Providing support and promoting excellence in science education

SciTalk

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Number 1 – February 2015

2015 is the International Year of Light

The UN has declared 2015 to be the International Year of Light (IYL). IYL aims to raise awareness of how light and light-based technologies promote sustainable development and provide solutions to worldwide challenges in energy, education, agriculture, communications and health.

Light has revolutionised our lives in so many ways, e.g. developments in optometry and medicine include improved imaging using MRI, ultrasound, etc and endoscopies that help in diagnosis and treatment of disease. Laser technologies are now indispensable in our daily lives – from scanners at grocery shop checkouts to playing CDs and in telecommunications. Where would communication be today without the internet? Light provides us with entertainment through fireworks and laser light shows, it allows solar lighting, electricity production from photovoltaic cells and security, amongst other things.

Light plays a vital role in our daily lives. In fact, all life depends on the light of photosynthesis. Light is all around us in the natural world, from sunsets and rainbows, to the amazing array of colours in plants and animals. Artists for centuries all over the world have captured light and shade and colour, e.g. to create artworks, stained glass windows, in photography and cinematography.

There are many ways that Science teachers can get involved in IYL, whether it is educating your students, or just putting your smartphone to good use. There are some great Science articles, links to educational materials, ideas for hands-on involvement and some ready-made presentations to make it easy for you to participate, on the international IYL website at: *www.light2015.org/* and on the Australian IYL website at: *light2015.org.au*

Inspired by IYL, the theme for schools for National Science Week this year (15–23 August) is *Making waves – the science of light*. More information about this will be available soon at: *www.scienceweek.net.au/schools/*

Did you notice the giant light bulb placed on the Sydney Harbour Bridge during the New Year's Eve Fireworks? This was done to help mark the beginning of IYL.

During the year, there will both scientific and cultural events tied in with IYL at several venues across the country. Events like *Enlighten* in Canberra during Autumn, *VIVID* in Sydney in May/early June, and *Light in Winter* in Melbourne in June will celebrate all things light from optics to astronomy to art and architecture.

If you would like to read about why the theme of 'light' was chosen for 2015, go to page 4 of this *SciTalk*.

INTERNATIONAL YEAR OF LIGHT 2015

★ *2015 editions Past HSC Questions & Worked Solutions ... see p7* ★

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★★ ATTENTION ★★

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

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

Please return to file or noticeboard.

PRIZES TO WIN!

See pages 1, 6 & 12

Send in your entries now

(ALL IN THE ONE ENVELOPE if you prefer!)

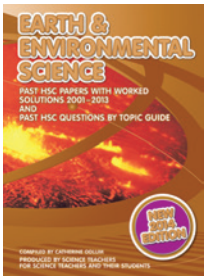
Past issues of *SciTalk* are available at www.odlumgarner.com

Book Giveaway

WIN a copy of ...

WIN

Earth & Environmental Science 2001-2013 Past HSC Papers



Also available as a 2008-2013 book ... published by Odlum & Garner (see page 7)

This book includes a ***Past HSC Questions by Topic Guide*** for ALL papers, so students can revise topic by topic or use the actual exam papers. It contains complete copies of ALL 2001–2013 exams with ALL questions, diagrams, etc, plus worked answers that are *an appropriate length* and would score full marks, a guide on *How to Achieve Success in the HSC*, and more. For more details about the Biology/Chemistry/Physics/Senior Science books in this series, go to:

www.odlumgarner.com

TO WIN: Send your name, school & school address on an envelope **by 2 April 2015** to: Book Giveaway, PO Box 442, Freshwater 2096

★ ★ ★

Winner for *SciTalk 4/14*

Anna Atkinson, Binnaway Central won *Senior Science Past HSC Papers & Worked Solutions 2001-2013 (rrp $39.95)*, published by Odlum & Garner.

Diary Dates

2015 International Year of Light 2015: *www.light2015.org/*

For Shell Questacon Science Circus 2015:
www.questacon.edu.au/outreach/programs/science-circus

FEBRUARY 2015

27 Schools' Clean Up Australia Day. www.cleanup.org.au/au/

MARCH 2015

1–7 National Seaweek 2015. www.mesa.edu.au/seaweek.asp & www.ausmepa.org.au

20, 23, 27, 30 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105

21 Autumn Equinox (9:45 am AEDT)

APRIL 2015

24, 27 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105

22 International Earth Day. www.earthday.org

tba Astronomy Open Night & Lectures: Macquarie Uni, www.physics.mq.edu.au/astronomy

MAY 2015

1, 22, 25 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105

b/w 20–27 Big Science Competition: www.asi.edu.au/bigscience/ Ph: 62012552

JUNE 2015

1, 5, 12, 26 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

5 World Environment Day

22 Winter Solstice (2:38 am AEST)

26 Closing date Crystal Growing Competition: www.raci.org.au/branches/nsw-branch

JULY 2015

5–8 CONASTA 64 in Perth: 'Science: A kaleidoscope of wonder & opportunity', asta.edu.au/conasta

23 National Chemistry Quiz. www.raci.org.au Ph: 9663 4960 (Registrations close 9 June)

AUGUST 2015

1 Jeans for Genes Day. www.jeansforgenes.org.au/

5 Chemistry Olympiad Exam. www.asi.edu.au/olympiads/ Close date: 6/7/15. Ph: 6201 2552

7 Earth & Env Science Olympiad Exam. www.asi.edu.au/olympiads/ Close date: 22/7/15.

10 Biology Olympiad Exam. www.asi.edu.au/olympiads/ Close date: 22/7/15. Ph: 6201 2552

12 Physics Olympiad Exam. www.asi.edu.au/olympiads/ Close date: 22/7/15. Ph: 6201 2552

14, 17, 21 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

15–23 National Chemistry Week. www.raci.org.au Ph: 9663 4960

15–23 National Science Week. Schools theme: Making waves – the science of light.
www.scienceweek.net.au/schools/

SEPTEMBER 2015

7, 11 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

23 Spring equinox (6:20 pm AEST)

OCTOBER 2015

11–17 Earth Science Week. www.earthsciweek.org

16, 19, 23, 26, 30 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

NOVEMBER 2015

2, 13, 16 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

20, 23, 27, 30 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

DECEMBER 2015

1–16 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

22 Summer solstice (3:48 pm AEDT)

JANUARY 2016 National Youth Science Forum. Forms to local Rotary club by 31/5/15, interviews from July. Only for Yr 11 in 2015. 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.

INTERNATIONAL YEAR OF LIGHT 2015

Update on BOSTES matters

You should regularly check the BOSTES website at *www.bostes.nsw.edu.au* to ensure you have the latest data – on syllabuses, past exam papers, news, Official Notices, Board Bulletins, statistics archive and more.

Program Builder

Designed by the Board of Studies, Teaching and Educational Standards NSW, Program Builder is an online programming tool that uses content from the new NSW syllabuses for the Australian curriculum to create scope and sequences and units. It is available on the BOSTES website.

up2now pilot project

Recognising that many employers and places of further education are interested in more than academic results, BOSTES piloted this online resource during 2014 as an adjunct to the RoSA to help senior secondary students bring together evidence of a range of extracurricular activities. The *up2now – my ongoing learning portfolio* website allowed Year 10, 11 and 12 students to record, organise and share evidence of their extracurricular activities, such as first-aid qualifications or volunteer work.

BOSTES enquiries

Ph: 9367 8111, fax: 9367 8484
www.boardofstudies.nsw.edu.au
and *www.bostes.nsw.edu.au*

BOSTES contacts for Science

Inspector Science, K–12

Courage is what
it takes to
stand up and speak;
courage is also
what it takes to
sit down and listen.

… Winston S Churchill

NOTE: When you purchase the Odlum & Garner Past HSC Questions & Worked Solutions books for Biology, Chemistry and Physics, you are helping to support the production of the Past HSC books for Earth & Environmental Science and Senior Science.

* * * * *

Thank you to all the teachers who support these projects.

OUT AND ABOUT

IMAX THEATRE SYDNEY

31 Wheat Rd, Darling Harbour, Sydney 2000

ISLAND OF LEMURS 3D

Captured with IMAX 3D cameras, the film takes students on a spectacular journey to the remote and wondrous world of Madagascar, where lemurs arrived millions of years ago as castaways. They've since evolved into hundreds of diverse species, but are now highly endangered.

Island of Lemurs: Madagascar 3D highlights the tireless efforts of trailblazing scientist Dr Patricia Wright and her lifelong mission to help these strange and adorable creatures survive in the modern world.

Ph: 02 9213 1600
Email: education@imax.com.au

Book online at:
www.imax.com.au/schools

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, Sydney 2000
Website: www.anmm.gov.au/

National Science Week

15–23 August 2015

Plan to participate in this annual event, so that your students can enjoy and explore the wonders and benefits of Science.

There will be many Science Week happenings. Details will be available in 2015 at:

www.scienceweek.net.au

Celebrate the 2015 National Science Week by going on a Science excursion. You could go to a fun park excursion through *Physics is Fun* to Luna Park Sydney on 14, 17 or 21 August 2015, or visit one of the other excursion venues on this page for National Science Week.

Science Centre & Planetarium

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

- ★ ***Taking bookings for 2015***
- ★ **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

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 Sydney
  (rides open at 11 am, Mon/Fri + any school day in December)

BOOK & PAY SEPARATELY FOR EACH EXCURSION

MUSEUM OF HUMAN DISEASE

2015 EDUCATION PROGRAMS & EVENTS

We offer visits for The Search for Better Health, Communications, Bionics and Junior Science, as well as online resources, Video Conference sessions, regional tours and Teacher Professional Development Days.

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.

Further information and bookings:

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

Blue LED discovery leads to lighting revolution

The LED revolution had its origin over 50 years ago with the invention of red and green LEDs. However, it took another 30 years before scientists worked out how to create a blue LED – this discovery was the critical step that has since enabled the use of LEDs to give white light.

By the early 1990s, semiconductor physicists, Isamu Akasaki, Hiroshi Amano and Shuji Nakamura, finally succeeded in making an efficient LED that emitted blue beams using a gallium nitride crystal with a 'smattering' of indium, which they discovered had the perfect quantum properties.

Recently, these three scientists were jointly awarded the 2014 Nobel Prize in Physics for 'the invention of efficient blue light-emitting diodes which have enabled bright and energy-saving white light sources'. Their discovery has triggered a transformation of lighting technology and is why LEDs are starting to be used so extensively today. The LED light revolution is only just beginning. This discovery has led to energy efficient, long-life light bulbs, LED TV screens and much more. Over the recent Christmas period, shops were only selling LED Christmas lights. Soon our windows will deliver natural light during the day and 'natural' LED light at night!

Figure 1 Light emitting diodes [From wordpress.com]

A light-emitting diode (LED) is a semi-conductor device that is assembled into a light bulb for use in lighting fixtures. An LED consists of a number of layered materials. In the LED, electricity is directly converted into light particles (photons) leading to efficiency gains compared to other light sources where most of the electricity is converted to heat and only a small amount into light.

In incandescent bulbs, as well as in halogen light bulbs, electric current is used to heat a wire filament, making it glow. In fluorescent lights, a gas discharge is produced creating both heat and light. LEDs require much less energy in order to emit light compared to older light sources and so use a fraction of the power of conventional lights. Moreover, LEDs are constantly improved, getting more efficient with higher luminous flux (measured in lumen/watt). The most recent record is just over 300 lumen/watt for LEDs, compared to 16 for incandescent light bulbs and 70 for fluorescent lights.

As about 25% of the world's electricity consumption is used for lighting purposes, switching to highly energy-efficient LEDs will help conserve Earth's resources as they use far less electricity. White LED lights are now gradually replacing compact fluorescent lights (CFLs) on the shelves of stores due to their higher efficiency for house lighting.

LED lights have a much longer lifespan than incandescent and fluorescent lights, as they will last for decades. For example, incandescent bulbs tend to last 1,000 hours, as heat destroys the filament, while fluorescent lights usually last around 10,000 hours. LEDs can last for 100,000 hours, which greatly reduces the consumption of materials.

LED lighting also holds great promise for improving the quality of life for the more than 1.5 billion people who currently lack access to electricity grids, as the low power requirements allow LED lights to be powered by cheap local solar power. Moreover, polluted water can be sterilised using ultraviolet LEDs, a subsequent development from the blue LED.

Many home appliances are now equipped with LEDs. They shine their light on LCD-screens in television sets, computers and mobile phones, for which they also provide a torch and a flash for the camera.

References: • www.nobelprize.org/nobel_prizes/physics/laureates/2014/ • Wikipedia • www.newscientist.com/

2015 Nyholm Youth Lectures

An activity of the RACI NSW Branch

The Nyholm Lecture Series commemorates Sir Ronald Nyholm FRS (1917-1971), an outstanding Australian researcher and passionate chemical educator.

These popular lectures are aimed at Year 9 and 10 students. They are loosely linked to the 7-10 Science Syllabus, although others will find the material inspiring. ***A feature of the lectures is their practical content and interactive presentation style***.

The 2015 Lectures will be presented alternately at a range of venues in metropolitan Sydney and country NSW by two outstanding chemical educators. Cost is around $5 per head. Schools may apply for discount bulk ticket purchases.

Glowing in the Dark

Dr Elizabeth New, *a lecturer at the University of Sydney, has studied in Australia, UK and US. Her research is focussed on fluorescence (emission of light from materials that have absorbed light or certain other radiation) and its applications, including fluorescent tracking of molecules in the body to better understand diseases. Liz will explain the fundamentals of fluorescence and reveal some of the amazing uses of fluorescence in medicine and research.*

Sugars, Drugs and Rock & Roll

Dr Michela Simone, *a lecturer at the University of Newcastle, has studied at The University of Oxford. Her research spans medicinal chemistry and chemical biology. Michela will highlight some real-world therapeutic applications of sugars in the design and action of drugs, which are underpinned by the fascinating and still mostly unexplored roles of carbohydrates in nature's biological processes. Her lecture will feature demonstrations of the many and varied properties of sugars.*

Venues with dates and times, from Term 2, will be advertised to local schools and at: www.raci.org.au/branches/nsw-branch
Advance bookings are highly advisable.

For more information: contact RACI NSW Branch Office
E: raci-nsw@raci.org.au T: (02) 9663 4960

Why is 2015 the International Year of Light?

The year 2015 was chosen as the Year of Light as it marked a few significant historical events in Science related to light and optics.

• It is 100 years since Albert Einstein changed the course of Science by proposing his general theory of relativity. This was just 10 years after he had proposed a quantum explanation for the photoelectric effect. General Relativity is the theory that explains all gravitational phenomena we know (falling apples, orbiting planets, escaping galaxies, etc) and it has now survived one century of continuous tests of its validity. General Relativity showed how light was at the centre of the very structure of space and time. The development of the theory was driven by experiments that took place mostly in Einstein's brain (that is, his so-called thought experiments). Central to these experiments were various concepts of light: 'what will happen if light is observed by an observer that is in motion?' and 'what happens if light travels in the presence of a gravitational field?

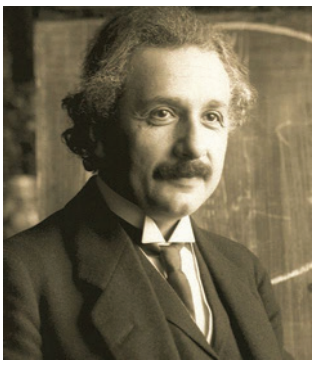


Figure 2 Albert Einstein
[Photo by F Schmutzer, Wikipedia]

• 2015 also marks the 1000th anniversary since the great Arabic scientist Ibn al-Haytham wrote his remarkable seven volume treatise on optics, *Kitab al-Manazir*. Ibn al-Haytham's influence on experiment and theory in optics is truly remarkable, and he is considered the father of modern optics, ophthalmology, experimental physics and scientific methodology. In his books, he explained the 'moon illusion' – the phenomenon where the Moon appears larger near the horizon than when it is higher in the sky. He understood the phenomenon of light travelling at different speeds in different media, introduced the concept of atmospheric refraction (the bending of light received on the surface of the Earth from celestial bodies), carried out experiments on the dispersion of light into its constituent colours, studied shadows, rainbows and eclipses, and developed mathematical equations to explain the reflection of light from curved mirrors. This all predated western optics by hundreds of years. Science made remarkable advances during the Islamic Golden Age with many of these advances being only recently re-discovered in ancient texts.

Figure 3 Ibn al-Haytham
[Photo from: www.arastiralim.net/]

Reference: • www.light2015.org/

Blue LEDs lead to blue lasers and blu-rays

After their discovery of blue LED lights in the 1990s, the three semiconductor physicists involved, Akasaki, Amano, and Nakamura, went on to also invent a blue laser. This invention led to blu-ray technology. As with LEDs, red lasers had been around for several years, but not blue. Within four years of their blue LEDs, they had invented a blue laser based on the crystals of gallium nitride, used in their blue LEDs. Blue light has a much shorter wavelength than the red light used previously in lasers. Hence the blue laser beam can be focused to a smaller spot, with more information embedded in each spot and much more information fits onto the same sized disc.

As a result of this discovery, blu-ray technology was able to be developed by the early 2000s. However, it was not available for consumers until around June 2006. A blu-ray disc is a digital optical disc data storage format. It is capable of storing high-definition video resolution due to its greater capacity for storage. Blu-ray gives a better picture quality than regular DVD players, as well as allowing multiple language subtitles on the one disc.

Figure 4 Blu-ray disc logo
[from Wikipedia]

Reference: • New Scientist 7 October 2014 • Wikipedia

WIN A FAMILY PASS TO IMAX

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 $90) … send in your name, school, & school address on an envelope **by 2 April 2015** 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: Heidi Englund, St Edward's College East Gosford, won an IMAX Sydney family pass for *SciTalk No. 4–2014.*

WIN A FAMILY PASS TO LUNA PARK SYDNEY

One lucky teacher's 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 2 April 2015** to:

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

WINNER: Simone Bartlett, St Edward's College East Gosford, won a Luna Park Sydney family pass for *SciTalk No. 4–2014.*

HSC statistics: Science entries in the 2014 HSC

The total number of entries for HSC Science courses* in 2014 was 46,328 and the total number of HSC entries for the 2014 HSC was 75,767. So Science entries were 61.1% of the total entries.

The number of HSC Science entries as a % of the total HSC entries from 1992–2014 is given in the bottom table below. This % has decreased significantly from a peak of 90.8% of the total candidature in 1992# with 54,414 students doing a Science course to only 55.8% in 2002. Since 2004, it has hovered around 58–62%, which is still much lower than in past years.

The pattern of options in the various Science courses for the 2014 HSC has not varied greatly from year to year and is given as a percentage in the following tables.

Biology	
Total 2014 candidature 17,138 (♂ 6630 ♀10,508)	
Communication	72.9%
Biotechnology	5.3%
Genetics: The Code Broken?	15.4%
The Human Story	6.1%
Biochemistry	0.25%
	99.5% §

Chemistry	
Total 2014 candidature 11,173 (♂ 6162 ♀5011)	
Industrial Chemistry	57.6%
Shipwrecks, Corrosion and Conservation	28.2%
The Biochemistry of Movement	1.2%
The Chemistry of Art	3.2%
Forensic Chemistry	9.8%
	100% §

Physics	
Total 2014 candidature 9598 (♂ 7554 ♀2044)	
Geophysics	1.1%
Medical Physics	28.1%
Astrophysics	19.1%
From Quanta to Quarks	50.5%
The Age of Silicon	1.2%
	100% §

Earth & Environmental Science	
Total 2014 candidature 1494 (♂ 828 ♀666)	
Introduced Species & the Australian Environment	78.3%
Organic Geology – A Non-renewable Resource	4.6%
Mining and the Australian Environment	0.5%
Oceanography	16.7%
	100.1% §

Senior Science	
Total 2014 candidature 6328 (♂ 3383 ♀2945)	
Polymers	4.3%
Preservatives and Additives	6.6%
Pharmaceuticals	22.3%
Disasters	61.4%
Space Science	5.5%
	100.1% §

* These are the total number of entries in Science courses, and not the actual number of students who study a Science course, since a fair percentage actually study 2 courses in the same year, and some students since Pathways do 3 Science courses.

\# The total number of entries prior to 1996 was based on the total English candidature. Since then, due to Pathways, the total figure each year is still based on English entries, but is slightly affected by acceleration students, Pathways students, etc.

§ The total number of students reflects the actual number of students who received a result for each subject. It can differ from the figures given in the media as their figures were the number of HSC entries for each subject as of October 2014. There is usually a difference between these two sets of figures because some students have illness/misadventure and so do not sit for the examination.

[Note: Individual option percentages are rounded to the nearest 0.1%, thus totals are not exactly 100.0% for some courses.]

Science Life Skills:
Total 2014 Candidature was 597 (410 males, 187 females).
(This course is part of the total science entries.)

These tables were prepared by Robert Garner using data from the NSW Board of Studies, Jan 2015.

Entries for HSC Science courses 1992–2014 as a percentage of the total number of HSC entries#

YR	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14
%	90.8	87.7	80.1	72.0	73.8	72.3	70.2	69.9	64.1	58.0	55.8	56.5	58.3	58.4	59.4	57.9	60.5	59.8	59.9	62.1	60.8	61.1	61.1

2015 editions: Past HSC Papers with Worked Solutions

All books include: PAST HSC QUESTIONS BY TOPIC GUIDE

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

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- 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
Biology:	2001–2014 Biology Past HSC Papers with Worked Solutions ... OUT NOW	978 1 921741 31 9	$39.95	
	2009–2014 Biology Past HSC Papers with Worked Solutions ... OUT NOW	978 1 921741 34 0	$27.95	
Chemistry:	2001–2014 Chemistry Past HSC Papers with Worked Solutions ... OUT NOW	978 1 921741 32 6	$39.95	
	2009–2014 Chemistry Past HSC Papers with Worked Solutions ... OUT NOW	978 1 921741 35 7	$27.95	
Physics:	2001–2014 Physics Past HSC Papers with Worked Solutions ... OUT NOW	978 1 921741 33 3	$39.95	
	2009–2014 Physics Past HSC Papers with Worked Solutions ... OUT NOW	978 1 921741 36 4	$27.95	
Earth Science:	2001–2013 Earth & Environmental Science Past HSC Papers with Worked Solutions	978 1 921741 21 0	$39.95	
	2008–2013 Earth & Environmental Science Past HSC Papers with Worked Solutions	978 1 921741 22 7	$27.95	
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Is the age of antibiotics over?

by Katrina Garner

Since their discovery by Alexander Fleming in 1928, antibiotics have been overused by healthcare workers (often at the demand of patients), sold over-the-counter in many countries, wasted by agricultural misuse, used to treat non-bacterial diseases, and also not used for the prescribed amount of time or in the prescribed doses. Hence we have seen their efficacy in humans diminish.

These misuses of antibiotics have led to the development of resistance by many bacteria to many antibiotics. The emergence of drug-resistant bacteria has also been linked to the explosion of household products that contain antibacterial agents. This 'antibacterial craze' defies the critical message that washing with soap and water provide adequate hygiene for healthy individuals.

Antibiotic resistance is increasingly getting international attention because of the threat it presents to global public health. Medical professionals are more and more frequently encountering patients with bacterial infections that cannot be managed with the current artillery of antibiotics. For example, the final straw of weaponry against gonorrhoea infections – third-generation cephalosporins – has had treatment failure confirmed in several countries, while there is a widespread prevalence of drug-resistant tuberculosis. *Staphylococcus aureus*, the bacterial culprit often responsible for severe hospital-acquired infections, has firmly established a lack of responsiveness to first-line antibiotics, and is now refusing to respond to last-resort treatments.

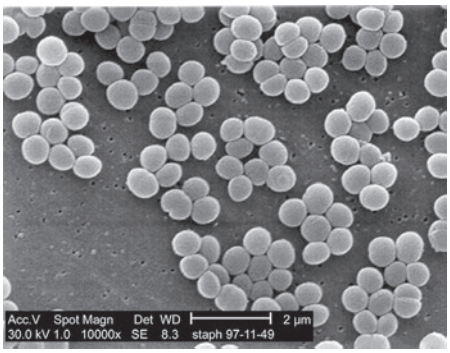

Figure 5 *Staphylococcus aureus* bacteria

[From Wikipedia]

The World Health Organisation (WHO) has reported high proportions of antibiotic resistance in all regions of the world for pathogenic bacterial species that commonly cause intestinal, urinary tract and blood infections. The WHO's 2014 report on global surveillance of antimicrobial resistance calls for urgent, coordinated action worldwide as we head towards a post-antibiotic era.

The UK Prime Minister, David Cameron, has echoed the concerns of WHO, stating 'If we fail to act, we are looking at an almost unthinkable scenario where antibiotics no longer work and we are cast back into the dark ages of medicine'. The UK commissioned review on antimicrobial resistance, led by renowned economist Jim O'Neill, has suggested that failure to effectively tackle drug-resistant infections will see over 300 million people killed by resistant bacteria by 2050, with economic ramifications of up to $100 trillion. He suggests that the medical and economic consequences of bacterial resistance will mirror those of HIV, if action is not taken swiftly.

Since 1928, over 100 antibiotics have been found. Antibiotic discovery was at its peak in the 1950s and '60s. However, no new antibiotics have been commercialised since 1987. Is the age of antibiotics truly over?

A recent breakthrough in bacterial culturing technique may have ended the antibiotic 'drought'. The magazine *Nature* has recently published the discovery of a new class of antibiotics, that have been called 'teixobactin'.

A team of researchers from the Northeastern University in Boston, US,

... continued on page 9

Figure 6 Some antibiotic tablets and capsules

[From Wikispaces]

have been literally digging up new microbial chemicals in the bid to find antibiotics through soil culturing. Many bacterial species produce chemicals that inhibit the growth of competing species. However, such bacteria have often been reticent to grow in the lab, limiting their use in antibiotics.

Boycotting traditional culturing techniques, scientists Kim Lewis and Slava Epstein took an innovative approach where soil bacteria were contained in pods within an iChip that was buried in the soil. The pods ensured each bacterial strain was kept separate, while the chip was designed so that the unique chemistry of the soil could permeate the device. This methodology has allowed the study of 10,000 types of soil bacteria that were previously unable to be cultured, and has revealed unique chemical compounds previously unseen. Of the 25 new antibiotics discovered using this method, teixobactin is the latest and most promising.

Teixobactin has allowed numerous lab mice to live to see another day after being inoculated with a variety of nasty infections. Teixobactin has successfully cured mice infected with bacteria responsible for tuberculosis and septicaemia, with *Clostridium difficile* colitis, which causes intestinal infections, and methicillin-resistant *Staphlococcus aureus* (MRSA), a particularly worrisome 'super-bug' implicated in many hospital-acquired infections. Better still, it cleared up these infections in a relatively short space of time, without any known side effects for the mice.

Bacteria are often classified into two categories, gram-positive and gram-negative, based on their cell walls. Teixobactin is effective against gram-positive bacteria that do not have an outer cell wall and works by interfering with the fats that bacteria need for constructing their cell wall. This method of attack underlies teixobactin's success rate. The present success rate of teixobactin, resulting in zero bacterial survivors, is limiting the ability of the bacteria to develop resistance.

Figure 7 iChip in the field

[Photo: Slava Epstein/Northeastern Uni]

If teixobactin works, we will have an important new drug for combating gram positive infections—this is particularly important in hospital-acquired infections, and in reducing the risk of post-operative complications following orthopaedic (or other implant) surgery. While now, only about 2% of patients undergoing this procedure develop infections, estimates are that by 2050, 30–40% of patients undergoing hip replacements without effective antibiotics would develop an infection, and that 30% of these would be fatal.

What could go wrong then?

It will still be some time before new antibiotics, such as teixobactin, are within our pharmaceutical reach. Successful human trials and drug approval for human use are time-consuming and costly processes. This path often takes 10+ years. However, the researchers are hoping for 5 years. Importantly, mice are not people, and we have no idea what toxicities might be seen in people. In fact, only 8% of compounds that pass into the animal testing phase ever make it to market. In addition to the risk of toxicity, efficacy in humans has yet to be shown.

Nevertheless, the use of this iChip technology for the screening of previously unculturable bacteria for useful compounds is an exciting development in antimicrobial research. It offers much more hope than a single antibiotic and may assist in prolonging the age of antibiotics.

We need to remember though that bacteria have an amazing ability to survive – so if we don't put strict controls on the use of new antimicrobial agents such as teixobactin and treat it as a treasure, it won't last long.

Syllabus links:

HSC Biology – Search for Better Health 9.4.3

Stage 5 – Living World LW4.c

References

• Lewis, K, Ling, L & Schneider, T, Peoples, A. *et al* (2015). 'A new antibiotic kills pathogens without detectable resistance.' (retrieved from *www.nature.com*), • Wright, G. (2015). 'Antibiotics: an irresistible newcomer.' (retrieved from *www.nature.com*), • WHO (2014). 'Antimicrobial resistance.' (retrieved from *www.who.int)*

Is white wine really just a 'lite' red?

Many vignerons have been surprised by the occasional white wine having a pinkish tinge and not known why.

Italian scientists have recently found that white grapes contain the same anthocyanin pigments that give red wine its colour. Until now, many wine experts claimed that 'what distinguishes red from white is that white wine grapes don't have anthocyanins'.

Anthocyanins originate from the skins of grapes and combined with other chemical compounds, are responsible for the majority of a red wine's colour. The precise colour of red wine is dependent on the acidity surrounding anthocyanins in wine and in alkaline solutions, they give a blue colour.

Using mass spectroscopy, the team of food analytical chemists at the Edmund Mach Foundation led by Panagiotis Arapitsas, analysed the skins of some white wine grapes – chardonnay, sauvignon blanc and riesling – and were able to detect and quantify the pigments present. They discovered that all of these white wine grapes did contain anthocyanins. However, the concentrations were usually several thousand times smaller than in red wine grape varieties, such as merlot and sangiovese. The team also found that the concentration of all pigments was highly influenced by climatic changes.

Reference: • NewScientist 1 Jan 2015 • doi.org/xrh, accessed Jan 2015

CONGRATULATIONS

SciTalk No. 4–2014 'Astronomy Giveaway' winners, Sue Siwinski (Bishop Druitt College) & Brian Tibbey (St John's College Woodlawn) each won a copy of:

ASTRONOMY 2015

A PRACTICAL GUIDE TO THE NIGHT SKY

by Glenn Dawes, Peter Northfield, Ken Wallace

Available from Quasar Publishing ($27.95): *www.quasarastronomy.com.au*

OR The Binocular & Telescope Shop: www.bintel.com.au

Summer skies progressing into autumn

... Robert Garner

As we progress from summer into autumn, there are many interesting celestial objects to see when observing the night sky.

The Planets

Mercury, the fastest moving planet as it is closest to the Sun, starts the year as a morning object in the eastern, pre-dawn sky. February to mid-March will provide the best pre-dawn viewing of Mercury in 2015 as it is higher above the horizon. Later in March, Mercury disappears in the twilight and then moves behind the Sun as it heads for superior conjunction in April. Mercury will reappear low in the evening western twilight sky near to Mars late in April, but will be hard to see against the twilight.

Venus spends the first part of the year low in the western evening sky. During February, Venus and Mars will move closer in the sky and will be within 1° of each other from 20–24 February, making this a good time to see them both. During March, the two planets separate as Venus rises to a higher position in the sky each evening for the first half of the year until it reaches its greatest elevation east of the Sun in early June. In April, Venus will be close to both the Pleiades and Hyades star clusters, that are located in *Taurus* on 11 April (see Constellations section).

Mars will be low in the western sky near Venus during February. It is dropping closer to the horizon to disappear in the twilight by mid-April and will not reappear until August.

Jupiter, the giant planet, will be at opposition on 7 February and so it will be at its largest and brightest as viewed from Earth with magnitude –2.6. As it will drop back to magnitude –2.2 by April, February is the ideal time to watch Jupiter's four Galilean moons moving back and forth, as did Galileo just over 400 years ago. A pair of binoculars (>7x) or a small telescope is needed. Binoculars need to be steadied against a solid surface or preferably mounted on a tripod. On 7 March at about 11 pm and again on 14 March at about 9 pm, four moons of Jupiter (Ganymede, Callisto, Europa and Io) will all be seen grouped to the east of Jupiter.

Saturn will be rising earlier each night over the months of February to April. Best viewing will be late March or April as Saturn will be rising before 9:30 pm by early April. Saturn is increasing in both size and brightness as it approaches opposition in May. A good pair of binoculars will allow you to see Saturn's rings and to maybe observe Titan, its largest moon.

Equinox

The autumn equinox occurs on 21 March 2015 at 9:45 am (AEDT). This is the exact time that the Sun appears to cross over the equator.

Contrary to the Latin meaning of 'equal night', the Equinox does not have equal hours of day and night, although it is close. There are in fact about 15 more minutes of daylight compared to night time on 21 March. Daylight and night time hours are in fact both closest to 12 hours on 25 and 26 March this year.

The date and time of an Equinox is determined by when the Sun crosses the celestial equator. On the day of any equinox, there will be exactly 12 hours between when the middle of the Sun's disc rises to when the middle of the Sun's disc sets. This is quite different to how we determine sunrise and sunset, as sunrise is timed by the appearance of the first edge of the Sun to appear in the east, and sunset by when the second edge disappears in the west.

Meteor showers

All meteor showers are best viewed after midnight and require much patience to see. Look out for the alpha-Centaurids peaking in early February, the gamma-Normids peaking around 15 March, and the Lyrids and pi–Puppids in late April (although these latter two are not renowned for high meteor rates).

Constellations

To the south east, *Crux* (or the Southern Cross) will be found in early February on its side with the pointers below it. As *Crux* rotates around the South Celestial Pole, its orientation in the night sky will gradually change to being more upright by winter. For those of you who live in NSW, *Crux* is visible all year round throughout the night.

The constellations of *Orion* and *Taurus* can be found in the northwest after sunset. These constellations are interesting to locate as the red giant star Betelgeuse can be easily seen in *Orion* and *Taurus* contains the Pleiades star cluster, also known as the 'Seven Sisters'. This small cluster contains many young blue giant stars. This cluster can be seen as a fuzzy patch with the naked eye, but binoculars will allow you to see many individual stars. On 11 April, Venus will be within 2.5° of this cluster and so can be used to locate the cluster. Interestingly, Subaru is the Japanese name for the Pleiades star cluster (M45). If you look at the logo on a Subaru car, you will see that it only has six stars, as according to Japanese tradition, one of the 'seven sisters' is invisible.

The constellation *Canis Major* will be found overhead in the night sky and spreading towards the north soon after sunset. Like all constellations, its exact location varies from night to night and depends on the time – such constellations are best found by using a sky chart or planisphere (see Box 1 below). The brightest star in our night sky is Sirius, a white star that can be found in *Canis Major*. Procyon, a yellow star, is in the nearby *Canis Minor,* and will be high in the north. Castor and Pollux, the twin stars of *Gemini*, will be low in the north-west, while Regulus, in *Leo*, will be low in the north-east.

The constellation of *Virgo* rises in the east after sunset. If you look just above *Virgo*, you should be able to find the kite-shaped group of stars that form the constellation *Corvus* (the crow).

Using a Sky Chart / Planisphere

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

Box 1: Sky Charts & Planispheres

- You can download free sky charts each month to explore the night sky from: *www.skymaps.com/downloads.html* Make sure that you scroll down 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 – make sure it is for the Southern Hemisphere. While the site itself is out-of-date, there is a planisphere (star wheel) to print and use at: *http:/members.ozemail.com.au/~starrylady/resources.html*

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–Dec inclusive). It opens 8–9.30 pm (in AEDT) or 7–8.30 pm (in non-AEDT).

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

There are also two **planetarium sessions** per semester on Friday nights from 7–8 pm, in the E7B Courtyard at Macquarie Uni. Tickets must be booked online at: *physics.mq.edu.au/community/planetarium/*

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