Providing support and promoting excellence in science education

SciTalk

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Number 1 – February 2016

2016 is the International Year of Pulses

The UN has declared 2016 to be the International Year of Pulses (IYP 2016) to help raise awareness about pulses and to increase our awareness and understanding of the challenges faced by pulse farmers, be they large-scale farms or small land holders. IYP is being coordinated by the FAO (Food and Agriculture Organization of the UN).

Pulses are a group of 12 plant crops that are harvested solely for their dry grain (small, hard, dry seeds) for food for humans and other animals, as opposed to crops harvested green for food and so classified as 'vegetable crops'. Sometimes called 'grain legumes', pulses develop with 1–12 grains of variable size, shape and colour within a pod. They include various types of dry beans, dry peas, chickpeas and lentils. Pulses keep for long periods as dried, unrefrigerated seeds.

Pulses are all high in proteins and both soluble and insoluble fibre, as well as various vitamins, essential amino acids and antioxidants. Hence pulses are increasingly being recognised throughout the world as playing a vital role in eating a more balanced diet, which helps to protect people from having health problems. They have been shown to lower the risk of heart disease and diabetes, lower blood pressure and cholesterol, and help with weight loss. Pulses are one of the most cost-effective proteins around and, as well as being affordable, they can be prepared in countless ways into tasty and nutritious dishes. Pulses can be added to pastas, soups and salads to make them more filling and to add plant-based protein and fibre. They can be used to 'stretch' meals, e.g. by adding them to a dish or by substituting some or all the meat with lentils.

The growing of pulses has a positive impact on the environment. Being leguminous plants, the roots of pulse plants have nodules containing nitrogen-fixing bacteria that contribute to

... continued page 9

Figure 1 Pulses at an Indian market. [Credit: Press Trust of India]

★ 2016 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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☐ 5. .....

Please return to file or noticeboard.

PRIZES TO WIN!

See pages 1, 6 & 12

Post in your entries now

(or send your details by email, if you prefer!)

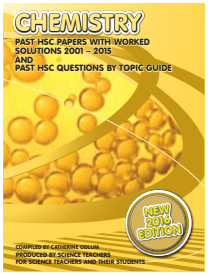
Past issues of *SciTalk* are available at www.odlumgarner.com

Book Giveaway

WIN a copy of ...

WIN

Chemistry 2001-2015 Past HSC Papers with Worked Solutions



rrp: $39.95

Also available as a 2010-2015 book (rrp 27.95) - see p7 ... published by Odlum & Garner

This new 2016 edition 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 2001–2015 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/Earth & Environmental Science/Senior Science books in this series, go to: *www.odlumgarner.com*

TO WIN: Send your name, school & school address to Book Giveaway, PO Box 442, Freshwater 2096 (or by email to *cathie@odlumgarner.com*) – **by 31 March 2016**

★ ★ ★

Winner for *SciTalk 4/15*

Wayne Foster, Carroll College, Broulee, won *Physics Past HSC Papers & Worked Solutions 2001-2014 (rrp $39.95)*, published by Odlum & Garner.

Diary Dates

2016 International Year of Pulses: *http://iyp2016.org*

Tour dates & towns for Shell Questacon Science Circus 2016:
www.questacon.edu.au/outreach/programs/science-circus

MARCH 2016

4	Schools' Clean Up Australia Day. www.cleanup.org.au/
6	Clean Up Australia Day. www.cleanup.org.au
18, 21	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
20	Autumn Equinox (3:31 pm AEDT)

APRIL 2016

1, 4, 8, 29	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
22	International Earth Day. www.earthday.org

MAY 2016

2, 6, 20, 23, 30	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105
b/w 18–25	Big Science Competition: www.asi.edu.au/bigscience/ Close date:20/4/16. Ph: 6201 2552
tba (or April?)	Astronomy Open Night & Lectures: Macquarie Uni, www.physics.mq.edu.au/astronomy

JUNE 2016

3, 6, 10, 17, 20	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com
tba	NSW Schools Titration Competition: www.raci.org.au/branches/nsw-branch
5	World Environment Day
21	Winter Solstice (8:35 am AEST)
26	Closing date Crystal Growing Competition: www.raci.org.au/branches/nsw-branch

JULY 2016

3–6	CONASTA 65 in Brisbane: 'Superheroes of Science: Unmask your potential', asta.edu.au/conasta
21	ANCQ (formerly the National Chemistry Quiz): www.ancq.com/home.aspx

AUGUST 2016

3	Chemistry Olympiad Exam. Close date: 20/7/16. Ph: 6201 2552, www.asi.edu.au
5	Earth Science Olympiad Exam. Close date: 20/7/16. Ph: 6201 2552, www.asi.edu.au.
5	Jeans for Genes Day. www.jeansforgenes.org.au/
8	Biology Olympiad Exam. Close date: 20/7/16. Ph: 6201 2552, www.asi.edu.au
10	Physics Olympiad Exam. Close date: 20/7/16. Ph: 6201 2552, www.asi.edu.au
12, 15, 19	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
13–21	National Science Week. Theme: Drones, droids & robots. www.scienceweek.net.au/schools/

SEPTEMBER 2016

3–11	National Seaweek 2016. www.mesa.edu.au/seaweek.asp & www.ausmepa.org.au
12, 16	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com
23	Spring equinox (12:22 am AEST)

OCTOBER 2016

11–17	Earth Science Week. www.earthsciweek.org
13	HSC exam period commences ... ends 4 November
14, 17, 21	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com
24, 28, 31	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

NOVEMBER 2016

11, 14, 18	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com
21, 25, 28	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

DECEMBER 2016

1–16	Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com
21	Summer solstice (9:45 pm AEDT)

JANUARY 2017 National Youth Science Forum. Forms to local Rotary club by 31/5/16, interviews from July. Only for Yr 11 in 2016. 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.

Update on BOSTES matters

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

If you have not updated yourself on the following BOSTES matters, please go to their website:

- *Senior years syllabus review* [4-12-15]
  Consultation on the senior years English, Mathematics, Science and History Draft Writing Briefs has closed. All feedback received will be incorporated in final writing briefs. These will be used to guide the draft syllabuses' development during 2016. Schools and teachers are assured that decisions about implementation of new syllabuses will only occur after extensive consultation.
- *Stage 5 & Preliminary course student work samples to be retained* [16-3-15]
- *2016 HSC key dates*
  (including HSC period: 13 Oct–4 Nov 2016)

You can also log in to have the weekly BOSTES Bulletin emailed to you.

BOSTES enquiries
Ph: 9367 8111, fax: 9367 8484
www.boardofstudies.nsw.edu.au

Science contact: Inspector Science, K–12

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.

Perfection is achieved,
not when there is
nothing more to add,
but when there is nothing
left to take away.

... Antoine de Saint-Exupery
(1900-1944)

OUT AND ABOUT

IMAX THEATRE SYDNEY

31 Wheat Rd, Darling Harbour, Sydney 2000

ROCKY MOUNTAIN EXPRESS

Rocky Mountain Express (opens 11 Feb, 2016) propels audiences on a steam train journey through the breathtaking vistas of the Canadian Rockies and highlights the adventure of building a nearly impossible transcontinental railway. Recruited to realise this venture—one of the greatest engineering feats of all time—were engineers and labourers from around the world. The film weaves together spectacular IMAX aerial cinematography, archival photographs and maps, and the potent energy and rhythms of a live steam locomotive to immerse audiences in this remarkable story from the age of steam. For a full list of films available in our 2016 educational film library, including *Unseen World 3D* and *Hidden Universe 3D*, contact the IMAX Education team today!

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

National Science Week

13–21 August 2016

Plan to participate in this annual event, so that your students can enjoy and explore the wonders and benefits of Science. The 2016 schools' theme is *Drones, droids and robots*. There will be many Science Week happenings. Details will be available in 2016 at:

www.scienceweek.net.au

Why not celebrate 2016 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 12, 15 or 19 August 2016, or to one of the other excursion venues on this page for National Science Week.

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

Science Centre & Planetarium

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

- ★ ***Taking bookings for 2016***
- ★ **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

MUSEUM OF HUMAN DISEASE

2016 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

WHY NOT COMBINE A FUN PARK EXCURSION AT LUNA PARK SYDNEY 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, ph: 02 9213 1600
  FUN PARK EXCURSION: www.odlumgarner.com, ph: 02 9939 6107
- **WHAT TO DO:** Allow 1 hr for IMAX (any film), then 2–3 hours for a Fun Park Excursion at Luna Park Sydney (rides open at 11 am, Mon/Fri + any school day in December)

BOOK & PAY SEPARATELY FOR EACH EXCURSION

NSW Crystal Growing Competition

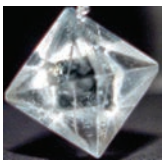
Have fun with Science! Do simple chemistry experiments that work with your students!

Enter the RACI NSW Crystal Growing Competition and learn all about growing beautiful crystals.

Crystals are grown during Term 2.

Results published before National Science Week. Winning crystals enter the National Competition.

Certificates for all and trophies for the winners!



ANCQ

(formerly the Australian National Chemistry Quiz)

'*A unique chemical education activity*.'

Gives a major focus for secondary school students on the relevance of chemistry in an exciting and stimulating way.

RACI invites all students to participate on Thursday 21 July 2016

Consider students from your school for this prestigious competition. Over 1,600 schools and 110,000 students in 2015.

For further information: ancq@raci.org.au

16OSM

Open Speaker Meetings

(Registered In-service for teachers)
BOSTES-accredited in-service
Attendance is open to all.

Talks on cutting edge topics from experts.
Schedule & registration on-line.

raci
Royal Australian Chemical Institute

School & chemical education activities in 2016

Nyholm Youth Lectures

The Nyholm Lectures are presented at a range of NSW school and university venues.

Aimed at Year 9 & 10 students, presentations occupy 1 hour class time, and are practical, interactive and popular with students and teachers.

'*Linked to the 7-10 Science syllabus and delivered by inspiring role models.*'

Dr Michela Simone – Oxford graduate, lecturer at the University of Newcastle. Highlights real-world therapeutic applications of sugars relating to drugs that are underpinned by carbohydrates in nature.

Dr Lidia Matesic – Wollongong doctorate, radiochemist at ANSTO Life Science. Describes applications and basic theory of radioactivity and radiochemistry.

Ask for information about current venues or to have a Nyholm lecturer come to your school.

Schools Affiliate Membership

★ Discounted entry in ANCQ and other competitions

★ Access to chemistry experts

★ Inspiring annual chemistry lectures

★ Access to education resources and tools

★ Free monthly issues of the RACI magazine *Chemistry in Australia*

★ Professional recognition for teachers

★ Student and teacher days at RACI conferences

★ Networking opportunities

★ ***Join now!***

RACI Schools Titration Competition

A competition for Year 11 & 12 students

In 90 minutes teams of 3 perform acid-based titrations to determine unknown concentrations of dilute acetic acid.

The best team score wins medals for the team and all competitors receive certificates.

Registration opens March 2016.

NSW Competition is in June 2016.

A National Competition is in September 2016.

Timing and venues advertised in advance. Schools can offer to host.

For information on all RACI activities, contact: raci-nsw@raci.org.au

Our fragile DNA can be repaired

Hidden within our cells, DNA (deoxyribose nucleic acid) is the 'hard drive of the human body'. It contains instructions for all the proteins we need to function correctly and so DNA orchestrates every process in our body.

At conception, the DNA in a zygote could be laid out end to end in a 2 m long, very narrow line. Within a week, the zygote has divided to form 2 cells, 4 cells, 8, 16 … 128 cells. The DNA in these would extend out to a line 30 m long. Billions of cell divisions later, it has been estimated that the DNA of an average human would stretch in a line to the Sun and back about 250 times.

DNA is the fundamental building block in all life. Every organism, from the simplest bacterium to plants and animals contains a vast quantity of genetic information in the form of DNA. This defines each species, as well as making each individual unique.

When the double helical structure of DNA was discovered in 1953 through the work of Watson, Crick, Franklin and Wilkins, it was initially thought to be chemically stable. Since then, it has become clear that DNA is damaged by environmental factors such as radiation, e.g. X-rays and UV in sunlight, and carcinogens, e.g. cigarette smoke. Also, during normal metabolic processes, our cells generate chemicals that can damage DNA.

DNA replicates every time a cell undergoes mitosis for growth and repair, or meiosis for gamete production. This continues to occur throughout the life of the organism. These processes are inherently prone to mistakes in the copying of the DNA.

It has been estimated that each body cell has over 10,000 DNA damage events on a daily basis, affecting a base sequence or nucleotide, or causing breaks to a single or double strand of DNA. Hence DNA repair is a critical process to maintain the health of an organism. Several mechanisms are involved, using enzymes such as DNA polymerase, DNA ligase, endonucleases or glycoslases. Some use the undamaged strand of DNA as a template to fix and replace the damaged DNA.

The rate of DNA repair is dependent on many factors, including cell type, age of the cell and the extracellular environment. Cells that have accumulated a large amount of DNA damage, or can no longer repair damage to the DNA, can enter one of three possible states: senescence (biological aging), death or they lead to the formation of a tumour.

Last October, the 2015 Nobel Prize in Chemistry was awarded jointly to three scientists – Swedish Tomas Lindahl, American Paul Modrich and US-Turkish Aziz Sancar – who worked independently to discover several different mechanisms by which DNA repair can occur in cells.

Their work has provided fundamental knowledge of how a living cell functions and could lead to the development of new cancer treatments – researchers are hoping to exploit DNA repair mechanisms for more effective and less toxic treatments. Researchers are also investigating whether DNA repair mechanisms might help in the treatment of genetic disorders.

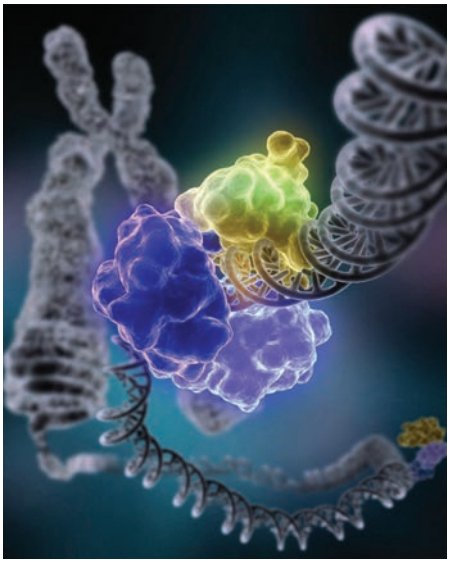


Figure 2 DNA ligase encircles the double helix to repair a broken strand of DNA

[Credit: Tom Ellenberger, Washington Uni School of Medicine.]

References:
- *www.nobelprize.org/*
- *student.societyforscience.org/*
- *theconversation.com/au*

Syllabus relevance: Biology Stage 6 Syllabus, Genetics Option – Dotpoint 9.7.6.2.2

For success, attitude
is equally as
important as ability.

… Harry F Banks
(1896-1984)

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 your name, school, & school address **by 31 March 2016** by email to *cathie@odlumgarner.com* or on an envelope 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: Steve Garthwin, Korowal School, Hazelbrook, won an IMAX Sydney family pass for *SciTalk No. 4–2015.*

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 your name, school, & school address **by 31 March 2016** by email to *cathie@odlumgarner.com* or on an envelope to:

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

WINNER: Samantha Potts, Ambarvale High, won a Luna Park Sydney family pass for *SciTalk No. 4–2015.*

HSC statistics: Science entries in the 2015 HSC

The total number of entries for HSC Science courses* in 2015 was 46,102 and the total number of HSC entries for the 2015 HSC was 76,461. So Science entries were 60.3% of the total entries.

The number of HSC Science entries as a % of the total HSC entries from 1992–2015 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 percentage of students studying each option in the various Science courses is given below for 2015. This percentage has not varied greatly from year to year. Also, the actual number of males versus females doing each of the Science courses has not changed significantly from year to year either.

Biology	
Total 2015 candidature 17,271 (♂ 6701 ♀10,570)	
Communication	73.3%
Biotechnology	4.5%
Genetics: The Code Broken?	16.3%
The Human Story	5.6%
Biochemistry	0.3%
	100%

Chemistry	
Total 2015 candidature 10,907 (♂ 6012 ♀4895)	
Industrial Chemistry	57.9%
Shipwrecks, Corrosion and Conservation	27.7%
The Biochemistry of Movement	1.1%
The Chemistry of Art	2.8%
Forensic Chemistry	10.5%
	100%

Physics	
Total 2015 candidature 9511 (♂ 7408 ♀2103)	
Geophysics	0.7%
Medical Physics	32.4%
Astrophysics	16.9%
From Quanta to Quarks	49.1%
The Age of Silicon	0.9%
	100%

Earth & Environmental Science	
Total 2015 candidature 1468 (♂874 ♀594)	
Introduced Species & the Australian Environment	80.0%
Organic Geology – A Non-renewable Resource	2.1%
Mining and the Australian Environment	1.1%
Oceanography	16.8%
	100%

Senior Science	
Total 2015 candidature 6320 (♂3456 ♀2864)	
Polymers	4.7%
Preservatives and Additives	4.2%
Pharmaceuticals	24.5%
Disasters	58.6%
Space Science	8.0%
	100%

* 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 science 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 September 2015. 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.

Science Life Skills:
Total 2015 Candidature was 625 (385 males, 240 females).
(This course is part of the total science entries.)

Entries for HSC Science courses 1992–2015 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	'15
%	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	60.3

These tables were prepared by Robert Garner using data from the NSW Board of Studies, January 2016.

2016 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
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- GLOSSARY OF EXAMINATION TERMS
- SKILLS REQUIRED FOR INVESTIGATIONS

Top HSC students and Science teachers use and recommend Odlum & Garner books.
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Odlum & Garner	Title	ISBN	RRP	ORDER
Biology:	2001–2015 Biology Past HSC Papers with Worked Solutions ... NEW RELEASE	978 1 921741 41.8	$39.95	
	2010–2015 Biology Past HSC Papers with Worked Solutions ... NEW RELEASE	978 1 921741 44 9	$27.95	
Chemistry:	2001–2015 Chemistry Past HSC Papers with Worked Solutions ... NEW RELEASE	978 1 921741 42 5	$39.95	
	2010–2015 Chemistry Past HSC Papers with Worked Solutions ... NEW RELEASE	978 1 921741 45 6	$27.95	
Physics:	2001–2015 Physics Past HSC Papers with Worked Solutions ... NEW RELEASE	978 1 921741 43 2	$39.95	
	2010–2015 Physics Past HSC Papers with Worked Solutions ... NEW RELEASE	978 1 921741 46 3	$27.95	
Earth Science:	2001–2014 Earth & Environmental Science Past HSC Papers with Worked Solutions	978 1 921741 39 5	$39.95	
	2009–2014 Earth & Environmental Science Past HSC Papers with Worked Solutions	978 1 921741 40 1	$27.95	
Senior Science:	2001–2014 Senior Science Past HSC Papers with Worked Solutions	978 1 921741 37 1	$39.95	
	2009–2014 Senior Science Past HSC Papers with Worked Solutions	978 1 921741 38 8	$27.95	

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

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PO Box 442, Freshwater NSW 2096
Ph: (02) 9939 6107 Fax: (02) 9939 6105
Email: robert@odlumgarner.com
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20% discount & FREE freight
for orders of 15+ books (may be mixed)
All other orders – $10 delivery charge

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1/16.COD

Drones, droids and robots

The 2016 National Science Week schools' theme is *Drones, Droids and Robots*. It will involve the 'technology' of STEM, as it centres on the uses of autonomous technologies with real world applications in areas such as agriculture, mining, manufacturing, medicine, space and deep ocean exploration. Such technology has transformed our day-to-day lives – from robot vacuum cleaners and lawn mowers to automated pool cleaners. So what are drones, droids and robots?

ROBOTS are machines designed to automatically perform one or more tasks repetitively, with speed and precision. The term 'robot' was first used to denote a fictional humanoid in a 1920 play (called R.U.R.) by the Czech writer Karel Čapek. Robots have featured in Science fiction ever since then. First-generation robots date from the 1970s and consist of stationary, non-programmable, electromechanical devices without sensors. Second-generation robots were developed in the 1980s and can contain sensors and programmable controllers. Third-generation robots were developed between approximately 1990 and the present. These machines can be stationary or mobile, autonomous or insect type, with sophisticated programming, speech recognition and/or synthesis, and other advanced features. Fourth-generation robots are in the research-and-development phase, and include features such as artificial intelligence, self-replication, etc.

Robots have replaced humans in performing repetitive and dangerous tasks that humans prefer not to do, or are unable to do because of size limitations, or which take place in extreme environments, such as outer space or the bottom of the sea. There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising unemployment as they replace workers in increasing numbers of functions. The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may become a realistic concern in the future.

Figure 3 R2-D2 and C-3PO are droids from Star Wars movies.
[Credit: Lucasfilm]

Robotics has developed greatly. Many robotic devices have been developed to enable people who are disabled at birth or by injury to function almost normally using prosthetic robotic devices, e.g. hands, arms, legs, jaws. Planes have had autopilot (colloquially referred to as 'George') for many years, allowing the plane to be flown without constant 'hands-on' control by a human operator. This has helped to overcome the problems associated with pilot fatigue. Some planes can even land and take off while on autopilot. Tesla Motors have just released a robotic app for the Tesla electric car. You may have seen the video of the car travelling over the Sydney Harbour Bridge in traffic and performing lane changes under its own control last October. Like most new technologies, this type of autonomous technology does not come cheaply. However, it will no doubt get cheaper once the development costs have been recovered.

The term DROID was created by special effects worker John Stears for the first of George Lucas' *Star Wars* movies in 1977. It refers to mechanical beings that often possess artificial intelligence. These fictional robots are either 'humanoid' or distinctly non-human-form utility machines. Droids have had a huge cultural impact on people worldwide, since *Star Wars* featured C-3PO, R2-D2 and many other mechanical creatures. Lucas actually based his C-3PO droid on the *Maschinenmensch* (German for 'machine-human'), the first fictional robot to appear in cinema – in the movie *Metropolis* in 1927.

Droids in the *Star Wars* universe do not resemble living things, as they are built and can be repaired easily. They do not have to learn skills, as they are directly programmed with them. Many droids have calculation abilities installed into them. Most possess a form of self-awareness, with some even having emotions, e.g. a fear for their existence. They do not need to sleep, although they can be deactivated as a form of sleep and have occasional maintenance cycles.

The word 'droid' cannot be used without permission from George Lucas, as he holds a trademark on the word 'droid'. So for every instance of its use, Lucasfilm Ltd either makes money, or takes legal action! This occurs even though a 'droid' is merely a form of 'android' (a robot with human-like qualities), which can be traced back nearly 300 years. However, Google has owned the trademark to the word 'android' since 2007. So a word of warning as you celebrate Science Week in 2016 – if you invent any robotic devices, take care that you do not use 'droid' or 'android' to refer to them!

A DRONE was once just 'a stingless male bee that has the role of mating with the queen bee' or 'one that lives on the labour of others.' Today it can also be 'a vessel guided by remote control', i.e. 'an unmanned aerial vehicle' (UAV). So, essentially, a drone is a 'flying robot'. It may be remotely controlled or can fly autonomously through software-controlled flight plans in their embedded systems, working in conjunction with GPS.

Until recently, UAVs were something used by the military for covert operations, e.g. gathering intelligence against enemy targets, or even to kill people in the Middle East war zones. Today, drones can also be used for search and rescue, monitoring traffic, weather or atmospheric pollution, fire fighting, remote exploration of volcanic craters, planting crops, controlling weed infestations, and more. When used for surveillance, drones take videos or photographs, e.g. to help sell real estate, and for advertising and TV coverage of sporting events. You may have seen the drone that crashed just before Christmas, narrowly missing a down-hill skier in a World Cup event in Europe! So perhaps drones should be kept away from where there are people.

Solar-powered drone technology beaming lasers down to Earth may one day be used to inexpensively connect the two-thirds of humanity not on the Internet, if the current vision of Facebook comes about.

References: • *www.scienceweek.net.au/schools/*
• *starwars.wikia.com/wiki/Droid*
• *priceonomics.com/lucasfilm-owns-all-of-your-droids/*
• *whatis.techtarget.com/* • *Wookipedia.com* • *Wikipedia*

Be who you are and say what you feel,
because those who mind don't matter
and those who matter don't mind.

... Dr Seuss (1904-1991)

MACQUARIE UNI OBSERVATORY & PLANETARIUM PUBLIC THURSDAY & FRIDAY NIGHT OBSERVING

The Macquarie University **Astronomical Observatory** (access via Gymnasium Rd) is open to the public every Friday night (March–Nov inclusive), plus some Thursday nights. It opens 8–9.30 pm (in AEDT) or 7–8.30 pm the rest of the year. Bookings are essential and must be made online. If doubtful weather, you will be sent an email and get a refund.

There are also **planetarium sessions** on the first Thursday of each month (Mar to Nov) from 6:30–7:30 pm at Macquarie Uni. Tickets must be booked online. These sessions are not weather dependent.

For details & bookings, go to: *www.mq.edu.au/* then search for either '*astronomical observatory*' or '*planetarium*' and follow the links.

... continued from page 1

reducing the need for nitrogen fertilisers (although phosphorus still has to be added to Australian soils). Hence pulse crops are often used in crop rotation by farmers. By lowering the amount of fertiliser needed to grow a crop, pulse production uses less energy and therefore produces less greenhouse gas. Pulses have a much lower carbon footprint than almost any other food group.

Pulse crops are also frost-hardy and being water-efficient, they are drought-tolerant. As a result, pulses grow well in areas that would be marginal for many other crops and suit Australia's arid climate, e.g. on average, it takes only 430 L of water to grow 1 kg of pulses, whereas nearly 2500 L of water are needed to grow 1 kg of soybeans and 3700 L of water to grow 1 kg of peanuts. Wheat and rice have even greater water demands. It takes a staggering 8000-18,000 L of water to produce the same amount of animal protein.

Pulses are grown as a staple food in developing countries in Asia, the Middle East and Africa. Pulses have only been grown widely in Australia since the 1980s, with production doubling every ten years since 1980. They are now being increasingly grown as crops in every Australian state, with much of our pulse crops being exported to India and Egypt.

Given the world's increasing population, it has been estimated that a 70% increase in agricultural production is needed worldwide by 2050. Producing more pulse crops would help to feed the world. Not only are pulse crops sustainable, but they are also healthy to eat.

There are many ways that Science teachers and their students can get involved in IYP. The IYP website (*iyp2016.org*) will be the main platform to share information and relevant resources. It will be updated regularly in 2016. There is also an Australian website for IYP at *www.pulseaus.com.au/about/international-year-pulses*

References:
• *iyp2016.org* • *www.fao.org/pulses-2016/en/*
• *www.pulseaus.com.au/about/international-year-pulses*
• *en.wikipedia.org/wiki/Pulse_(legume)*

CONGRATULATIONS

SciTalk No. 4–2015 'Astronomy Giveaway' winners, Kathy Donnelly (GRC Penshurst Campus) & Toni Edwards (Forbes High) each won a copy of:

ASTRONOMY 2016
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

Astronomy

Summer into autumn skies for Term 1

... Robert Garner

As summer progresses towards autumn, the skies are getting darker earlier, while the weather still remains warm for comfortable viewing.

The Planets

Four of the five naked eye planets, Mercury, Venus, Mars and Saturn, will all be visible in the pre-dawn sky.

Only Jupiter will be visible the whole evening during Term 1. It will rise in the east just after the Sun sets in the west. Right now, is one of the best times of the year to view Mercury, while it is at its greatest angular separation from the Sun. As viewed from Earth, the angular separation of Mercury and the Sun is never greater than 28° and usually less. As a result, Mercury always rises in the two hours before sunrise or sets less than two hours after the Sun. On 7 February, Mercury will be a good viewing object about 1 hour before sunrise. Mercury will be a little lower in the pre-dawn sky with each passing day and will disappear in the early morning twilight by mid-March.

Venus will be a little higher in the sky than Mercury and a little further north (to the left). It will rise around 4 am in February and around 5 am in March. Venus, like Mercury, cannot ever be seen high in the sky. Its angular separation from the Sun is never greater than ~46°. For the first half of 2016, Venus will be seen getting closer to the horizon as its separation from the Sun decreases.

Mars will rise around midnight in mid-February. It rises a little earlier each day, and will be rising at 10 pm by the end of March. It sets after sunrise, so it will be seen crossing the sky until dawn.

Jupiter will be good viewing over the first half of 2016. It will reach opposition on 8 March when the Sun and Jupiter are on opposite sides of Earth. The giant planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will appear bigger and brighter than at any other time of the year and will be visible all night long. On 24 February, Jupiter will be near the waning gibbous Moon and on 22 March, it will be close to the near Full Moon. A good pair of binoculars will allow you to see Jupiter's Galilean moons, appearing as bright dots on either side of the planet. Galileo observed the movements of these four biggest moons of Jupiter a bit over 400 years ago, thus showing that the Earth was not the centre of all astronomical movements. You can duplicate his feat by observing their changing positions over a number of successive nights.

Saturn will be in the pre-dawn sky, rising around midnight in mid-February. It rises a little earlier with the passing days, and rises around 10 pm by end of March. As it does not set until after sunrise, Saturn can be seen crossing the sky over the hours until dawn.

Constellations

The summer constellations will be high in the sky. *Orion* (the Hunter) and *Taurus* (the Bull) will be overhead each night and slightly to the north-west. *Crux* (the Southern Cross) and its two Pointers will be low to the south-east, with the Magellenic Clouds above. *Crux* will be lying on its side.

Being in the Southern Hemisphere, *Orion* (the hunter) appears upside down to us. His 'belt' forms the base of 'the saucepan' asterism that we see, and his 'sword', pointing into the air from the belt is 'the saucepan's handle'. Above 'the saucepan' are Orion's 'legs' with Rigel, a bright blue-white star, at the foot. Below 'the saucepan' at one of Orion's 'shoulders' is the red supergiant, Betelgeuse. This appears as an orange-red colour to the visible eye.

To the east of *Orion* is *Taurus*, containing the beautiful star cluster 'Pleiades' or 'Seven Sisters' (Messier 45). Only 6 of this cluster's stars are visible to the naked eye, but about 250 bluish stars can be seen if one uses a telescope. 'Pleiades', known as 'Subaru' in Japan, has been depicted in the name and 6-star logo for Japan's Subaru car.

Partial lunar eclipse

On Wednesday 23 March, a partial eclipse of the Moon will be visible in the whole of eastern Australia. The Moon dips into the outer edge of the Earth's shadow at 8:37 pm (AEDT) and will have fully emerged a bit after mid-night at 00:57 am early on Thursday 24 March. At mid-eclipse, which occurs at 10:47 pm (AEDT), about 80% of the Moon's disc will be in the Earth's penumbral shadow. Being a partial eclipse of the Moon, we will only observe a slight darkening from the southern edge of the Moon. This will spread towards the northern edge until it affects about 80% of the Moon. Then, after mid-eclipse, the shadow will retreat again.

Meteor showers

The best time to view meteors is generally after 1:00 am in the morning. It is good to get away from city lights and to avoid a bright Moon.

There will be a New Moon around the peak for the following meteor showers that will occur during Term 1, so conditions for viewing should be good if the weather is favourable:

- alpha-Centaurids: 28 Jan-21 Feb – peak rate on 8 February
- gamma-Normids: 25 Feb-28 March – peak rate about 14 March

The alpha-Centaurids are one of the main showers in the Southern Hemisphere, but have been disappointing over recent years. They appear to originate from the two pointers to *Crux* (α Centauri and β Centauri). The gamma-Normids appear to rise from close to the south celestial pole.

Equinox

The autumn equinox occurs at 3:31 pm (AEDT) on 20 March. The Sun will then shine directly on the equator and there will be nearly equal amounts of day and night throughout the world.

Many people (and text books) state that there is an equal length of day and night at the time of the equinox, but this is not true. What is true, is that from the time that the middle of the Sun rises above the horizon in the morning until the middle of the Sun sets below the horizon will be 12 hours. However, sunrise is a little earlier when the first edge of the Sun appears, and sunset is a little later when the Sun totally disappears below the horizon. So, on the equinox, daytime is about 9-10 minutes longer than the darkness hours. Daylight and night-time hours become equal about three days after the equinox.

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 University Observatory and Planetarium

Details for these happenings are on page 9.

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TO ENTER: Send an answer to the Quiz Question, your name, school & school address on an envelope to: Competition Corner, PO Box 442 Freshwater 2096 (or send by email to *cathie@odlumgarner.com*) – **by 31 March 2016**

***SciTalk 4/15* winner:** Naomi Eagleton, ASC St Joseph's Campus, Lochinvar, won *Earth & Env Science 2001-2014 Past HSC Papers with Worked Solutions* (rrp $39.95), published & donated by Odlum & Garner.

QUIZ QUESTION:
What travels with a velocity of 3×10^{8} m s^{-1}?

SciTalk 4/15 answer: Photosynthesis

SciTalk

SciTalk is a quarterly newsletter for secondary Science educators. Now in its 22nd year, *SciTalk* has been produced by Odlum & Garner for Science teachers since1995. 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 the Science teachers at your school, so they can benefit from it .

Contributions, advertising and inserts are welcome.

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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–February 2016 ... Dec 19
- *SciTalk* No. 2–May 2016 ... April 8
- *SciTalk* No. 3–July 2016 ... July 1
- *SciTalk* No. 4–October 2016 ... Sept 23

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