SAPS
SCIENCE & PLANTS FOR SCHOOLS

OSMOSIS

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Botanic gardens, biodiversity . . . and brilliant days out

A cycad in the Cambridge University Botanic Garden

How can a botanic garden provide a brilliant learning environment for children and a rich resource for teachers to access topics throughout the curriculum?

Botanic gardens house living collections of plants brought together to create environments on which animals and fungi depend. Here, your pupils can encounter the fascination, beauty and diversity of plants from all over the world, whilst also experiencing at first hand the physical characteristics of some of the most extreme environments to which plants have become adapted. Most young children respond intuitively and very positively to contact with nature. However, access to these rich and stimulating environments tends to be restricted. Regrettably, few children now have the opportunity to develop a personal understanding of the natural world.

There are over 130 botanic gardens throughout the UK. They function primarily as resources to support the scientific study of plants. Each is unique, reflecting its location and ecology, its history and particular role, its size and financial status. Botanic gardens would fulfil their scientific purpose adequately if organised simply as serried ranks of labelled species. Fortunately, for centuries, horticulture and amenity have developed side by side to create wonderful landscapes, with the result that many botanic gardens are beautiful and inspiring environments in which to learn, irrespective of the age, nationality or ability of the student.

continued on page 2...

Dear Colleague

This is the first issue of our new style *OSMOSIS*. You can see that we are presenting the newsletter in two parts. This 8-page section is aimed mainly at teachers of secondary pupils and will contain a range of articles and ideas or protocols for practical investigations. These all use plants or plant material, similar to those in our earlier issues of *OSMOSIS*. Our emphasis is always to offer fresh ideas that are realistic for you or your students to do in the laboratory, without excessive demands for sophisticated equipment and to encourage you to find interesting ways to use plants in your teaching. The 8-page section will also include the SAPS workshop calendar and other short news items.

The 4-page section is aimed mainly at primary teachers, though we hope all teachers will read the 8-page section and find interesting ideas in it. In the primary section, we plan to give worksheets in a form that can be used directly with pupils as well as some other ideas that may help in a teaching programme.

Please send us your comments on this new style (email us on saps@homerton.cam.ac.uk). We want to know whether you find it useful (or whether you prefer the mixture as in previous issues of *OSMOSIS*). More than that, if you have ideas you would like to share with other teachers, send them to us so that we can publish them in a future issue of *OSMOSIS*.

Paul Beaumont, Director, SAPS

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School visits . . .

We all depend on plants for our survival, so it makes sense to encourage people to learn to respect and care for them from an early age. A visit to a botanic garden enables children to tune in to plants, to find out what makes them tick and the vital part they play in maintaining the planet for all species. Plants have a profound influence on our lives economically, culturally and spiritually, so botanic gardens are valuable resources for teaching arts and humanities as well as science. Since the introduction of citizenship into the National Curriculum, botanic garden collections are also becoming recognised as valuable resources for addressing issues of sustainability, global equality and social inclusion.

Many UK botanic gardens welcome visits, from pre-school upwards, focusing on topics that can most effectively be enriched by access to the plant collections or about which teachers request specialist support. Many gardens employ education staff who liaise with teachers to develop education programmes geared to the curriculum. These staff often work directly with school groups. Some gardens also run adult education programmes including INSET sessions for teachers and opportunities for teacher placements. Details of provision in your area can be accessed via the Botanic Gardens Education Network (BGEN) whose contact details are given at the end of this article.

. . . to the Cambridge University Botanic Garden

Cambridge University Botanic Garden is a green oasis in the city. It offers a lively education programme for learners of all ages. In the Garden, you immediately become aware of the enormous diversity of the Plant Kingdom. Here is an environment that stimulates questions . . . 'Why are there so many kinds of plants?' . . . 'What are they for?' . . . 'Why do they look so different from each other?'

Within its 16 hectares and around 8 000 species, the Garden has areas of naturalised wildflowers, a lake, stream and woodland. These make it an ideal location for comparing local habitat types and discovering the associated wildlife. Our aim is to make plants exciting for children, whilst helping them to make sense of plant diversity, adaptation and the dynamic processes that sustain survival and initiate plants interaction with other species.

A note about Cycads *(see page 1)*

Cycads look rather like palm trees, but aren't even closely related. They evolved about 455 million years ago and represent the sort of plants that grew in dinosaur times. Herbivores like *Stegasaurus* probably ate them for lunch.

Cycads reproduce by means of cones rather than flowers. Their leaves are often hard and woody or strongly armoured with spines. They grow in tropical and subtropical regions throughout the world.

North American Indians used the stems, roots and seeds as a food.

People frequently enjoy the fascination of plants without considering what their existence entails. Die-hard species that survive in the most challenging environments have evolved intriguing strategies to overcome their immobility. Their weird physical or behavioural characteristics are plain for all to see, touch, smell or even hear. The secrets of plants and their colourful life-styles generate surprise and respect in visitors, irrespective of their age.

Inside the glasshouses, children step beyond our shores to explore the flora of the world's extreme environments. They can compare the appearance of alpine plants (that survive much of the year under deep snow) with the adaptations of succulents (that cope with life in parched deserts). Whilst experiencing the humidity, heat and lushness of the tropical rainforest, they discover how much we rely on the plants of these highly productive regions for everyday commodities, such as chocolate, bananas, chewing gum, cosmetics, rubber gloves and medicines.

Gardens are dynamic, their plants and wildlife changing constantly in response to weather, season and even time of day. Instead of prescriptive worksheets, more appropriate activities for learning are detective work using all the senses: discussion, data collection, creative writing, theatre, role play, drawing and exploring themed trails.

For a successful visit, active planning involving the teacher is essential. A pre-visit exploration with the Education Officer is a good starting point, specially for teachers visiting for the first time. Each teacher responds to the garden as an individual, and can select areas and activities that provide the most appropriate focus for their own teaching.

Visits can take place at any time of year, but ideally in the term when the children cover related plant topics in the curriculum. We usually plan that children spend maximum time amongst the plants, though our classroom is used as a base, whatever the weather. Preparing the class beforehand enables children to link what they find here with what they have already learned, and contribute their own ideas when encountering strange plants in an unfamiliar environment.

A few comments from children reveal why they find the Botanic Garden such an exciting place for learning:

"I am normerly [sic] not interested in Plants but now I really know the secrets of flowers now I really like them they seem really powerful and full of magicle [sic] spirits. I would love to come again." Luke, Cambridge.

"The plants looked amazing. My favourite part was the smell garden because you could rub the leaves and there was a smell". Lucy, Saffron Walden.

"It was probably the best school trip I have ever had. My favourite place in the gardens was the lake (water garden). Mind you I like the Glasshouses, especially the Tropical one. The Succulent House was cool even though I got pricked by a cactus."

Prof. John Parker (Director)
and Christine Preston (Education and Interpretation Officer)
Cambridge University Botanic Garden
email:cmp25@cam.ac.uk

Contact for BGEN: Tel 0131 248 2962

Stresses and strains in plants . . . botanical biomechanics

We readily recognise autumn as the season when leaves on deciduous trees and shrubs change colour and fall from the branches. But are any students curious enough to wonder about the *forces* involved in holding the leaves up, against gravity and the wind? What about the rest of the year? How do woody and herbaceous plants support their shoots and branches, their flowers and fruits and shed them (let them go) at the appropriate time?

You do not need sophisticated equipment to make some interesting biomechanical observations on plants. The collection of suggestions described here can be used to stimulate ideas for practical investigations, suitable for KS4 as well as for AS and A2 or other post-16 studies. They all allow the generation of raw data and can lead to a better understanding of plant biology, linked to more traditional studies of plant morphology and histology. As an example, biomechanical studies of storage tissues (such as potato) can be used to illustrate the importance of turgor in plant support.

Let's call it 'botanical biomechanics' and treat our plants as beams or junctions . . . or just objects to be pulled or compressed, bent, pierced or peeled. Take your pick, then follow through some of the ideas shown in the illustrations below. The 'comments' on each method may help you see how to tackle it or give you other ideas to investigate.

Beams - testing for stiffness and strength

Take a whole part of a plant, such as a green shoot, twig or small branch and regard this as a 'beam'. When *stressed* by an applied force, it becomes distorted or *strained*. Up to a certain strain, known as the 'elastic limit', the beam recovers its shape when the stress is removed (because it behaves elastically). Beyond this elastic limit, the beam may become deformed ('plastic changes') or it may break ('failure') [*see Fig 1*]. Within its elastic limits, you can investigate the behaviour of the beam. You can determine its stiffness (Young's Elastic Modulus) from the gradient of the stress / strain line or you can use the stress at which failure occurs to provide a measure of the strength of the beam. Two different methods are shown in Figs 2 and 3.

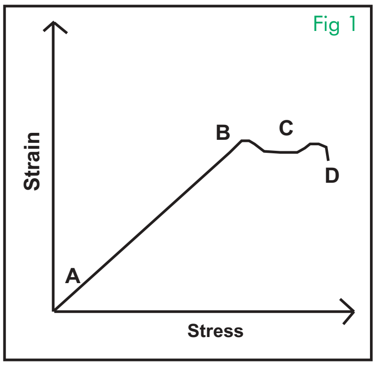


Fig 1
This graph shows the theoretical behaviour of an elastic material, up to and including failure. Between A and B, the strain of the material is elastic (and so it recovers), but between B and C, irreversible distortion (plastic deformation) is occurring. Between C and D, the material has failed, and has broken. The slope of the graph between A and B gives a measure of stiffness.

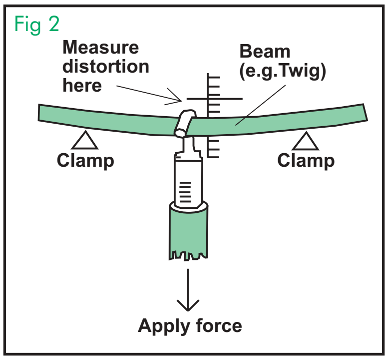


Fig 2
Hold a twig firmly between the clamps of two retort stands with a ruler (marked in mm) alongside it. Suspend a mass (the stress) from the centre of the beam and note its distortion (strain). Add further masses and note the strain in each case. A force meter can be used instead of the masses.

Comments *(Fig 2)*: You may need to do some preliminary work to find out what range of stress (masses), and length of beam, is appropriate for a particular plant tissue. Let's look also at the physics of what is happening. For a cylindrical horizontal beam, the deflection δ (measured in meters) is related to the applied load W (measured in Newtons), the length of the beam L (measured in meters and the Elastic modulus E (measured in MPa). The moment of inertia I (measured in m^4) is calculated from $I = r^4/4$, where r is the radius of the beam in meters). $\delta = 48WL^3/EI$, therefore $E = \delta I/48WL^3$. If you plot a graph of a series of values for I against WL^3, the slope of the line of best fit gives E.

If cut samples of tissues of the same dimension are used, then direct comparisons in stiffness can be made without the need for much mathematics. If the samples are cut in different orientations, the strength and stiffness of the tissue samples may be very different. The skin of a tissue often provides a major contribution to the stiffness (by being 'pre-stressed' during development), so you could test the stiffness of peeled and unpeeled beam samples.

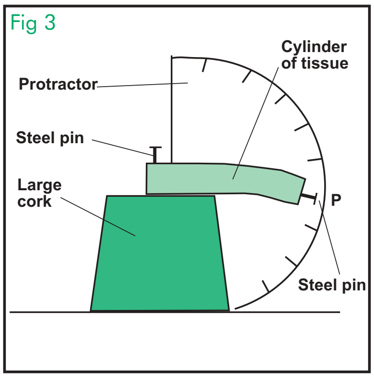


Fig 3
Take a cylinder or block of tissue and pin it to the top of a cork. Insert another small pin (P) into its tip. Place a protractor behind it so that the pin (P) passes over the scale on the protractor. You can then read off the degrees of curvature from the self-loading of the beam. The stiffer the material, the less the bending that occurs.

Comments *(Fig 3)* **:** Take a 'beam' of tissue that depends on turgidity for its stiffness (e.g. cylinders of potato tuber) and attach it to this apparatus. As the beam loses water by evaporation, it bends more. You can weigh the beam beforehand and follow the changes in mass of the whole assembled apparatus (including beam) over a period of time. Changes in stiffness (measured as degrees of bending) can be related to the water loss of the tissue (as a percentage of the fresh mass). You need to do preliminary experiments to establish the optimum diameter and length of beam. You can, for example, compare tissues with and without skin. If comparing tissues from different plants, you could calculate the density of the tissues. For comparing stiffer materials, such as twigs, increasing loads might be applied to the ends of the beam, and the strain measured as degrees of bending. If the twigs differ in their cross-sectional area, this must be taken into account.

Junctions - pulling things apart

Leaf petioles and fruit stalks are two examples of specialised 'junctions' that form abscission layers. When a fracture line develops in this abscission layer, the organ (leaf or fruit) may become detached (fall off!). The force required to cause 'failure', hence detachment of the organ, gives a measure of the strength of the junction. You can measure this quite quickly using a force meter [*see Fig 4a*]. For deciduous trees, you may require three force meters - 0 to 1.0 Newtons, 1 to 10 N and 10 to 100 N. (Class sets can usually be borrowed from the Physics store!) Another simple technique is shown in *Fig 4b.* Using these methods, a lot of interesting data can be collected in a short time. Look at *Table 1* and see if this can give you some ideas for investigations to do.

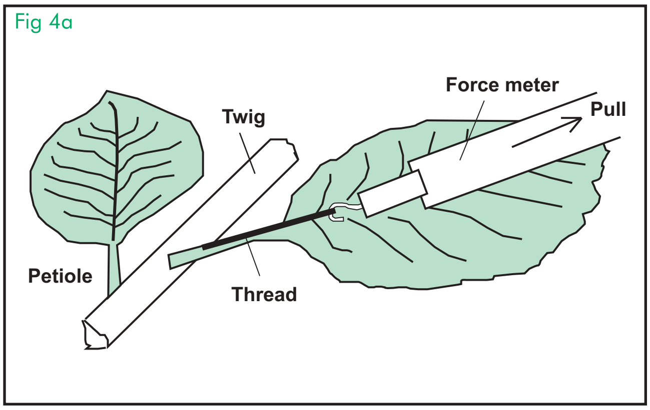


Fig 4a
Tie a strong thread to the base of the petiole, being careful that you do not actually cut into the epidermis. Attach the hook of the force meter to the other end of the thread. Gradually pull the force meter away from the branch, keeping the pull at 90° to the axis of the branch (and in the direction of the natural position of the leaf). Watch the scale of the meter carefully, so that you know what the force was just before the leaf pulls off.

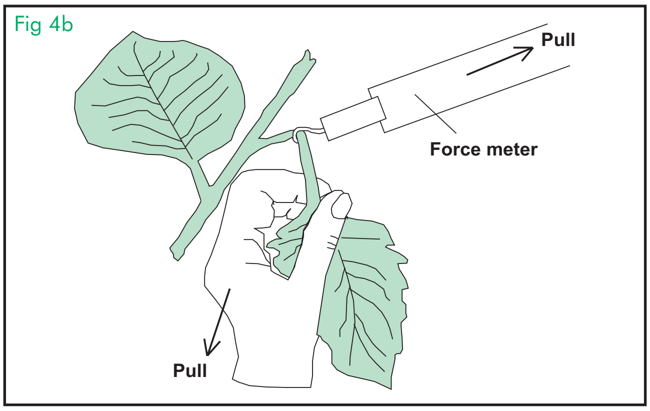


Fig 4b
Hold the petiole so that you can pull it with one hand, *against* the force of the meter. If this technique is used, the total force measured must be divided in half. The tensile strength of the petiole is usually greater than that of the attachment of the leaf to the twig! In both 4a and 4b, keep the leaf - you may wish to make measurements of the surface area of the petiole or the leaf, or to measure the shape or mass of the leaf.

Table 1 - **A survey of the strength of attachment of some tree leaves- data collected in autumn 2001**

Tree	State of leaf	Maximum force / N	Minimum force / N
Cherry	Healthy green leaves	7.0	6.5
	Yellow at edges only	6.0	5.0
	Yellow along veins	4.0	3.5
	All yellow	1.0	0.3
Horse chestnut	Healthy green	50	25
	Yellowing at tips	35	20
	No green (all yellow)	20	10
Holly	Healthy green leaves	20	15

SAPS Workshop Calendar

The names given are those of the person you should contact if you wish to go to the workshop

9th February 2002
IoB Day - DNA electrophoresis, Transformation and Ethics
Robert Gordon University, Aberdeen
Peter Anderson 01592 414676

19th February 2002
5-14 Cells and Biotechnology, Ayrshire
SAPS 0131 650 7124

19th February 2002
Advanced Higher Practicals, Ayrshire
SAPS 0131 650 7124

28th February 2002
Higher Biology Practicals, Glasgow
David Lawson 0141 287 8177

13th March 2002
Primary Supermarket Science, Middlesbrough
Lesley Charlton 01642 802322

21st March 2002
Plant Science Workshop for Secondary Teachers
Wrexham
Chris Millican 01558 668768

22nd March 2002
Plants for Primary Schools
Wrexham
Chris Millican 01558 668768

10th July 2002
Phosphatase Enzyme (post-16), Middlesbrough
Lesley Charlton 01642 802322

Compression tests - testing for softness or squashiness

Whole fruits, such as tomatoes or grapes, undergo significant softening as part of the ripening process. You can obtain a measure of these changes by using some sort of compression test. Apply a force to the organ and measure its consequent distortion [*see Fig 5a*]. Alternatively, apply a sudden traumatic force and measure the resulting spread of injury to the tissues (bruising) [*see Fig 5b*].

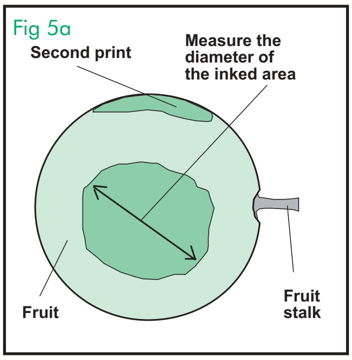


Fig 5a

Spread some ink on a flat metal surface. Put the fruit on this surface and place a flat metal plate on top. (No lateral movement allowed.) Place masses on the top plate, sufficient to distort the fruit (but not burst it!). Carefully remove the fruit and use a flexible tape to measure the diameter of the inked area of the fruit. Use this figure to calculate the total area covered.

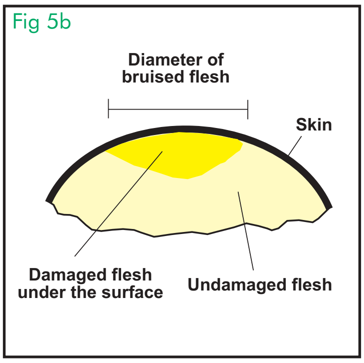


Fig 5b

This vertical section through the skin and flesh of a bruised fruit shows the extent of the damaged area hidden beneath the surface. Ions have leaked from the damaged cells, encouraging the reactions involving phenolic compounds that result in browning of the tissues.

Comments: You can make fair comparisons only by comparing fruits of equal dimensions, so that their areas are compatible. The orientation of the fruits should also be the same when measurements are made. For larger fruits, you can repeat the readings by rotating the fruit on its axis and making further 'prints'. You could repeat your measurements in Fig 5 several times around the equator of a single fruit.

Some fruits and vegetables bruise more easily as they become softer. This is as a result of the enzyme catalysed oxidation of polyphenols, which leak from damaged cells. For tissues that brown in this way (including the flesh of certain vegetables such as potato), you could devise a systematic way of providing a sudden blow of known force from a blunt object. This would allow you to measure the extent (area and depth, and hence volume) of the resulting bruising. You could provide the blow with a metal ball on a pendulum. You could then alter the starting positions as a way of allowing the force to be systematically varied.

Stripping or peeling - how easily can you peel your plant material?

The bark of a twig or the skin of a banana may be removed by animals. You can use a force meter to assess the force required to fracture the attachment of these 'surfaces' from the underlying tissues. For a ripening banana, the 'skin' becomes more easily detached as the process continues [*see Fig 6a and Fig 6b*].

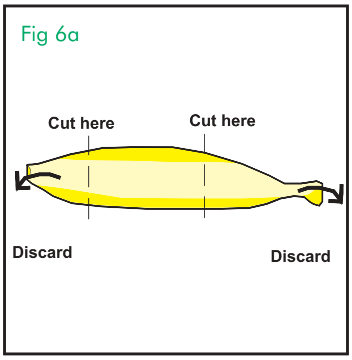


Fig 6a

To simplify the process of peeling, cut away the tapering ends of a banana to give a section of relatively similar dimensions.

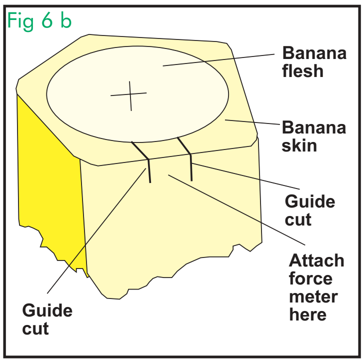


Fig 6b

Then, starting at the edge of one cut face, make parallel guide cuts, approximately 1 cm apart. This means you remove a regularly shaped area of skin. Lever up a small portion of the skin and hook the force meter into it. Pull on the meter, at 90° to the axis of the fruit surface. Note the maximum force required to detach the skin.

Comments: You can investigate the relationship between the force required to peel and the surface area being removed, by varying the distance between the guide cuts. Study the changes that occur during ripening and relate these to changes in the thickness of the skin. Another interesting investigation is to determine how, in a banana, the total fresh mass of the skin relates to the fresh mass of the flesh. You will see that this ratio changes during the ripening process. It might be interesting to compare the ease of peeling of 'easy-peel' fruits and their ordinary counterparts, or the effects of treating the pricked skin of oranges with a pectinase enzyme solution. See if there are right and wrong directions of force application when peeling fruits!

Roger Delpech, Haberdasher's Askes' School

References

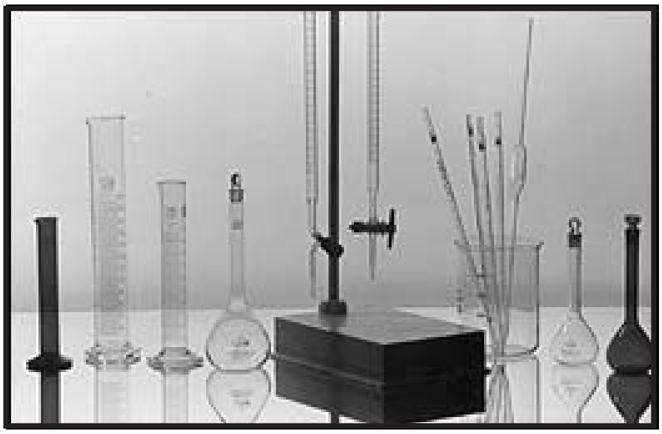
Ackerman J. D. & Nishizaki T. (1999), How stiff is a French fry? - Teaching Biomechanics to Biology Student, *J. Biol. Ed.* 34(1) 36-40
Nicklas K. J. (1999), *The Evolutionary Biology of Plants* The University of Chicago Press Ltd, London
Nicklas K. J. (1992) *Plant Biomechanics* University of Chicago Press, Chicago
Vincent J. F. V. (1990), *Structural Biomaterials* (*Revised Edition*) Princeton University Press, New Jersey
Vincent J. F. V. (1992) *Biomechanics materials - A practical approach* IRL at Oxford University Press, Oxford

How accurate is that piece of apparatus?

Most experimental situations require us to make measurements using standard laboratory apparatus. Our students place great faith in the ability of a given device to measure with both accuracy and precision. Persuading students that there are intrinsic (i.e. not of their own making!) errors in the measurements that they make can be a difficult process. The following exercise can be used with various student groups to explore the concepts of accuracy, precision, errors, and (possibly) statistical significance of data.

A major outcome of this practical is for your students to assess how accurate various devices are at dispensing given volumes of water. Here we suggest you use a 100 cm^3 measuring cylinder, a 10 cm^3 graduated pipette and an automatic (micro)pipette, but the experiment could be easily adapted to investigate other items of apparatus. In order to achieve this, the mass of water that is dispensed by a given device is measured and compared with the predicted value.

The same principle is used in each case – measure the mass of the empty vessel and subtract this from the mass of the vessel + water. Assume that the mass of 1.0 cm^3 of water is 1.00 g. It is desirable to have access to a balance (recently calibrated!) that can measure to 2 decimal places although for work with micropipettes accuracy to 3 decimal places is preferred.



1. 100 cm^3 measuring cylinder

a) Take a measuring cylinder (100 cm^3) and fill with water until the meniscus indicates that 100 cm^3 has been taken. Pour the contents into a beaker (minimum size 150 cm^3) of known mass and measure the new mass. It is important to recognise that you are seeking to determine the accuracy of the measuring cylinder rather than one's ability to dispense exactly 100 cm^3 of water into the beaker.

b) Take the same measuring cylinder (100 cm^3) and fill with water until the meniscus indicates that 10 cm^3 has been taken. Pour the contents into a beaker (recommended size 50 cm^3) of known mass and measure the new mass. Empty the contents of the beaker and repeat the experiment until 10 readings have been made under these conditions.

2. 10 cm^3 pipette (graduated)

Take a pipette and discharge 10 cm^3 of water into a beaker (recommended size 50 cm^3) of known mass and measure the new mass. Empty the contents of the beaker and repeat the experiment until 10 readings have been made under these conditions.

3. Automatic pipette

Using an automatic pipette draw up 1000 µl of water and discharge this into a beaker (or similar vessel, recommended size no larger than 5 cm^3) of known mass and measure the new mass. Empty the contents of the vessel and repeat the experiment until 10 readings have been made under these conditions.

Interpretation When considering the results of the practical, students should be encouraged to reflect on, amongst other things, the following:

Which was the most accurate device?
Which was the most precise device?

continued on page 7...

Biotechnology Summer School at Edinburgh University . . .

Follow up symposia

For the last four years around 200 Biology teachers and FE lecturers in Scotland have had the opportunity to attend a Biotechnology Summer School hosted by the University of Edinburgh. The participants experience a week of labs, lectures, discussions and visits to update them in this fast growing field and to enable them to introduce some of the new biology and biotechnology courses into their schools and colleges. These Summer Schools are sponsored by Unilever and The Wellcome Trust.

On 4 December 2001 an extension to this programme of continuing professional development began. Teachers and lecturers who had attended a previous Summer School were invited along with some of their 6th Year students to attend a follow up symposium. The event, sponsored again by the Wellcome Trust, took place in Dollar Academy (near Edinburgh) and the theme for the day was *Issues in Human Genetics.*

In the morning, speakers from The Beatson Institute and AstraZeneca described the impact that the Human Genome Project would have on cancer treatment and on future therapeutics. Then in the afternoon, participants carried out a practical activity 'finding the genes' followed by discussions on an issues website and on the use of animals in genetic research.

There certainly seemed to be complete agreement from the participants that this event was extremely worthwhile and was providing them with the type of support that they require. Their message to the organisers was a very emphatic 'more please'! Funding is in place to continue this update programme in other areas of Scotland.

Marjorie Smith (Dollar Academy)
SAPS Biotechnology Scotland Project

Typical data

The following tables represent data sets generated by groups of students using various items of apparatus. Each student group had their own set of devices and balance and so direct comparisons may not be valid. However clear trends emerge!

Student group	Item of apparatus					
	Measuring cylinder (100 cm³) to dispense 100 cm³ of water			Measuring cylinder (100 cm³) todispense 10 cm³ of water		
1	98.38 98.93 97.41	98.80 98.51 97.93	98.46 98.23 97.48	09.53 09.85 11.40	09.18 11.17 08.80	08.95 09.41 09.81
2	98.07 97.67 98.80	98.94 98.16 98.11	98.98 98.76 98.16	08.90 08.68 08.88	08.80 08.90 08.88	08.88 08.84 08.83
3	97.82 97.42 97.60	97.66 97.53 97.64	98.01 98.27 97.77	08.22 08.29 08.74	08.94 09.15 09.11	09.56 09.43 09.16

Student group	Item of apparatus					
	Graduated pipette (10 cm³) to dispense 10 cm³ of water			Automatic pipette (1 cm³) set to dispense 1 cm³ of water		
1	09.80 09.83 09.90	09.80 09.77 09.73	09.78 09.97 09.74	00.97 00.97 00.96	00.98 00.99 00.99	00.99 00.98 01.00
2	09.77 09.75 09.77	09.84 09.82 09.96	09.87 09.73 09.85	01.00 01.01 00.99	01.01 01.00 01.01	00.99 01.00 01.00
3	09.73 09.78 09.80	09.84 09.80 09.77	09.86 09.83 09.77	01.01 00.97 01.01	00.99 01.00 01.01	00.99 01.01 00.97

This simple experiment can give rise to some interesting discussion about which device should be selected for a given purpose. A number of different experiments can be performed. For example:

Compare the accuracy and precision of measuring cylinders of different sizes (100 cm^3, 50 cm^3 and 10 cm^3) when dispensing a given volume (10 cm^3) of water. Is a 10 cm^3 measuring cylinder more accurate than a graduated pipette?

Compare 10 cm^3 and 1 cm^3 graduated pipettes when dispensing a given volume (1 cm^3) of water.

Paul Beaumont, Director, SAPS

SAPS website update

Our new website address is www.saps.org.uk. You can still get into the website through the old address, but we hope our new address will be easier for people to use. We are in the process of looking at ways by which the SAPS website might be reviewed and updated. Over the past 12 months there have been nearly 1million hits on the site and we hope that the level of usage will continue to grow. During the coming months we plan to update and expand the range of resources available. Your suggestions for improvement are always welcome and so please pass these on to us either electronically (saps@homerton.cam.ac.uk) , or in writing (SAPS, Homerton College, Cambridge CB2 2PH).

One suggestion that we are investigating is the establishment of an email database so that we can alert readers of *OSMOSIS* and visitors to the website when significant changes have been made to the content. The email database will be used only to circulate material that is related to the work of SAPS. Personal information will not be divulged to other organisations. If you would like your name to be added to our email database please send an email to saps@homerton.cam.ac.uk with the word 'database' as the subject of your message. If any of your colleagues would like to be on the list, tell them about this and they can email us direct.

A new feature on our website is that we will be including some articles, previously published in *School Science Review* (SSR) and *Journal of Biological Education* (JBE). These include recent articles, and the full article will be available so that you can access them directly on the SAPS website. The articles selected will be key articles related to other items on the SAPS website, or that are particularly useful for support in your teaching of plant science.

Osmoweb at a glance . . .

This chart introduces you to a cluster of practical activities you can find on the SAPS website. They are all within the OSMOWEB section.

Here are plenty of ideas for investigations . . . they can all be done with readily available fruits and vegetables . . . and they link into important areas of biology that you will study in your specifications. This chart just gives an outline and lets you see where you can go . . . protocols, slide shows, background information, links to other websites. Try it and see.

Go direct to: www-saps.plantsci.cam.ac.uk/osmoweb/index.htm (or through the SAPS home page: www.saps.org.uk)