STS
Scope includes Science, Technology and Safety

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The Bulletin is published by
SSERC, St Mary's Building, 23 Holyrood Road, Edinburgh, EH8 8AE
Tel: 0131 558 8180
Fax: 0131 558 8191
E-mail: sts@sserc.org.uk
Managing Editor: Fred Young
Editor : Ian Birrell

It's a' geek tae me!

Those of you who are, like me, going ever yet grumpier into your very own medieval phase, may be familiar with a need to approach, at an alarmingly accelerating rate, those agencies which deal with one's aged rellies. I got the forms from one such agency only this week. They were models of clarity and deservedly bore the "*Crystal Mark*" of the Campaign for Plain English. In contrast, and at about the same time, we received an enquiry at SSERC about difficulties one adviser was experiencing accessing the online learning programmes of SCHOLAR at Heriot Watt University. These problems, no fault of SCHOLAR's let us add, were to do with technicalities cried "Active X controls".

We said we'd do our best. We knew something (not a lot) of Active X but set off surfing to find out more which might explain our adviser's particular little problem (watch it, oot there!). The ever faithful Google™ threw up (if you'll pardon the image) thoosands of search results. We looked at most of the apparently authoritative ones. Several of them deserve to be awarded our new "*Mud Mark*" for obscurity. Most were written in pure nerdo-anorak. In the worst of them, "*ActiveX*" was only ever defined in other technical terms. For example:

"An ActiveX control is essentially a simple OLE object that supports the Iunknown (sic) *interface. It usually supports many more interfaces in order to offer functionality, but all additional interfaces can be viewed as optional and, as such, a container should not rely on any additional interfaces being supported. By not specifying additional interfaces that a control must support, a control can efficiently target a particular area of functionality without having to support particular interfaces to qualify as a control."*

Best (worst?) of all was the usage of the word "container" - see above. In Active X circles, it seems to have been assigned some obscure techno-meaning totally unrelated to a metal box which has fallen onto the back of a lorry (as in some alternative Glaswegian universe). Nowhere, not anywhere should you prefer it, in most of these websites were there any reference points providing a linguistic fix, no techno-trig points in plain, simple English.

There were one or two exceptions, such as whatis.com[1] but more often than not with these oxymoronic 'helpline' websites, we simply found ourselves rudderless, cast adrift on a sea of techno-gabble.

Regular readers (sad or what?) of these columns or of our scribblings and screivins elsewhere will know of our, allegedly irrational, fears of a new Dark Age. Well, maybe not a Dark Age. How about a new feudal system, one in which the entirely literate but only semi-numerate are held in bondage, serfs and vassals to a numerate but entirely illiterate techno-ruling class?

"Over our dead bodies", I hear you say. So, not that long to go then.

We've had similar dark thoughts and broodings about the role of the increasing army of IT specialists in education many of whom seem intent on removing the "C" for "communication" from applications of ICT.

On that more anon, if we're spared.

Reference

1 http://www.active-x.com/articles/whatis.htm

Accident with a pinhole camera

An accident occurred, where a girl's hair caught fire, when a naked candle flame was used as the object in a pinhole camera experiment.

The accident occurred in an S1 Science Class. Pupils were working with a typical pinhole camera – cardboard box with removable black card with pinhole at one end and screen of tracing paper at the other. The object was a naked candle flame.

When the camera was correctly positioned in the line of vision between the girl's head and the candle, the black card fell out, causing the image to disappear. The girl, while holding the camera in one hand in its original position, moved her head to the other side of the camera to see what was wrong. Her hair brushed against the candle and caught fire resulting in burns to her hair and forehead.

A subsequent enquiry by a Council health and safety officer found that the experiment had not been risk assessed. The department had always done this experiment with candles. As it was an activity that was simple, familiar and with no accident history the teachers thought that a risk assessment was not required.

The accident report by the officer said:-

"In this particular experiment it is not unforeseeable that a hazard (anything that can cause harm) and a risk (the likelihood that somebody will be harmed) were present."

When making a risk assessment, you have to spot the hazards and ask who might come to harm and in what way. You then decide what control measures, if any, are necessary in order to minimise the risk.

Naked flame hazards

The root cause of this accident was the use of a candle. The girl had long hair and, although she had been instructed to tie it back, it is not known if she had done so. Hair products could have increased the risk of her hair catching fire. These are hazards we have to identify in risk assessments. A risk is present with any naked flame, whether with a candle, Bunsen, or other source.

In many experiments, there is no substitute to working with an open flame. This applies particularly to applications with the Bunsen burner. The risk of serious harm from a Bunsen flame is obvious and generally much greater than the harm that might be caused by a candle flame. It is because the Bunsen risk is self evident that people are put on their guard to be cautious. This applies less when working with a candle flame.

Another contributing factor is that pupils are normally seated when working with pinhole cameras. This could create a false sense of security when working with an open candle flame.

Another hazard would be the use of blackout, because the experiment is normally carried out in the dark, the risk of working with an open flame is increased.

Yet another factor is the age of the children. The accident happened to a girl in First-Year, when growth spurts [3] and nervousness at handling apparatus can lead to clumsiness.

Control measures - substitution

High in the hierarchy of control measures is substitution. When a hazard is identified in a risk assessment that can be eliminated by substitution, then go for it provided that the substitute is patently safer. In this experiment, the candle should be replaced with a lamp.

The optical source used with a pinhole camera is, normally, the carbon filament lamp [1, 2]. This is not, itself, without hazards: –

1. Electrical - it operates off the mains supply. The risk of electrical shock can be controlled by fitting the lamp to a safety batten lampholder.

2. Implosion - the lamp is a vacuum device therefore there is a risk of an implosion. The risk of injury to the eyes can be reduced by ensuring that everyone in the room wears eye protection.

A safer optical source is a raybox fitted with a 12 V SBC lamp with diffuse (or pearl) finish. A small opaque screen in which a character has been cut out, being the image for the experiment, should be placed in front of the lamp. The character should have asymmetry (e.g. a capital "F"), so that its image would show the inversion and lateral transposition we are looking for in the experiment. A commercial version is the Asymmetric Source (280-219 at £5.63) from Technology Supplies.

Conclusions

Lessons can be learned from accidents and we are all a bit wiser with hindsight. A young pupil's hair was set alight, resulting in burns to her scalp, as she went about an elementary experiment which had been performed without incident for very many years, but which had never been risk assessed.

Apart from the legal obligation to risk assess work activities, teachers have an ethical obligation to ensure that children in their care are, insofar as can be reasonably arranged, not exposed to unnecessary danger. All experiments should be risk assessed, even the ones that seem innocuous – this is not as time consuming as it may first appear!

Time should be given at departmental meetings, and meetings of PT's from different schools, to routinely discuss the management and practice of health and safety arrangements.

References

1. Nuffield Physics Guide to experiments, Book 3, Experiment 7, Pinhole camera and lens camera, 1967.
2. Provisional Technical Guide, Unit 7, Leisure, Standard Grade Physics, Activities 1-3, SSERC, 1990.
3. http://www.bbc.co.uk/science/humanbody/body/articles/lifecycle/teenagers/growth.shtml

Hero's engine explosion

A report of an STE glass model Hero's engine supplied by Anderson Scientific (Order code: 12746) exploding during use.

The pressure vessel consists of a borosilicate glass bulb, about 70 mm in diameter, with two right-angled glass tubes mounted axially. The glassware is supported by a metal stand which allows it to rotate about a horizontal axis. The instructions suggest the vessel should be part filled with between 25 to 30 cm^3 water, heated with a Bunsen flame and allowed to boil: the issuing steam exerts a torque, causing the engine to turn.

The explosion that occured was violent and dangerous. The apparatus was nearly new and had been inspected for scratches or cracks before use. With the correct quantity of water, and a blue Bunsen flame supplied from a half-opened gas tap, the explosion happened just as the engine started to turn.

Anderson Scientific have been unable to provide us with any information on the quality of their product.

Philip Harris also stock a Hero's engine of similar construction which has been on sale since, at least, the 1970's (Cat. No. XXA43254) . We understand from Harris that there have not been any reports of their engines exploding.

The *Pressure Systems Safety Regulations 2000*, see :-

www.legislation.hmso.gov.uk/si/si2000/20000128.htm

apply to any system containing steam, no matter what pressure (even 1% above atmospheric). One of the conditions of the Regulations is that the pressure system must be fitted with a protective device designed to release the contents safely. The designer of a Hero's engine might assert that the engine's two vents are sufficient to prevent danger. With the STE design this may not be so, for it would seem that steam was not vented sufficiently fast to prevent the vessel being over-pressurized. It suggests that the vents were too narrow because of either poor design or lack of proper quality control in manufacture.

Control measures

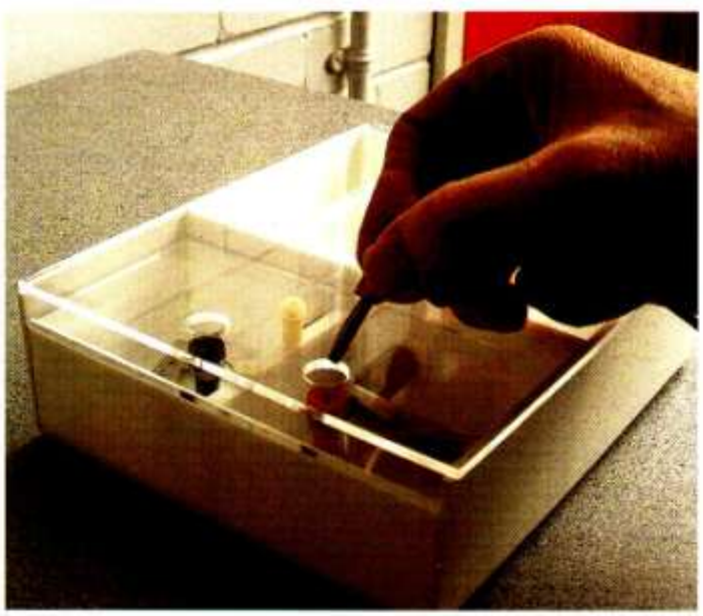
1. Until we get suitable reassurance from the supplier, we recommend that you do not buy the STE glass model Hero's engine .

2. When working with a Hero's engine of any construction, employ two safety screens, one to protect the pupils, and the other to protect the operator.

3. Before use check that, the vessel has no scratches or cracks; the vents are not obstructed by grit or gunk; use distilled water.

Chromatography - Griffin Paper Electrophoresis Kit

An electrophoresis kit obtained on trial from Griffin shows the danger that can occur with unshrouded HT connectors.



The apparatus (shown in the photograph) has unshrouded sockets accessed through holes in a clear, acrylic, top panel. Although this design prevents the operator from touching the conducting part of the 4 mm plug while it is being inserted or removed, it does not prevent contact at other times. The system wil not *fail to minimal danger.* It is therefore dangerous. For those who have already purchased this item we advise replacing the unshrouded sockets and connectors with the shrouded type. The modified equipment is shown in the photo opposite.

We are awaiting comments from Griffin Education.

Chemistry Residential Summer School 2004

A very successful Chemistry Residential Summer School (CRSS) was held at The University of Edinburgh 28 June – 2 July 2004.

The delegates, from as far afield as Shetland and Yorkshire, experienced a wide range of lectures, workshops and labs, and some of their comments included:

"The museum visit was absolutely fascinating".

"Excellent talk on atmospheric pollutants".

"ICT workshop really good – Excellent resources".

"Chemistry's Pleasure was a delight and a reminder to ensure that I incorporate many more exciting expts and demos into my lessons".

"The Protein session was very good, and like all the lectures we've had so far I've picked up things to help enrich my lessons"

"Practical Investigations - good ideas and food for thought".

"Dyestuffs backed up the info received regarding the latest Mass specs and NMR techniques – cool!".

"Assessment for Learning - excellent presentation – lot of good do-able ideas".

Some reflections from a CRSS Delegate

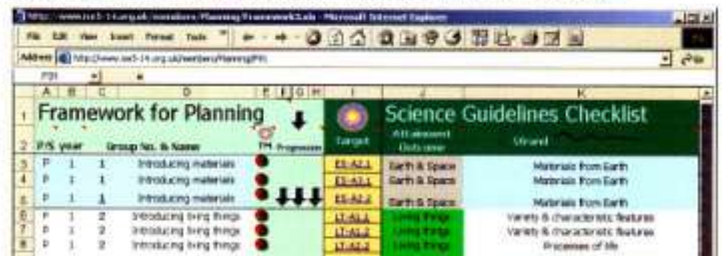
"What was obvious to all of those who attended the Chemistry Summer School held at the University of Edinburgh in the fine setting of Arthur's Seat and Holyrood Park was the experience of the week far exceeded five single days. We have been treated to a veritable feast of.....

- Lectures from leading experts in the fields of vitamin chemistry, atmospheric chemistry, fabric dyes behind the scenes at the National Museum of Scotland and the chemistry of life that took us to the very frontiers of research at the university and in one local company, Organon;
- Up to date materials from the DUSC project that put us in touch with latest developments in ICT that are ready for use with our students;
- Workshops on analytical techniques that are now found in the Higher and Advanced Higher courses; and,
- Discussion groups on the curriculum review in Scotland that were interspersed with practical down-to-earth suggestions regarding investigative work with younger students.

But for me the essence of the school was twofold. The first strand put me in touch with a network, which extended far beyond the bounds of this beautiful city. And the second is now encapsulated in what I am now wearing around my neck in the form of a pendant containing my own DNA. If this DNA is the key to me, and chemistry the key to life on earth, then the summer school has been the key to opening many new doors."

Improving Science Education 5-14 - Planning Spreadsheet

Accessible from a link on the Home Page (to registered users only), and a key part of the ISE 5-14 Web Site, is the *Planning Spreadsheet*. It may be found at the following URL - **http://www.ise5-14.org.uk/members/Planning/Framework3.xls**



As well as showing the relationship between the *Framework for Planning* and the *Science component of the Guidelines* in Environmental Studies, it allows cross-referencing with the other components and relevant resources and references. You will need *Microsoft Excel*.

By scanning across the spreadsheet (columns A-I remain fixed) references within relevant publications can be found; Column M- *Be safe!*, N- Direct route to Safety advice for each target, Y-*Renfrewshire Assessments*, AV-*Concept Cartoons*, AW- *Thinking Science (CASE) materials*, AX to AZ-*Starting Science*, BA to BE-*Spotlight Science* and BF-*Science 5-14 from* Hodder Gibson. These entries are simply references and do not link to the materials themselves.

Other columns have entries which link to other pages and files held on the ISE 5-14 website. These include columns O to X- *Renfrewshire/Highland Resources*, AA to AH- Cross referencing to other science targets plus those in Health Education, Social Subjects, Technology, Maths, Art, ICT & Music, AI to AL-*SAPS Microbiology materials*, AM–*Borders materials*, AN to AT- *Glasgow materials* and AU-*Stromness Academy S1/2 Homework/Extension materials*.

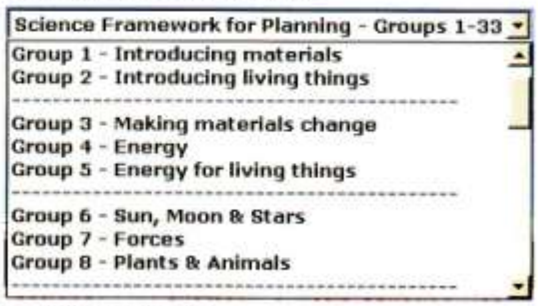
Framework for Planning - provides advice on learning experiences for P1 to S2. It is not intended to be prescriptive and therefore represents only one pathway of learning which is consistent with advice on effective teaching and learning within science education. *Attainment Targets* are arranged into *Target Groups* which may be accessed on the Home Page from a drop-down menu (below), via a larger menu for the visually impaired or by a numbered link on the spreadsheet (column C). Each Target has a *Target menu* (column E), which provides links to *development of the target, teacher's guide, resources, homework, skills, equipment list, assessment, CPD* and *safety*. Progression from one Target Group to the next appropriate point within the Framework for Planning is suggested in columns F to H.

Science component of the Guidelines - Each attainment level contains 3 *Attainment Outcomes* (AO) - *Earth & Space, Energy & Forces and Living Things & The Processes of Life* (column J). They contain the main areas of learning and encompass knowledge and understanding, skills and developing informed attitudes. Each AO has three *Strands* (column K), each of which reflects the 'big idea' in each of the major areas of scientific investigation. The Strands are described & exemplified by *Attainment Targets*, each of which represents an area of knowledge. Interactive Guidelines and their levels may be accessed directly from the Home page via the grid shown below right.

Attainment Target - These are not precise objectives. Rather, they reflect the areas of knowledge and understanding, skills and attitudes encompassed within a series of suggested learning activities and experiences. The target codes in *column I* (above) link to the relevant place each target has within the Interactive Guidelines. The codification is represent by the following :-

Attainment Outcome (ES, EF or LT) - Attainment level (A,B,C,D,E or F), Attainment Strand (1, 2 or 3), Target number (1....) or see http://www.ise5-14.org.uk/Prim3/New_Guidelines/Levels/topics-c.htm#3-2-3

e.g. LT-C2.3 (Living Things at Level C, second strand, third target).



Component	Attainment Level					
Science	A	B	C	D	E	F
Social Subjects	A	B	C	D	E	F
Technology	A	B	C	D	E	F
Other interactive guidelines						
Health Eductn.	A	B	C	D	E	F
ICT	A	B	C	D	E	F

Crystal growth and Liesegang rings

Crystal growth is an area where there has been considerable research. This has been carried out because crystals are useful in the area of solid-state science and, more importantly, they are fun to grow and beautiful to look at!

We recently decided to look at this interesting area of chemistry because of a number of enquiries that we had received about the Advanced Higher Chemistry starter investigation – Crystals[1]. The method of growing crystals described in this starter investigation is the diffusion technique, which often results in the formation of bands of crystals known as Liesegang rings. These are named after the German colloid chemist Dr. R. Liesegang who first described them.

The enquiries that we received centred around problems associated with the preparation of the gels and with the formation of the Liesegang rings.

Gel preparation[2]

The starter investigation describes two methods of gel preparation:

a) Sodium silicate gel[3]

The density of the sodium silicate solution has a direct influence on the pH of the final gel[4] which, in turn, can affect the setting of the gel and ring formation. The starter investigation states that a solution of sodium silicate of density 1.06 g cm^{-3} should be used. We found that it was worthwhile checking the density of the water to be used in the preparation of the solution in order to get this right and to check the density of the solution after making it up before use. A freshly made solution should always be carefully made up and used straight away as results are badly affected by small amounts of contamination.

Several problems can occur when adding the inner electrolyte and the ethanoic acid to the silicate solution. We found the easiest and fastest way was to dissolve the inner electrolyte[2] in the ethanoic acid and then add the silicate solution to the ethanoic acid drop by drop. Adding the ethanoic acid to the silicate solution frequently results in instantaneous setting as well as local ion formation and gel pockets. When adding the silicate solution to the ethanoic acid, we recommend drop by drop addition, using a magnetic stirrer to ensure complete mixing. Drop by drop addition is laborious, time consuming and requires patience but it is necessary to prevent localised ion formation and gel pocket formation.

b) Using a packet of gelatine

The starter investigation suggests, as an alternative to the use of sodium silicate gel, using packets of gelatine to prepare gelatine gels. We used the method suggested in the Schibeci and Carlson paper[5] – "Add gelatine (1.5 g) and one of the chemicals (2.5 g) to 50 ml of distilled water. Heat with stirring until the solution is clear. Pour into a standard test tube (25 mm x 150 mm) until it is about two-thirds full. Stopper the tube and leave to set; this usually takes about 12 h. Add the second solution above the gel nearly to fill the test tube. Do not stopper, but cover with a watch glass" - and found that this gel was very easy to prepare.

For both systems the gels were left to set overnight before the addition of the outer electrolyte. At the setting stage it is very important to ensure that the test tubes containing the gel are held vertical and kept motionless[4] Diffusion and ring formation reflect the starting contour of the gel surface and an uneven surface leads to uneven diffusion and uneven ring patterns making them difficult to observe and categorise.

Systems listed as having produced Liesegang rings

The gel systems used by us were those suggested in the starter investigation and are listed in the table below.

Gel with Inner Electrolyte	Outer Electrolyte Solution	
cobalt(II) chloride	conc. ammonia	0.880
magnesium chloride	sodium hydroxide	19 mol l^{-1}
magnesium chloride	conc. ammonia	0.880
copper(II) sulphate	silver nitrate	0.1 mol l^{-1}
manganese(II) chloride	conc. ammonia	0.880
copper(II) chloride	sodium hydroxide	19 mol l^{-1}
potassium chromate	silver nitrate	0.1 mol l^{-1}

Table 1 *Gel systems*

Observations & comments

Gelatine

The gelatine is much easier to make up than the sodium silicate gel. Well defined ring systems were obtained, within two weeks, when using gelatine with cobalt(II) chloride/0.880 ammonia (fig.1), copper(II) sulphate/silver nitrate solution and magnesium chloride/0.880 ammonia (fig.2), manganese(II) chloride/0.880 ammonia and potassium chromate/ silver nitrate solution (fig.3).

The systems using 19 mol l^{-1} sodium hydroxide produced poor results as the hydroxide flooded through the tube very quickly and the rings formed were very close together and indistinct. Apart from the poor results, we have concerns regarding the use of sodium hydroxide at this concentration. Thinking of the COSHH requirement to, whenever

Fig.1 cobalt chloride + conc. ammonia

possible, substitute a hazardous substance with a less hazardous alternative we tried 4 mol l^{-1} and 2 mol l^{-1} sodium hydroxide. This resulted in slightly better ring formation although they took some three to four weeks to develop. See Table 2 (below).

Gels	Ring Formation
cobalt(II) chloride/ conc. ammonia gelatine	Good clear ring formation.
magnesium chloride/ sodium hydroxide	Poor electrolytes, clump at bottom of tube.
magnesium chloride/ conc. ammonia	Good ring formation.
copper(II) sulphate/ silver nitrate	Good ring formation, black colour makes some areas difficult to see.
manganese(II) chloride/ conc. ammonia	Good ring formation.
copper(II) chloride/ sodium hydroxide	Poor. Alkali floods through system making it difficult to observe rings brown patches in dark blue.
potassium chromate/ silver nitrate	Strong band at top with very faint rings.

Table 2 - *Gelatine systems*

Sodium silicate

Single bands were formed in the silicate gels but no ring systems developed. Small individual crystals were observed and a gradation of colour along the tube showing the diffusion path of the outer electrolyte could be seen (Fig. 4 & Table 3).

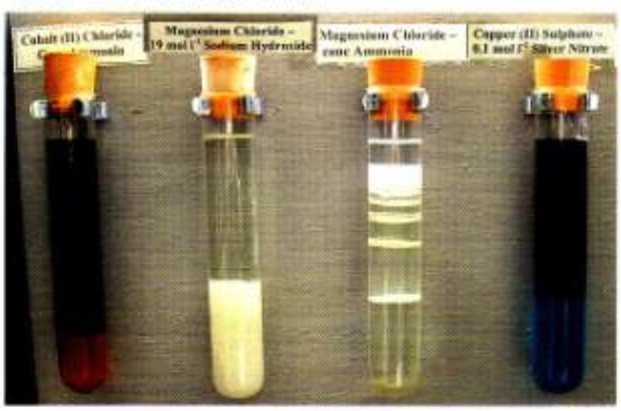
Those systems using 19 mol l^{-1} failed to produce anything resembling Liesegang rings or crystals. Again the sodium hydroxide systems were rerun using 4 mol l^{-1} and 2 mol l^{-1} alkali. This produced better results with some bands being observed. In some cases the use of light and a magnifying glass aided observation of the Liesegang rings and individual crystals.

Silicate gels	Crystal Formation
cobalt(II) chloride/ conc. ammonia gelatine	Strong band at top, colour diffusion down tube.
magnesium chloride/ sodium hydroxide	Poor, nothing discernible.
magnesium chloride/ conc. ammonia	Poor, difficult to discern bands.
copper(II) sulphate/ silver nitrate	Single black band on surface of gel, crystals formed on surface
manganese(II) chloride/ conc. ammonia	Dark band with beige colour diffusing down gel, no crystals observed
copper(II) chloride/ sodium hydroxide	Poor, dark blue colour diffuses through pale copper chloride. No banding pattern identified, impossible to categorise.
potassium chromate/ silver nitrate	Single band formed, crystals formed on band.

Table 3 - *Sodium silicate gel systems*

Safety advice

The safety advice given as part of the Introduction to the Starter Investigations Guide points out that "it is the responsibilty of the teacher/lecturer to ensure that employers' guidelines in relation to the COSHH Regulations are complied with". Whilst this is true, there are many other Regulations that require the employer to assess the risks in the workplace.



Figs.2 & 3 *Gelatine-based gels after about 8 days (Note - bungs were used for diplay purposes only)*

Before work starts on a project it is very important that consideration is given to **any** hazards that could cause serious harm. The process of risk assessment should not be overcomplicated. The HSE expect risk assessments to be suitable and sufficient, not perfect. Following the process of risk assessment it should be possible to demonstrate that:

- a thorough check was carried out
- those who could be affected were consulted
- the obvious significant hazards have been considered and dealt with
- safety precautions have been put in place and that any remaining risk is acceptably low

Fig.4 *Sodium silicate-based gels after about 8 days*

References

1. *Chemistry, Starter Investigations (Advanced Higher):* Crystals
2. *Stern, KH: the Liesegang Phenomenon:* Chem. Rev.; 1954; 54(1); 79-99
3. *An Experimental Study of the Liesegang Phenomenon and Crystal Growth in Silica Gels:* A.H. Scharbaugh III and A.H. Scharbaugh Jr. JCE, 1989, 66, 7, 589.
4. *Crystal Growth in Gels:* S.L.Suib, JCE,1985,62,81
5. *An Interesting Student Project: Investigating Liesegang Rings:* R.A. Schibeci and C. Carlsen, JCE, 1988, 65, 365.

S1/S2 Electronics

There is no perfect set of microelectronics resources for teaching electronics in S1/S2 Science. There are difficulties with whatever approach you choose. However weighing up all of the pros and cons, *MFA* (at least until this new JJM product, the *Angus Systems Board*) continued to stand out head and shoulders above the rest of the pack. Admittedly it is not pupil-proof. But were a kit to be built like a tank, then it would look like a tank rather than a microelectronic system.

With his considerable understanding of teaching electronics and designing electronics kits, Alex Munro (the owner of JJM Electronics and a principal teacher of physics) has devised a new kit – the *Angus Systems Board* - that closely resembles the MFA *Decisions Board*, but which has some modifications and additional features. The chief improvement is to let pupils use the kit with external devices. For instance, a closed-loop control system could be set up causing a train to run to and fro on a track. Thus whereas MFA mainly models abstract systems, the Angus Board, to a greater extent, models practical ones.

Kits	Pros	Cons
MFA and JJM Angus Board	They look the part and are well designed. Cover many basic concepts of electronics. Suitably simple for beginners, yet have sufficient depth to challenge all abilities. Place the emphasis on processes and problem solving, as opposed to learning lots of facts. Can stand on their own. Do not depend on pre-knowledge of electricity or other physics. Excellent self-learning support materials. Can be taught by non-experts who have little understanding of either electricity or electronics. Include facilities to operate external devices (e.g. a buggy). Reasonably robust and reliable. Good guidance available on repairs and spares.	Susceptible to malicious damage. Skilled electronics technician needed to repair faults or damage.

The Angus Systems Board costs £49.85 alone, or an extra £8.95 with its remote sensor pack.

Note that the scope of electronics systems that can be designed with MFA is considerably greater than the ones with the Angus Board.

The latter includes no more than logic, whereas the former, with a set of three boards, also includes counting, display and memory. Thus the Angus Board would be an adequate resource for a short course of about two or four lessons on electronics at S1 or S2. For a course of greater length or depth, MFA would be a better buy.

Sodium absorption spectrum with a white Lumiled LED source

The D lines of the sodium absorption spectrum can be displayed reliably and easily with the aid of a high-power, white-light, LED source such that the demonstration can be shown in daylight.

Description

With apparatus that is easily set up, radiation from an intense white-light source is focused on a sodium vapour flame. The fraction of light transmitted through the flame is refocused on the aperture of a hand spectroscope, thus demonstrating with little trouble the D lines of the sodium absorption spectrum.

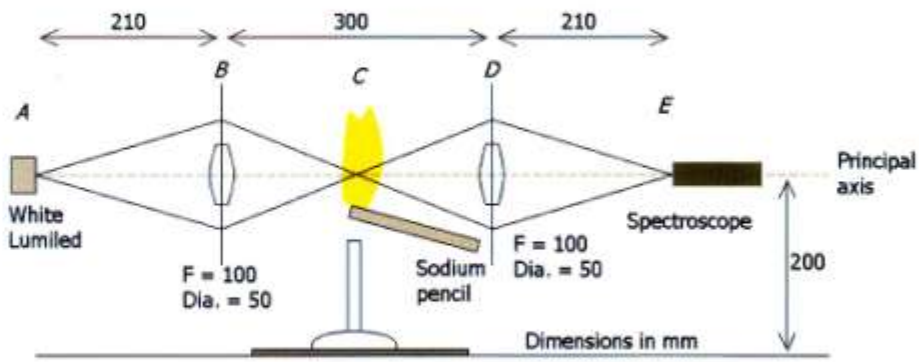


Fig.1 *Schematic diagram showing the optical parts. When these specifications are applied, relatively little radiation is lost.*

This demonstration experiment requires a little over one metre of bench space, with a gas supply for running a Bunsen. The principal axis of the radiation should be set at around 200 mm above the bench to accommodate the height of the Bunsen funnel, sodium pencil and flame (Fig. 1).

The demonstration can be carried out in daylight because the radiation from the 1 W white Lumiled (Lumiled Luxeon 1W Star with Optic (Low Dome Batwing] Enhanced-White LXH-NWE8, RS, 467-7519, £10.49) is sufficiently bright. What makes the experiment so easy to perform is the nature of the white-light radiation source. The LED, mounted on a heatsink, should be run off a 5 V voltage-regulated supply capable of delivering at least 350 mA of current. There should be a parallel combination of resistors, 10 Ω and 22 Ω, both rated 3 W, wired in series with the LED (Fig. 2). For information on wiring a Lumiled and fitting a heatsink, please refer to Bulletin 210, p8, and the SSERC website:-

http://www.sserc.org.uk/members/bulls/210/physics.htm#Product%20description

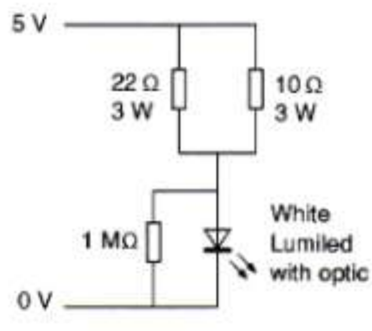


Fig.2 *Circuit diagram.*

Referring to Figure 1, radiation from the white Luxeon LED (A) is focused on a spot (C) above a Bunsen with a 50 mm diameter converging lens (f = 100 mm) (B). Radiation is re-collected with another 50 mm diameter lens (f = 100 mm) (D) and focused on the entrance aperture (E) of a hand spectroscope mounted on a clamp stand. Separations between each element (A – E) should be roughly as shown (Fig. 1).

The lens types have been optimized for the application. Because the LED has what is not quite accurately called a 'collimating lens', the LED emits a narrow beam of white light that has a small amount of divergence. At the first converging lens (B), the beam width has broadened out to just over 50 mm, completely filling this lens. This lens therefore captures most of the LED's radiation and brings the radiation to a focus in the sodium flame. The white light radiation that gets transmitted through the flame diverges to fill the second lens (D), which gathers it to refocus on the entrance aperture of the hand spectroscope. Because relatively little white light gets lost on its way to the spectroscope, the spectrum in the spectroscope is stunningly vivid.

Other lenses that could be substituted include condenser lenses, or fresnel ones. The specified focal lengths are given for guidance, but generally should lie between 100 and 150 mm.

In the photographs illustrating this article (Figs. 3 & 4), the lenses shown have diameters of 75 mm – not 50 mm as recommended in the text – and focal lengths of 150 mm. During our research, we found that the smaller size of lens is adequate and is recommended since it is a standard size held by schools. The complete setup is shown in Figure 3; while in Figure 4, the method for setting the positions of the sodium pencil and Bunsen funnel is shown: the focus is about 3 – 4 cm above the tip of the pencil, which is a similar height above the funnel. A second spectroscope can be mounted above the first (E) to observe the sodium emission spectrum.

With sodium pencils no longer available, an effective substitute can be made by rolling two sheets of large diameter filter paper into a tight roll and soaking one end in a saturated solution of sodium chloride and water. The dry end is clamped to a stand with the wet tip pointing slightly upwards and at a height of about 30 mm above the Bunsen funnel. This should give a sodium flame lasting 20 minutes or more. The only critical adjustment is ensuring that the flame transects the LED radiation. When this happens, an absorption line (the two D lines can be resolved with some makes of spectroscope) will be clearly seen through the spectroscope, while the corresponding emission line (or pair of lines) can be seen with the white source covered.

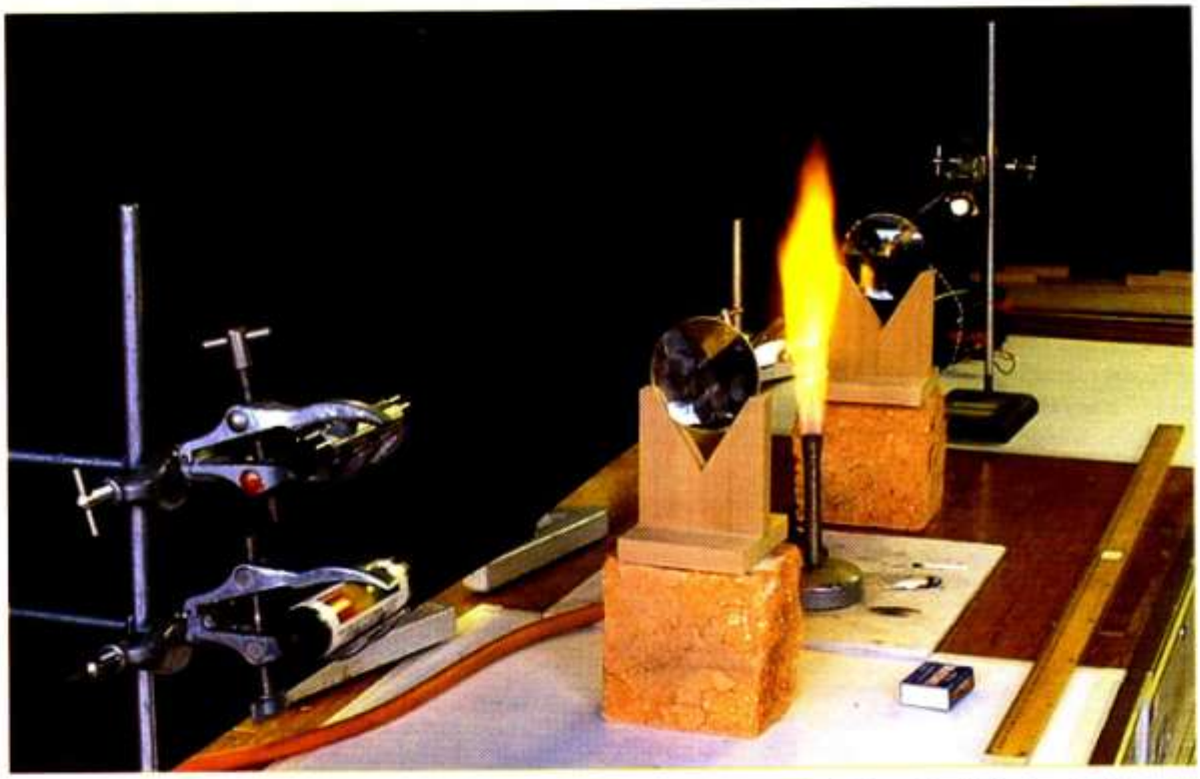


Fig.3 *Photograph of the apparatus looking towards the white-light Lumiled. Note how little peripheral light is emitted from the source when the viewpoint lies only a few degrees off axis. The lenses in the photograph have diameters of 75 mm, whereas the ones recommended in the text are 50 mm.*

Fig.4 *The light must be brought to a focus about 3 – 4 cm above the sodium flame source, which itself must sit a similar distance above the top of the Bunsen. Because the LED is an extended source (rather than a point source), the focused image is also extended.*

Risk assessment

As the LED produces intense white radiation, do not look directly at a Luxeon LED from close range (brief close-up viewing is harmless). Do not look for long periods of time at a Luxeon LED source either directly, or with peripheral vision. Ventilate the room to prevent a build-up of hazardous vapours and do the demonstration on a heat-resisting mat.

Let's count

We have a supply of haemocytometers at SSERC for anyone who wants to cover *Unit 2: Microbiological Techniques* (Higher Biotechnology). Part (iii) *Enumerating micro-organisms* covers the use of a haemocytometer for obtaining a measure of the total cell count of a yeast culture.

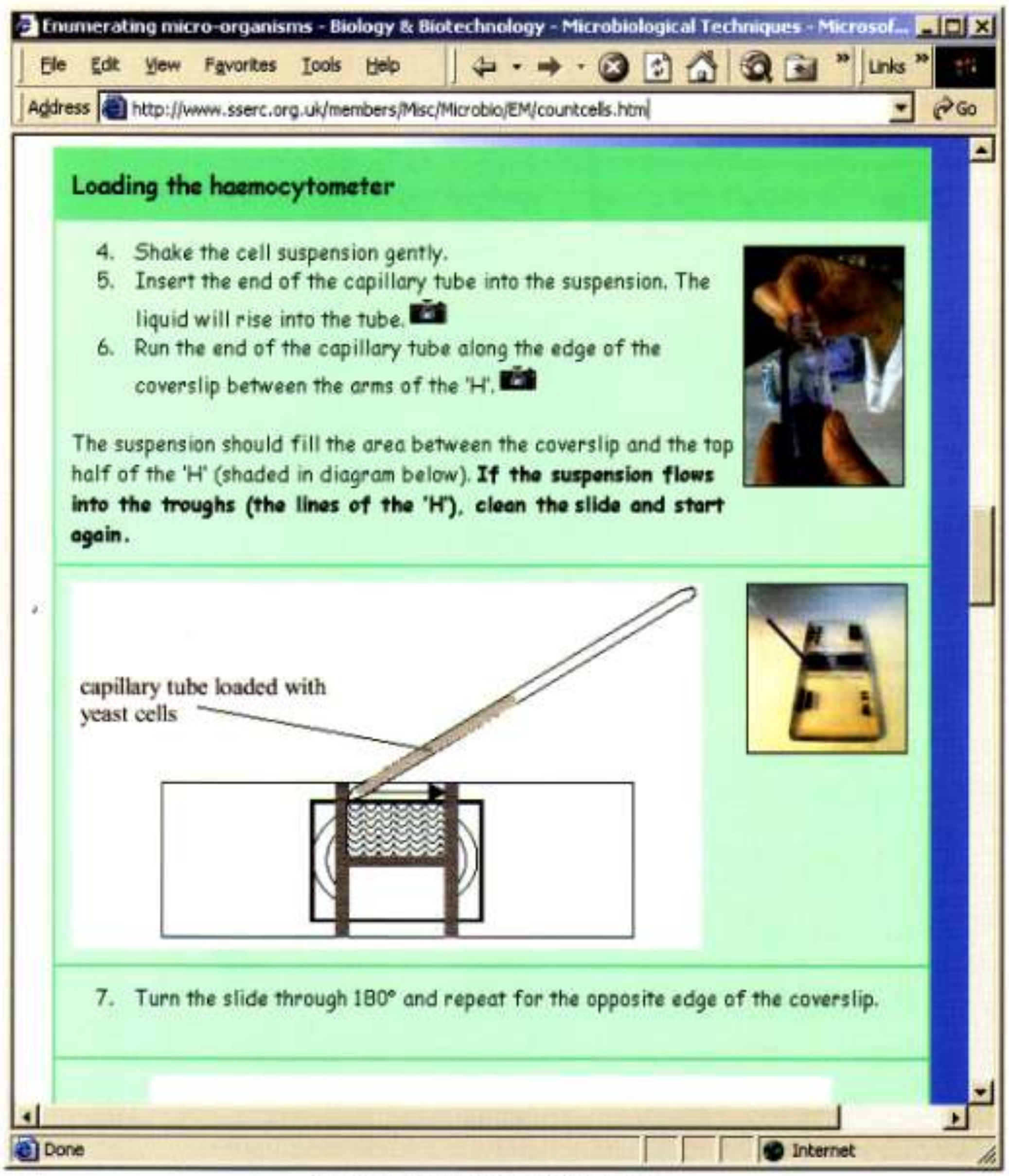
Phone (0131 558 8180) or E-mail (a.adams@sserc.org.uk) with name, address and number of haemocytometers required.

Postal charges : 1 - 20p 10 - £1.68 First-come first-served basis

Want to know more about how to count cells in a yeast culture using a haemocytometer?

Find out all there is to know by getting on to the SSERC Website at :-

http://www.sserc.org.uk/members/Misc/Microbio/EM/countcells.htm



Screenshot from the web/CD pages

Annual Conference and AGM of SSERC Limited

Friday 5th November 2004 at Business Learning & Conference Centre, Lauder College, Dunfermline

Programme & Booking Form

9.15-10:00	**Exhibitions open, registration and coffee.**
10:00-10:10	**Welcome and introduction**: Councillor David L. McGrouther, BA, JP, Chairman SSERC Limited, West Lothian Council.
10:10-10:40	***Keynote Address:*'A National Science Learning Centre for the UK'**
	Professor John Holman, Director, National Science Learning Centre, York.
10.40-11:10	**Improving Achievement in Science Education**
	Dr. Jack Jackson, HMIe, Assistant Chief Inspector and Leader, HMIe Science Team.
11:10-11:40	**Coffee and exhibitions**
11:40-12:10	**PGCE Residential Events & CPD**: John Richardson, SSERC; Jan Barfoot, SIBE; Douglas Buchanan, DUSC
12:10-12:40	**Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)**
	David Richardson, HM Inspector of Health & Safety
12:40-12:50	**Display Screen Equipment**: Jim Jamieson, Senior Associate, SSERC.
	Closing remarks – Bristow Muldoon MSP
13.00-14.00	**Lunch, Exhibitions**
14.00 onward	**Annual Report and General Meeting**
	Board Meeting of SSERC Limited (Directors and Officers of the Company)
	Exhibitions
15.00	**Depart**

I wish to reserve a place at the Annual SSERC Science, Technology and Safety Conference:

Name : ______________________ Position ______________ Date ________

Address ____

I enclose my cheque/official order* in payment of the delegate fee(s) of £60 + VAT (£70-50) for members*/£80 + VAT (£94) for non members* [delete if inapplicable]. I wish*/do not wish* a receipt.

Return to: SSERC, St Mary's Building, 23 Holyrood Road, Edinburgh EH8 8AE

SSERC open courses

These will be held within the SSERC premises in Edinburgh and cost £70 + VAT (£82.25) per person. The Fee includes all training materials, teas, coffees and lunch. In the period up to the Easter holidays we offer:

Management of Health and Safety for School Technicians - Wednesday, 8th December 2004

Electrical Apparatus Testing - Thursday, 3rd February 2005

Microscope Maintenance – Wednesday, 9th February 2005

Chemical Storage and Handling for non Chemistry Technicians – Thursday, 17th February 2005

Management of Health & Safety for Physics Teachers – Wednesday, 16th March 2005

For more information or to reserve a place on any of these courses contact Anne White on:

Tel : 0131 558 8180 Email : om@sserc.org.uk