SSERC *Bulletin*

Ideas and inspiration supporting science and technology for all Local Authorities

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From photons to food - illuminating

The wonders and importance of the process of photosynthesis are presented to learners at many different levels and in several different contexts within *Curriculum for Excellence* [1]. Learners embarking on the study of photosynthesis at H*igher* level will already understand the importance of the process of photosynthesis to life on Earth.

Ideas about the global importance of photosynthesis in terms of the gas balance of the atmosphere and world food production may also be familiar to them. They will know that, in the presence of light energy, green leaves will synthesise carbohydrate and that this process requires the presence of water and carbon dioxide and that oxygen is a product. From their study of photosynthesis at National 5 level, they will also already know that the simple 'equation' often given for photosynthesis is a summary of a complex process and that photosynthesis involves two main stages each with multiple steps.

Carrying out the Hill reaction, which is a suggested learning activity in the new *NQ (CfE) Higher Biology* [2], is an excellent context in which learners can begin to engage with the more complex biochemistry of photosynthesis required at Higher level. Interestingly it also provides a historical perspective on the development of our understanding of photosynthesis.

A vital clue to understanding the mechanism of photosynthesis was the discovery that the oxygen released by plants during photosynthesis is derived from water and not from carbon dioxide. This had been predicted in the 1930s by CB van Niel, a Dutch-American microbiologist, researching photosynthesis in bacteria. Working at Cambridge a short time later, Robert Hill was able to demonstrate that, in the presence of light and a suitable electron acceptor, isolated chloroplasts will generate oxygen even if no carbon dioxide is present, thus confirming that the oxygen which is generated during the light dependent stage of photosynthesis comes from water rather than from carbon dioxide.

$$2H_2O + 2A \longrightarrow 2AH_2 + O_2$$

Here 'A' represents an artificial electron acceptor. During what has come to be known as the Hill reaction, 2, 6-dichlorophenol-indophenol (DCPIP), which is blue in its oxidised form and colourless when it is reduced (DCPIPH2), is the electron acceptor.

$$DCPIP + 2H^+ + 2e^- \longrightarrow DCPIPH_2$$

$$2H_2O + 2DCPIP \xrightarrow[\text{Chlorophyll}]{\text{light}} 2DCPIPH_2 + O_2$$

Hill concluded that:

- When leaf extract was illuminated, a non-biological electron acceptor (dye) became colourless and oxygen was evolved
- In the dark neither reduction of the dye nor evolution of oxygen took place.
- Oxygen was neither required nor was it reduced under these conditions i.e. oxygen evolution did not involve carbon dioxide.

Hill was able to hypothesise that water had been split into oxygen and hydrogen.

Following Hill's discoveries it has been shown that the electrons and hydrogen produced by the splitting of water in chloroplasts are accepted by the coenzyme NADP.

$$2H_2O + 2NADP^+ \xrightarrow{\text{light}} 2NADPH + 2H^+ + O_2$$

For learners at Higher level the light dependent reactions of photosynthesis may be summarised as:

- Light energy is absorbed by chlorophyll and other pigments creating excited electrons.
- High energy electrons are transferred through an electron transfer chain releasing energy and generating ATP.
- Energy is also used to split water (photolysis) into oxygen which is released and hydrogen which is accepted by NADP to form NADPH.

The following protocol describes a method which might be used in the classroom to demonstrate the Hill reaction.

photosynthesis

Demonstrating the Hill reaction

Equipment

- Fresh spinach leaves
- Scissors
- 5 x test tubes and parafilm covers
- 1 x 100 cm^3 beaker
- 1 x large beaker
- 1 x microcentrifuge tube
- 1 x foam tube holder

- 1 x 10 cm^3 syringe
- 5 x 1 cm^3 disposable pipettes
- Mortar and pestle
- 1 x filter funnel
- 1 x Bijou bottle
- Muslin
- Aluminium foil

- Stopwatch
- Bench lamp
- Crushed ice
- Centrifuge
- Ice bath
- Water bath set at 800° C
- DCPIP solution
- Buffer solution

DCPIP (dichlorophenolindophenol)
Solution: 0.01 g DCPIP in 100 cm^3 of buffer solution.
Buffer solution: 2.8 g anhydrous disodium hydrogen phosphate (Na_2HPO_4), 6.4 g potassium dihydrogen phosphate (KH_2PO_4), 102.8 g sucrose, potassium chloride, 1 litre water.

Figure 3

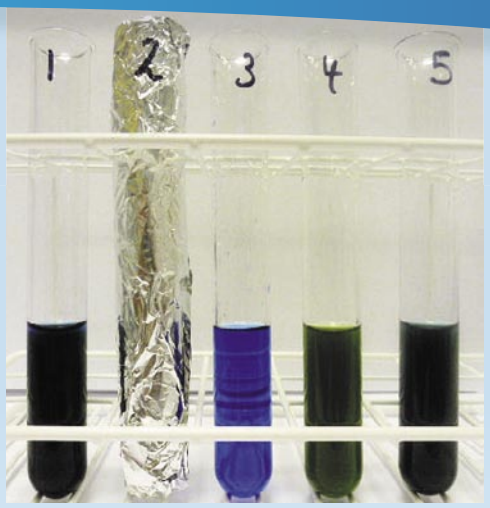


Figure 1

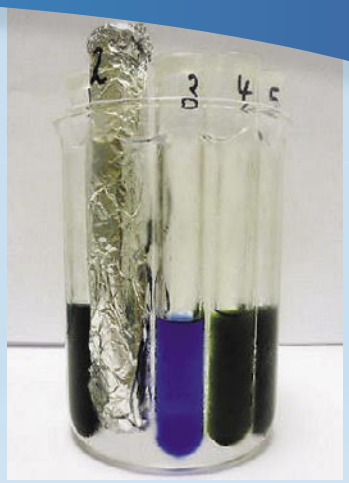


Figure 2

Method

Note:
It is essential that all solutions, tubes and other equipment are chilled beforehand and kept in melting ice until the DCPIP reduction stage.

1) Chop 3 fresh spinach leaves (excluding stems) into a mortar. Add 10 cm^3 of buffer solution and grind with the pestle.
2) Quickly strain the mixture through muslin held in a filter funnel over a small beaker. Squeeze the liquid through the muslin by gathering the corners and twisting them. Discard the solid contents.
3) Fill the microcentrifuge tube with the suspension. Label the tube with your initials. Centrifuge the suspension for 10 minutes.
4) While the centrifuge is running, prepare 5 test tubes for the next stage as follows:
   - Label the test tubes 1-5.
   - Cover test tube 2 with aluminium foil to exclude light.
   - Place all 5 tubes in a large beaker of iced water.
   - Using the syringe, add 3 cm^3 buffer solution to tubes 1, 2, 4 and 5. Add 4 cm^3 buffer solution to tube 3.
   - Using a clean pipette, add 2 cm^3 DCPIP to tubes 1, 2 and 3.
   - Using a clean pipette add 2 cm^3 distilled water to tube 4.
5) Once the 10 minute centrifuge run is complete, pour off the supernatant taking care not to lose the pellet. Discard the supernatant.
6) Place 5 cm^3 buffer solution in the Bijou bottle. Using a pipette add a little of this buffer solution to the pellet in the microcentrifuge tube and mix to re-suspend the pellet. It is important that the re-suspension is done thoroughly. Add this re-suspended mixture to the buffer solution in the Bijou bottle and mix well to produce an appropriate volume of chloroplast suspension.
7) Using a fresh pipette, add 1 cm^3 chloroplast suspension to tube 5. Cover the tube with parafilm and place it in the water bath for 2 minutes. Allow to cool. Add 2 cm^3 DCPIP. Place the tube in the beaker of iced water.
8) Now add 1 cm^3 chloroplast suspension to tubes 1, 2 and 4.
9) Cover all 5 tubes with parafilm, shake each gently and note the starting colour of the contents [Figure 1].
10) Replace the tubes in the beaker of iced water ensuring that they are lying against the inner surface of the beaker [Figure 2].
11) Place the beaker in bright light [Figure 3] and examine the contents of the tubes for disappearance of the blue colour after 5 minutes, 10 minutes and 20 minutes [Figure 4].

Figure 4 *- This photograph, taken in natural sunlight, shows the resulting colours in the test tubes after 20 minutes.*

A detailed protocol for this activity can be found on the SSERC website.

Table 1 provides a summary of the contents and treatment of each test tube.

What might learners conclude from the appearance of the contents of each tube?

- Test tube 1 demonstrates that in the presence of light and a chloroplast suspension DCPIP loses its blue colour indicating that it has been reduced.
- Test tube 2 demonstrates that the reactions in test tube 1 will not proceed without the presence of light.
- Test tube 3 demonstrates that without the 'reducing agent' supplied by the chloroplasts DCPIP will not be reduced.
- Test tube 4 shows that the colour of the chloroplast suspension and buffer solution remains stable - the buffer solution does not change the colour of the chloroplast suspension
- Test tube 5 demonstrates that the presence of intact chloroplasts is required for the reduction of the DCPIP in this scenario.

Like Hill, learners with support might reasonably conclude that in bright light a reaction happens in chloroplasts which results in water being split into oxygen and hydrogen. The reduction of DCPIP is evidence that hydrogen from the photolysis of water has been produced. This provides a context in which to discuss, the role of chlorophyll and electron transfer in the capture of solar energy and the production of ATP and NADPH in the light dependent reactions of photosynthesis.

	Tube1	Tube 2	Tube 3	Tube 4	Tube 5
Covered with aluminium foil	No	Yes	No	No	No
Buffer solution	3 cm^3	3 cm^3	4 cm^3	3 cm^3	3 cm^3
DCPIP	2 cm^3	2 cm^3	2 cm^3		2 cm^3 *
Distilled water					2cm^3
Chloroplast suspension	1 cm^3	1 cm^3		1 cm^3	1 cm^3
Heated to 800° C for 2 minutes **	No	No	No	No	Yes

** Add DCPIP to tube 5 after heating buffer and chloroplast suspension mixture.*
*** Heat tube 5 before adding chloroplast suspension to tubes 1, 2 and 4.*

Table 1

In the *NQ Higher Biology (2002)* photosynthesis is located in the unit called Cell Biology. Here the emphasis is on both photosynthesis and respiration as major 'biochemical conversions' taking place within cells [3]. In the new *NQ (CfE) Higher Biology (2014)* the study of photosynthesis is positioned at the beginning of Unit 3, *Sustainability and Interdependence* [4]. While knowledge of the biochemical conversions involved in photosynthesis is still required, there is a shift in emphasis that reflects current biological research into understanding photosynthetic processes in the context of of world food production:

"Food production is an area of vital importance for biological research. An understanding of photosynthesis lies at its core. Studies should focus on the energy-gathering process and the transfer of high-energy electrons through an electron transfer chain to generate ATP. The action of RuBisCo as part of the Calvin cycle should be included as this is the carbohydrate-forming stage." [5]

SSERC has developed a discussion activity [Figure 5] which might also spark the interest of learners to do some follow-up research of their own into the role of RuBisCo in carbohydrate production [6], C3 and C4 photosynthesis and the genetic modification of food crops [7, 8] especially 'Turbo-charged Rice' [9].

Figure 5 *- Discussion cards, Let's Talk Genetic dilemmas.*

Curriculum links

Higher Biology Unit 3 - *Sustainability and Interdependence*

Mandatory Course - *key area (b) (i) Photosynthesis*

Absorbed energy excites electrons in the pigment molecule. Transfer of these high-energy electrons through electron transport chains releases energy to generate ATP by ATP synthase. Energy is also used for photolysis, in which water is split into oxygen, which is evolved, and hydrogen, which is transferred to the coenzyme NADP....

The enzyme RuBisCO fixes carbon dioxide by attaching it to ribulose bisphosphate (RuBP) in the Calvin cycle. The intermediate produced is phosphorylated by ATP and combined with hydrogen from NADPH to form glyceraldehyde-3-phosphate (G3P). G3P is used to regenerate RuBP and for the synthesis of sugars. These sugars may be synthesised into starch or cellulose or pass to other biosynthetic pathways to form a variety of metabolites.

References

[1] *Curriculum for Excellence* Science Experiences and Outcomes are available at http://www.educationscotland.gov.uk/myexperiencesandoutcomes/sciences (accessed August 29th 2014).
[2] Course and Unit Support Notes for the *new NQ (CfE) Higher Biology* are available via the SQA website www.sqa.org.uk/ (accessed August 29th 2014).
[3] Arrangements documents for the *NQ Higher Biology* are available at http://www.sqa.org.uk/sqa/39306.html (accessed August 29th 2014).
[4] Course and Unit Support Notes for the *new NQ (CfE) Higher Biology* are available via the SQA website www.sqa.org.uk/ (accessed August 29th 2014).
[5] Course Support Notes for the *new NQ (CfE) Higher Biology* (Sustainability and Interdependence, Introduction), http://www.sqa.org.uk/files_ccc/CfE_CourseUnitSupportNotes_Higher_Sciences_Biology.pdf
[6] Available at http://www.sserc.org.uk/index.php/biology-2/biology-resources/higher-biology-revised/sustainability-a-interdependence/3747-the-science-of-food-production-2 (accessed August 29th 2014).
[7] Student support material, SAPS available at http://www.saps.org.uk/students/further-reading/1266.
[8] http://www.saps.org.uk/secondary/teaching-resources/828-genetic-engineering-and-photosynthesis.
[9] International Rice Research Institute, http://irri.org/news/media-releases/rice-of-the-future-gets-financial-boost.

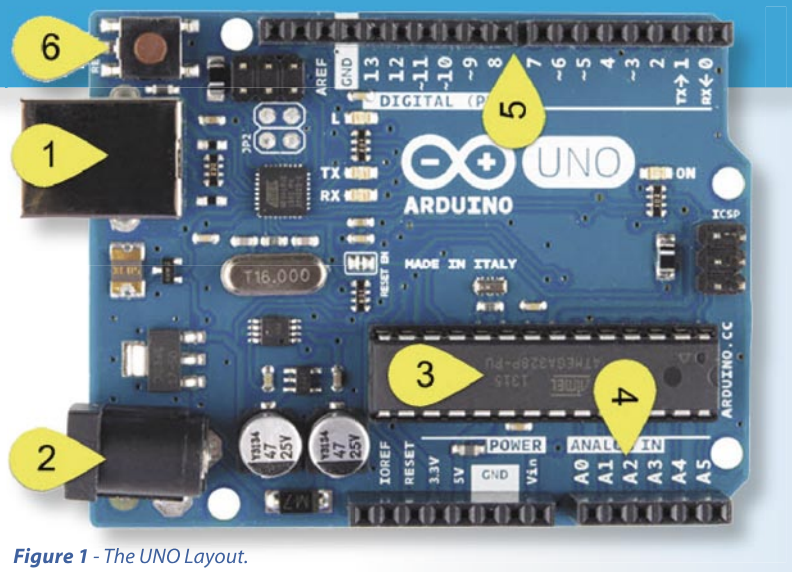


Figure 1 *- The UNO Layout.*

Interfacing with

Using Arduino within Engineering Science SQA Courses

National 5 Engineering Science requires learners to give examples of the use of microcontrollers in commercial and industrial applications, also the advantages/disadvantages of microcontroller based systems compared with hard wired electronic equivalent circuits.

Within Higher Engineering Science, Arduino (also PICAXE and STAMP) are all suitable platforms for developing electronic control systems (Unit Support Notes, SQA, Page 37). Typical programmable control systems will involve up to four inputs and four output signals. The controlling of the speed of a d.c. motor using pulse width modulation is also required.

Advanced Higher Engineering Science further develops programmable systems by introducing interfacing microcontrollers. Principles and applications of A-D and D-A conversion are also included.

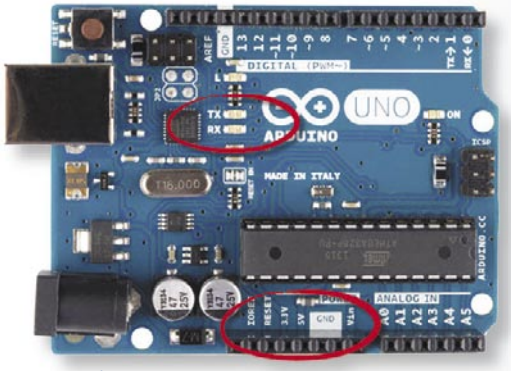


Figure 2 *- Power Pins, transmit/receive indicator lights.*

Introduction

As there are a number of Arduino boards available, selection can be difficult for the beginner. Perhaps the best 'starter' board is the Arduino UNO (Figure 1), it's simple and relatively straight forward to use and is a great 'springboard' for further interfacing with other boards in the Arduino family. UNO boards are currently priced at around £25. UNO has been available since September 2010.

The UNO interfacing board is connected to a computer via an 'A to B' USB cable The 'B' connection is shown at 'Ref 1' in Figure 1. Computers running Windows, MacIntosh, and Linux operating systems can be used with Arduino boards.

The Arduino board obtains power via the USB cable, but it also has a power input socket, as indicated by 'Ref 2' in Figure 1, this allows the board to operate independent of the computer, an AC adapter, 9 volts, 2.1 mm barrel tip, with the centre positive is recommended. Arduino can also be battery powered.

'Ref 5' as indicated in Figure 1 shows 14 digital input/output pins 0–13. These pins can be programmed for either digital input or output. Six of these 'digital' pins (3, 5, 6, 9, 10 and 11) also have another function, they can be programmed as Analogue Outputs.

Six dedicated analogue pins (Ref 4 in Figure 1) will take voltage readings from sensors and convert the voltage into values in the range 0–1023.

A reset button is indicated in reference 6 in Figure 1.

Introduction to programming using IDE (Integrated Development Environment)

Checking the communication port

With the Arduino board connected via an USB cable, it is important that the computer and the Arduino board are set up for correct communication. Using, in this case a Windows 7 platform, click 'Start' and right click over 'Computer', now left click 'Manage' as shown in Figure 3.

Figure 3 *- After right click on 'Computer' select 'Manage'.*

When 'manage' is selected, Figure 4 is displayed. Now select 'Device Manager'.

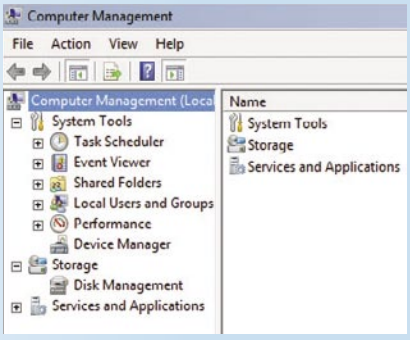


Figure 4 *- Selection of Device Manager.*

the Arduino UNO platform (part 1)

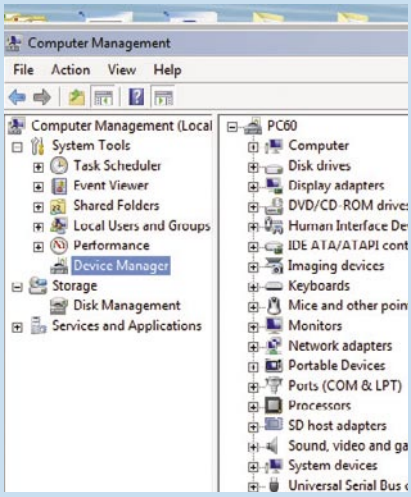


Figure 5 *- Device Manager selected.*

Figure 6 *- Arduino board Connection.*

Select 'Ports' as shown in Figure 5.

Now click Ports. You should see the port where Arduino Uno is connected (COM3) and that the computer is recognising 'Arduino'

Now, the Arduino board must be set up with COM3.

Figure 7

Double click the Arduino icon on the desktop as shown in Figure 7. If the Arduino software has not yet been downloaded, refer to the note at the end of this article.

From the IDE screen, select 'Tools' Click over 'Serial Port' COM3 should be selected, as shown in Figure 8. The computer and Arduino board are now able to communicate with one another.

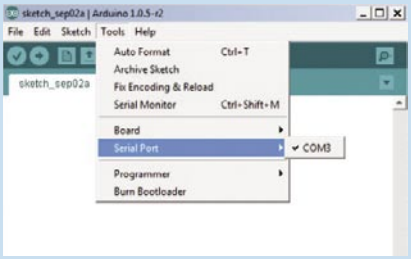


Figure 8 *- The IDE.*

The IIDE (Integrated Development Environment), is an editor which allows a program, called a 'Sketch' to be generated. The IDE is shown in Figure 8.

Arduino provides open source hardware and software. At the computer, software called the Integrated Development Environment (IDE) allows code to be written for Arduino. A 'Sketch' is the IDE code (a program), the sketch is then uploaded to the UNO board. The Sketch code requires to be compiled and finally converted into the form of code the Arduino microprocessor (Ref 3, Figure 1) can work with - this is an automatic process.

Figure 9 shows all the pull down menus available via the IDE (integrated Development Environment).

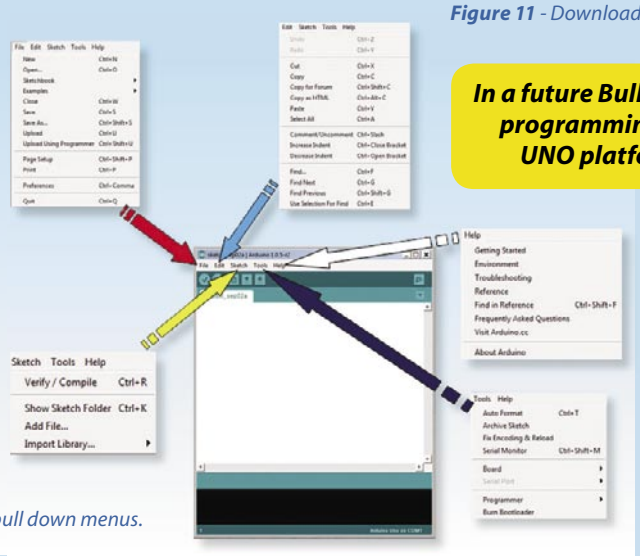


Figure 9 *- The IDE and associated pull down menus.*

Note:
Downloading Arduino IDE
Download from the following website http://arduino.cc/
The following website should be displayed (Figure 10).

Using a free 'Download' as indicated in Figure 10, scroll down until Figure 11 is displayed. Select Windows installer. The download process should be automatic resulting in the Arduino icon (Figure 7) displayed on desktop.

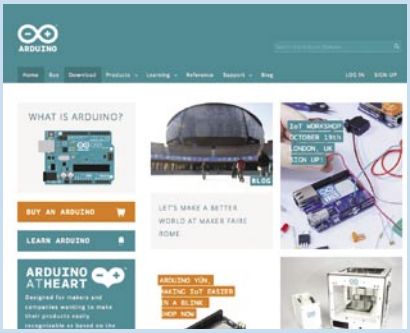


Figure 10 *- Arduino website.*

Figure 11 *- Download options.*

In a future Bulletin, Interfacing programming the Arduino UNO platform (part 2).

Colorimetry in the school laboratory

Over recent years, colorimeters have become essential pieces of equipment to support secondary biology and chemistry practical work and their use is specifically mentioned in the Course/Unit Support notes for both *CfE* Advanced Higher Biology and *CfE* Advanced Higher Chemistry [1].

Figure 1 *- WPA CO7500 and Mystrica colorimeters.*

In addition colorimetry is a valuable technique for use in Higher Biology and Higher Human Biology (in particular for enzyme assays) and Higher Chemistry (for example in kinetic studies). As noted previously [2], we routinely use WPA CO7500 and Mystrica colorimeters (both types of device are available from Scientific and Chemical, http://www.scichem.com/) for practical activities (Figure 1).

Figure 2 *- Semi-micro (left) and standard (right) cuvettes (1 cm pathlength).*

We have produced a simple activity called 'How good is your colorimeter?' and details are available on the SSERC website [3]. As an extension to that activity we present here another simple protocol which should allow users to use their colorimeter more confidently and effectively.

In common with many pieces of equipment, failure to follow some basic rules means that the data obtained are unreliable and/or incorrect. Over several years of running professional development courses across the sciences we have noticed that some teachers and technicians would not qualify for what might be termed the 'full colorimeter driving licence'. It is entirely possible that poor technique is then transferred to pupils.

For most school colorimeters there are two cuvettes which are in common use as shown in Figure 2.

Both of the cuvettes shown have a pathlength (i.e. the distance through which the light beam passes) of 1 cm. The cuvette on the left has a maximum volume of ~2.7 cm^3 and the one on the right a maximum volume of ~4.5 cm^3. A common problem which we encounter is the volume of solution used for measurements. The basic question one needs to ask (or know the answer to) is how much solution is needed for reliable measurements? Alternatively 'Can you have too little or too much in the cuvette?'

To generate answers to the question, a solution of $CuSO_4.5H_2O$ (approximate concentration was 0.2 mol dm^{-3}) was prepared in distilled water. The colorimeter (in this case a WPA CO7500) was set up to measure absorbance at 680 nm and distilled water was used as the blank. 2.5 cm^3 of the $CuSO_4.5H_2O$ was put into a standard cuvette and the absorbance measured to be 0.66.

For the purposes of the activity which follows let us assume that the 'true/correct absorbance' of a 0.2 mol dm^{-3} solution of $CuSO_4.5H_2O$ at 680 nm is indeed 0.66. What we did next was to take an empty standard cuvette (referenced against an 'identical' cuvette containing distilled water) and added 0.2 cm^3 aliquots of the $CuSO_4.5H_2O$ solution measuring absorbance after each addition. The results are shown in Table 1 and plotted in Figure 3.

Reading	Volume (cm^3) of 0.2 mol dm^{-3} $CuSO_4.5H_2O$ present	Absorbance (680 nm)
1	0.0	0.00
2	0.2	0.00
3	0.4	0.00
4	0.6	0.01
5	0.8	0.07
6	1.0	0.48
7	1.2	0.66
8	1.4	0.66
9	1.6	0.66
10	1.8	0.66
11	2.0	0.66

Table 1

The explanation for the data shown in Figure 3 is that at low volumes (< 0.6 cm^3) the light beam passes through the cuvette but there is insufficient volume of $CuSO_4$ present to absorb any of the light. At volumes between 0.8 and 1.2 cm^3 the light beam is probably passing partly through solution and partly through air; this causes scattering and so the absorbance recorded is not accurate. At volumes above 1.2 cm^3 the readings represent 'true/correct absorbance'. So, what is the impact of this on measurements using a colorimeter? Well, we would recommend that:

- when using a WPA CO7500 colorimeter, you use a minimum volume of 1.4 cm^3 in your cuvette to ensure accurate readings;
- when using a WPA CO7500 colorimeter, there is no need to have more than 2.0 cm^3 of solution in your cuvette - keeping the volume at about this level not only reduces the amount of solution needed but also reduces the risks of spillages;
- if you use a different colorimeter you cannot assume that the light beam will travel at the same height through the cuvette and so you will need to do similar experiments as outlined above to determine the minimum volume required.

The same experiment was run using a semi-micro cuvette using aliquots of 0.05 cm^3 of the $CuSO_4.5H_2O$ solution (Figure 4). In this case the scattering is more pronounced but from the plot one can see that a minimum volume of ~ 0.55 cm^3 is required to ensure that measurements of the 'true/correct absorbance' are obtained.

References

[1] Course/Unit Support Notes for Advanced Higher Chemistry and Course/Unit Support Notes for Advanced Higher Biology are available via the SQA website www.sqa.org.uk/ (accessed August 20th 2014).

[2] The Mystrica Colorimeter, SSERC Bulletin (2009), **228**, 10-12.

[3] Available at www.sserc.org.uk/index.php/biology-2/biology-resources/advanced-higher/cells-proteins/3438-laboratory-techniques-for-biologists (accessed August 22nd 2014).

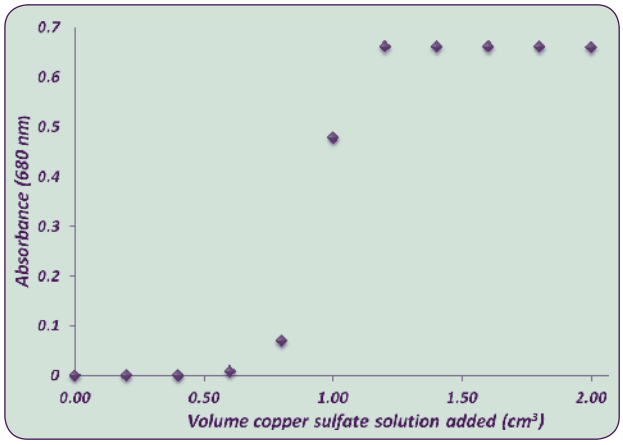


Figure 3 *- Plot of measured absorbance of 680 nm as a function of volume of 0.2 mol dm^{-3} $CuSO_4.5H_2O$ contained in a 'standard' 1 cm pathlength cuvette.*

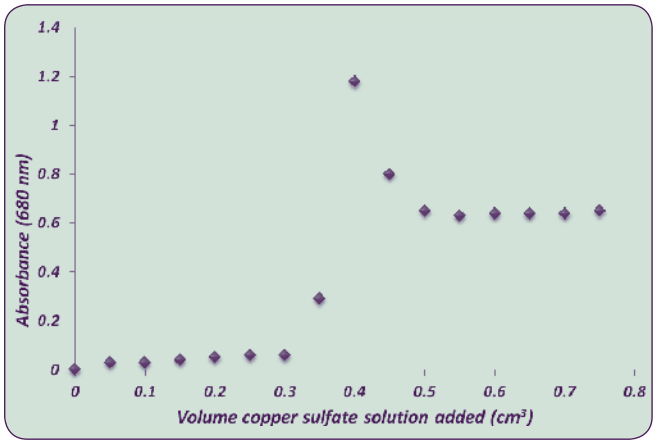
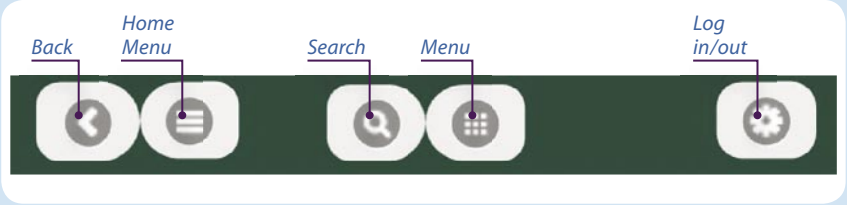


Figure 4 *- Plot of measured absorbance at 680 nm as a function of volume of 0.2 mol dm^{-3} $CuSO_4.5H_2O$ contained in a 'semi-micro' 1 cm pathlength cuvette.*

Ch ch ch changes

Keen observers will have noticed that the SSERC website has been undergoing a number of changes over the past few months. For those who haven't spotted them now seems like a suitable time to let you know what we have been up to.



Going mobile

The website as a whole now has a mobile version to make it easier to access on your phone or tablet. While the view is generally similar, there are some differences in navigation.

Here is the home page, after log-in. You will see some unfamiliar icons at the top. Most of these are pretty straightforward: back takes you to the previous page you were on and log in/out and search are self explanatory.

The **Home Menu** button brings up the menu that goes across the top and is the same on all pages.
The **Menu** button brings up the menu or menus that appear to the left of each page; these differ from page to page.

There are still a few teething troubles. In particular, some of our tables don't display all that well but it is possible to scroll left and right to see the entries without too much trouble.

Search

Clicking search from the top menu bar does not appear very different at all but there is a different search engine working underneath which makes it much more likely that you will actually get the search results you want.

The index

While it is fairly straightforward to find chemicals such as copper sulphate and potassium hydroxide, by looking under 'c' and 'p' respectively for the appropriate entry, dyes, indicators, stains and various biological reagents have been much harder to find as they are bundled together.

To solve this problem, there is now an Index in the chemistry menu that takes you to a long list of all the chemicals we have information about under all the names we could think of and links to the appropriate page.

So now, if you are looking for recipes for Sachs solutions, you can just look under s and follow the link instead of having to remember that they are on the Biochemicals - Plant growth substances page, under B. The index also contains entries from the background information section so you can track down 'goggles' or 'Safe Shelf Lives' etc.

New entries in the Hazardous Chemicals Database

Over the last year, a lot of new chemicals have been added to our database. It seemed unhelpful to have no information about low hazard substances, leaving you to wonder that if something was not included in our list perhaps it has not hazardous.

So there are now pages with information about: aluminium compounds, ammonium compounds, magnesium compounds, potassium compounds, sodium compounds, phosphates, sulphates & sulphites, alcohols, esters, organic acids and, most recently, strontium compounds and molybdenum compounds. Most of these are pretty low hazard but at least you can now check to see if that really is the case.

Open access

Thanks to an enlightened decision by the board, all our educational resources are now available without logging on. That will probably not affect many of you but it will mean that if you put links in other documents you will get straight to the resource. The same applies to all bulletins more than a year old. Health and Safety information remains accessible to registered members only.

Educational resources

New material is constantly being uploaded to the site, though in a trickle when we get the time rather than a flood. The Biology, Chemistry and Physics pages are structured to reflect the new curriculum to make it easier for you to find activities to support the topics you are teaching.

The future

Before a flood of emails come in, we are still looking at the possibility of enabling printing more easily, especially of the Hazardous Chemicals Database. Oddly enough, it really isn't easy.

We will continue to upload educational and H&S resources. If there is anything else you would like to see, please let us know. No promises but if an enhancement is possible we're happy to give it a go.

Let's talk stem cells

Stem cell research is often in the news and can be found in the Scottish curriculum from *CfE* level 4 up to *CfE* Higher for both Biology and Human Biology. SSERC is providing resources to support learning and teaching about this exciting, developing area of science.

Examples of Stem Cell Reports.

As part of our suite of Let's Talk activities we have been updating our resource on Stem Cells. *Let's Talk Stem Cells* is an activity that provides teachers with a resource which supports (i) an understanding of stem cells, (ii) how they can be used therapeutically, and (iii) a discussion activity which raises some of the issues relating to stem cells. The original research and development for this resource was funded through the Wellcome Trust's 'Engaging Science Scheme'.

The resource is available on the SSERC website at http://www.sserc.org.uk/index.php/let-s-talk-2/1337-let-s-talk-stem-cells.

The resource consists of help cards, background information, a pupil sheet, a stem cell story and a suite of stem cell reports which give up-to-date news on some of the latest stem cell innovations. These stem cell reports will be updated on a regular basis. An associated Teacher's Guide gives suggestions about how one might use the activity as well as detailing the areas of the curriculum which are supported.

Health & Safety

Health and Safety toolbox

The HSE website has now included a 'toolbox' section which brings together publications which relate directly to the responsibilities of employers in the workplace.

This is a useful website resource which has direct application to school technology departments. This website gives access for example to a Health and Safety checklist for classrooms. Health and Safety in a school is about taking a sensible and proportionate approach to ensure that the premises provide a healthy and safe place for all who use them, including the school workforce, visitors and pupils.

HSE website - http://www.hse.gov.uk/toolbox.

Work holding during wood machining

For an extra hand at the saw/planer-thicknesser or bandsaw try using a featherboard. MAGSWITCH have a range of magnetically held featherboards, which are held down at at quarter turn on each magnet. Two magnet sizes are available, smaller (ref 8110004) requires 44 kg to move it while the larger (ref 8110005) requires 67 kg to move it. Once fixed onto a steel machining table - they do not move! Setting and resetting can be carried out in seconds. School technicians with class size runs of timber through a machine will benefit from this extra hand. I now find myself using them for machining short runs of timber.

On a circular saw, fix the featherboard just before the saw blade. If the machine fences are magnetic then the same system can be used to hold down timber by applying the magnets to the fence (check fence is not aluminium!).

Figure 1 *- Magswitch Starter Kit.*

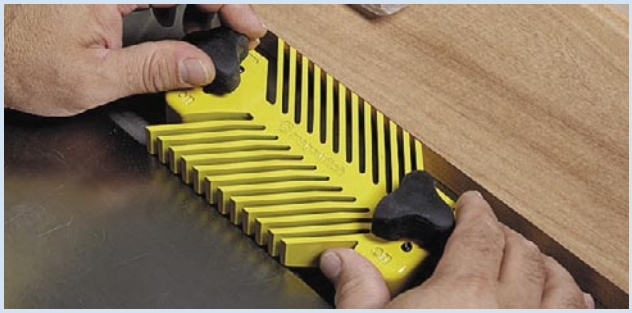


Figure 2 *- The Universal Featherboard.*

Figure 1 shows a Magswitch work holding starter kit which uses a universal base and two magnets. Typical price for a starter kit as shown in Figure 1 is around £66.

An internet search for 'Magswitch' will reveal a number of UK based suppliers and will show a variety of hold down devices and variations specifically for individual machines. The Universal featherboard shown in Figure 2 is priced at around £42.

Welcome to BS 4163: 2014

BS 4163: 2007 has been revised and version 2014 has now taken its place. To give it its full title:

BS 4163: 2014 Health and Safety for Design and Technology in Educational and similar Establishments - Code of Practice.

Including a slightly different title, the whole document has been brought up to date, being published on 31st August 2014 and is now available in either hard copy or in pdf format.

This British Standard now includes sections on 3D printers, laser cutters and rapid prototyping.

Members' price	£30
Non-Members' price	£60
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