Providing support and promoting excellence in science education

SciTalk

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Number 3 – August 2005

This *SciTalk* & past issues are available at http://homepage.mac.com/robertgarner

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See pages 1, 3 & 12

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TO WIN: Send in your name, address, ph. no. & school on the back of an envelope

by 26 September 2005 to

Book Giveaway, PO Box 442, Harbord 2096

★ ★ ★

Winner for *SciTalk 2/05*

Congratulations to Michael Robson, Keira HS, who won the 8 books in the *Spotlight Surfing series for Preliminary & HSC Physics* ($16.95 ea) by B Shadwick, donated by Science Press.

New evidence is causing scientists to evaluate current ideas

Some astronomers believe that a tenth planet may have been discovered. Other astronomers are disputing that the object is even a planet, while others claim that Pluto should not be considered a planet either.

Are your students up-to-date with this new evidence about our solar system? The article on page 10 in this issue of *SciTalk* reveals how astronomers are being forced to re-examine their definition of a planet, given recent discoveries. This dilemma demonstrates how our past knowledge of the universe has to change as new evidence becomes available. It shows how some ideas may have to be modified while others may have to be rejected, and will therefore help you to teach 4/5.1 (c) and (f), and 4/5.3 (c) in the Science 7–10 Syllabus. This dilemma is a good example to discuss how scientists today are influenced by their past thinking and illustrates how 'the nature of observations made depends upon the understanding that the observer brings to the situation'… 4/5.2 (g).

Astronomy is an area of past and current scientific research. This area of astronomy will allow you to 'describe areas of current scientific research' and to 'discuss evidence supporting different viewpoints' (Focus Areas 4.5 & 5.4). It demonstrates how, as technology improves, it impacts directly on our knowledge of the universe, as these new discoveries are being made by spacecraft, space telescopes such as Hubble, and new improved, ground-based telescopes on Earth … 4/5.3 (c).

It will help you to show your students 'the role of science in providing information about issues being considered and in increasing understanding of the world around them' … 4/5.26.

Some highlights of the night sky that your students can observe over the months from August and into early November are provided on page 11 of this *SciTalk*. This will give your students some great hands-on learning as they make both naked eye and/or binocular observations of the night sky. ☐

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Join us during National Science Week for Physics is Fun at Luna Park Sydney

Enquiries/bookings: (02) 9939 6107. See p7.

You can celebrate the 2005 International Year of Physics on any school day with a Physics is Fun excursion to Luna Park Sydney

Sydney's LUNA PARK *just for fun*

INSIDE SCITALK ▶▶▶▶

Diary Dates

Einstein International Year of Physics

AUGUST 2005

19, 22 National Science Week: Physics is Fun at Luna Park. http://homepage.mac.com/robertgarner
24 Physics Olympiad National Qualifying Exam. Closing date: 29 July. (02) 6125 9645
31 Biology Olympiad National Qualifying Exam. Closing date: 29 July. (02) 6125 9645

SEPTEMBER 2005

1 (–16 Oct) Great Australian Marsupial Night-stalk http://www.perthzoo.wa.gov.au/nightstalk/
7 National Threatened Species Day. www.deh.gov.au/biodiversity/threatened/information/
7 Chemistry Olympiad National Qualifying Exam. Closing date: 29 July. (02) 6125 9645
13, 19 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
23 Spring equinox

OCTOBER 2005

8 Astronomy Open Night & Lecture. Macquarie University E7B. 6–10 pm. (02) 9850 7111. http://www.physics.mq.edu.au/astronomy/cal.html
9–15 Earth Science Week 2005. http://www.earthsciweek.org/
17 HSC exams commence … see box on this page for science exams timetable
21, 24, 25 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
26, 31 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105

NOVEMBER 2005

1, 4, 14, 15, 18 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
7, 8 School Certificate Tests – 7/11: English / Science. 8/11: Maths / AH,G,C&C
22, 23, 25, 28, 30 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105

DECEMBER 2005

1, 2, 6, 7 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
16 HSC results released

JANUARY 2006 National Youth Science Forum. Forms to local Rotary club by 15/5/05, interviews in July. Only for Yr 11 in 2005. Enquiries: 6125 2777, fax 6125 8015, email: nsss@anu.au, www.nysf.edu.au/

While all dates have been checked to ensure that information in DIARY DATES is correct, no responsibility will be accepted by the publisher or Editor for any omissions or inaccuracies in it.

2005 HSC Science Examination Dates

25 Oct	Earth & Environmental Science: 9.25 am–12.30 pm
28 Oct	Biology: 9.25 am–12.30 pm
31 Oct	Senior Science: 1.55 pm–5 pm
2 Nov	Chemistry: 9.25 am–12.30 pm
4 Nov	Physics: 9.25 am–12.30 pm

2005 School Certificate Tests

7 November

- English: 9.20–11.30 am (includes 10 mins reading time)
- Science: 12.50–2.30 pm (includes 10 mins reading time)

8 November

- Maths: 9.25–11.30 am (includes 5 mins preparation time)
- Australian History, Geography, Civics & Citizenship: 12.50–3 pm (includes 10 mins reading time)

To be a great champion you must believe you are the best. If you're not, pretend you are.

… Muhammad Ali

Attention: Year Advisers

End-of-year Fun days / Reward days at Luna Park Sydney are cheaper if they are a Peer Support excursion.

(as only curriculum-based excursions to a fun park can claim back the GST component)

The Great Australian Marsupial Night Stalk

1 September–16 October 2005

Many Australian marsupials are on the brink of extinction and need your help. If you would like to help Australian scientists and conservationists, you can take part in this year's Night Stalk.

Anyone can do a Night Stalk survey – all you need is a torch. It's fun! It's free, and easy to do! Get a group together, count the number of marsupials you see in your local bush, record your findings on a spotter's log and send to Perth Zoo.

This annual survey, now in its 7th year, can be done any night from 1 September–16 October, and is designed to collect information about marsupial and feral animal numbers and their distribution.

For more information, please contact:
The Great Australian Marsupial Night Stalk in partnership with Tiwest
Ph: (08) 9474 0497 Fax: (08) 9474 4113
Email: nightstalk@perthzoo.wa.gov.au
Visit: www.perthzoo.wa.gov.au/nightstalk/

BOARD OF STUDIES

Update on BOS matters

Mapping of Information and Communications Technologies (ICT) in Revised syllabuses on BOS website

The ICT statements from each syllabus are collated into a separate document for each subject. Simply click on ICT Skills, then Science, and you can download the *ICT Skills List* for Science. These relate to the Science 7–10 Syllabus 'dot points' 4.15–18 and 5.15–18.

Make sure that you have checked these items of interest for science teachers:

- **HSC Notes from HSC Marking Centre** (including **Marking Guidelines**)
- **Past HSC exams** and **SC Science Tests**
- **Approved scientific calculators for 2005 HSC** (*BOS 15/05*): *www.boardofstudies.nsw.edu.au/manuals/calculators_hsc05.html*
- **Criteria for calculator use in SC tests**: *www.boardofstudies.nsw.edu.au/manuals/calculators_hsc_gen_maths.html*
- Exams in which scientific calculators are allowed: *www.boardofstudies.nsw.edu.au/manuals/equipment_list.htm*
- **HSC Chemistry & HSC Physics: periodic table for 2005 amended** *(BOS 22/05)*
- **Stage 6 Science Syllabuses amendments are for 2005 HSC**
- **New SC Science Syllabus implementation:** Yrs 7 & 9: 2005, and Yrs 8 & 10: 2006

BOS enquiries
Ph (02) 9367 8111, fax (02) 9367 8484
Website *www.boardofstudies.nsw.edu.au*

OUT AND ABOUT

UNSW Medical Sciences Schools Programs

UNSW Medical Sciences – Schools Programs 2005

The Museum of Human Disease is a pathology museum offering amazing insights into the nature and progression of disease in its many forms. Opportunities for curriculum-linked Biology/ Senior Science programs are available again after a recent relocation of the Museum. These include:

- 2 hr workshops for Biology students doing 'The Search for Better Health'
- 2 hr workshops for Senior Science students learning about 'Bionics'
- 2 hour workshops covering micro-organisms, infectious and non-infectious diseases included in the Science 7–10 Syllabus
- latest Hall of Health Exhibition on neurological disorders: *Getting on My Nerves*

★ **NEW LOCATION:** Gr'd floor, Samuels B'lding, UNSW (see website map)

Cost: Student workshops $7 (GST exempt) per student. Bookings essential.

Enquiries: Phone: (02) 9385 1522. Fax/ph: (02) 9385 1747
Email: j.horder@unsw.edu.au http://hallofhealth.med.unsw.edu.au

SCIENCE CENTRE & PLANETARIUM

University of Wollongong
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★ ***NEW for 2005***: Star Trails Outreach Program – we visit schools with a portable planetarium and interactive Science Shows.

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- **Stellar Evolution** – planetarium program for HSC Physics
- **Superconductors & Liquid Nitrogen** – live science show
- **Zap! Understanding Electricity**
- **Energy and Motion**
- **The Changing Earth**

★ School entry includes two floors of hands-on exhibits, a science show, plus a ***planetarium / laser show***.

★ ***Also available***: environmental field trips, science shop, kiosk, science fun bags, membership programs.

★ ***Book now*** for your school excursion.
For information and bookings, phone (02) 4286 5000.
www.uow.edu.au/science_centre

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Terms I and II were almost completely booked out this year. Why has Nerringillah become possibly the most sought after overnight venue for fieldwork in NSW?

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New bookings for 2006 will be taken Term IV this year. Remember in Terms I and II 2006 there is only very limited space available.

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Note: This business is for sale, at a newly reduced price.

Are you looking for field study options for the NEW Stage 4 and 5 Science Syllabus?

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SCIENCE IN FOCUS AT IMAX

31 Wheat Rd, Darling Harbour, Sydney 2000

IMAX THEATRE SYDNEY

★ **NEW FILM: Wild Safari 3D** … starts 8 September 2005
Experience the thrill of the search and the wonder of discovery. This film showcases the most dangerous and spectacular animals on the continent. Students will experience incredible face-to-face encounters with charging elephants, hungry lions and cunning leopards. For more info, visit: *www.nwave.com/wildsafari/*

★ **FREE TEACHER PREVIEW SCREENINGS:**
- Tuesday 23 August, 6 pm–7.30 pm: This session includes a guest presentation by one of Taronga Zoo's senior African keepers.
- Sunday 28 August, 10 am–11 am: Family & friends of teachers receive a 20% discount at both sessions.

RSVP is essential. Call Penny Breen on (02) 9213 1600.

★ **SHARKS 3D**: A breathtaking underwater voyage with astonishing up-close 3D view of sharks, rays, sawfish, jellyfish and turtles. Free resource materials for this are at: *http://www.sharks3d.com*

★ **For IMAX Sydney School Bookings:** Ph (02) 9213 1600, fax: (02) 9281 3833, or email: sydgroups@imax.com.au

★ To check session times and all films available for schools, visit ***www.imax.com.au/schools***

WIN A FREE FAMILY PASS TO IMAX

Sydney's IMAX Theatre, at Darling Harbour, is open every day. More than 8 storeys high, IMAX has the world's biggest cinema screen designed to give audiences the ultimate film experience. IMAX films are both entertaining and educational. Films are constantly changing and cover a wide range of themes. High quality resource materials & teacher guides which link individual films directly to school programs are provided for school visits.

★ ✧ ★ ✧ ★ ✧ ★

TO WIN A FREE FAMILY PASS* TO IMAX: (for 2 adults and 2 children) worth $45 (for a 2D movie) or $49 (for a 3D movie) … send in your name, school, home address and home phone number on an envelope **by 26 September 2005** to:

IMAX Give Away, PO Box 442, Harbord NSW 2096

* This pass will be valid for any one film for 2 adults & 2 children, for any session, except public holidays and films advertised as 'no free list'.

WINNER: Sheila Peres Da Silva, Delaney College, won the IMAX Sydney family pass for *SciTalk No. 2–2005.*

IMAX THEATRE SYDNEY

OLYMPIC GLORY FOR AUSTRALIA'S SCIENCE OLYMPIANS

Australia's talented teams have returned victorious from the International Science Olympiads held during July in Spain (Physics), China (Biology) and Taiwan (Chemistry) with a swag of medals.

The 2005 medal tally for these 'Olympic Games of Science' included 4 Gold, 3 Silver and 5 Bronze. There was also one Honourable Mention.

Dr Colin Taylor, Executive Director Australian Science Innovations, this result showed that Australia was a world leader in brain-power as well as on the sporting field: "This is a great result for Australia. These students have completed the most challenging science education program in Australia, and have now proved themselves to be amongst the best in the world."

Selection for these teams began last year when around 3 500 Year 11 students across Australia were nominated by their teachers to sit the Australian Science Olympiads National Qualifying Examinations in Physics, Chemistry and Biology. 67 of these students went on to be ASO Scholars and attended a residential training school in Canberra. The teams were selected after completing a final exam in March.

Congratulations to the following students who gained an award – their results were:

- **Physics:** 16th/70 countries
36th International Physics Olympiad

1 Gold Medal – Casey Handmer (The Scots College, NSW); 1 Silver Medal – David Yang (James Ruse Ag HS, NSW); 2 Bronze Medals – Rachel Effeney (St Rita's College, QLD) & Alexander Zhang (James Ruse Ag HS, NSW): 1 Honourable Mention – Tom Molomby (The French School of Sydney, NSW).

- **Chemistry:** 7th/59 countries
37th International Chemistry Olympiad

2 Gold Medals – Harry Yan (James Ruse Ag HS, NSW) & Kim Zhou (Sydney Tech HS, NSW); 2 Bronze Medals – Andrew Lin (Anglican Church Grammar, QLD) & Dustin Stuart (Wesley College, WA).

- **Biology:** 8th/50 countries
16th International Biology Olympiad

1 Gold Medal – Emma Leitinger (University High School, VIC); 2 Silver Medals – Joy Thompson (James Ruse Ag High, NSW) & Anna Wang (Sydney GHS NSW); 1 Bronze Medal – Heli Simpson (Lauriston Girls School, VIC).

* * * * *

Enquiries: ph 6125 9780, www.aso.edu.au □

Individuals can make all the difference with environmental issues

The last 50 years has seen humans change ecosystems more rapidly and extensively than any other time. The demand on the environment has dramatically increased with increasing population numbers and many human activities have not been environmentally sustainable.

Whilst governments need to have improved policies, planning and management of our resources, all too often we hear people saying that 'the government' needs to get something done about various environmental issues. Yet what they forget is that action can actually start with what they as individuals do, no matter how insignificant it seems.

Governments can introduce anti-litter laws for instance, but there is no easy way to stop people from littering. As with any environmental issue, it is the individuals that have to agree with such ideas and comply. For example, many years ago it was common to find stubbed out cigarette butts everywhere that had been flicked out of cars or dropped into waterways, on streets, in gutters and on beaches. Through community education and awareness, and the introduction anti-litter regulations and fines, this gross habit has diminished greatly. Now, only a few selfish people still do this unfortunately, e.g. outside office blocks and shops, and at bus stops. In time, if each person does their bit, we should begin to find less cigarette butts and other forms of litter such as bottle tops, and food and drink containers littering our environment.

We must keep making sure that our science programs in schools develop environmentally correct values and attitudes in our students so that they will be more aware of environmental issues than past generations, so that more effort will be taken to ensure the conservation, protection and maintenance of the Earth's resources. Each individual in society must do what they can to reduce pollution, land degradation, salinity problems, and the proliferation of weeds and pests. We must work together to keep the enhanced greenhouse effect to a minimum. Everyone must learn not to waste water or the resources we need for energy, and to reduce the impacts on the biosphere of wastes from the use of these resources. The popular environmental slogan, 'take nothing but photos, leave nothing but footprints', is a good one to impress on your students when teaching them about the ecological damage of humans on this planet.

The item 'Making a Difference' that appears below highlights the concept that each individual person can make a contribution, and can be used when teaching Outcomes 5.3, 5.10 and 4/5.27 in the Science 7–10 Syllabus. It will help you to reinforce the idea that it is the shared responsibility of each individual to conserve, protect and maintain the quality and sustainability of the environment for future generations.

* * * * *

Making a Difference

While walking along a beach
a man saw someone in the distance leaning down
picking up something and throwing it into the ocean.
As he came closer, he saw thousands of starfish
the tide had thrown onto the beach.
Unable to return to the ocean during low tide,
the starfish were dying.
He observed a young man picking up the starfish
one by one and throwing them back into the water.
After watching the seemingly futile effort,
the observer said, "There must be thousands
of starfish on this beach.
It would be impossible for you to get to all of them.
There are simply too many.
You can't possibly save enough to make a difference."
The young man smiled as he continued
to pick up another starfish and toss it back into the ocean.
"It made a difference to that one," he replied.

(Source unknown)

Australia gets a synchrotron

Synchrotrons were first proposed back in 1945 as the latest accelerator for high energy physics, designed to push particles, such as electrons, to higher energies than could a cyclotron, the particle accelerator of the day. There are now about 50 synchrotrons in the world being used by an ever growing number of scientists, and Australia will have its first synchrotron by 2007.

This synchrotron will be located next to Monash University in Melbourne. A two-storey circular building, that takes up the space of a football field, was completed in March 2005 ready for the installation of the synchrotron. An electricity substation, large enough to power a small suburb, has also been built within the facility to supply the enormous amounts of power required to run a synchrotron.

A synchrotron is a large machine that accelerates stationary charged particles, such as electrons to almost the speed of light. Large magnets are used to make these moving electrons travel around a circular storage ring, thus making them change direction continually. Every time the electrons are forced to turn a corner, energy is released in the form of extremely bright 'synchrotron light', a million times more intense than sunlight. 'Synchrotron light' is electromagnetic radiation ranging from infrared through to visible light to x-rays. This 'light' is channelled off into tubes called 'beamlines' which lead out from the main machine to experimental workstations. Special instruments are then used to focus it, spread it out, or to select the part of the spectrum that is needed.

'Synchrotron light' enables scientists to see and analyse the structure of matter down to the level of atoms and molecules in great detail.

To 'see' atoms, which have dimensions of the order of a tenth of a nanometre , you need to use a different form of 'light', one that has a much shorter wavelength than visible light. This type of 'light' is known as X-rays. Discovered by Röntgen in 1895, X-rays have many well-known applications in medicine. But they can also be used to reveal important information about the organisation of the atoms that make up a material.

'Synchrotron light' consists largely of very 'bright' X-rays, in other words, the beam of X-rays is as thin as a hair and very intense. Just as laser light is much more intense and concentrated than the beam of light generated by a flashlight, so an X-ray beam produced by a synchrotron is a thousand billion times brighter than the beam produced by a hospital X-ray machine.

So far, synchrotron light has been used successfully to advance research and developments as diverse as:

- medicine (understanding how tumours migrate through the body, high resolution imaging, cancer radiation therapy, micro-biology, disease mechanisms)
- forensics (analysing extremely small and/or dilute samples to assist in crime detection)
- food technology (making smoother chocolate, lowering the fat in potato chips)
- biology (seeing how insects breathe, protein crystallography and cell biology)
- environmental sciences (toxicology, atmospheric research, clean combustion and cleaner industrial production technologies)
- creating new and better pharmaceuticals
- agriculture (improving productivity, animal and plant imaging, plant genomics, soil studies)
- minerals exploration (rapid analysis of drill core samples, comprehensive characterisation of ores for ease of mineral processing)
- advanced materials (nanostructured materials, intelligent polymers, ceramics that are more heat resistant for jet engines, light metals, alloys, electronic and magnetic materials)
- engineering (imaging of industrial processes in real time, high resolution imaging of cracks and defects in structures, the operation of catalysts in large chemical engineering processes). □

[REFERENCES: www.synchrotron.vic.gov.au; www.nsls.bnl.gov/about/history/; www.esrf.fr/; Velocity: Science in Motion, June 2005]

★ *A FREE e-magazine* ★

Velocity: Science in Motion is a free, quarterly e-magazine from ANSTO. It features stories on breakthrough Australian science and some of ANSTO's medical, environmental and industrial innovations in nuclear science which are enhancing the lives of millions throughout Australia. It can be subscribed to at: *www.ansto.gov.au/* by clicking on 'subscribe'.

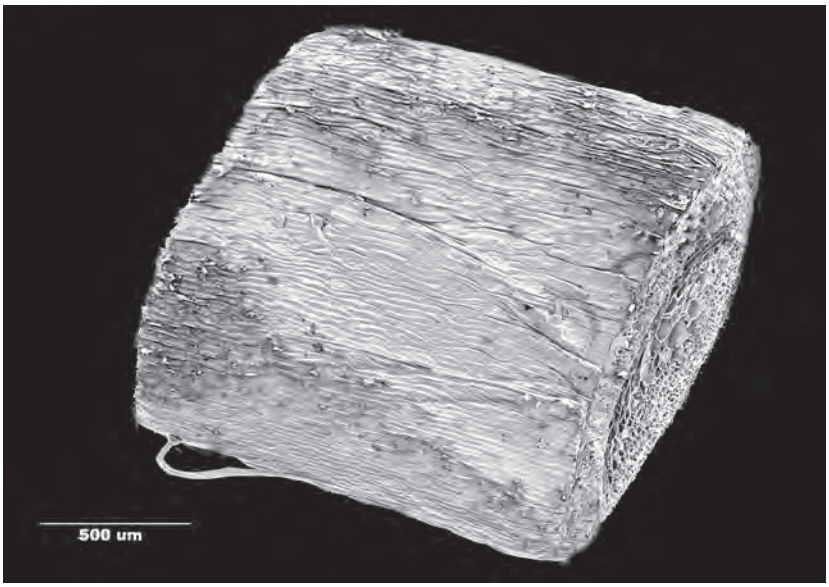
Photo Spot The art of electron microscopy

Scientists today can study biological specimens in great detail using a scanning electron microscope (SEM). SEMs have revealed the great beauty that can be found in nature.

The first SEM was developed in 1942 with the first commercial instruments around 1965. SEMs today have magnifications ranging from 10x up to 950 000x (depending on the model), and extremely high resolution.

The photomicrograph on the right was taken using an SEM and is magnified approximately 110x. It shows the stem of a Wandering Jew plant (*Tradescantia pendula*). This waxy succulent plant which has small white flowers, about 1 cm across, is a native of Central America, but in Australia it is often considered to be a weed, as it can take over and choke a whole garden due to the way it spreads over the ground forming extensive mats.

Details on the fibrous stem include stomata and small hair-like structures that aid in surface contact water gathering. The vascular bundles are seen at the right edge of the photomicrograph.



ABOVE: Small section of a Wandering Jew plant stem showing vascular bundles at the right edge.

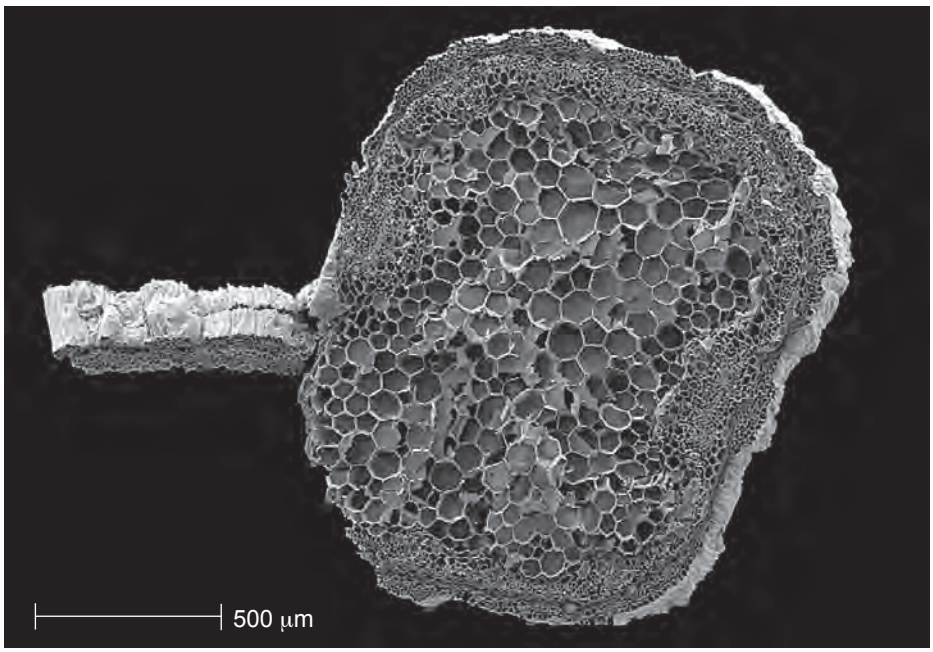
Photos are by Scott M Streiker, a student doing his Masters Applied Science at the Electron Microscope Unit, The University of Sydney.

How an SEM works

An SEM uses electrons rather than light to form an image. Whereas an optical microscope uses glass lenses to bend the light waves and the lenses are adjusted for focus, the SEM uses electromagnets to bend an electron beam that is used to produce the image on a screen. The beam of electrons is produced at the top of the microscope by the heating of a metallic filament. The electron beam follows a vertical path through the column of the microscope. It makes its way through electromagnetic lenses that focus and direct the beam down towards the sample. Once it hits the sample, other electrons (backscattered or secondary) are ejected from the sample. Detectors collect these electrons and convert them to a signal that is sent to a viewing screen similar to the one in an ordinary TV, producing an image that is rendered in black and white. By changing how the electrons are bent and how the beam of electrons strikes the sample, you can change the magnification and focus of the TV image.

Inside an SEM the column and sample must always be at vacuum. A vacuum is needed because: if the filament were surrounded by air, it would quickly burn out, like a light bulb; if the column were full of air, the electrons would collide with the gas molecules and never reach the sample; and if gas molecules react with the sample, different compounds could form and condense on the sample which would lower the quality of the image.

There are many advantages to using an SEM instead of a light microscope – the SEM has a much larger depth of field, which allows a large amount of the sample to be in focus at one time; and it produces images of very high resolution, which means that closely spaced features can be examined at a high magnification and preparation of the samples is relatively easy. For this reason the SEM can produce an image that is a good representation of a three-dimensional sample. Thus the SEM is now one of the most heavily used instruments in research.



LEFT: Cross section of Wandering Jew plant stem showing vascular tissue, with outer part of tissue breaking away on left edge.

Preparing a specimen for viewing

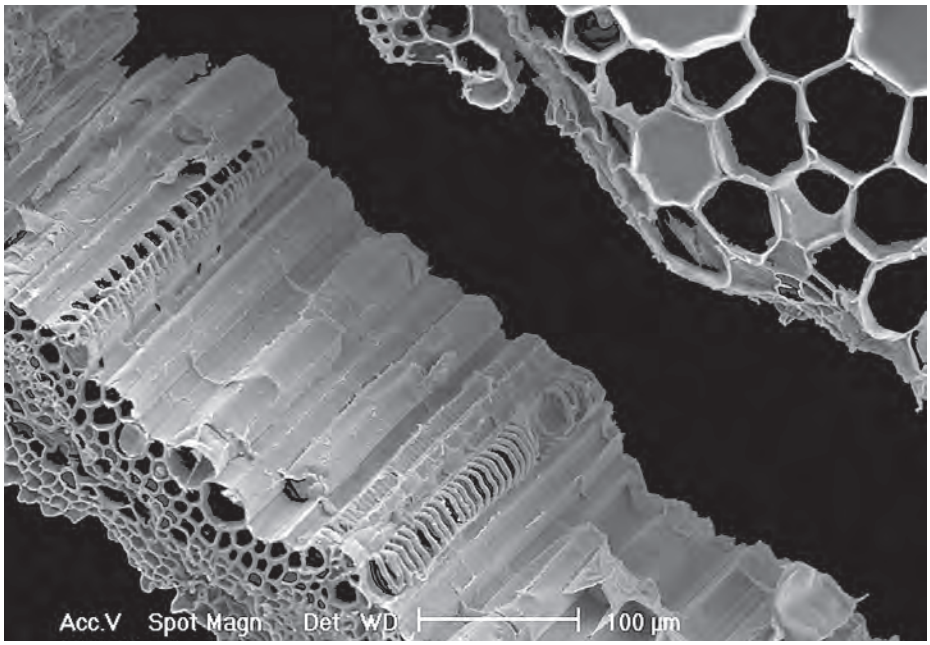
SEM requires careful handling of samples so that specimens can be evaluated without artefacts or distortions. Biological samples have to prepared so that they can withstand a vacuum. This firstly involves chemical fixation, e.g. using 2.5% glutaraldehyde in phosphate buffer, rinsing the sample in phosphate buffer, infusing it with a buffer and osmium tetroxide, then dehydrating it so that ethanol replaces all the water in it. The specimen then goes through a special drying procedure called critical point drying that prevents it from shrivelling. At a specific temperature and pressure, known as the critical point, there is zero surface tension so biological specimens can be dried without

introducing surface artefacts or distortions. The sample is put in a pressure chamber where the solvent is replaced with liquid carbon dioxide – the pressure is altered so that the sample passes through the critical point where the carbon dioxide changes from liquid to gas. Once the specimen has been critically dried it may be mounted onto an aluminium stub. The specimen can either be mounted to the stub by attachment with double-sided, non-conductive tape, or a coating of conductive carbon adhesive painted onto the stub. Because the SEM illuminates a specimen with electrons, the specimen also has to be made to conduct electricity, e.g. by coating it with a very thin layer of a conductive metal, such as gold or platinum, in a chamber designed for sputter coating.

The specimen can then be placed inside the SEM's vacuum column through an air-tight door. After the air is pumped out of the column, an electron gun (at the top) emits a beam of high-energy electrons. This beam travels downward through a series of magnetic lenses designed to focus the electrons to a very fine spot. Near the bottom, a set of scanning coils moves the focused beam back and forth across the specimen, row by row. As the electron beam hits each spot on the sample, secondary electrons are knocked loose from its surface. A detector counts these electrons and sends the signals to an amplifier. The final image is built up from the number of electrons emitted from each spot on the sample. □

– Catherine Odlum & Scott Streiker

BELOW: A closer view of the inner surface of the tissue that is broken away. This clearly shows how some tracheids in the xylem have spiral wall thickenings.



2005 NSW SCHOOLS TITRATION COMPETITION WINNERS

The 2005 NSW Schools Titration Competition was held in June. This event is organised by the Chemical Education Group of the Royal Australian Chemical Institute (RACI), NSW each year.

There were 299 teams of three entered from schools across NSW at 16 venues, whch spanned NSW from Lismore to Wollongong and from Broken Hill to Newcastle.

The results this year were again strong, with 33 teams achieving an Excellent award (i.e. scores of less than 100). In this competition, like golf, the lower the score the better the result. Congratulations to the following teams: • *1st place:* Shore (with a score less than 10); • *Eq 2nd place:* Mount St Benedict College and Merewether High; • *Eq 4th place:* Coffs Harbour Christian Community School and Penrith High.

27 teams have been selected to compete in the National Competition in September.

Alasdair Hey, the competition organiser, was pleased with the results across NSW, saying "The high quality of results is an important statement of student preparation and illustrates the excellent work of students and their teachers."

For information about this competition:
– ph/fax 9601 1021, POB 282 Georges Hall 2198
– internet: *www.nswtitration.com*
– email: *ajhey@ozonline.com.au* □

A problem is a chance for you to do your best.

... Duke Ellington

Astronomy

When is an astronomical object a planet, an asteroid, or a planetoid?

Astronomers have made new discoveries in the late 20th and 21st centuries which are threatening to change their definitions of planets, asteroids and planetoids. The universe is incredibly vast, and they are finding that there is still a great deal that is unknown.

Until recent years it has all been easy – planets, moons and asteroids were all distinct and defined. There were nine planets orbiting the Sun. Most of the planets had one or more moons orbiting them.

The smallest planet was Pluto with a diameter of 2 274 km, while the biggest asteroid was Ceres with a diameter of 940 km. This asteroid was the first to be discovered back in 1801 (by the Italian astronomer Giuseppe Piazzi) and, until recently, was the largest known object orbiting the Sun that was not a planet. Several thousand asteroids have now been discovered since Ceres, and had their orbits calculated.

Asteroids orbit the Sun and were probably formed in the same way as the planets. All asteroids also spin on their own axis, just like stars, planets and moons. Most asteroids are found in the Asteroid Belt between the orbits of the planet Mars and the planet Jupiter. Some asteroids have orbits that take them inside the orbit of Mercury or bring them close to Earth. Other asteroids, called Trojans, travel in Jupiter's orbit but 60° ahead or behind the giant planet. Mars also has some Trojan asteroids. Another band of asteroids also occurs in the Kuiper belt (pronounced 'KYE-per'), an area extending from within the orbit of Neptune (at 30 AU) to 50 AU from the Sun.

When Pluto was originally discovered in 1930 the uncertainty of referring to it as a planet was supposedly resolved by the discovery of Pluto's satellite Charon in 1978. Even though Pluto is considerably smaller than Earth's Moon (diameter 3 476 km) and six of the solar system's satellites of the various planets (Io, Europa, Ganymede, Callisto, Titan and Triton), it orbits the Sun and the satellites orbit their respective planet, so astronomers decided that there was no problem with current definitions of planets, asteroids, and satellites. Pluto has until recently been referred to as the 'ninth' planet, however in the late 20th century it was found that its elliptical orbit brought it closer to the Sun than Neptune for a few years, so it is actually sometimes the 'eighth' planet!

New discoveries are changing our beliefs

New techniques involving spacecraft, space telescopes and new improved ground-based telescopes on Earth have resulted in new discoveries. They have also led however to new dilemmas for astronomers as to whether an astronomical object is to be classified as a planet, an asteroid or planetoid (see Box 1).

In November 2003, astronomers Brown (Californian Institute of Technology), Trujillo and Rabinowitz discovered an object that was at a farther distance from the Sun than Pluto. Whereas Earth is only 149.7 million kilometres from the Sun, and Pluto's average distance from the Sun is 5.8 billion kilometres, this object (a trans-Neptunian planetoid) was 4 billion kilometres beyond Pluto, and was orbiting the Sun in an elliptical path. Its estimated diameter (1 100–1 800 km) is approximately two-thirds the size of Pluto. This object (2003 VB_{12}) has been officially named Sedna (see Box 3).

The exact location of Sedna is still debated. Sedna's discoverers have argued that Sedna is actually the first observed body belonging to the Oort cloud (see Box 4), a region beyond the Kuiper belt, saying that it is too far out to be considered a Kuiper Belt object. Because it is a great deal closer to the Sun than was expected for an Oort cloud object, and has an inclination roughly in line with the planets and the Kuiper Belt, they described the planetoid as being an inner Oort cloud object, situated in the disc reaching from the Kuiper Belt to the spherical part of the Oort cloud. However, others believe that its inclination and size qualify it as a Kuiper Belt object. These astronomers suggest that previous assumptions about the outer edge of the Kuiper Belt should be revised outward.

Many trans-Neptunian objects (see Box 5) apart from Sedna have been discovered since 1992. One of these, 2003 UB_{313}, may possibly be a tenth planet as it is up to one-and-a-half times larger than Pluto. This has rekindled the debate about whether Pluto is a major planet or just one of the larger trans-Neptunian objects. Some astronomers consider that trans-Neptunian objects are minor planets, so should Pluto be considered to be a minor planet? Perhaps the definition of a planet needs revising? Some astronomers say that a planet should be roughly spherical and have a nearly circular orbit around the Sun. But this would exclude Pluto, Sedna and 2003 UB_{313} which have very elliptical orbits.

Further discoveries complicate things

The definition of an asteroid has become further complicated due to other recent discoveries. In 1993, the Galileo spacecraft passed close to the asteroid Ida (discovered in 1884, and only 24 km x 21 km) and the spacecraft's cameras spotted a smaller companion, the 'moonlet' (now called Dactyl), orbiting asteroid Ida, making it a binary asteroid. Then it was found that asteroid 87 Sylvia, known to astronomers since 1866, had two satellites. This is the first 'asteroid trio' to ever be discovered. 87 Sylvia (named after Rhea Sylvia, the mythical mother of the founders of Rome) is one of the largest known asteroids to orbit the Sun in the main asteroid belt between Mars and Jupiter. Its first 'moonlet' was only found four years ago and the second one was just announced in August 2005. These 'moonlets' have been named Romulus (diameter 18 km) and Remus (diameter 7 km) after Rome's mythical founders. It is also thought that satellites up to 5 km wide could lurk between these two known 'moonlets' and an even larger object could exist inside the orbit of Remus and escape detection.

About 60 asteroids are now definitely known to have a companion, and it is thought that between 6–10% of larger asteroids may be in binary pairs because several of the large meteorite impact craters on Earth have been found to occur in pairs.

Such discoveries show that astronomers still have a great more to learn about asteroids and planets, and our solar system.

★ ✧ ★ ✧ ★

BOX 1 Planetoids

Planetoid (meaning planet-like) was an old synonym of asteroid. An asteroid is a small, solid object in our Solar System, orbiting the Sun. The term 'planetoid' is again coming into use, but now meaning only the largest asteroids and trans-Neptunian objects (see Box 2) such as 1 Ceres, 50000 Quaoar, 90482 Orcus or 90377 Sedna.

BOX 2 Trans-Neptunian objects

A trans-Neptunian object is any object in the solar system with all or most of its orbit beyond that of Neptune. The Kuiper belt and Oort cloud are names for some subdivisions of that volume of space beyond Neptune. The planet Pluto and its moon Charon are trans-Neptunian objects. If Pluto had been discovered today, it might not have been called a planet given the further discoveries of other similar astronomical bodies.

BOX 4 The Oort cloud

The Oort cloud (sometimes called the Öpik-Oort Cloud) is a postulated cloud of comets situated about 50 000 to 100 000 AU from the Sun (approximately 1 000x the distance from the Sun to Pluto). The Oort cloud is a remnant of the original nebula that collapsed to form the Sun and planets five billion years ago, and is loosely bound to the solar system.

BOX 3 2003 VB_{12} is named Sedna

Because of its cold, distant nature, and because all other planets of the Solar system are named after Roman and Greek gods, the scientists who discovered 2003 VB_{12} (thought at first to be a planet) unofficially named it after Sedna, the Inuit (Eskimo) goddess of the sea, who was believed to live in the cold depths of the Arctic Ocean. As of September 28, 2004, the International Astronomical Union officially accepted the name 'Sedna'. Sedna is so far from the Sun that the temperature never rises above –240°C. Observations have shown that it is one of the reddest objects in the solar system, nearly as red as Mars. Unlike Pluto and Charon, Sedna appears to have very little methane ice or water ice on its surface.

What's coming up in the night sky?

The Earth is heading to the vernal (spring) equinox on 23 September. The Sun will rise and set due east and west, and the day and night will be equal.

During August Venus (the 'evening star') will be prominent in the night sky around 8–9 pm. By end August and in early September, Venus (the 'evening star') and Jupiter are very close together just below Spica. On 7 September, the new Moon will be between Spica and Venus, with Jupiter just below them. Jupiter sets earlier each night, disappearing in evening twilight by the end of September as it approaches conjunction in October. It will reappear as a morning star in November.

Mars will be rising just prior to midnight in August, and you will be able to locate it easily on 24 and 25 August as the Moon will be near it. Mars will increase in brightness and apparent size during September. Between 21–23 September the Moon will be near Mars and on 23 September, the Moon will occult (hide) the Pleiades star cluster ("The Seven Sisters") between midnight and 3.30 am. So if you get out before midnight and look for the Moon, you will easily locate Pleiades next to it. The best viewing of Mars however will be from mid-October to mid-November. Although Mars is heading to opposition by 7 November, the time of closest approach between Earth and Mars is on 30 October and so Mars will appear its brightest and largest then.

During September, the Southern Cross can be seen in the early evening tipped over on its side with the two pointers (α- and β-Centauri) almost vertical above it. α-Centauri (the pointer closest to the Southern Cross) is a yellow star and β-Centauri is blue. Directly overhead in September, just after sunset, the curl of the Scorpius tail can be seen next to the teapot shape of Sagittarius. Above the western horizon, the bright star Spica in the constellation Virgo can be seen. The Moon is in Scorpius on 11 September and in Sagittarius on 12–13 September.

There will be a partial eclipse of the Moon on 17 October. The Moon will only reach a small way into the umbral shadow, but observers will be able to see a dark notch into the Moon for an hour from 9.34–10.32 pm.

The Taurids meteor showers will be visible in north-eastern skies from 1 October through to 25 November, and should peak around 5 November. These are noted for producing colourful fireballs.

November will be a great time to locate Sagittarius (the "Teapot'), as Venus will be in Sagittarius all month. On 5 and 6 November, about one hour after sunset, a thin crescent Moon will be near Venus and so will help you to locate both Venus and Sagittarius. ☆

Robert Garner & Catherine Odlum

BOX 5 Trans-Neptunian objects found in the quest for a tenth planet

Continued searching by astronomers in the trans-Neptunian region has revealed many large solar-orbiting objects, such as Orcus (2004, 600 km)*, Quaoar (2002, 1 200 km), Ixion (2001, 1 065 km), Varuna (2000, 900 km), and others yet to be named, e.g. 2000 OO_{67}, 2003 EL_{61}, 2003 UB_{313} and 2005 FY_9.

The largest of these, 2003 UB_{313}, was discovered in 2005 (although it was actually in a photo taken in 2003) and is now the farthest object discovered to orbit the Sun. It may be a 'tenth planet' as its diameter (2 390–5 000 km) is larger than Pluto's. So far however, these large objects in the Kuiper Belt are known as planetoids – as they are considered too large to be asteroids, but not quite large enough to be a planet.

* (year of discovery, diameter of object)

When everybody's
somebody,
then no-one's anybody.

... W. S. Gilbert

Rio Tinto Big Science Competition

Held for the first time in 2004 as the Australian Science Challenge, the Rio Tinto Big Science Competition was renamed to reflect the new sponsor and growth of the competition. This annual competition was held in May 2005. It showcases science as an important subject in the curriculum, vital to a modern Australia, and gives students an opportunity to discover their talent. It will enrich their scientific study and reports are issued. The stimulating questions are multiple choice and suitable for all abilities. It will help to identify students capable of the more challenging activities of the Australian Science Olympiads. This could result in their being identified and trained to represent Australia at the International Science Olympiads in Biology, Chemistry and Physics.

Get your students involved in next year's competition. Details will go to schools in February 2006 and will be available at: *www.rtbsc.edu.au* □

Did you know? ★★★★★★★★

It's time to celebrate the centenary of $E = mc^2$

As you know, 2005 marks the 100th anniversary of theoretical physicist Albert Einstein's 'miraculous year' in which he wrote three of his most famous scientific papers. One of these papers was submitted on 27 October 2005 and in it Einstein (1879–1955) actually proposed the famous equation: $E = mc^2$.

In 1921 Einstein was awarded a Nobel Prize 'for his services to theoretical physics and in particular for discovering of the law of the photoelectric effect'.

☆ ☆ ☆

P.S. What have you done this year to celebrate the 'Einstein International Year of Physics'?
Have you been on a physics excursion yet? If not, see page 7 of this *SciTalk* for details about *Physics is Fun* excursions. ☆

COMPETITION CORNER

Send in an entry NOW to win these books:

Surfing topic books: HSC Senior Science

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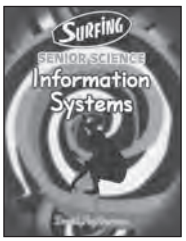

All **HSC Senior Science** topics: *Lifestyle Chemistry, Medical Technology – Bionics, Information Systems,* and *Disasters* (rrp $16.95 each) are available in the Science Press *Surfing* series. Each book contains a summary, with a few more detailed sections, for all mandatory syllabus sections. Exam-style questions (MC, short/structured/free response) & answers, plus a topic test are provided. They are great for both an initial understanding of a topic as well as for revision. They cover all aspects of a topic, & are great for exam practice. Marking guidelines are supplied where appropriate.

QUIZ QUESTION: What supports the weight of an insect as it walks across the surface of water?

HOW TO ENTER: Send an answer to the Quiz Question, your name, school, address, & home ph. no. on the back of an envelope to: Competition Corner, PO Box 442 Harbord NSW 2096 – by 26 September 2005.

Winner for *SciTalk 2/05*: *Active Science 3: Student's Workbook ($19.95)* and *Teacher's Answer Book and CD* ($32.90), from Oxford Uni Press, were won by: Ian Young, Murrumburrah HS.

SciTalk 2/05 answer: 99 Einsteinium

SUBSCRIPTIONS … *SciTalk* is available FREE to all secondary science faculties in NSW and the ACT. However, if you would like to receive your OWN personal copy or extra copies of *SciTalk*, subscriptions are available for just $16 per 4 issues. Please send a cheque for $16 + GST = $17.60 (to *SciTalk*), plus your name, address and telephone number … and you will receive the next four issues of *SciTalk*.

SciTalk

SciTalk is a newsletter for secondary Science educators, now is in its 11th year, and is produced quarterly by Odlum & Garner as a service to Science teachers. It is sent FREE-of-charge to all secondary Science faculties in schools and TAFE throughout NSW and the ACT.

SciTalk aims to provide science teachers with up-to-date information, important dates, the latest products available, plus 'what's on' in various excursion venues.

Please pass *SciTalk* on to all Science teachers at your school so they can benefit from it – or put it up on your notice board for reference.

Contributions, advertising and inserts are welcome.

Copies of *SciTalk* are also available at:
http://homepage.mac.com/robertgarner

CONTRIBUTIONS

SciTalk is due into schools mid-term. All contributions for *SciTalk* should be directed to the Editor (see below).

CLOSING DATES

- *SciTalk* No. 4–November 2005 … Sept 24
- *SciTalk* No. 1–February 2006 … Jan 27
- *SciTalk* No. 2–June 2006 … April 14
- *SciTalk* No. 3–August 2006 … July 2

ADVERTISING & INSERTS

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