org.uk for an electronic copy.

Crumple zones - a new mindset

As physics teachers begin to tie together Outcome One investigations with N4 Added value units and N5 Assignments, the interest in reliable experiments suitable for these course elements has increased. We know that our friends at Road Safety Scotland have been lending out their "Pimp my Trolley" kits, as the exemplars in SQA course documentation on N4 and N5 relate to vehicle safety.

However, we heard of another piece of apparatus that might be suitable, one that had the advantage of being relatively inexpensive. We refer to the USB accelerometer from Mindsets [1] which at the time of writing, costs £24.95 before VAT (Figure 1).

The device uses standard Windows drivers and the software to configure it and download data is free. We will suggest a number of activities you could carry out using the accelerometer later in this article but, for now, we will concentrate on collision investigation.

Once the software is installed, the accelerometer has to be configured. This is done by inserting it into a USB port, loading the application and selecting Configure. This displays the pop-up shown in Figure 2.

For collisions, the maximum sampling rate (200 per second) and the maximum range (±8 g) should be selected. A delay between the logger being activated and the beginning of data capture can be set too. Note that the logger can only collect 30 seconds of data at this rate.

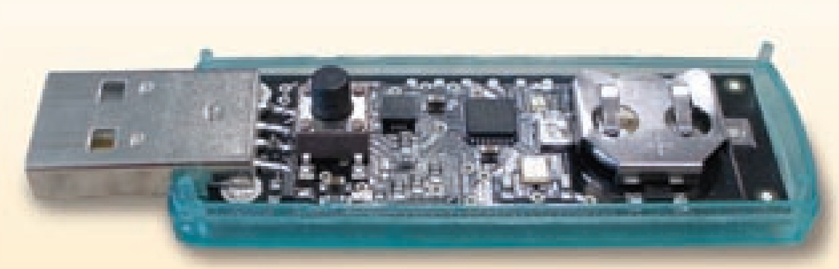


Figure 1 - USB accelerometer with lid removed to show circuitry. Because we're physicists.

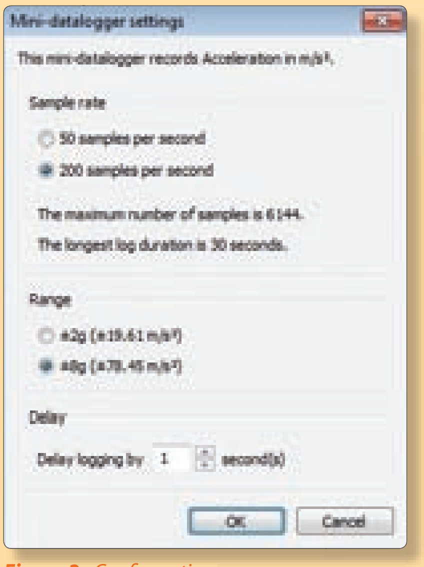


Figure 2 - Configuration.

Prior to this, we prepared a set of stick-on crumple zones 1, 2, 3... up to 8 strips of paper (Figure 3).

These zones did not protrude in front of the trolley sufficiently for good results. A new set, one example of which is shown attached to a trolley in Figure 4, was created.

The accelerometer was removed from the computer and mounted on a trolley. The trolley was placed on a gentle slope around 40 cm from a wooden block placed at

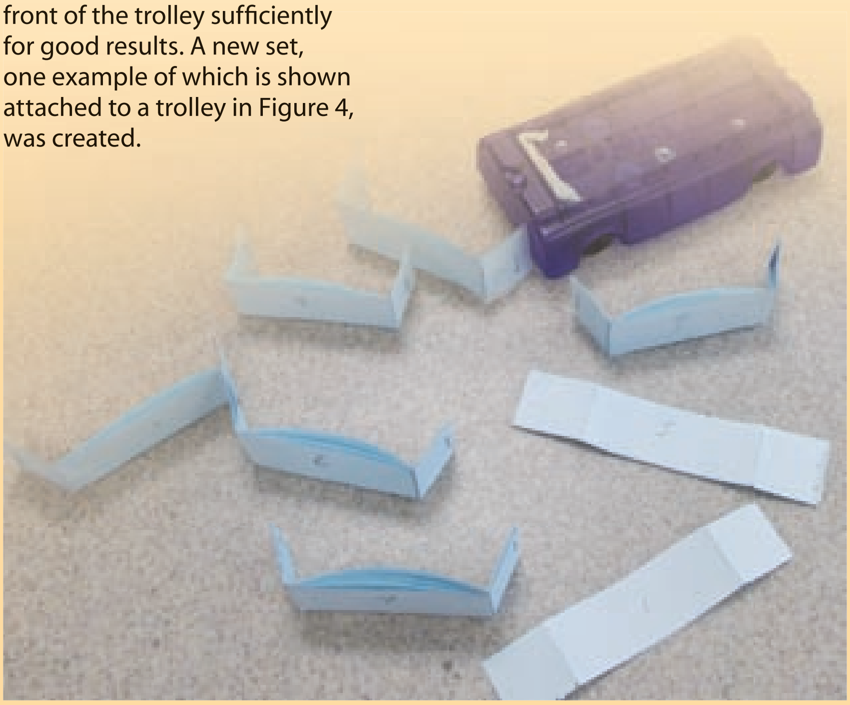


Figure 3 - Trolley with crumple zones of varying thickness.

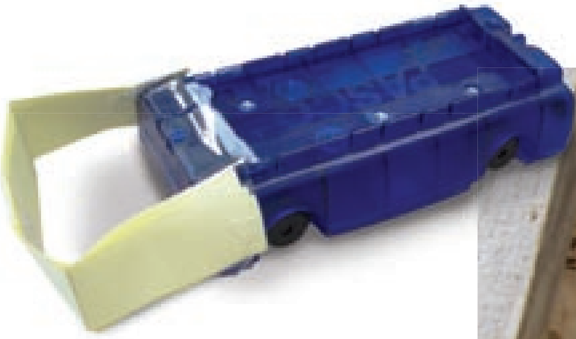


Figure 4 - Trolley with longer crumple zone.

Figure 5 - Trolley with accelerometer.

the ramp's end (Figure 5). The button on the accelerometer was pressed and the trolley was released, allowing for the delay before logging was due to begin.

Note that fairly wimpy collisions can produce large accelerations. Although the students are expected to contribute extensively to the design of the experiment, it is worth doing a few test runs to have some sort of idea of the angle of slope and the distance run by the trolley that will yield accelerations that consistently remain within the device's range. The data capture rate is good, but it could still miss a sharp, short-lived spike or perhaps take a misleadingly small measurement corresponding to a point on the shoulder of the peak.

We felt pupils would find data easier to understand if we mounted the accelerometer such that accelerations in collisions would be positive. Some of you may disagree with this.

After the collision occurred, the logging button was pressed to stop data collection. The accelerometer was inserted once more into a USB port on the computer and the "Add data" option chosen (Figure 6).

You can at this point name your data run. You can also specify which axes you are interested in. For our collisions, we were only interested in X.

Several runs of data can be overlaid, making comparisons very easy.

Figure 7 shows (1) an unprotected collision, (2) a collision with a balloon "airbag" and (3) a collision with a paper crumple zone attached to the trolley.

As can be seen from Figure 7, some judgement was needed in taking readings from the graph. Data can be saved in a spreadsheet-compatible format. For more sophisticated investigations, for example at Advanced Higher, this technique should be used.

Figure 6 - Add data.

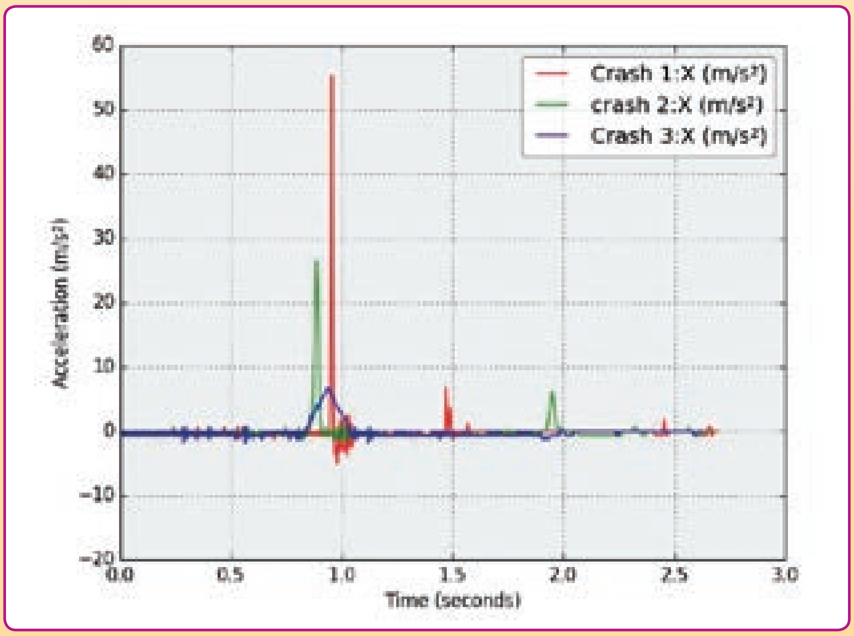


Figure 7 - Three collisions on the same graph.

The results of our investigation are shown in Figure 8. Are these suitable for pupils studying Nationals? Each time we did the investigation, we found that the trend was for increasing thickness to reduce acceleration, up to a point when it began to increase again. The data was “messy”. There were results that were higher or lower than expected, for example the last two on Figure 8. Repeating the experiment in order to take an average would be time consuming. When a collision occurs, the crumple zone may lose some of its effectiveness. New crumple zones would have to be made each time. Indeed, we carried out an investigation that showed that the crumple zone became less effective with each bump. Nevertheless, we conclude that this is a valid investigation. Interestingly, it mimics a particularly sophisticated form of accident investigation. “Black boxes” in some vehicle systems, for example the control circuitry for seat belt pre-tensioners, continuously log information about the car’s motion. In some cases, the police have applied for permission to access this data to determine what happened in a crash.

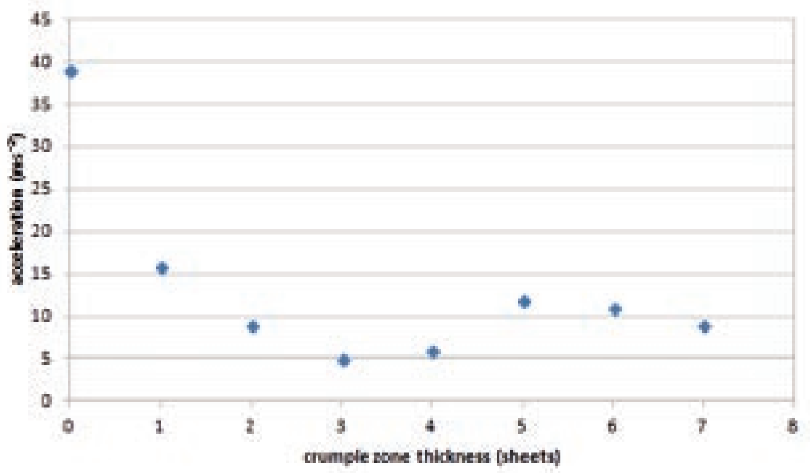


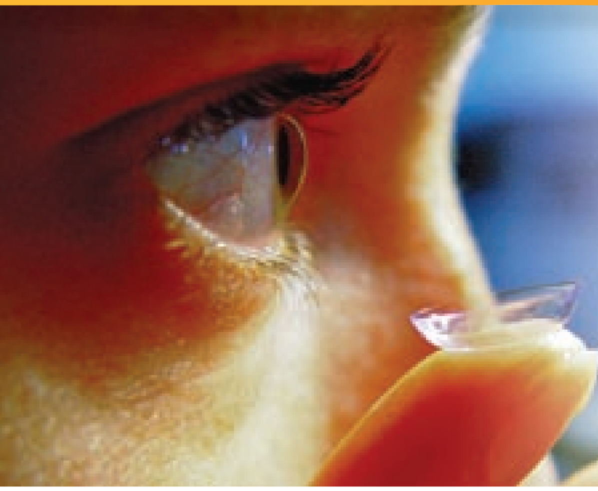
Figure 8 *- Acceleration versus thickness.*

We tried other activities with the accelerometer such as mounting it on a mass suspended on a spring to study acceleration during simple harmonic motion. We also placed it in the nose cone of a model rocket, though the initial acceleration was off the scale. As with other accelerometers, the Mindsets unit will sense an acceleration of 1 g even when at rest. This can cause confusion for freefall experiments. To their great credit, the developers have been willing to enter into a dialogue with us about their product and have sent us a test version of software with a “zeroing” feature. This seems to work perfectly and will probably be fully implemented by the time this article goes to print.

We acknowledge the work of the teachers in Highland schools whose “acceleration versus thickness” experiments gave us the idea for this article.

Reference
[1] www.mindsetsonline.co.uk.

Hydrogels



The International Union of Pure and Applied Chemistry (IUPAC) defines a *gel* as a 'non-fluid... polymer network that is expanded throughout its whole volume by a fluid' and a *hydrogel* as a 'gel in which the swelling agent is water' [1].

Figure 1 *- Contact lens (© Eitan Tal (איתן טל))*

This swelling is such that hydrogels are nearly all liquid, over 99% in some cases, but they behave like solids due to a three-dimensional cross-linked network within the liquid: it is this cross-linking that gives a gel its structure. Thus gels can be considered as molecules of a liquid dispersed within a solid, having properties ranging from very weak and soft to hard and tough. The term *gel*, incidentally, was coined by the 19th-century Scottish chemist Thomas Graham.

Hydrogels are formed from highly absorbent natural or synthetic polymers. When hydrated, they possess a degree of flexibility very similar to natural tissue, due to their significant water content. This sounds rather technical, and indeed some of the chemistry is very advanced but there are many everyday examples of hydrogels:

Jelly - this is a hydrogel formed from a protein network of gelatin.

Disposable nappies - these contain dried sodium polyacrylate. This polymer can rapidly absorb a large amount of water, up to 500x its mass of distilled water and over 90x its volume of urine. This time the cross-linking is largely due to hydrogen bonding.

Artificial snow - another use for polyacrylate.

Alginate balls - the algal beads beloved of biologist are made by cross-linking alginate with calcium ions. The same method is used in molecular gastronomy to make 'fruit caviar' and similar exotic foods.

Polymer slime - the PVA/borax slime we all love playing with so much is another example of an ionically cross-linked hydrogel, this time the linking agent is the borate ion.

Contact lenses - soft contact lenses are made from cross-linked, usually silicone, hydrogels.

More recently hydrogels have been developed to act as gel explosives, biosensors, fire retardants, fertiliser/water release controls in plants and for a variety of biomedical uses.

Hydrogels in the curriculum

CfE - There are numerous activities that can be done with hydrogels at this level, though the chemistry behind the behaviour of the materials may be quite complex.

National 5 - where they form that basis of the exemplar investigation for the Assignment.

Higher (*CfE*) - It could be argued, though, that they fit more naturally here: in the structure and bonding section of Chemical Changes and Structure, it states: Hydrogen bonding is at the heart of 'hydrogel' materials.

Figure 2 *- Green Jello (© Gisela Francisco).*

Some simple activities

(Details of all these activities can be found on the SSERC website [2]).

Ionically cross-linked hydrogels

Making simple hydrogel balls
Take a 2% solution of sodium alginate and let drops fall (from close to the surface) into a 2% solution of calcium chloride. Leave for a few minutes and then remove (using a sieve is easier) and inspect the properties.

Investigating cross-linking
The procedure above can be expanded by using a variety of different cross-linking ions: Fe2+, Fe3+, magnesium, aluminium and others. Changing the ion can dramatically alter the nature of the gel.

Using hydrogel balls to model drug-release systems
Using the same system as above, mix some food colouring (or other dye) into the alginate so you get coloured balls.

The effect of salts on ionic cross-linking
If you get a blob of (cheap) hair gel and sprinkle some salt on it, the gel will rapidly liquefy as the ionic cross-linking is disrupted. Showing that the same does not happen with sugar is a good demonstration of a difference between ionic and covalently bonded substances.

Figure 3 - Spherification (© Javier Lastras).

Figure 4 - Disposable nappies.

It is possible to extend this and investigate the effect of concentration on the rate of dissolution or the effect of different salts.

Hydrogen bonded hydrogels

Extracting a hydrogel from a nappy

These are sodium polyacrylate. It is possible to extract them from (clean!) disposable nappies. The process is rather messy though because of the large amount of fibrous material present. The larger the size of nappy, the more hydrogel you get out.

Investigate the absorption of a nappy hydrogel

Take a known mass or volume of your hydrogel, add 50 cm^3 of distilled water and stir. This will solidify in a few seconds. Keep on adding samples of water until the gel becomes liquid and record the volume. (The change from solid to liquid is a continuous spectrum so you will have to make a judgement about where you draw the line as to the gel's solidity).

You can then repeat the experiment using tap water or fake urine (0.9% sodium chloride with a bit of yellow food colouring in is a good recipe).

Once these are removed and rinsed with distilled water, place a known number of balls in a test tube with some distilled water. The dye will slowly leach out of the balls and colour the solution. Samples can be taken every few minutes and examined in a colorimeter (or simply by eye).

Using hydrogel as a fire retardant

This works best with the polyacrylate taken from nappies or using 'magic snow'. Take a wooden splint, spray with water (or dip it in) and hold it in a hot Bunsen burner flame, timing how long it takes to catch fire. Then take another splint and coat it with the hydrogel. Hold this in the flame and see the difference in tame taken to burn.

Using 'water beads'

These are hydrogel beads used in flower arranging to retain water. They swell up from a couple of millimetres to more than a centimetre in diameter (over a few hours). The will eventually dry out again and can be re-used.

The colourless ones can be used to demonstrate refractive index - as they are almost all water, they are all but invisible in water so you can offer someone a glass with water in and when they put their hands in they feel these slippery spheres.

The size the balls swell to is affected by the ionic content of the water. If you take a range of salt solutions and put beads in them, they will all expand to different amounts and it is possible to get a measure of the concentration by seeing the diameter of the beads.

Gel formation and temperature

Methylcellulose is an interesting material in that gels formed from it behave in the opposite manner to what we normally expect. When the gel is heated, instead of melting, like gelatin, it solidifies: a property that allows for interesting uses like hot ice-cream.

In the classroom, investigations can be done into how the physical properties of different gels vary with temperature.

Obtaining materials

It is possible to obtain hydrogels from a number of sources:

- The usual suppliers such as Scientific & Chemical (http://education.scichem.com/Catalogue/Search) sell polyacrylate hydrogel and 'magic snow'; as do mindsets (www.mindsetsonline.co.uk).
- Water beads can be obtained for a few pence from Amazon or EBay, or from florists.
- Nappies, gelatin and hair-gel can be obtained from any supermarket. (For nappies, get the largest size as these will contain the most hydrogel).
- Sodium alginate will almost certainly already be in your school (if not it is cheap and easy to obtain from the usual suppliers). Biologists use the cross-linking reaction with calcium ions to make algal balls.
- Methylcellulose can be obtained from suppliers but it is also the main component of wallpaper paste. Normal wallpaper paste is not really suitable (especially for younger pupils) because of its fungicide content. It is possible, however, to buy fungicide-free wallpaper paste.

The term hydrogel covers a vast range of materials will all sorts of properties and the field is constantly evolving. In particular there is exciting work going on regarding the use of hydrogels in medicine for wound dressing, controlled-release devices for drugs, scaffolds for tissue engineering and many more. We will, without doubt, be re-visiting this subject in the not too distant future.

References

[1] http://goldbook.iupac.org/HT07519.html.

[2] http://www.sserc.org.uk/index.php/new-cfe-higher-chemistry/chemical-change-and-structure-h/3073-hydrogels.

Reptiles in schools

Recently the issue of whether reptiles should be kept in schools has been raised with SSERC. The concern on this occasion was that reptiles can be a source of *Salmonella* infection. It should be assumed that all reptiles carry Salmonella as part of their normal gastrointestinal flora.

The issue then becomes as reptiles present a *Salmonella* hazard, what is the risk of harm and can the risk be reduced to an acceptable level through a risk assessment that provides a suitable and sufficient set of control measures?

The Health Protection Agency (HPA) in its *Guidance on infection control in schools and other childcare settings* [1] states that "reptiles are not suitable as pets in schools and nurseries as all species carry *Salmonella*". Health Protection Scotland (HPS) in its equivalent guidance [2] makes no reference to reptiles although it is reasonable to assume that if asked they would concur with the advice from HPA.

SSERC's Code of Practice *Materials of Living Origin* [3] states that reptiles should not normally be kept in schools. If reptiles are to be kept in schools *Materials of Living Origin* requires three considerations need to be taken into account. These are:

- There should be sound educational reasons for keeping the animals in school.
- A member of staff must have an understanding of the biology and natural history of the animal and thus be able to cater for its needs and ensure its well being.
- Any hazards associated with keeping the animal in school must be identified and a suitable risk assessment carried out and the control measures applied.

Be safe! The Association for Science Education (ASE) guide for health and safety in school science and technology for 3 to 12 year olds [4] considers garter snakes and leopard geckos as examples of suitable reptiles to be kept in schools. This is probably based on these species being less demanding to maintain than some other reptile species.

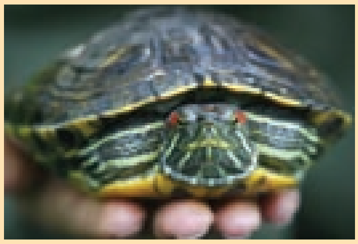


Figure 1 *- Image taken from http://www.telegraph.co.uk/lifestyle/pets/.*

Infection by *Salmonella* from reptiles is through a hand to mouth oral route. Handling reptiles, cleaning cages and vivaria, contact with water from swimming species can all result in *Salmonella* shed in reptile faeces contaminating hands. Transmission of *Salmonella* can be controlled by effective hand washing and hygiene measures. Soap, running water and disposable paper towels is the preferred means of hand washing, wipes and hand gels are not an acceptable substitute for proper hand washing.

Reptiles should not be allowed to roam freely, surfaces that have been in contact with reptiles should be cleaned with a surface cleanser containing a non-ionic surfactant disinfectant or equivalent (e.g. Dettox Antibacterial Surface Cleanser). Useful advice on preventing *Salmonella* infection from reptiles is provided by the Health Protection Agency [5] and the British Veterinary Zoological Society [6].

Salmonella presents a greater hazard to under-fives than it does to older children. Individuals whose immune system is compromised are also at greater risk from *Salmonella* infection. Because of the serious consequences *Salmonella* can have for under-fives, reptiles should not be kept in establishments with children under the age of five.

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[1] Guidance on infection control in schools and other childcare settings, Health Protection Agency (2010), www.hpa.org.uk.
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Candida utilis - the Torula food yeast

From time to time SSERC has been asked for advice on using the yeast species *Candida utilis* for project and experimental work in schools. *Candida utilis* (also known as the Torula food yeast) is a yeast of industrial interest.

It is used as a means of producing single cell protein and as a flavour enhancer imparting a meat like flavour to food products. As well as food for human consumption, its benefits of containing protein and having a meat like flavour make it a suitable ingredient for pet foods. Its ability to secrete proteins also makes it a suitable organism to be engineered for the production of recombinant proteins. Its phylogenetic relationship to some other selected yeast species is shown in the diagram below [1].

Candida utilis is considered non pathogenic and, with an appropriate risk assessment, should be suitable for work in schools. The risk associated with the use of *Candida utilis* in schools can be regarded as low. The control measures for working with microorganisms listed in Appendix 2 of *Safety in Microbiology* [2] are suitable and sufficient to control any risk associated with *Candida utilis*. It can be considered as a suitable candidate for inclusion in Appendix 2 of Safety in Microbiology. Cultures of *Candida utilis* may be obtained from national culture collections or from other suitable sources.

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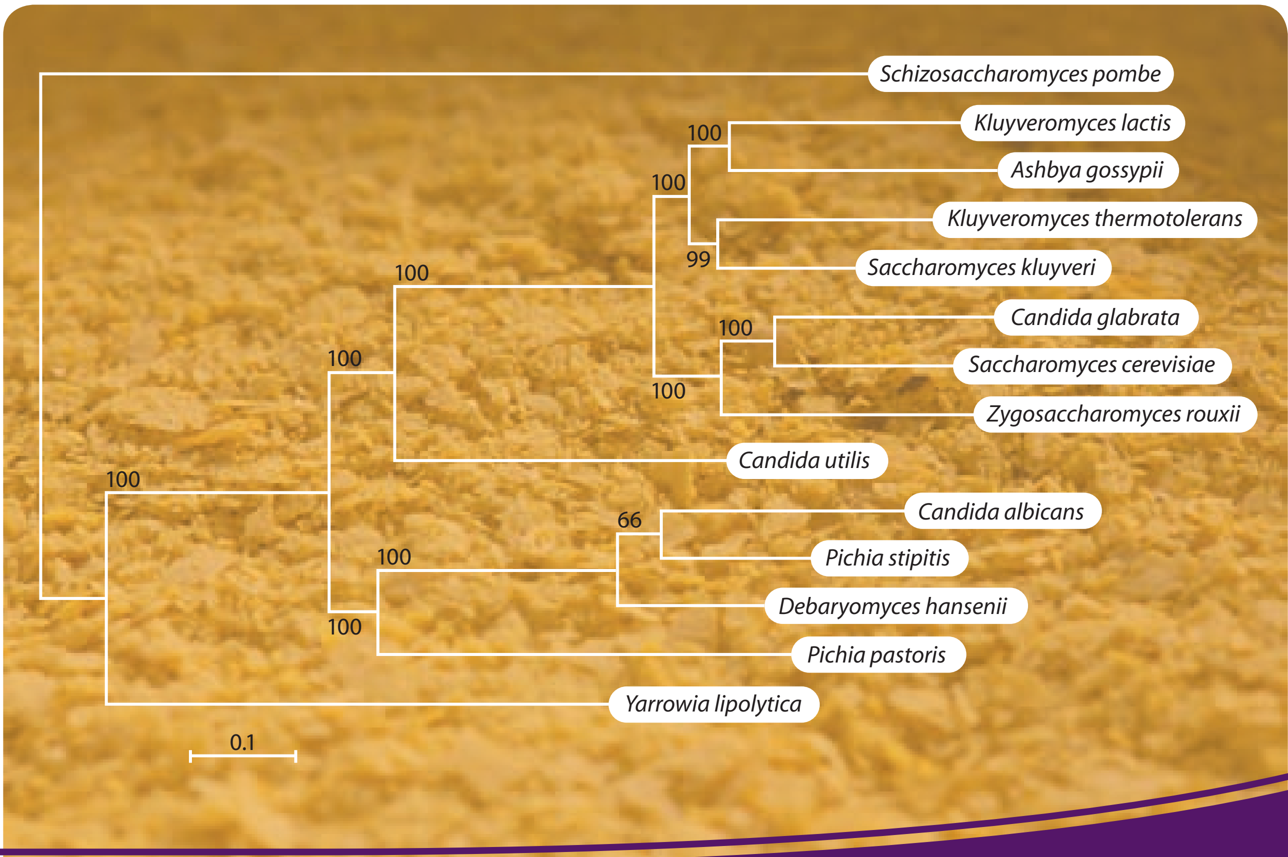

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