Providing support and promoting excellence in science education

# SciTalk

ISSN 1323-7667

Number 2 – May 2013

## *Are you using the correct names for chemical compounds?*

Among its many activities, the International Union of Pure and Applied Chemistry (IUPAC) is the official naming body for both inorganic and organic chemical compounds. So IUPAC puts forward the rules that determine matters of chemical nomenclature. This ensures that any specific chemical compound can be given a preferred name under the IUPAC rules, thereby avoiding competing or duplicate names.

Be aware that a number of current HSC chemistry textbooks and resources are not using the IUPAC rules correctly for the naming of haloalkanes. The correct naming of haloalkanes caused problems last year with Question 12 in the 2012 HSC Chemistry paper, as the correct name was not amongst the alternatives provided for this question. IUPAC uses an alphanumeric system for naming substituent halogens in haloalkanes. The previous method was replaced many years ago, but is still given in some current textbooks. There is also a problem in some of these textbooks with the incorrect naming of complex ions, which are taught in the Option 'Chemistry of Art'.

All HSC Chemistry teachers must ensure that they use the correct nomenclature for organic compounds based on the rules put forward by IUPAC and should teach their students the preferred IUPAC way to name chemical compounds – refer to the Board of Studies *Official Notice BOS 12/13*. It is not The Royal Australian Chemical Institute (RACI) that determines correct chemical nomenclature. However, RACI do have a useful summary of IUPAC rules for naming the organic compounds specified in the Chemistry Stage 6 Syllabus. This document, *Organic Nomenclature for the NSW HSC*, can be downloaded from the RACI website at *www.raci.org.au/education/secondary*

IUPAC, which was formed in 1919 by chemists from both industry and academia, is also the body that rules on matters such as accepting or rejecting claims for the discovery of new elements and their symbols for addition to the Periodic Table. You may recall how the new elements, flerovium (element 114, symbol Fl) and livermorium (element 116, symbol Lv) were officially added to the Periodic Table last year. IUPAC also has a system for giving codes to identify amino acids and nucleotide bases. For further information about IUPAC and its many functions refer to its website: *www.iupac.org*

Disappointingly, well over half the entries received for 'Competition Corner' in the last edition of *SciTalk* did not correctly identify that IUPAC determines correct chemical nomenclature. So please spread the word to make sure that all chemistry teachers know about IUPAC and are using the current IUPAC rules to correctly name chemical compounds.

★ *2013 editions Past HSC Questions & Worked Solutions ... see p7* ★

## INSIDE THIS ISSUE ▸▸▸▸



## ★★ ATTENTION ★★

After you have read this, please write/tick your name below and pass it on.

☐ 1. .....
☐ 2. .....
☐ 3. .....
☐ 4. .....
☐ 5. .....

*Please return to file or noticeboard.*

## PRIZES TO WIN!

*See pages 1, 9 & 12*

*Send in your entries now*

*(ALL IN THE ONE ENVELOPE if you prefer!)*

**Past issues of *SciTalk* are available at www.odlumgarner.com**

## Book Giveaway

*WIN the new* ***Stage 4:***

***Core Science***

***NSW Australian Curriculum Edition & eBookPLUS***


*Published by Jacaranda (rrp: $79.95 ea)*
*Details at: www.jaconline.com.au*

The new Stage 4 and Stage 5 *Core Science* textbooks offer a comprehensive, flexible teaching and learning program with in-depth coverage of essential and additional NSW Science syllabus content for the Australian curriculum. They include a range of investigations, activities and questions to cater for all types of students. eBookPLUS is an electronic version of the text and a complementary set of digital resources.

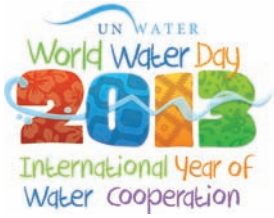
**TO WIN:** Send your name, school & school address (& subject) on an envelope **by 28 June 2013** to: Book Giveaway, PO Box 442, Freshwater 2096

★ ★ ★

**Winner for *SciTalk 4/12***

John Hart, Ivanhoe Central, won *2001–2011 Earth & Environmental Science Past HSC Papers & Worked Solutions (rrp $39)*, published & donated by Odlum & Garner.

# Diary Dates




## 2013 – *International Year of Water Cooperation*

For Shell Questacon Science Circus 2013: sciencecircus.questacon.edu.au/on_the_road.html

### JUNE 2013

| | |
|---|---|
| 3, 7, 14 | Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com |
| 5 | World Environment Day |
| various dates | Nyholm Youth Lectures: Energy for the Future ... at metro & country venues – www.raci.org.au/events/event/the-raci-nyholm-youth-lecture-series-2013 |
| 14, 15 | NSW Schools Titration Competition. www.nswtitration.com/ (see website for regional dates) |
| 21 | Winter Solstice (3.04 pm EST) |
| 28 | Closing date Crystal Growing Comp: www.raci.org.au/events/event/nsw-crystal-growing-competition-2013 Ph: (02) 9663 4960 (RACI) |

### JULY 2013

| | |
|---|---|
| various dates | Nyholm Youth Lectures: Energy for the Future ... at metro & country venues – www.raci.org.au/events/event/the-raci-nyholm-youth-lecture-series-2013 |
| 7–10 | CONASTA 62 in Melbourne: 'Transforming the future through Science Innovation', conasta.edu.au/ |
| 20–27 | National Chemistry Week. www.raci.org.au/national/events/chemistryweek.html |
| 25 | National Chemistry Quiz. www.raci.org.au/ in 'Events'. Details: ph (02) 6331 5125 |

### AUGUST 2013

| | |
|---|---|
| 2 | Jeans for Genes Day. www.jeansforgenes.org.au/ |
| 7 | Chemistry Olympiad Exam. www.asi.edu.au/olympiads/ Close date: 17/7/13. Ph: 6201 2552 |
| 9, 12, 16 | Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105 – come on one of these dates to celebrate National Science Week |
| 10–18 | National Science Week. School theme: 'A Century of Australian Science' www.scienceweek.net.au |
| 12 | Biology Olympiad Exam. www.asi.edu.au/olympiads/ Close date: 17/7/13. Ph: 6201 2552 |
| 14 | Physics Olympiad Exam. www.asi.edu.au/olympiads/ Close date: 17/7/13. Ph: 6201 2552 |

### SEPTEMBER 2013

| | |
|---|---|
| 13, 16 | Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com |
| 14 (tbc) | National Schools Titration Competition (Sydney): www.nswtitration.com/ |
| 23 | Spring Equinox (6.44 am EST) |

### OCTOBER 2013

| | |
|---|---|
| 13–19 | Earth Science Week. www.earthsciweek.org & www.ga.gov.au/education/public-events, ph 6249 9111 |
| 14, 18, 21, 25, 28 | Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com |

### NOVEMBER 2013

| | |
|---|---|
| 1, 11, 15 | Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com |
| 18, 22, 25, 29 | Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com |

### DECEMBER 2013

| | |
|---|---|
| 2–18 | Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com |
| 22 | Summer Solstice (4.11 pm AEDT) |

**JANUARY 2014** National Youth Science Forum. Forms to local Rotary club by 31/5/13, interviews from July. Only for Yr 11 in 2013. Enquiries: 6125 2777, 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.*

## Night Stalk 1 September–16 October 2013

Sponsored by TRONOX

You can help Australian scientists and conservationists to save our native species by taking part in this year's nationwide Night Stalk spotlight survey, sponsored by Tronox.

It's easy, fun and free. Schools can participate by focusing on the numbers and distribution of native animals and feral pests. All you need is a torch and a Spotter's Log. Choose one or more nights between 1 September and 16 October and spotlight in your local bushland. Record all native/introduced animal species: mammals, birds, reptiles and frogs that you find and send your Spotter's Log to Perth Zoo. You can download a Night Stalk Teacher Support Pack to find out how to incorporate conservation into your science program. Student Activity Sheets are also available.

Now in its 15th year, this survey collects information about animals still living in the wild, especially near urban areas, and their distribution over time.

For information: Night Stalk, PO Box 489 South Perth WA 6151 or email the Night Stalk Coordinator, nightstalk@perthzoo.wa.gov.au

Visit www.perthzoo.wa.gov.au/Act/Night-stalk/ to download a Spotter's Log.

## Update on BOS matters

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

**Program builder - to program directly from the new NSW K–10 syllabuses**

You can select outcomes and content from the new NSW K–10 syllabuses for the Australian curriculum to create scope and sequences and units instantly, using the Board's new online programming tool 'Program Builder'.

**Personalised exam materials in a number of HSC examinations**

Biology will be one of the subjects in the 2013 HSC exams that will be given some or all the following: a personalised multiple-choice answer sheet, a personalised question/answer booklet, a personalised writing booklet.

The BOS is continuing to expand the use of such personalised examination materials that are pre-printed with the student's student number, centre number and, generally, the student's name and school. This reduces work for students during the exam, and allows greater efficiency in identification when it is scanned for processing and onscreen marking. [see BOS 24/13].

**New NSW syllabuses for the Australian curriculum**

An interactive version of the new NSW K–10 Science syllabus for the Australian curriculum is available on the BOS website.

Remember, implementation of the new Science syllabus will occur as follows:

- Years 7 & 9 in 2014
- Years 8 & 10 in 2015 (BOS 24/12)

Schools are to use the existing *Science Years 7–10 Syllabus* (updated in 2009) in 2013 [see BOS 37/11].

**BOS enquiries**

Ph: 9367 8111, fax: 9367 8484
Website: *www.boardofstudies.nsw.edu.au/*

### 2013 HSC Examination Dates

| | |
|---|---|
| **18 Oct** | Earth & Environmental Science: 9.25 am–12.30 pm |
| **23 Oct** | Senior Science: 1.55 pm–5 pm |
| **30 Oct** | Chemistry: 9.25 am–12.30 pm |
| **1 Nov** | Physics: 9.25 am–12.30 pm |
| **4 Nov** | Biology: 9.25 am–12.30 pm |

**NOTE: When you purchase Odlum & Garner's Past HSC Questions & Worked Solutions books for Biology, Chemistry and Physics, you are helping to support the production of their Past HSC books for Earth & Environmental Science and Senior Science. Thank you to all the teachers who support these projects.**

# OUT AND ABOUT

## SHIPWRECKS, CORROSION & CONSERVATION

### STAGE 6 CHEMISTRY

This program relates to the *Shipwrecks, Corrosion and Conservation* option. Students attend an AV presentation on conservation and restoration, including footage taken during the recovery of material from HMS *Bounty*. Students then participate in a hands-on workshop focusing on desalination of metal objects, metal and corrosion product identification, methods of protecting metals and rates of corrosion.

This is followed by a guided tour of shipwreck material in the museum. Students may also visit the destroyer HMAS *Vampire* and submarine HMAS *Onslow*.

Program is 4 hours, at a cost of $22.00 per student (teachers free).

**Bookings & Information:**

Phone: 02 9298 3655 Fax: 02 9298 3660
Email: bookings@anmm.gov.au
Location: 2 Murray Street, Darling Harbour
Website: www.anmm.gov.au/

AUSTRALIAN NATIONAL MARITIME MUSEUM

## MUSEUM OF HUMAN DISEASE

2013 EDUCATION PROGRAMS & EVENTS

The Museum of Human Disease is Australia's only publicly accessible medical Pathology collection and offers a unique opportunity for Biology, Senior Science and Junior Science students to gain a deep understanding of body and disease elements in the curriculum.

We offer visits for The Search for Better Health, Communications, Bionics and Junior Science, as well as online resources, Video Conference sessions, regional tours (Albury 30 & 31 July, Port Macquarie 6 & 7 August) and Teacher Professional Development Days (Biology 18 October).

**Further information and bookings:**

**T** 02 9385 1522
**E** diseasemuseum@unsw.edu.au
**W** www.diseasemuseum.unsw.edu.au

MUSEUM OF HUMAN DISEASE

UNSW THE UNIVERSITY OF NEW SOUTH WALES

## Science Centre & Planetarium

University of Wollongong
Squires Way, North Wollongong
Only 45 mins from southern Sydney.

- ★ ***Taking bookings for 2013***
- ★ **Star Trails Outreach Program** – visiting schools with Planetarium Shows and interactive Science Shows.
- ★ We have an extensive range of ***shows & exhibits***, including:
  - **The Machine**
  - **Stellar Evolution** – planetarium program for HSC Physics
  - **Superconductors & Liquid Nitrogen** – live science show
  - **Energy and Motion**
  - **Changing Worlds and Visions**
  - **Nanotechnology**
- ★ 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 an excursion. Information/bookings: 02 4286 5000 Website: *http://sciencecentre.uow.edu.au*

## IMAX THEATRE SYDNEY

31 Wheat Rd, Darling Harbour, Sydney 2000

WORLD'S BIGGEST IMAX DARLING HARBOUR

### ★ HIDDEN UNIVERSE 3D

*Opens September 2013. School Bookings available now.*


This film takes us on a breathtaking tour of deep space in a way that only IMAX does best. Our universe is brought to life on the giant screen with unprecedented clarity through mesmerising, real images captured by the most powerful telescopes on Earth and in space.

Explore spectacular galaxies and travel the terrain of Mars, witness images of distant celestial structures including stunning images of our Sun, and peer deep inside vivid clouds of nebula to see previously unseen forms. Journey back further into space to learn secrets that until recently were completely hidden, providing a whole new insight about how the universe was formed. Discover amazing clues that reveal the stars in the night sky are not only tiny specks of light but actual opportunities for life to exist on other planets. In an age where space tourism has become reality, the film offers an inspiring story of human endeavour from a prime seat with a magnificent point-of-view.

Ph: (02) 9213 1600 Email: education@imax.com.au
Book online at: www.imax.com.au/schools

## WHY NOT COMBINE A FUN PARK EXCURSION BOOKED THROUGH PHYSICS IS FUN WITH SEEING A FILM AT IMAX?

Combine your Fun Park Excursion at Luna Park Sydney booked through **PHYSICS IS FUN** with a visit to IMAX for a great action-packed, fun time of interactive learning.

- **DETAILS:**
  IMAX: www.imax.com.au/schools
  FUN PARK EXCURSION (through Physics is Fun): www.odlumgarner.com
- **WHAT TO DO:** Allow 1 hr for IMAX (any film), then 2–3 hours for Physics is Fun at Luna Park (rides open at 11 am, Mon/Fri + any school day in December)

BOOK & PAY SEPARATELY FOR EACH EXCURSION

## National Science Week

### 10–18 August 2013

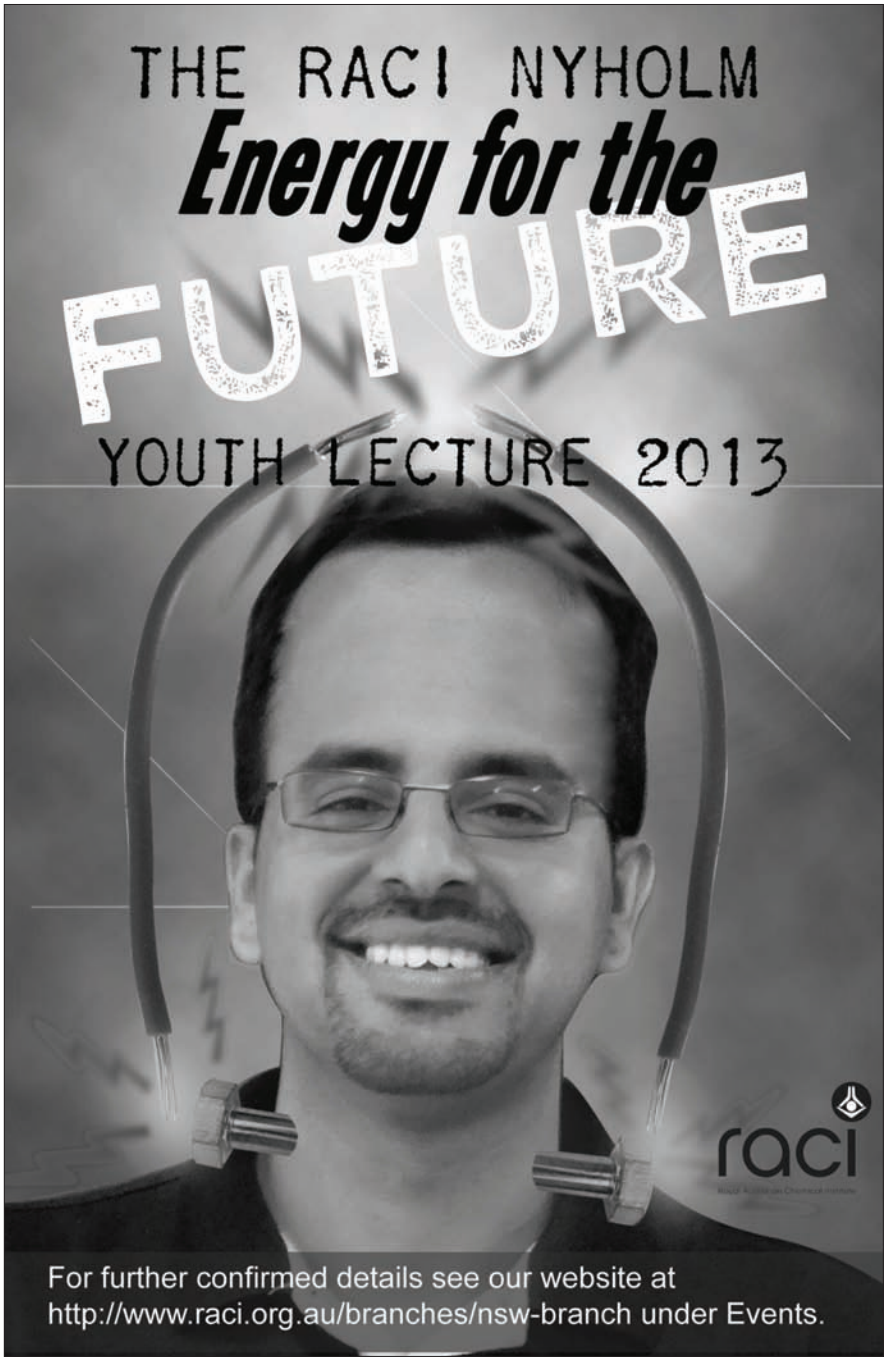
NATIONAL SCIENCE WEEK

This is an annual celebration of Science in Australia. Join in to enjoy and explore the wonders and benefits of Science.

There will be many Science Week happenings. For more details, go to:

*www.scienceweek.net.au*

Why not celebrate this year's National Science Week by going on an Science excursion? You could go a fun park excursion through *Physics is Fun* to Luna Park Sydney on 9, 12 or 16 August 2013, or visit one of the other excursion venues on this page for National Science Week.




## Threat to monarch butterflies

Have you seen the amazing IMAX 3D film *Flight of the Butterflies*? If so, you will know about the annual long distance migration of the monarch butterfly.

This is the only butterfly to migrate both north and south as birds do regularly, but no individual makes the entire round trip. Monarchs go through four stages during one life cycle, and four generations in a year. Each generation goes through the same stages from egg to larvae to pupa to adult, except that in the fourth generation, the adults do not die two to six weeks after they become beautiful monarch butterflies. Instead, when autumn arrives, they migrate southward to the warmer climates of Mexico or California, where they hibernate for six to eight months. Then in spring, they come out of hibernation to find a mate. The butterflies then migrate northward to Canada and North America to lay their eggs. This starts stage one of the first generation, and is followed by the second and third generations. The eggs for each generation are laid on milkweed plants and the larvae feed on the milkweed in order to grow.

However, milkweeds are rapidly disappearing due to the use of herbicides. A University of Minnesota study has attributed a decade-long decline in monarchs to the loss of milkweed from the soybean and corn fields that blanket the Midwestern area. Last year saw the lowest number of monarchs making their iconic southward trek. A census by the World Wild Fund for Nature (WWF) revealed a drop in numbers by 59% since 2012. To overcome this problem it is hoped that more milkweed can be grown in garden plantings, prairies, and roadsides.

Figure 1 Female monarch butterfly
– by Kenneth Dwain Harrelson

*[Sources: NewScientist 23 March 2013; www.monarch-butterfly.com; www1.umn.edu/news/ (2011)]*

## Activity on the Sun affects Earth and space

Eruptive events on the Sun can be wildly different. The Sun is always active – from sunspots, to solar flares, to the ejection of solar material – called a coronal mass ejection (CME). Some events include complex moving structures in association with changes in the magnetic field lines that loop up into the Sun's atmosphere, the corona. Such events can play havoc both on Earth and in space. For example, they can result in damage to power systems, disrupt communications, degrade high-tech navigation systems, or create the spectacular aurora (the Northern and Southern lights).

On 19 July 2012, an eruption occurred on the Sun that produced a simply amazing display. A moderately powerful solar flare exploded on the Sun's lower right hand limb, sending out light and radiation. Next came a CME, which shot off to the right out into space. And then, the Sun treated viewers to one of its dazzling magnetic displays – a phenomenon known as coronal 'rain'.

What falls in coronal 'rain' is not water, but rather, the extremely hot plasma in the Sun's corona. As this plasma cools and condenses, its electrically charged particles (electrons, protons and ions) are channelled along the invisible magnetic loops near the Sun's surface. They show up brightly in the extreme ultraviolet wavelength of 304 Angstroms, which highlights material at a temperature of about 50,000 Kelvin. This plasma acts as a tracer, helping scientists watch the dance of magnetic fields on the Sun, outlining the fields as the plasma slowly falls back to the solar surface.

This event was captured by NASA's Solar Dynamics Observatory's AIA instrument. The official NASA video of this event, with music added to it by Lars Leonhard can be viewed at: *www.youtube.com/watch?v=HFT7ATLQQx8&feature=youtu.be* Each second in the time lapse video takes about 6 minutes in real time, so that the entire coronal rain sequence lasted about 10 hours.

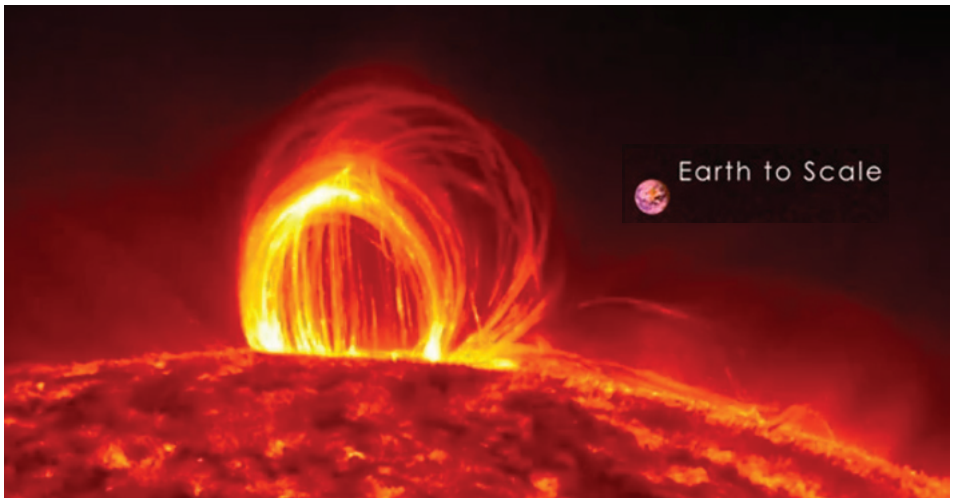



Figure 2 'Fiery looping rain' on the Sun
[Image by NASA/SDO]

## Meteor trace from asteroid entering Earth's atmosphere

A small asteroid entered Earth's atmosphere over the Urals near Chelyabinsk in Russia on 15 February 2013, forming a large, exceptionally brilliant fireball – the Chelyabinsk meteor. The dazzling light of the meteor was brighter than the Sun. It was so bright that many scientists are referring to it as a superbolide.

The asteroid, about 17–20 metres in size and 10,000 metric tons, entered Earth's atmosphere at high speed (between 15–18 km $s^{-1}$) and at a shallow angle. The energy of the resulting explosion exceeded 470 kilotons of TNT. By comparison, the Hiroshima atomic bomb was approximately ten kilotons.

The explosion from the meteor disintegrating occurred at about 20–30 kilometres above Earth and generated a bright flash. This resulted in a shower of stony meteorites that fell to Earth in an impact region more than 100 kilometres long. It also resulted in a powerful shock wave that caused damage to many buildings and shattered windows. This resulted in about 1,500 people being injured, mainly from flying glass. The meteor was observed over a wide area of the region and in neighbouring republics. Eyewitnesses also felt intense heat from the fireball.

As a meteor passes through the Earth's atmosphere, it burns up at extremely high temperatures due to friction with the air, thus leaving behind a distinctive white meteor trace. This process also ionises the air along the trail. The Chelyabinsk meteor trace shown in Figure 3 was captured from a distance of about 200 km, about one minute after the photographer, Alex Alishevskikh, saw the blast.

Imagine if this meteor had occurred over a major city such as New York, Tokyo or even Sydney. Inevitably, this will happen sooner or later. Our Earth is littered with numerous reminders of its violent past, many of which are over 20 kilometres in diameter and occurred between 20–500 million years ago. The Chelyabinsk meteor is the largest known natural object to have entered Earth's atmosphere since the 1908 Tunguska event which destroyed a wide, remote forest area of Siberia.

Interestingly, investigations into the composition of the meteorites and the asteroid's path show that it probably originated somewhere between Earth and Mars, and that there was no connection between the Russian fireball event and the close approach of asteroid 2012 DA14, which occurred just over 16 hours later.

Figure 3 Chelyabinsk meteor trace
[Image by Alex Alishevskikh]

# NEW 2013 editions: Past HSC Papers with Worked Solutions

**All books include: PAST HSC QUESTIONS BY TOPIC GUIDE**

• *Biology* • *Chemistry* • *Physics*
• *Senior Science* • *Earth & Environmental Science*

**20% discount for bulk orders***

- **PAST HSC QUESTIONS BY TOPICS guide for all questions in all HSC papers** – this allows students to **revise topic by topic, or to use the actual HSC exam papers**
- Complete HSC exam papers with ALL QUESTIONS & **ALL OPTIONS** – PLUS sample answer sheet for Multiple Choice questions
- WORKED ANSWERS to **all** the Core and **all options** – would score full marks AND are an **appropriate length**, with full EXPLANATIONS for all multiple choice questions
- Periodic Table, Data Sheet (Phys/Chem), Formulae Sheet (Phys), Geological Time Scale (EES)

**PLUS**
- GUIDE ON HOW TO ACHIEVE SUCCESS in each of these subjects
- GLOSSARY OF EXAMINATION TERMS
- SKILLS REQUIRED FOR INVESTIGATIONS


*Top HSC students and Science teachers use and recommend Odlum & Garner books.*
*These books are produced by Science teachers for Science teachers & their students*

| Odlum & Garner | Title | ISBN | RRP | ORDER |
|---|---|---|---|---|
| **2001–2012 books:** | 2001–2012 Biology Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 13 5 | $39 | |
| | 2001–2012 Chemistry Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 14 2 | $39 | |
| | 2001–2012 Physics Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 15 9 | $39 | |
| **2007–2012 books:** | 2007–2012 Biology Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 16 6 | $27 | |
| | 2007–2012 Chemistry Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 17 3 | $27 | |
| | 2007–2012 Physics Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 18 0 | $27 | |
| **Earth Science:** | 2001–2011 Earth & Environmental Science Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 11 1 | $39 | |
| | 2009–2011 Earth & Environmental Science Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 12 8 | $23 | |
| **Senior Science:** | 2001–2011 Senior Science Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 10 4 | $39 | |
| | 2009–2011 Senior Science Past HSC Papers with Worked Solutions ... NEW | 978 1 921741 09 8 | $23 | |

Name: .....

School: .....

Address: .....

..... Postcode: .....

Phone no: .....

School orders can be invoiced if a School Order Form is sent.
All personal orders need to send payment or Credit Card details (Mastercard or Visa only) with order. Make cheques to 'Odlum & Garner'.

Name on credit card: .....

Card No: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ Expiry date: __ __/__ __

**Send to:** Odlum & Garner (ABN 54 942 891 924)
PO Box 442, Freshwater NSW 2096
Ph: (02) 9939 6107 Fax: (02) 9939 6105
Email: robert@odlumgarner.com
www.odlumgarner.com

***20% discount & FREE freight**
***for orders of 15+ books (may be mixed)***
***All other orders – $9 delivery charge***

*Odlum & Garner books are also available from educational booksellers.*

2/13.CLO

# Tardigrades – a water bear, moss piglet or an alien?

... by Katrina Garner

When teaching about extreme organisms we tend to launch into the prokaryotic domain of archaea and bacteria living in unusual places. However, we rarely think of the humble water bear (also known as the tardigrade). The water bear is most commonly found sucking water from lichens and moss, and with a little help from NASA and the European Space Agency (ESA), has taken on the role of being a 'lab-rat' in space.

Tardigrades are mysterious and fascinating creatures. All life on Earth is based on water. The water in our cells constantly needs to be replenished, and a lack of water is fatal. However, tardigrades have evolved to be able to survive a loss of water – in essence, to cheat death until water reappears – as they can survive in a dehydrated state for many years. Wild theories have speculated that they originate from other planets. However, most scientists concur that they evolved here on Earth. So if tardigrades are not alien, what are they?

Tardigrades are 'extremophiles'. They are able to withstand some of the toughest conditions. Although only a fraction of a millimetre in length, tardigrades are nearly indestructible. They can survive extreme temperatures as low as -200°C without freezing as well as upwards to 151°C. They can withstand well over 1000 times atmospheric pressure, as well as the vacuum of space. If you were to step outside a spaceship in orbit, your lungs would expand in a matter of seconds and you would explode. (Do you remember that scene in 'Event Horizon'?)

Over 700 species of tardigrades belong to the Phylum Tardigrada, which is closely related to the Phylum Arthropoda (insects, arachnids, etc). The name 'tardigrades' is derived from the Greek *tardus* (slow) and *gradus* (step), while their nickname 'water bear' refers to their slow waddle, which is reminiscent of a bear. Tardigrades live in aquatic or moist terrestrial habitats, especially in moss and lichen. Hence they are sometimes referred to as 'moss piglets'. Tardigrades have been found in exotic locations such as in hot springs and on top of the Himalayas, as well as more day-to-day places such as lakes, ponds and meadows.

Tardigrades are mostly herbivores, feeding on moss, microscopic phytoplankton and cyanobacteria. Some feed on bacteria, while others attack nematodes, rotifers and other tardigrades that share their habitat. Tardigrades have short, cylindrical bodies, with a head plus four segments and four pairs of non-jointed legs, each with four to eight claws. Tardigrades have no respiratory organs – gas exchange occurs across their moist body surface.

Tardigrades made their debut space voyage in 2007 on the ESA's Foton-M3 mission, during which time they were outside the shuttle for 10 days. For the Doctor Who fans out there, you will be pleased to know the ESA's 2007 'TARDIgrades In Space' research was officially abbreviated to 'TARDIS'. This mission showed that most of the tardigrades were resistant to the cosmic radiation and oxygen-deprivation they experienced in the vacuum of space. Some even showed that they were still able to reproduce fertile offspring when back on Earth. Of the tardigrades that were also exposed to ultraviolet radiation (UV), only a few survived. This was not surprising as UV damages cellular material and DNA. Before this experiment, only lichen and bacteria were known to be able to survive exposure to the combination of a vacuum and ionising radiation, as in space. In May 2011, Italian scientists sent tardigrades into space along with other extremophiles on STS-134, the final flight of Space Shuttle *Endeavour*. The survival of these tardigrades indicated that they were not significantly affected by microgravity and cosmic radiation, confirming that tardigrades represent a useful animal for space research.

So what is the secret to the survival of tardigrades? It has been found that tardigrades can undertake cryptobiosis. This process is somewhat similar to hibernation, but to a more extreme level, whereby all metabolic processes come to a reversible standstill until suitable environmental conditions return. In dry conditions, tardigrades survive by curling up into a little ball called a tun. Tun formation requires the metabolism and synthesis of a protective sugar known as trehalose, which moves into the cells and replaces lost water. While in a tun, their metabolism can lower to less than 0.01% of normal. Revival typically takes a few hours, depending on how long the tardigrade has been in the cryptobiotic state. Once they are re-moistened, they successfully recover from their tuns. In freezing conditions, such dehydration to form a tun ensures that the body of a tardigrade does not get ripped apart by freezing ice, as water expands on freezing. Another adaptive feature that makes tardigrades so durable is their ability to repair their own DNA, which allows them to survive ionising radiation.

Want to share tardigrades with your class? There are a number of videos featuring tardigrades on YouTube, e.g. if you search for 'Tardigrades adorable extremophiles' you will find a great four-minute video introducing tardigrades by the SciShow.

Figure 4 Ventral (lower) surface views of adult tardigrades (*Hypsibius dujardini*) ... by Willow Gabriel and Bob Goldstein using a scanning electron microscope

Figure 5 Tardigrade (*Hypsibius dujardini*)
... by Dr Diane Melson (US National Park Service)

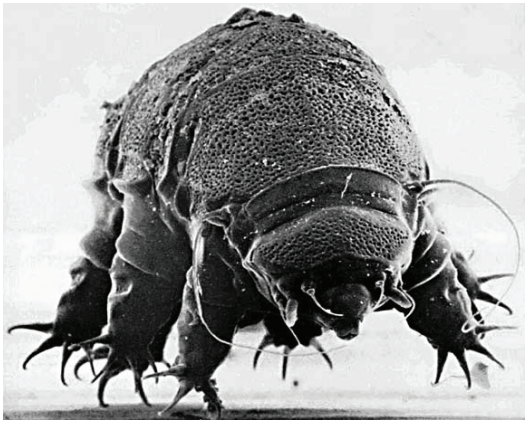


Figure 6 Tardigrades have eight non-jointed legs, each with claws.

**Sources**


- Guidetti, R., Altiero, T. & Rebecchi, L. (2011). On dormancy strategies in tardigrades. *Journal of Insect Physiology*, 57:5, 567-576
- Guidetti, R., Rizzo, A., Altiero, T. & Rebecchi, L. (2012). What can we learn from the toughest animals of the Earth? Water bears (tardigrades) as multicellular model organisms in order to perform scientific preparations for lunar exploration. *Planetary & Space Science*, 74:1, 97-102
- tardigrades.bio.unc.edu
- spaceref.com/news/
- serc.carleton.edu/microbelife/topics/tardigrade/index.html
- UV Radiation Tolerance of Tardigrades: astrobiology.nasa.gov/seminars/

## Science Snippets

### • Gene therapy cures leukaemia in eight days

Within just eight days of starting a novel gene therapy, David Aponte's 'incurable' leukaemia disappeared. Similarly, for a few other patients, who had also been diagnosed with acute lymphoblastic leukaemia, the same happened within eight weeks. These patients have now been in remission for between 5 months and 2 years. So scientists are hoping to undertake further trials and to treat other cancers.

In acute lymphoblastic leukaemia, immune cells called B-cells become malignant. The scientists were able to target a surface molecule known as CD19 that is only present on B-cells. Doctors extracted other immune cells called T-cells from the patients. These were treated with a harmless virus, which installed a new gene redirecting them to attack all cells bearing CD19. When the engineered T-cells were reinfused into the patients, they rapidly killed all B-cells, cancerous or otherwise. So the key to the new therapy is identifying a molecule unique to the surface of cancer cells, then genetically engineering a patient's immune cells to attack it.

[Source: *NewScientist 30 March 2013*]

### • Problem as Antarctic ice is both growing and melting

While Arctic sea ice has dropped more than 15%, Antarctic ice has risen by 5%. It would appear that ocean water below a depth of 100 metres has been getting warmer, in line with rising ocean temperatures worldwide, but surface waters and the air above have become cooler. The deep warm water is melting the shelves of floating ice that extend from the continent, resulting in more icebergs. These icebergs are creating a layer of cool surface water that insulates the remaining floating ice from warm deep currents. This is resulting in the build-up of Antarctic ice.

However, satellite images show that ice melt in other parts of Antarctica is at its highest level this millennium. An ice core taken from the west Antarctic Peninsula shows ice is melting ten times faster each summer than it did 600 years ago. This core came from the tip of the west Antarctic Peninsula, an area that is warming rapidly. What's more, most of the increase in melting has occurred since the mid-20th century.

More ice should mean no increase in sea levels, while surface melt is thought to cause sea levels to rise. So what will happen to sea levels in the Antarctic due to global warming is still being debated.

[Source: *NewScientist 30 March & 20 April 2013*]

### • New vaccine for foot and mouth disease

Foot-and-mouth disease remains a major plague of livestock and outbreaks are often economically catastrophic. Until recently, the only vaccine available for preventing foot and mouth disease in cattle was a whole, deactivated version of the virus. Vaccinated cattle react to it by producing the same protective antibodies that they would if they were infected by the live virus – making them indistinguishable from infected cattle. This vaccine did not help countries that export cattle. It meant that only countries declared free of foot and mouth could export cattle, because to testers, a vaccinated herd looks infected.

A new synthetic version of the vaccine has recently been developed. It produces a different antibody signature. To make it, scientists inserted the genes coding for the virus's outer shell into moth cells. The moth cells pumped out inanimate outer shells, without the genetic core that allows the live virus to infect cells, multiply and spread. Vaccinated herds only produce antibodies against this shell, whereas genuinely infected animals produce antibodies to the core as well. The new vaccine will allow the development of diagnostic tests to discriminate between infected and vaccinated animals.

[Source: *NewScientist 16 April 2013*]

### • Pre-op diet tip

It has been found that the preoperative diet in rodents impacts the way their adipose tissue responds to surgical trauma. Rodents given a high-fat diet were more likely to experience chemical imbalances and inflammation after an operation than those fed normally. So calorie restriction may be an inexpensive way to help protect the body from the stress of an operation.

> Science is a great game. It is inspiring and refreshing. The playing field is the universe itself.
>
> … Isidoe Isaac Raabi

### Are you interested in the history of Luna Park Sydney?

WIN


Sam Marshall's book *Luna Park Just for Fun* celebrates all the fun provided by Sydney's Luna Park since it opened in 1935. With many historical and colourful photos, this book follows the sometimes rocky history of Sydney's famous landmark amusement park – including the fire in the late seventies and the saga with the reopening in 2004.

To win a copy of this book (rrp $17.95) from Physics is Fun, send your name, school & school address on an envelope **by 28 June 2013** to:

*Physics is Fun Book Offer, PO Box 442 Freshwater NSW 2096*

### WIN A FAMILY PASS TO IMAX

WIN

IMAX Sydney, at Darling Harbour, is open every day. More than 8 storeys high, it has the world's biggest cinema screen to give the ultimate film experience. IMAX films are entertaining and educational. They constantly change and cover a range of themes. Resource materials & teacher guides are provided.

★ ✧ ★ ✧ ★ ✧ ★

**TO WIN A FAMILY PASS* TO IMAX** (for 2 adults and 2 children worth $88) … send in your name, school, & school address on an envelope **by 28 June 2013** to:

*IMAX Give Away, PO Box 442, Freshwater NSW 2096*

* This pass will be valid for any one film for any session, except public holidays/films advertised as 'no free list'. Details at: *www.imax.com.au*

**WINNER:** Helen Foster, Riverina Anglican College, won an IMAX Sydney family pass for *SciTalk No. 1–2013*.

### WIN A FAMILY PASS TO LUNA PARK SYDNEY

WIN

One lucky family can win this special offer through Physics is Fun and Luna Park Sydney. To find out more about Fun Park Excursions for schools, go to the Physics is Fun website at:

*www.odlumgarner.com*

* * * * *

**TO WIN A FAMILY PASS TO LUNA PARK SYDNEY**

(unlimited ride passes for 2 adults & 2 children worth $179.80) … send in your name, school, & school address on an envelope **by 28 June 2013** to:

*Physics is Fun - Luna Park Sydney Teacher Offer*
*PO Box 442, Freshwater NSW 2096*

**WINNER:** Toni Edwards, Forbes High, won a Luna Park Sydney family pass for *SciTalk No. 1–2013*.

Astronomy

# Winter Night Skies

... Robert Garner

**The night skies get dark earlier in Winter, and so provide more viewing time. So get out your binoculars and sky charts for some great viewing at this time of the year.**

## Constellations

At the start of June, low in the western sky soon after nightfall, we have our last look at the brightest star in the sky, Sirius, before the constellation of *Canis Major* (the Great Dog) disappears from the sky for the winter. Above and to the south of Sirius, Canopus in the constellation *Carina* (the keel) is the second brightest star of the night sky and is always visible.

Sirius is about 9 light years (ly) away, while Canopus about 310 ly from Earth. So although Sirius and Canopus 'appear' to have similar brightness, Canopus is in fact much brighter, as it is 35x further away than Sirius. Canopus is a supergiant star about 100x the diameter of our Sun and giving off about 10,000x the energy of the Sun.

Looking further to the south and close to the southern horizon is the bright star Achernar in the constellation *Eridanus* (the river). Immediately above Achernar, you will see *Crux* (the Southern Cross) in its winter orientation. At this time of the year, *Crux* is at its highest point in the sky with the two pointers lying to the east of *Crux*.

Remember that the open cluster called the Jewel Box is a good binocular object to find between the two brightest stars of *Crux* and $\alpha$ Centauri is easily resolved as a double star with binoculars.

Looking eastward in the sky, the bright red star, Antares in *Scorpius* (the scorpion) is easy to identify, as *Scorpius* is one of the few constellations that can be easily seen to resemble its namesake. Below *Scorpius* lies the teapot shape of the constellation *Sagittarius* (the archer). *Sagittarius* gives the direction of the centre of our galaxy, the Milky Way galaxy, some 26,000 ly distant.

## Meteor Showers

The theta-Ophiuchids can be observed until mid-June, with best viewing in the northwest pre-dawn sky around 10–11 June. Using a star map to locate the Ophiuchus constellation will help you to locate these meteor showers. The Perseids (17 July–August 24) are worth looking out for in the pre-dawn sky this year with favourably dark skies near their peaks.

Remember that meteors are better seen pre-dawn than in the evening, because in the pre-dawn, the morning sky is facing the Earth's motion in space.

### MACQUARIE UNI OBSERVATORY & PLANETARIUM PUBLIC FRIDAY NIGHT OBSERVING

The Macquarie University Observatory (access via Gymnasium Rd) is open to the public every Friday night (March–Nov inclusive). It opens 8–9.30pm (in AEDT) or 7–8.30pm (in non-AEDT).

Bookings are essential and must be done online at: *physics.mq.edu.au/community/observatory/* If doubtful weather, check online after 5pm.

You will be guided through the night sky by professional astronomy staff, who will show you planets, binary stars, nebulae, star clusters, and even bright galaxies through their 16" and 12" professional in-dome telescopes. Even with the light pollution of the city, you can easily see such features of the night sky. The Moon and planets, when in suitable positions, are easily viewed with any of their instruments. On dark, moonless nights with good seeing, you may also observe the brightest galaxies.

There are two **planetarium sessions** per semester on Friday nights from 6–7pm ... in the E7B Courtyard at Macquarie Uni. Tickets must be booked online at: *physics.mq.edu.au/community/planetarium/#sessions*

## The Planets

With the start of winter, Mercury, Venus and Jupiter are visible in the western sky at dusk. Jupiter will be near the horizon with Venus and Mercury in a line above it. On successive nights, Jupiter will be seen lower towards the horizon, soon to disappear in the Sun's light as it approaches conjunction on 20 June. Venus and Mercury stay close in the sky throughout June and are only 2° apart from 20–23 June. On 13 June, Mercury will be at its greatest height above the horizon. Mercury remains visible in the evening sky until the beginning of July. It reappears at the end of July in the morning sky after passing between the Earth and the Sun at inferior conjunction on 10 July. Mercury disappears again in August to return to the evening sky in September. Venus remains as the evening star in the western evening sky throughout the winter months.

Mars is visible in the north-eastern pre-dawn sky throughout winter. Initially Mars is in *Taurus* before moving into *Gemini* in July and into *Cancer* at the end of August. The red planet is in a good position in the sky to compare it with the two red giant stars, Aldebaran in *Taurus* and Betelgeuse in *Orion*.

Saturn is high in the northern sky at 9 pm at the start of winter moving to the north western sky by August.

## Winter Solstice

This occurs at 3.04 pm on Friday 21 June and is when the Sun will reach its most northerly position for 2013. Thereafter, the daylight hours will begin to lengthen again with each passing day, even though the difference initially is only a few seconds from one day to the next.

## Using a Sky Chart / Planisphere

Remember, viewing the night skies is much simpler if you have a Sky Chart or Planisphere. See Box 1 about easily obtaining one of these.

### Box 1: Sky Charts & Planispheres

- You can download free sky charts each month to explore the night sky (planets, stars & constellations) from: *http://skymaps.com/downloads.html* Make sure you scroll to 'Southern Hemisphere Edition'.
- A planisphere (star wheel) helps to find *stars* and locate *constellations*. These 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/resources.html*

The best thing to give to your enemy
is forgiveness; to an opponent, tolerance;
to a friend, your heart; to your child,
a good example; to a father, deference;
to your mother, conduct that will make
her proud of you; to yourself, respect;
to all men, charity.

... Benjamin Franklin

# Exam Choice

ABN 56 345 318 164

**Fax: 02 9975 1886**
**PO Box 71 Forestville NSW 2087**

## Trial and Preliminary Science Exams

Exam Choice is a group of teachers highly experienced in all facets of the exam process. Once again we are producing **Trial and Preliminary Science Exams** which:

- assess over the **full range of performance** and are mapped to outcomes and the syllabus
- come with **clear marking guidelines** and **sample answers.**

Our **Year 10 Science Examination** proved popular last year and we shall be producing another for 2013. It will test Stage 5 outcomes and will be of a similar style and format to the old School Certificate. This paper will be free with all orders of six or more of our other papers.

Complete the order form below and fax this sheet back to us.

**Contact Person** .....

**Phone No.** ..... **Fax** .....

**School** .....

**Delivery Address** .....

..... **Postcode** .....

| | Price | Tick to order |
|---|---|---|
| Biology Trial | $85 | |
| Biology Preliminary | $75 | |
| Chemistry Trial | $85 | |
| Chemistry Preliminary | $75 | |
| Physics Trial | $85 | |
| Physics Preliminary | $75 | |
| Senior Science Trial | $85 | |
| Senior Science Preliminary | $75 | |

| | | |
|---|---|---|
| Year 10 Examination | **$100**<br>Or free when ordered with 6 or more other papers | |

Total cost of order

All prices include delivery, are current for 2013 and are not inclusive of GST. (10% GST will be added to invoice)

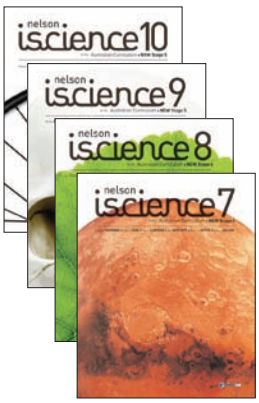
All papers will be delivered in **Week 1 of Term 3**. Invoices will be sent with the papers. Papers can be used as exams at any time after delivery, but are not to be released to students before 12 August (Trial), 16 September (Preliminary) or 28 October (Year 10 Exam).

| | |
|---|---|
| In response to feedback, we will be supplying our papers just in electronic format this year. They will be mailed to schools on a CD. Schools also requiring blackline master paper copies can still obtain them, free of charge, by ticking the box to the right. | |

# COMPETITION CORNER

WIN a *Nelson iScience Year 7* Textbook & Activity Book:

## *Nelson iScience NSW for the Australian Curriculum*




Designed in consultation with practising NSW teachers and authored by experienced teachers, this series captures the depth and scope of the NSW syllabus for the Australian Curriculum. It integrates Web 2.0 technology suggestions for students for investigating, analysing, summarising and presenting. Higher-order thinking skills, inquiry and student-centred learning are reinforced in every chapter through creative activities and questions that follow Bloom's revised taxonomy. Teacher resources will be available to support each year level ... as either a printed book or digitally. Supporting activity books will be available separately for Years 7 and 8. For more information, go to: *www.nelsonsecondary.com.au*

**HOW TO ENTER: Send an answer to the Quiz Question, your name, school and school address on an envelope to: Competition Corner, PO Box 442 Freshwater 2096 – by 28 June 2013.**

**QUIZ QUESTION:** What name is given to a huge cloud of interstellar gas and dust?

*SciTalk 1/13 answer: International Union of Pure & Applied Chemistry [or IUPAC]*

**Winner for *SciTalk 4/12*:** The *Pearson Science 10* books, published & donated by Pearson Australia, were won by Sylvia Lane, Epping Boys HS.



**SUBSCRIPTIONS** ... ***SciTalk* is available FREE to all secondary science faculties in NSW and the ACT. It is also published on our website. If you would like to receive your OWN personal copy of *SciTalk*, subscriptions are available for $20/4 issues or FREE if emailed to you. Please send either your email address or a cheque for $20 + GST = $22.00 (to *SciTalk*), plus your name, address & phone number, to receive the next four issues of *SciTalk*.**


## *SciTalk*

***SciTalk* is a newsletter produced for secondary Science educators. Now in its 19th year, it has been produced quarterly by Odlum & Garner as a service to Science teachers since 1995. It is sent FREE-of-charge to all secondary Science faculties in schools and TAFEs 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, and more.**

**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:**

**www.odlumgarner.com**




## CONTRIBUTIONS

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

CLOSING DATES

- ***SciTalk* No. 1–January 2013 ... Dec 21**
- ***SciTalk* No. 2–May 2013 ... April 12**
- ***SciTalk* No. 3–August 2013 ... June 28**
- ***SciTalk* No. 4–October 2013 ... Sept 20**

## ADVERTISING & INSERTS

**All enquiries to the *SciTalk* Editor:**

**Catherine Odlum**
**PO Box 442, Freshwater NSW 2096**
**(34 Ocean View Rd Freshwater 2096)**
**Ph 02 9939 6107 Fax 02 9939 6105**
**Email cathie@odlumgarner.com**
**ABN 54 942 891 924**

The opinions expressed in *SciTalk* are those of the contributors, and do not necessarily represent those of either the Editor or the publisher.