

SciTalk

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Number 3 – August 2009

Thomas Harriot – an unsung hero of science

Galileo is often credited with being the first to look through a telescope and make drawings of the celestial objects he observed. However, he was not the first.

Thomas Harriot (1560 –1621), an English astronomer and mathematician, was the first person to make a drawing of the Moon based on his observations through a telescope on 26 July 1609, over four months before Galileo. Harriot went on to make other maps of the Moon’s surface between 1610–1613 that would not be bettered for decades.

It was the appearance of a comet (Halley’s Comet) in 1607 that originally turned Harriot’s attention towards astronomy. In early 1609 he bought a ‘Dutch trunk’ (telescope), invented in 1608, and his many observations were amongst the first uses of a telescope for astronomy.

He was also the first to discover sunspots in 1610, which he made while observing Jupiter’s moons. He had obviously heard about Galileo’s discovery, and so was investigating Jupiter’s satellites when he made this discovery. His original telescope had a magnification of 6x. Then he constructed a telescope with a magnification of 20x, and by 1611 he had a 32x magnification telescope.

Harriot’s accomplishments in mathematics, science, navigation and astronomy were many, but remained relatively obscure because he did not publish his results and because many of his manuscripts were lost. Unfortunately, nothing was published until after his death.

Although the saying ‘publish or perish’ has a number of meanings, is it any wonder that we hear academics today saying this, when you read what happened in Harriot’s case. □



★★ ATTENTION ★★

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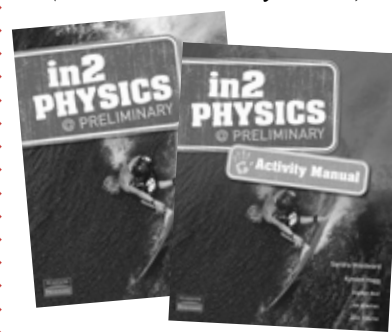
See pages 1, 11 & 12
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(ALL IN THE ONE ENVELOPE if you prefer!)

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www.odlumgarner.com

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★★★

Winner for SciTalk 2/09
Congratulations to Vivien Smeulders, Mercy Catholic College, who won *Understanding Science for Years 9 & 10* (rrp \$26.95) published by Odlum & Garner.

STOP PRESS: Special prices for school orders ... see page 7

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... see page 6 for full details

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**Come to Physics is Fun
to celebrate
National Science Week
14–23 August 2009**

Diary Dates 2009



Update on BOS & UAC matters

Regularly check the BOS website to ensure you have the latest data – for syllabuses, past exam papers, news, Official Notices, Board Bulletins, the statistics archive & more.

Official Notices are now online ONLY

Official Notices will be effective from the date they appear on the BOS website.

Approved scientific calculators for 2009 HSC (BOS 08/09)

Approved calculators are on the BOS website.

Advice to Teachers of Science (BOS 17/09)

This reminds teachers that the NSW Science curriculum content relating to evolution is consistent with accepted scientific knowledge and understanding. The BOS is reminding teachers that Creationism and Intelligent Design are not part of any BOS syllabuses. If taught as part of any school-based programs, it should be made clear to students that these ideas are not accepted as being scientific. They will not be tested in the SC or HSC, nor will responses based on these ideas be accepted as relevant responses to any questions in the SC or HSC on evolution.

UAC changes to Universities Admission Index (UAI) for 2009 NSW HSC students

The Universities Admissions Centre (UAC) has announced that NSW is changing the UAI to a new Australian Tertiary Admission Rank, or ATAR. The top ATAR rank will be 99.95 (rather than 100, the top rank of the UAI). This change to the top rank is to bring NSW students into line with their interstate peers, where the top rank is 99.95. This will have no impact on the HSC. HSC marks report on what a student has achieved in each course, and a mark of 100 will still be possible.

BOS enquiries:

Ph: (02) 9367 8111, fax: (02) 9367 8484
 Website: www.boardofstudies.nsw.edu.au/
 BOS contacts for Science:
 • Inspector Science, K-12 & Senior
 • Assessment Officer – Science

2009 – International Year of Astronomy

AUGUST 2009

- 15–23 National Science Week. *Astronomy: Science Without Limits*. www.asta.edu.au/nscwk
- 14, 17, 21 National Science Week events: Physics is Fun at Luna Park. www.odlumgarner.com
- 19 Physics Olympiad Nat. Qualifying Exam. www.aso.edu.au/ Close date: 27 June. 6125 9645
- 26 Biology Olympiad Nat. Qualifying Exam. www.aso.edu.au/ Close date: 27 June. 6125 9645
- 29 Astronomy Open Night & Lecture. Macquarie Uni E7B. 6–10pm, lecture 7.45pm. Cost: Adult \$10/Child \$5/Family \$25, (02) 9850 7111, www.physics.mq.edu.au/astronomy/news/calendar.html

SEPTEMBER 2009

- 2 Chemistry Olympiad Nat. Qualifying Exam. www.aso.edu.au/ Close date: 27 June. 6125 9645
- 18, 21 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
- 23 Spring Equinox (7.18 am EST)

OCTOBER 2009

- 11–17 Earth Science Week. www.ga.gov.au/education/events, 6249 9859 (www.earthsciweek.org)
- 18 Geoscience Australia Open Day: 10am–4pm, www.ga.gov.au/education/events/open-day.jsp
- 20 Oct–16 Nov HSC Examination period
- 23, 26, 30 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105

NOVEMBER 2009

- 2, 16, 20 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
- 9–13 School Certificate Tests.
- 23 Science Teachers' Forum. Children's Medical Research Institute. www.cmri.com.au
- 23, 27, 30 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105

DECEMBER 2009

- 4, 11 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
- 22 Summer Solstice (3:47 am EST)

JANUARY 2010 National Youth Science Forum. Forms to local Rotary club by 15/5/09, interviews in July. Only for Yr 11 in 2008. 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.

2009 HSC Science Examination Dates

29 Oct Biology: 9.25 am–12.30 pm
2 Nov Chemistry: 9.25 am–12.30 pm
3 Nov Earth & Env Science: 1.55 pm–5 pm
4 Nov Physics: 9.25 am–12.30 pm
5 Nov Senior Science: 1.55 pm–5 pm

2009 School Certificate Tests

9 November

- English: 9.20–11.30 am (includes 10 mins reading time)
- Science: 12.50–3 pm (includes 10 mins reading time)

10 November

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

11–12 November (each school does either an online test on one of these days or the pen & paper test)

- Computing skills test (online): 8 am–5 pm

13 November

- Computing skills test (online): 8–11 am
- Computing skills test (pen & paper): 11 am–12.15 pm

NOTE: Your purchase of the Odlum & Garner Past HSC Biology, Chemistry and Physics books helps to support the production of Past HSC books for Earth & Environmental Science and Senior Science. Thank you to all the teachers who support these projects.

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- Physics • Senior Science • Biology • Photography
- Peer Support • Commerce/Bus. Studies/Tourism
- Primary Science & Technology, English, Maths

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Australian wildlife is in trouble and needs your help! If you would like to help Australian scientists and conservationists, you can take part in this year's Night Stalk.

Twist Night Stalk is easy, fun and something everyone can do. All you need is a torch and a Spotter's Log. Choose one night or a number of nights between 1 September and 16 October and spotlight in your local bushland. Record all native/introduced animal

1 September–16 October 2009

species: mammals, birds, bats, reptiles and frogs, that you find and send your Spotter's Log to Perth Zoo.

This annual national survey, now in its 11th year, is designed to collect information about animals still living in the wild, especially near urban areas, and their distribution over time.

For information: Twist Night Stalk
 PO Box 489 South Perth WA 6151
 Fax: (08) 9474 4113
 Email: nightstalk@perthzoo.wa.gov.au
 Visit: www.perthzoo.wa.gov.au/Get-Involved/Nightstalk & download a Spotter's Log or complete one online.

Australian Museum 2009

Exhibitions to explore

Find out about minerals, fossils, dinosaurs, megafauna, endangered Australian animals, adaptations, birds, insects and other invertebrates in our semi-permanent exhibitions:

- Planet of Minerals
- Chapman Mineral Collection
- Dinosaurs
- Surviving Australia
- Birds and Insects
- Skeletons

Science spotlights

Self-guided activities in the new *Surviving Australia* exhibition:

- Stage 6 – *Evolution, survival and extinction* – focusing on Australian megafauna and platypus evolution.
- Stage 5 – *Evolution, and natural selection* – activities on environmental influences and adaptations, species diversity, changes over time, megafauna and cloning the Tasmanian Tiger.
- Stage 4 – *Classification and adaptation* – marine invertebrate features, vertebrate classes, dichotomous keys, adaptations on land and in water, and a scientist's work.

Sessions with a Museum Educator:

- Stage 6 – *Human Story* – hands-on investigations of fossil evidence, skeletal characteristics and different scientific interpretations.
- Stage 6 – *Learning from fossils* – specimen-based activities investigating extinct megafauna and playpuses through comparisons with modern relatives.

For bookings and further information:

Ph (02) 9320 6163 Fax (02) 9320 6072
www.australianmuseum.net.au/education-services

AUSTRALIAN MUSEUM
6 College Street, Sydney
(opp. Hyde Park)
open daily 9.30 am – 5 pm
www.australianmuseum.net.au



Science Teachers' Forum

To be held at the
Children's Medical Research Institute – Westmead, Sydney
Monday 23 November 2009
9.45 am–4.30 pm

This one-day forum will focus on the science of genetics and disease, concentrating on topics relevant to the HSC Biology syllabus.

It will include an introduction to the use of Gene Technology in Medical Research, followed by captivating presentations from two prominent CMRI scientists on cutting edge basic research. There will be time for questions after each presentation. There will also be an informative session devoted to the topic of genetics and ethical issues followed by interactive hands-on practical lab demonstrations of simple DNA-based techniques.

Cost: \$55 to cover cost of refreshments and lecture notes.



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Science on the Web

• Topics on NOVA: Science in the News

www.science.org.au/nova

Maintained and updated regularly by the Australian Academy of Science, this site provides reliable and up-to-date information on many topical issues in Science. It is great for research and assignments, as well as for encouraging an interest in Science.

• The Apollo 15 Hammer-Feather Drop

http://nssdc.gsfc.nasa.gov/planetary/lunar/apollo_15_feather_drop.html

At the end of the last Apollo 15 moon walk, Commander David Scott performed a live demonstration that is shown on this website (although the resolution is not great!) He held out a geologic hammer and a feather and dropped them from about 1.6 metres height at the same time. Because they were essentially in a vacuum, there was no air resistance and the feather fell at the same rate as the hammer and they both hit the ground simultaneously,

as Galileo had concluded hundreds of years before - all objects released together fall at the same rate regardless of mass.

• How DVDs Work

<http://electronics.howstuffworks.com/dvd.htm>

It wasn't really that long ago that VHS tapes dominated the home video market, but now, DVDs have all but wiped them out completely. On this website, you will learn what a DVD consists of, how a DVD player reads a disc, what to look for when buying a DVD player, a little DVD history, DVD storage capacity, all about HD DVDs, and much more.

• How CDs Work

<http://electronics.howstuffworks.com/cd.htm>

CDs are everywhere these days. Whether they are used to hold music, data or computer software, they have become the standard medium for distributing large quantities of information in a reliable package.

This website explains all about CD technology and how it operates, e.g. it looks at how CDs and CD drives work, the different

forms CDs take, as well as what the future holds for this technology.

• How Internet Infrastructure Works

<http://computer.howstuffworks.com/internet-infrastructure.htm>

On this website, you will learn about the basic underlying structure of the Internet – a global collection of interconnected networks – and how it started. You will not only learn how your computer connects to others, but you will learn about domain name servers, network access points, backbones, web servers, domain names, and much more!

• Global Positioning Satellites (GPS)

<http://hyperphysics.phy-astr.gsu.edu/Hbase/gps.html#c1>

This useful site describes all about GPS – when it started, what it is and how it works, the global positioning orbits, how the navigation positioning signals are coded and sent, plus the process of using triangulation. The illustrations accompanying the text are excellent.

● **Science Daily**

www.sciencedaily.com

This site has the latest science research news. As well as having the top science news items, it also archives stories in categories such as Health & Biomedical Sciences, Biological & Earth Sciences, Physical & Applied Sciences plus a facility for searching for items.

● **Misconception of NASA involvement in the invention of Velcro**

www.velcro.co.uk/cms/History.6.0.html and www.abc.net.au/science/articles/2009/02/03/2480864.htm

The discovery of Velcro was actually made by the Swiss engineer, Georges de Mestral, not NASA. In 1941, while returning from the fields with his dog, Mestral noticed how difficult it was to detach the burrs from the burdock mountain thistle's flowers from his trousers and his dog's fur. Surprised, he removed them carefully from his clothing and observed them under a microscope. It was then that he discovered why they clung on to the fabric and fur so strongly – they were covered in hundreds of tiny, but strong hooks.

He realised that these hooks were potentially a really neat way to fasten clothes and spent a number years of research and experimentation to develop a revolutionary fastening system that never jammed. He was able to patent his product by 1950. The Velcro® brand name has, since 1959, been given to an extensive range of products that have greatly simplified fastening and closure operation. The Velcro name came from the French words 'velours' (velvet) and 'crochet' (hook).

Velcro got a major public exposure in NASA's space program. Velcro was used to attach food pouches to walls, note pads to astronauts' legs and even to attach astronauts' bodies to the wall for sleeping. This is probably why the misconception that NASA was linked to Velcro arose.

● **Pump action a trigger for earthquakes**

www.csiro.au/news/Natural-deep-earth-pump.html

While it's reasonably well understood why earthquakes happen, when tectonic plates slip past each other causing stress build-up, the triggering of earthquakes is much more complex. To understand the 'where' and 'when' of earthquakes, the 'how' needs to be understood first.

Scientists have recently discovered the presence of a natural deep earth pump that is a crucial element in the formation of ore deposits and earthquakes. The process, called 'creep cavitation', involves fluid being pumped from the mantle through pores in deformed rock in mid-crustal shear zones, approximately 15 km below the Earth's surface.

The fluid transfer through the middle crust also plays a key role in tectonic plate movement and mantle degassing.

The discovery was made by examining one millimetre sized cubes of exposed rock in Alice Springs, which was deformed around 320 million years ago during a period of natural mountain formation.



Some activities to help you celebrate the 2009 International Year of Astronomy

**MACQUARIE UNI OBSERVATORY
FRIDAY NIGHT OBSERVING**

On clear nights, our 'starfinder' (planisphere) sessions demonstrate how to identify bright stars, constellations and planets. This is followed by observing with the telescopes (12" & 16" Meade telescopes). Even with the light pollution of the city, we can easily see double and multiple stars, open and globular star clusters, and the brighter nebulae. The Moon and planets, when in suitable positions, are easily viewed with any of our instruments. On dark, moonless nights with good seeing, we may also observe the brightest galaxies. In the event of cloud, our program includes a mixed al fresco presentation of slides, posters and scale models.

Located in the grounds of Macquarie Uni (access via Gymnasium Rd), the observatory is open to the public every Friday night, March–27 November inclusive, 7:30–9 pm, subject to bookings or rain. You can phone 0427 433 388 if the weather is doubtful.

**ASTRONOMY OPEN NIGHT
AT MACQUARIE UNIVERSITY
29 August 2009**

Look through ~20 different telescopes to see the Moon, stars, planets, nebulae and clusters. An illustrated talk will begin at 7.45 pm. See displays of posters, software, telescopes, magazines, books, and maps.

Venue: Macquarie Uni E7B. 6–10 pm.
Cost: Adult \$10/Child \$5/Family \$25.

More details: (02) 9850 7111, www.physics.mq.edu.au/astronomy/news/calendar.html

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This year, why not consider taking your students for a day or night visit to Sydney Observatory before or after Luna Park Sydney.

For more information about Sydney Observatory, go to: www.sydneyobservatory.com.au

National Curriculum progress

The Australian Curriculum, Assessment and Reporting Authority (ACARA) is responsible for the development of Australia's national curriculum from K–12, starting with the learning areas of English, mathematics, the sciences and history, for implementation from 2011. As a second phase of work, national curriculum will be developed in languages, geography and the arts.

If you wish to follow the progress of the National Curriculum, go to: www.acara.edu.au/curriculum.html Development timelines for writing the national curriculum are set out on their website.

You can be fully involved and up-to-date with the national curriculum development by registering for the online consultation and feedback system available in the 'Get involved' section. □

● **Rabbits bouncing back from calicivirus**

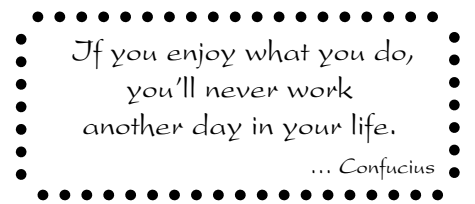
www.invasiveanimals.com/invasive-animals/rabbits/index.html

Rabbits are still a serious problem in Australia in economic terms, as they are estimated to cause losses of up to \$200 million each year, as well as causing severe environmental damage. Now rabbit numbers are on the rise again.

Rabbits were first introduced to Australia 150 years ago. Just 24 introduced rabbits multiplied into a population of about 600 million by 1950. They have been able to adapt to most Australian habitats.

Grazing by rabbits destroys agricultural and native grasses, shrubs and trees. They compete with both native and farm animals for food. Rabbits also cause soil erosion by removing vegetation and by burrowing.

The introduction of the rabbit virus, myxomatosis, in 1950 resulted in about 99% of the rabbit population being wiped out at the time. However, just a few rabbits had a resistance to the virus and these rabbits were able to continue to breed. By the 1990s,



the virus was not keeping rabbit levels low enough. When calicivirus was released in 1995 it reduced rabbit populations by more than 50% in some dry areas of Australia. However, calicivirus has not been so effective in cool, high rainfall areas because, as researchers have discovered, some of these rabbits apparently carry a non-lethal virus that gives them immunity to calicivirus.

Until a better way of controlling rabbits is developed, land owners have been advised to use other rabbit control methods such as the destruction of rabbit warrens and baiting where viral control is not enough.

[Note: Rabbit calicivirus (RCV) is also known as rabbit haemorrhagic disease virus (RHDV).]

FUN PARK EXCURSIONS

2009 DATES

March 13, 16, 30. May 8, 29.
June 1, 5. Aug 14, 17, 21.
Sept 18, 21. Oct 23, 26, 30.
Nov 2, 16, 20, 23, 27, 30. Dec 4, 11.

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[Note: Luna Park only open on Mondays & Fridays]

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WORKSHEETS ... secondary / primary

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Business Studies, Tourism; Photography.

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- Then send a deposit of \$100 (+ 10% GST)
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- Worksheets (if requested) are sent after
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Physics is Fun was co-authored in 1983 by Robert
Garner and Sylvia Jennings and was based on their
earlier excursions at Luna Park in the 1970s. Robert
has conducted these fun park excursions since their
inception ... both at **Luna Park** (1983-1987, 1995,
2004-2009) and **Wonderland Sydney** (1990-2004)
– covering many different subject areas. With the
closure of Wonderland Sydney in early 2004, these
Fun Park Excursions have been at **Luna Park Sydney**
since its re-opening in April 2004.

Please note: Our excursion notes are only for use when on
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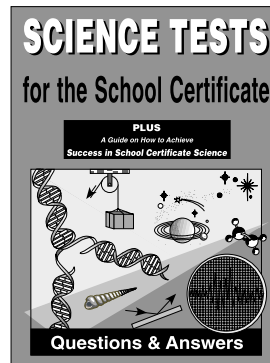
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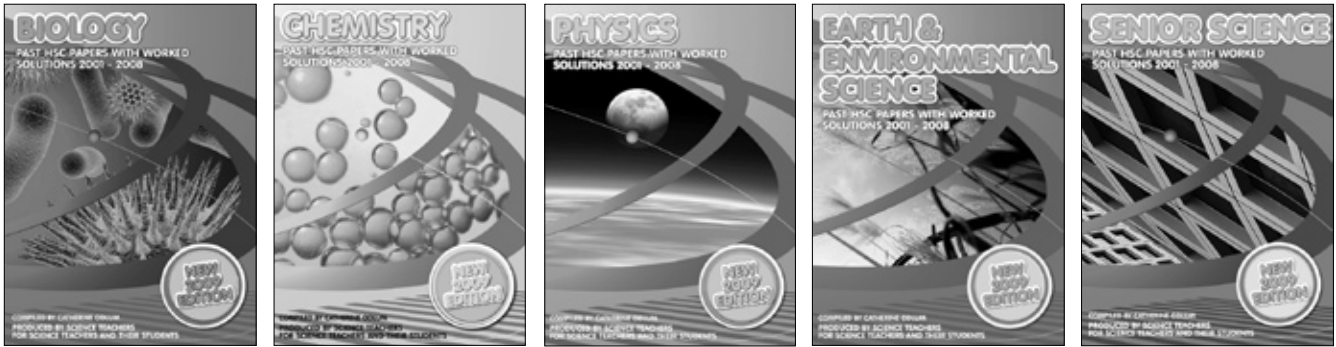
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Photo Spot *Onychonema*, a freshwater green algae

Onychonema is a unicellular genus of freshwater, free floating green algae. It occurs abundantly in running water.

It belongs to the placoderm desmids, a group of green algae in the family Desmidiaceae. Their symmetry distinguishes them from all other algal groups.

These algae are very well known for their diversity of form. They form attractive shapes and so make interesting microscopic objects. Most of the placoderm desmid algae consist of two symmetrical halves each of which contains just one chloroplast and a vacuole. The halves are joined by a narrow region in which the nucleus is located. A single, 3-layered cell wall surrounds the two halves. They often have elaborate ornamentation, as seen in the SEM photo of *Onychonema* in Figure 1 on the right.

While many of the placoderm desmids can exist as solitary unicellular organisms, they can also be united end to end in a filamentous colony. Although *Onychonema* are unicellular, they exist as a filamentous colony, as can be seen in Figure 2 below.

Many species are capable of self-locomotion by gliding. They are phototropic, as the direction of their movement is determined by their response to light.

Like many other algal species, desmids are important indicators of water quality. Their occurrence provides information on environmental conditions such as pH and the trophic state of a water body (i.e. what food chains are present). □

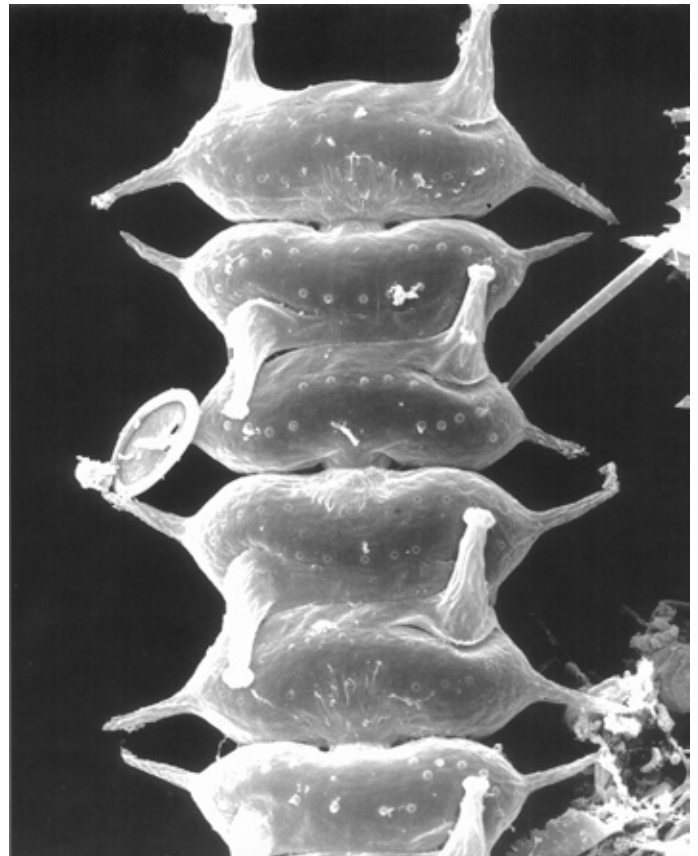
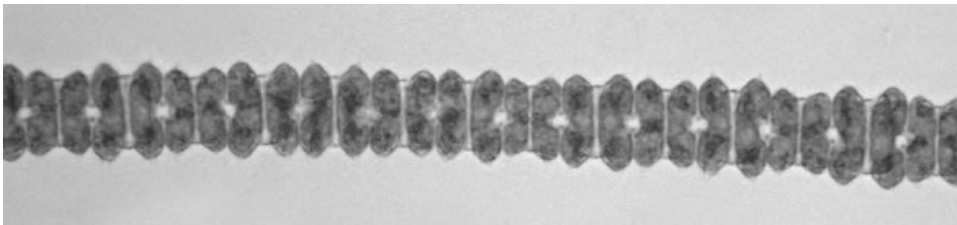


FIGURE 1 (above): *Onychonema*, a freshwater green algae (a placoderm desmid) ... nicknamed 'flying pigs'.

This photomicrograph was taken using a scanning electron microscope (SEM) by Anna McEldowney and Gerry Nash (Antarctic Division EM Unit, Hobart).

FIGURE 2 (below): *Onychonema* – this shows how the unicellular *Onychonema* exists as a pseudofilamentous organism. Photo by Stephen Durr.



Oil from algae

Every drop of oil on Earth has come from millions of years of buildup from algae and other natural residue that has been buried, compressed, and eventually drilled to supply our energy needs since the late 1800s. Research is now being conducted to investigate the use of algae to make biofuels as an alternative to our dwindling supplies of fossil fuels.

Research at leading universities suggests that algae could supply enough fuel to meet all of America's transportation needs in the form of biodiesel ... using a scant 0.2% of the nation's land. In fact, enough algae can be grown to replace all transportation fuels in the US on only 15 000 square miles, or 4.5 million acres of land. That's about the size of the state of Maryland.

High oil prices, competing demands between foods and other biofuel sources and the world food crisis have ignited interest in algaculture (farming algae) for making vegetable oil, biodiesel, bioethanol,

biogasoline, biomethanol, biobutanol and other biofuels. Among algal fuels' attractive characteristics are that they do not affect fresh water resources, they can be produced using ocean and wastewater, and are biodegradable and relatively harmless to the environment if spilled. However, as of 2008, such fuels were too expensive to replace other commercially available fuels.

Currently most research into efficient algal-oil production is being done in the private sector, but predictions from small scale production experiments bear out that using algae to produce biodiesel may be the only viable method by which to produce enough automotive fuel to replace current world diesel usage. And microalgae have much faster growth-rates than terrestrial crops!

Studies show that algae can produce up to 60% of their biomass in the form of oil. Because the cells grow in aqueous suspension where they have more efficient access to water, CO₂ and dissolved nutrients, microalgae are capable of producing large amounts of biomass and usable oil in either high

rate algal ponds or photobioreactors. This oil can then be turned into biodiesel, which could be sold for use in motor vehicles.

Butanol can also be made from algae or diatoms using only a solar powered biorefinery. This fuel has an energy density similar to petrol, and greater than that of either ethanol or methanol. In most petrol engines, butanol can be used in place of petrol with no modifications. In several tests, butanol consumption is similar to that of petrol, and when blended with petrol, provides better performance and corrosion resistance than that of ethanol or E85.

Research into algae for the mass-production of oil is mainly focused on microalgae, i.e. organisms capable of photosynthesis that are less than 0.4 mm in diameter, including the diatoms and cyanobacteria, rather than macroalgae, e.g. seaweed. This preference towards microalgae is due largely to its less complex structure, fast growth rate, and high oil content (for some species). □

[Source: www.oilgae.com/]

Science Updates

● A free program, *WorldWide Telescope*, brings space exploration to Earth

This service is free-of-charge from Microsoft – it lets students and lifelong learners tour the night sky using high-resolution images from the world's best land- and space-based telescopes.

'WorldWide Telescope' is available at www.worldwidetelescope.org and can be downloaded for use on either PC/Mac computers. The application itself is a blend of software and Web 2.0 services created with the Microsoft high-performance Visual Experience Engine, which allows seamless panning and zooming around the heavens with rich image environments.

● New *SkyMapper* telescope at Siding Spring Observatory

SkyMapper, Australia's first new optical research telescope for 25 years, finally became fully operational in May 2009 at the Siding Spring Observatory facility of The Australian National University. It will be the first telescope to conduct a comprehensive digital map survey of the southern skies. It will be operated remotely via a 700 km optical-fibre link from Mt Stromlo in the ACT. *SkyMapper* has been custom built to undertake the Southern Sky Survey – the first ever systematic digital map of the southern skies – which should take about 5 years to complete. This will generate around 400 Terabytes of data – equivalent to 100 000 DVDs – and that data set will be freely available to astronomers globally via the Internet.

[From: <http://rsaa.anu.edu.au/skymapper/index.php>]

● New telescopes will be bigger than ever!

The legendary 5 metre Hale telescope at Palomar Observatory in southern California was once the world's largest telescope. Then came larger telescopes with even bigger mirrors, such as Gemini North (8.1 m), Subaru (8.2 m) and Keck (10 m). These telescopes had 4x the light-gathering power of the Hale telescope. These telescopes are on top of Hawaii's Mauna Kea, a dormant volcano. At an altitude of 4 267 metres, they are above 40% of Earth's atmosphere and most of its water vapour. However, most people cannot work at this altitude and so use them remotely from another location. These telescopes are able to compensate for atmospheric turbulence as they use adaptive optics systems.

Several new proposed telescopes with massively large mirrors, such as the European Extremely Large Telescope with a 42 metre diameter mirror and the Thirty Metre Telescope are due to be built by 2018 and will also employ adaptive optics. These are expected to deliver images ten times

sharper than the Hubble Space Telescope's. These enormous telescopes will not render older telescopes obsolete. When the larger ones come on line, the older ones will be put to use to do survey work, to find interesting phenomena for the larger ones to investigate in detail.

As Timothy Ferris aptly wrote in his article on these telescopes in the July 2009 *National Geographic*, 'A telescope doesn't just show you what's out there; it impresses upon you how little you know, opening your imagination to wonders as big as all outdoors.'

[From: *National Geographic*, July 2009]

● Element 112 to be officially added to the Periodic Table

In honour of scientist and astronomer Nicolaus Copernicus (1473-1543), Professor Sigurd Hofmann's team, who discovered Element 112 in 1996 at their laboratory in Darmstadt, Germany, suggested the name 'copernicium' with the element symbol 'Cp' for this new element. It was Copernicus who discovered that the Earth orbits the Sun, thus paving the way for our modern view of the world.

In order to have the element officially recognised by the International Union of Pure and Applied Chemistry (IUPAC), the scientists were required to repeat experiments and perform new ones in order to provide more evidence for the element's existence. Element 112 is not found in nature – it is made in particle accelerators. To make the element, scientists fire accelerated zinc atoms with 30 protons towards lead atoms with 82 protons. The collision can result in this new element with 112 protons. It only has a half-life of 240 microseconds, so observable quantities have not yet been made – only detectable amounts.

The discovery of element 112 has now been accepted by IUPAC. Element 112 is the heaviest element in the periodic table. It is about 277 times heavier than hydrogen, the lightest element. In around 6 months, IUPAC will officially endorse the new element's name. This period is set to allow the scientific community to discuss the suggested name 'copernicium' before the IUPAC naming.

[From: *Science Daily*, 15 July 2009]

● Wave energy and wind energy

Global demand for energy will double throughout the world over the next 20 years – and it is still uncertain from where this energy will come.

One renewable energy source under development is wave or ocean energy. This form of energy is inexhaustible and ocean waves contain enormous amounts of energy. Energy output is determined by wave height, wave speed, wavelength, and water density. To date there are only a handful of experimental wave generator plants in operation worldwide.

Today, Australia is a world-leader in the development of wave technology, e.g. through Oceanlinx, an Australia-based company. Oceanlinx have developed the technology of using wave power, at a similar cost to the well established technology of using wind power. Their system can be used to turn turbines to generate electricity, or to provide desalinated industrial or potable grade fresh water from sea water by desalination. Their current prototype unit off the coast in Port Kembla, NSW produces zero CO₂ and SO₂ pollution, with noise emissions of less than 77 db. It should be noted that wave power plants in offshore locations have a lower visual impact from the shore than wind generators on land.

You may be wondering by now, how Sydney's desalination plant will get its energy. This desalination plant will be powered by 100% renewable energy. Infigen Energy has recently built a new 67-turbine wind farm at Bungendore, NSW. Power generated by the wind farm will be supplied to the east coast electricity grid – the same grid that the desalination plant draws its power from. This means that the plant has a renewable energy source directly offsetting its energy use. The wind farm has been designed to produce more than enough energy to operate the desalination plant to cover the days when there is less wind. It will increase the supply of wind energy in NSW by over 700%. It is a massive boost to the renewable energy sector and an environmentally sensible way to offset the power needs of the desalination plant.

[From: www.oceanlinx.com AND www.sydneywater.com.au/majorprojects/Desalination/renewableenergy.cfm]

● Magic flute from the Ice Age

Ice Age people in Europe did not just hunt and live in caves. They loved music, and are now known to have made flutes from bird bones and mammoth ivory at least 35 000 years ago. An almost complete ancient flute made from vulture bone has been unearthed recently in a cave near Ulm in Germany, along with fragments of three ivory flutes in the same region. This is the oldest evidence to date of human music-making. The vulture bone flute is about 22 cm, and has precise carving marks to reflect the measurements made to carve its 5 holes. It was probably carved using chipped-stone tools.

[From: *Sydney Morning Herald*, 25 June 2009]

● Speed kills economy ... reduce your car's environmental impact

The faster you travel, the more wind resistance you'll encounter and the more fuel your vehicle will consume just to maintain speed. Travelling at 110 km/h uses up to 25% more fuel than cruising at 90 km/h.

[<http://fsd.monash.edu.au/pool-vehicle-services/driving-tips-reduce-emissions>]



Viewing the skies in Winter and early Spring

... Robert Garner

The centre of the Milky Way is always great viewing as it is directly overhead during late Winter and early Spring. If you can locate the constellation Sagittarius, you will be looking in the direction of the centre of the Milky Way.

Locating constellations

The Winter and Spring constellations, *Capricornius*, *Sagittarius* and *Scorpius* now dominate the night sky. *Sagittarius* is directly overhead around 8 pm, at the start of September with *Capricornius* to its east and *Scorpius* to its west.

You will be looking up towards the centre of the Milky Way if you look directly through *Sagittarius*. The centre of the Milky Way is 29 000 light years away (i.e. 2.7×10^{17} km) and is thought to have a huge black hole of about one million solar masses. This area of the sky is rich in nebula and star clusters that are easily visible with binoculars. The Lagoon Nebula (M8), the Swan Nebula (M17) and the Trifid Nebula (M20) are all in *Sagittarius*, as are several globular clusters including M22, the third brightest visible from the Earth as well as a number of open clusters. M23 is a cluster of 150 stars. To find and identify these objects, the book *Astronomy 2009* is an invaluable guide (see the free offer at the bottom of page 11).

Locating Planets

Mid-August is a good time to look for Mercury and Saturn. They will be visible in the western evening sky. Mercury is usually hard to see, however on 16 and 17 August it will be about 9° above the horizon one hour after sunset with Saturn about 3° below and slightly to the north of Mercury. Mercury will appear the brighter of the pair. On 21 August, the new Moon will be 3° away from Mercury with Saturn below and slightly north of the pair. Saturn will then get closer to the Sun and not be visible again until it appears in the dawn sky late in October.

Jupiter is visible all night throughout Spring as it rises in the afternoon and sets early in the morning. Ideal viewing will be in mid-September when it will be overhead in the northern skies around 10 pm. Earth and Jupiter are on the same side of the Sun at present, which means that Jupiter appears larger than usual – so it is a good time to emulate Galileo’s Jovian observations that the moons of Jupiter orbit it. The nights of 17 and 18 September, if clear, will provide an excellent showing of Jupiter’s moons. From 9–9.30 pm on 17 September, Europa (and its shadow) will transit the face of Jupiter and will exit just in time for Ganymede (and its shadow) to commence its transit. On 18 September, all four Galilean moons will appear on the same side of Jupiter (best to see from about 10.30 pm).

Venus and Mars are rising in the east at around 2 am and 4 am respectively and so both are only visible in the pre-dawn morning sky.

Meteors

One of the most consistent meteor showers of the year comes up next school holidays. The Orionids are best seen from late evening until dawn from 2 October to 7 November. Good rates can usually be observed on consecutive nights around this date, e.g. in the past, rates of 14–31 per hour have been seen. This year will be particularly favourable for viewing because the maximum coincides with a new Moon on 16 October, so a dark sky should make the showers more spectacular. □

BOX 1 Sky Charts & Planispheres

- You can download free sky charts each month to explore the night sky from: <http://skymaps.com/downloads.html>
- A planisphere (star wheel) is a great aid for exploring the stars and locating constellations. They are inexpensive and available from astronomy shops, or you can download one from the internet – make sure it is for the Southern Hemisphere. There is a planisphere (star wheel) to print and use at:
<http://members.ozemail.com.au/~starrylady/Planis1.htm>

The Milky Way

At night, from any dark location on Earth, part of the clear sky looks milky. This unusual band of dim light is generally visible during any month and from any location. It’s a great activity to get your students to identify the visible part of the Milky Way, especially if they go away on holidays away from city/town lights.

Until the invention of the telescope, nobody really knew what the ‘Milky Way’ was. About 300 years ago, telescopes revealed that the Milky Way was made of stars. Only 70 years ago, more powerful telescopes brought the further revelation that the Milky Way is only one galaxy among many. Now telescopes in space allow yet deeper understanding. Figure 1 is an infrared image taken by the COBE satellite and shows the plane of our Milky Way Galaxy (from our position inside the disk, of course). This infrared image allows us to see through obscuring dust clouds, revealing a more accurate view than is possible using visible light.



Figure 1 – The infrared COBE satellite image of our Milky Way

Credit: E L Wright (UCLA), The COBE Project, DIRBE, NASA

The Milky Way is a gravitationally bound collection of roughly a hundred billion stars. Our Sun is one of these stars and is located approximate 24 000 light years (or 8 000 parsecs) from the centre of the Milky Way Galaxy. The Galaxy has three major components: a thin disk consisting of young and intermediate age stars – this disk also contains gas and is actively forming new stars, a bar of older stars, and an extended dark halo whose composition is unknown. Since the matter in the halo does not consist of luminous stars, it does not show up in the COBE satellite image (see Figure 1). The existence of the dark halo is inferred from its gravitational pull on the visible matter.

Previously the Milky Way was thought to have four spiral arms, but information from NASA’s Spitzer Space Telescope has discovered that the Milky Way’s spiral structure is dominated by just two arms wrapping off the ends of a central bar of stars. An artist’s impression in Figure 2 illustrates this new view of our Milky Way Galaxy (as if seen from outside the galaxy). □



Figure 2 – An artist’s impression of our Milky Way Galaxy, as if viewed from outside the galaxy.

Credit: NASA/JPL-Caltech

Aboriginal perspectives on the origin of the Milky Way

The Milky Way, which spreads in a broad arc of diffused light across the night sky, was commonly regarded by the Aborigines as a river in the Sky World. They thought of the large bright stars as fish and the smaller stars as water-lily bulbs.

The darkness and clarity of the night sky also allowed them to see clearly what northern hemisphere people could rarely glimpse, the dark regions that divide the southern Milky Way and, in particular, the dark region which Europeans first saw when they journeyed south and named the ‘Coal Sack’. The Aboriginal people in various areas developed various legends, many of them involving a moral lesson, to account for the formation of the Milky Way and the dark regions:

- Aboriginal groups in Central Australia believed that the Milky Way divided the sky people into two tribes and so it was a continual reminder that a similar division of lands should be observed by local neighbouring tribes.
- In north-east Arnhem Land, the Milky Way was associated with an act of adultery and subsequent vengeance, and so it served as a continual warning against wrong-doing.
- Another group in Queensland, identify the Milky Way with the deeds of Priepriggie, who was well-known for his songs and dances, as well as for his hunting. When he sang, the people danced to the rhythm until they dropped with exhaustion, and declared that if Priepriggie wished he could make even the stars dance. One morning when he speared a flying fox, its companions descended upon him in vengeance, carrying him up to the sky. Unable to find him, his people decided to perform his dance, hoping for his return, but without him they could not capture the rhythm. Suddenly they heard a sound of singing in the sky. As the rhythm grew louder and more pronounced, the stars began to dance and arrange themselves in time to Priepriggie’s song. Thus the Milky Way serves as a reminder that a tribal hero should be celebrated with traditional songs and dancing.
- Around Yirrkala in the Northern Territory, the Milky Way is linked to a legend of two brothers who drowned while fishing. Their bodies, floating in the water, are two dark patches in the Milky Way in the constellations of Serpens and Sagittarius, while their canoe is a line of four stars near Antares. Their canoe is surrounded by the rest of the stars in the Milky Way. The two brothers can also be seen in the upper panel, the elder one standing on a black rock that represents a dark part of the Milky Way near Theta Serpentis. The outer panels, depicting the wake of the canoe, represent wavy lines of stars in the Milky Way near Scorpio. □

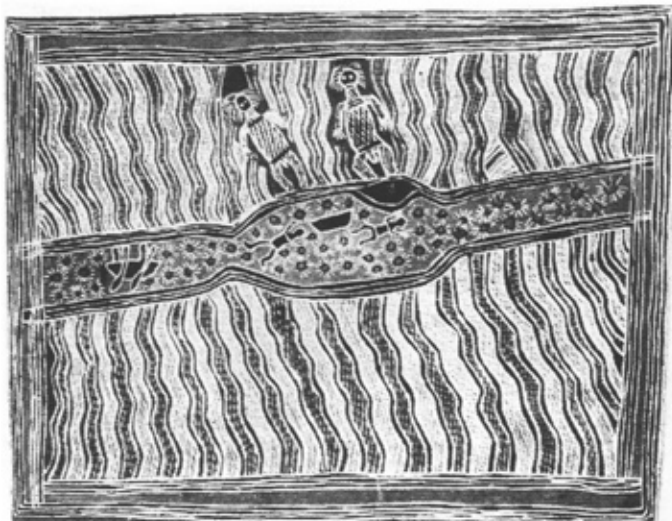


Figure 3 – Drawing of a bark painting of the Milky Way from Yirrkala (NT) depicting their legend about two brothers who drowned while fishing.

Source: Mounford Collection, State Library of South Australia.



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WINNER: Andrew Eaton, Wollondilly Anglican College won the Sydney Aquarium family pass for SciTalk No. 2–2009.



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