

SciTalk

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Australia's movements play havoc with GPS

As the Earth's tectonic plates move, a build up of tension drags Australia's entire landmass closer to the equator each year. Australia actually sits on the fastest moving continental plate and is moving northwards and slightly to the east by about 7 centimetres each year. Hence the continent has shifted by around 1.5 metres over the past 22 years.

This means the country's coordinates are slightly out and the continent is not actually where our GPS systems think it is. People on the ground may not notice, but a GPS does. So Australia needs to adjust its longitudes and latitudes to line up with GPS coordinates.

Four times in the last 50 years, Australia has reset the official coordinates of everything in the country to make them more accurate. Australia's local coordinate system, the Geocentric Datum of Australia (GDA), was last updated in 1994. If not corrected, it will be out by 1.8 metres by 2020. The next adjustment, due in 2017, needs to be about 1.5 metres, according

to scientists. This will put the majority of the country back into alignment with the world's GPS systems.

The coordinates also need correcting for other sources of error, other than continental drift. For example, large earthquakes often change the shape of a continental plate. The magnitude 8.1 earthquake that struck north of Macquarie Island on 23 December 2004 – just before the devastating Indian Ocean tsunami (Boxing Day Tsunami) – shifted the distance between Sydney and Hobart by a few millimetres.

The problem does not affect consumer-grade GPS devices as much as it affects surveying, navigation by airplanes and ships, and transportation, e.g. mining companies such as Rio Tinto need accurate GPS navigation for their fleet of ore trucks in regions such as the Pilbara as they are remotely controlled from their Perth office.

Digital maps indicate where a country is supposed to be based on detailed coordinates supplied by the government. As GPS systems become more accurate, these digital maps will need to be continually adjusted. This will enable organisations such as Google Maps to use the data they obtain from satellites orbiting the globe, to accurately determine where users are and match their position to a point on a map.



Figure 1 GPS Block II-F satellite in Earth orbit
[Credit: www.USCG.gov]

References: • news.nationalgeographic.com
• abc.net.au • sciencealert.com • nytimes.com
• ga.gov.au/scientific-topics

★ 2017 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.
- 3.
- 4.
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Please return to file or noticeboard.

PRIZES TO WIN!

See pages 1, 9, 10 & 12
Post in your entries now
(or send your details by email, if you prefer!)

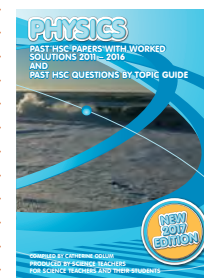
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Book Giveaway

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TO WIN: Send your name, school & school address to Book Giveaway, PO Box 442, Freshwater 2096 (or by email to cathie@odlumgarner.com) – by 11 April 2017.

★★★

Winner for SciTalk 3/16

Henna Ali, Arthur Phillip HS, won *Chemistry Past HSC Papers & Worked Solutions 2001-2015* (rrp \$39.95), published by Odium & Garner.

Diary Dates

Nyholm Lecture series 2017. In Term 2, dates tba. www.raci.org.au/branches/nsw-branch

MARCH 2017

- 3 Schools' Clean Up Australia Day. cleanupaustraliaday.org.au/about/about-the-event/
- 5 Clean Up Australia Day. cleanupaustraliaday.org.au/about/about-the-event/
- 11, 20 Questacon Science Circus: NSW dates - questacon.edu.au/outreach/programs/science-circus
- 17, 20, 31 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- 20 Autumn Equinox (21:29 pm AEDT)

APRIL 2017

- 3, 7, 28 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- 6 Investigating Science Teachers' day. Enquiries: Human Disease Museum, UNSW
- 7 Biology Teachers' Professional Development day. Enquiries: Human Disease Museum, UNSW
- 22 International Earth Day. www.earthday.org

MAY 2017

- 1, 5, 19, 22, 29 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- b/w 17–24 Big Science Competition. Closing date: 19/4/17. www.asi.edu.au/programs Ph: 6125 6228
- 20 Astronomy Open Night: Macquarie Uni, 6:30–10 pm, details/tickets at www.mq.edu.au/

JUNE 2017

- 2, 5, 9, 16, 19 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- 5 World Environment Day. www.un.org/en/events/environmentday/
- around 17 (tbc) NSW Schools Titration Competition. Entries close: 19 May. raci.org.au/branches/nsw-branch
- 21 Winter Solstice (14:24 pm AEST)
- 30 Closing date for Crystal Growing Competition: raci.org.au/branches/nsw-branch

JULY 2017

- 9–12 CONASTA 66 – annual conference of Australian Science Teachers Association (ASTA). Theme: *The art of science*. Venue: Hobart, TAS. www.scienceweek.net.au/schools/

AUGUST 2017

- 1 ANCQ (Australian National Chemistry Quiz). schools.raci.org.au/competition/ancq/
- 2 Chemistry Olympiad Exam. Closing date: 19/7/17. Ph: 6201 2552, asi.edu.au/programs
- 4 Earth Science Olympiad Exam. Closing date: 19/7/17. Ph: 6201 2552, asi.edu.au/programs
- 5 Jeans for Genes Day. www.jeansforgenes.org.au/
- 7 Biology Olympiad Exam. Closing date: 19/7/17. Ph: 6201 2552, asi.edu.au/programs
- 9 Physics Olympiad Exam. Closing date: 19/7/17. Ph: 6201 2552, asi.edu.au/programs
- 11, 14, 18 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
– come on any of these dates to celebrate National Science Week
- 12–20 National Science Week. Theme: Future Earth. www.scienceweek.net.au/schools/

SEPTEMBER 2017

- 4–10 Seaweek 2017. www.aace.org.au/ & www.ausmepa.org.au
- 11, 15 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- tba National Schools Titration Competition. raci.org.au/branches/nsw-branch
- 21 & 22 Zombie Apocalypse Junior Science event. Enquiries: Human Disease Museum, UNSW
- 23 Spring equinox (06:02 am AEST)

OCTOBER 2017

- 8–14 Earth Science Week. 'Earth and human activity'. www.earthsciweek.org
- 13, 16, 20 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- 16 HSC written exams commence ... ends 10 November
- 23, 27, 30 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107

NOVEMBER 2017

- 3, 6, 17 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- 20, 24, 27 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107

DECEMBER 2017

- 1–15 Physics is Fun at Luna Park Sydney. Enquiries: www.odlumgarner.com, ph (02) 9939 6107
- 22 Summer solstice (03:28 am AEDT)

• **JANUARY 2018** National Youth Science Forum. Forms to local Rotary club by 31/5/17, interviews from July. Only for Yr 11 in 2017. 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 NESA matters

The NSW Education Standards Authority (NESA) replaced the Board of Studies, Teaching and Educational Standards NSW (BOSTES) on 1 January 2017. Its website is: educationstandards.nsw.edu.au

NESA will be responsible for setting the state's K–12 curriculum, accreditation of teachers, registration of schools and home schooling, delivering the HSC and approving tertiary teaching degrees, including minimum entry standards and a pre-graduate literacy and numeracy test.

Teachers should regularly check the new NESA website to ensure they have the latest information on syllabuses, past exam papers, news, official notices, statistics archive and more.

Make sure you have updated yourself on:

- *New Periodic Table for HSC* [19-5-16]
The Periodic Table for use in HSC exams was updated to provide consistency with the latest International Union of Pure and Applied Chemistry (IUPAC) conventions for naming elements 113 through to 118.
- *Minor edit for HSC Physics Data Sheet* [10-2-17]
The subscript 10 has been added to the absolute magnitude equation, i.e. (\log_{10}) . The new sheet is on the NESA website.
- *Student work samples to be retained for Stage 5 and Preliminary courses* [27-2-17]
For 2017, schools should keep a minimum of three work samples representing the upper, middle and lower range of achievement for Stage 5 Science and all the Preliminary Science courses.

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

NESA enquiries

Ph: 9367 8111, fax: 9367 8484
educationstandards.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.

National Science Week
12–20 August 2017



This year's National Science Week schools' theme is *Future Earth*.

futureearth

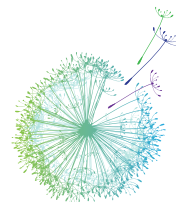
Launched in 2015, *Future Earth* is a major 10-year international initiative to advance global sustainability science. In brief, the eight key challenges of *Future Earth's* 2025 vision are to:

- deliver water, energy, and food for all
- decarbonise socio-economic systems to stabilise the climate
- safeguard the terrestrial, freshwater and marine natural assets underpinning human well-being
- build healthy, resilient and productive cities
- promote sustainable rural futures
- improve human health
- encourage sustainable consumption and production patterns
- increase social resilience to future threats.

The **2017 National Science Week teacher resource book** for *Future Earth* will focus on Australia's sustainability science and will highlight those issues that are unique to Australia and its region.

Schools around the nation will be contributing to National Science Week celebrations by organising and participating in a diverse range of activities and events to enthuse their students' interest in science and to encourage them to become fascinated by the world we live in.

International Year of Sustainable Tourism for Development



2017 is the UN International Year of Sustainable Tourism for Development (IY2017).

There are now more than one billion international tourists travelling the world each year. Tourism has become a powerful and transformative force that is making a genuine difference in the lives of millions of people.

The potential of tourism for sustainable development is considerable. As one of the world's leading employment sectors, tourism provides important livelihood opportunities, helping to alleviate poverty and drive inclusive development.

The IY2017 will promote tourism's role in the following five key areas:

- Inclusive and sustainable economic growth
- Social inclusiveness, employment and poverty reduction
- Resource efficiency, environmental protection and climate change
- Cultural values, diversity and heritage
- Mutual understanding, peace and security.

These initiatives are appropriate given that 2014–2024 is also the UN Decade of Sustainable Energy for All, in an effort to make sustainable energy for all a reality.



UNITED NATIONS DECADE OF SUSTAINABLE ENERGY FOR ALL 2014-2024

School & chemical education activities in 2017

Crystal Growing Competition

Primary and Secondary students in years K-6 & 7-12.

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

Crystals are grown during Term 2.

Certificates for all and trophies for the winners!



Join us in our Centenary Year 1917 - 2017

raci-nsw@raci.org.au
www.raci.org.au/branches/nsw-branch

Titration Competition

A competition for Year 11 & 12 students.

Registrations open: 13 March 2017.

NSW Competition: June 2017.

National Competition: September 2017.

Certificates for all and trophies for the winners!

Does your school want to be a venue for 2017?

ANCQ

(formerly the Australian National Chemistry Quiz)

"A unique chemical education activity."

ancq@raci.org.au

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Can plastic-eating mushrooms solve the world's plastic problem?

Non-biodegradable plastic wastes are the scourge of our planet. Many oceans are polluted by plastics, resulting in harm to marine organisms and landfill sites are overflowing with plastic waste that will not break-down for perhaps hundreds of years. Yet global production of these plastics continues to increase, especially in developing nations. The sheer volume of plastics produced each year presents a huge problem for waste disposal worldwide.

However, signs of a possible solution have now appeared. Back in 2012, scientific researchers from Yale University discovered the fungus, *Pestalotiopsis microspore* in the Amazonian rainforests of Ecuador in South America. This fungus can consume polyurethane, a plastic polymer, under both aerobic and anaerobic conditions.

Following on from this discovery, Katharina Unger and Julia Kaisinger have recently developed a device that turns polymer waste into edible 'mushrooms' in collaboration with researchers from Utrecht University in the Netherlands. Their Fungi Mutarium, as this device is called, consists of many mushroom-shaped bowls that are made of agar, mixed with starch and sugar.

Of course, not all fungal species work. The device uses *Schizophyllum commune* and *Pleurotus ostreatus*, two fungi that were shown to degrade plastic. These fungi are edible and already eaten in many parts of the world.

The fungi are placed into the Mutarium's agar bowls, along with UV-sterilised plastic. As the fungi grow, using the nutrients from the agar, they extract carbon from the plastic and so break it down. This process takes between a few weeks to several months to completely digest all the plastic – and results in a non-toxic, biodegradable and edible biomass. The end result can vary in flavour depending on the strain of fungus used. So scientists are now working on flavours to make the flavour more appealing to eat. This discovery is a promising environmental solution to an environmental problem that most of us unconsciously contribute to every day. Further research is needed,



Figure 2 Set-up for growing plastic-eating fungi. [Credit: LIVIN/Paris Tsitos]



Figure 3 UV sterilisation of plastic in incubator below (left); close-up of Fungi Mutarium (right). [Credit: LIVIN/Paris Tsitos]

but scientists are looking at the idea of injecting fungi into landfill waste piles to start the breakdown of plastics in them.

References:

• www.smithsonianmag.com • www.livinstudio.com/fungi-mutarium/ • www.dezeen.com



Museum of Human Disease

Professional Development for Science Teachers

Our PD focuses on the latest research from UNSW with presentations, workshops and Museum experiences. Full catered and NESA (BOSTES) accredited for 6 hours.

April 6 will focus on Senior Science and the new Investigating Science course.

April 7 will focus on Biology.

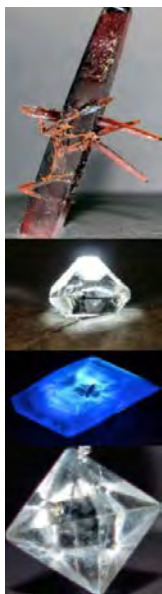
Final programs TBC – but previous topics have included Goal Setting for student success, e-portfolios, sexual selection, gene therapy, nano-medicine, embryology, neuroplasticity and de-extinction.

Details at: www.diseasemuseum.unsw.edu.au

Contact: 9385 1522 diseasemuseum@unsw.edu.au



RACI Crystal Growing Competition 2017



Crystals are everywhere. Just think of our daily lives – sugar and salt are crystals and the only reason LCD computer and television screens work is because of the many tiny crystals inside.

Where else can you find crystals? How about your classroom? Why not enter the RACI Crystal Growing Competition and learn all about growing beautiful crystals.

This competition takes place in Term 2 and is open to both primary (K-6) and secondary (7-8) students to grow single crystals of alum and K-10 students to grow any crystal.

Crystals are to be grown for no longer than 6 weeks – and must be at the RACI office by the closing date: Friday 30 June 2017.

The best crystals will be sent to the National Crystal Growing Competition (judged in Term 4).

Details and entry forms: www.raci.org.au/branches/nsw-branch

Contact: Jenny Jones, jennyjonesdr@gmail.com

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Vulnerability of keyless car locks

Early cars were keyless and had to be cranked over with a handle to start. This handle was usually left in place on the car. However, then as now, thieves would just crank the handle to start and drive off in the car. In 1908, *Scientific American* reported that security-conscious drivers in the US had to carry their heavy crank-handles to prevent car theft. It suggested that car-makers introduce a locking system.

Luxury cars had keys by around 1913 and other cars started to get them in the 1920s. By World War II, nearly all cars had mechanical keyed locking systems to open the doors, unlock the steering and operate the ignition system. However, thieves soon caught up with this technology – as mechanical locks can be picked, or duplicate keys produced with common locksmith’s tools.

In the 1990s, electronic ignition systems appeared and were supposedly unable to be tampered with. Car thefts dropped dramatically – for a while. But tech-savvy thieves soon caught up with this technology.

A recent study by computer scientists at the University of Birmingham in the UK has shown that keyless entry systems using a two-way radio signal between the key fob and car unit are relatively easy to hack into. A would-be thief has only to ‘eavesdrop’ on a single signal from the vehicle’s remote key to detect the cryptographic algorithms used in it and the car’s control unit. All it takes is some equipment for grabbing radio signals for an outlay of less than \$100 and a few minutes of computation on a laptop – and a key’s signal can be cloned to gain unauthorised entry to the vehicle to steal it or any valuables in it.

If your car can detect the key’s signal from a big distance, e.g. from inside your house to the car on the street, then a would-be thief parked nearby with a signal amplifier can detect the two-way radio communication and then analyse that signal to decode it. Thus your car is vulnerable to being broken into.

Some newer cars today have better security systems that require the key and car to be within a few metres of one another before communication is possible. However, there are now signal amplifiers with increased amplifying power. These ‘power amplifiers’ can work over a large distance to eavesdrop and so can still obtain your car’s key code.

Millions of vehicles worldwide sold over the last 20 years are susceptible to this type of cyber theft. The findings of the Birmingham University study could explain unsolved insurance cases of theft from allegedly locked vehicles. So beware, a vehicle in a driveway or parking lot today is open to this method of theft.

Reference: Garcia, F D, *et al* (August 2016). ‘Lock It and Still Lose It – On the (In)Security of Automotive Remote Keyless Entry Systems.’

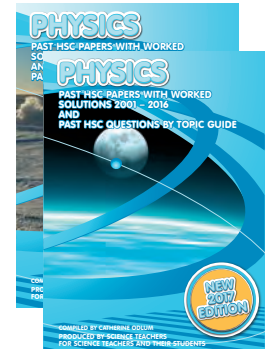
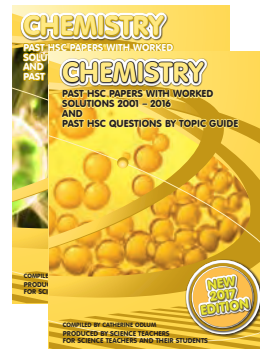
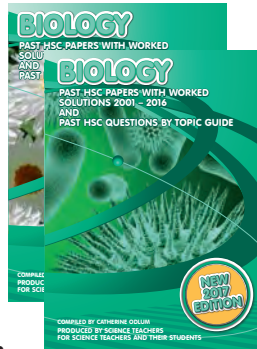
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Australian continent shifts with the seasons

The Australian continent has been recently found to move with the seasons because of changes to Earth’s centre of mass.

Earlier this year, researchers confirmed that Australia has moved by around 1.5 metres over the past 22 years due to tectonic shifts (see article on page 1) and the government will be updating the country’s latitude and longitude to reflect the change. However, a new study has shown that, in addition to this northward drift, the continent is shifting and tilting back and forth by several millimetres every year.

This study, led by Professor Shin-Chan Han from the University of Newcastle, found that Australia moves northwest by about 1 millimetre during its summer. At the same time, its northwestern edge tilts downwards by 2 to 3 millimetres. Then during its winter, the trend reverses, and Australia shifts southeast and reverses its tilt.

This occurs because the Earth’s mass is not perfectly balanced, although Earth is roughly spherical. Earth’s centre of mass (about 6000 kilometres below the surface) is affected by the seasonal changes in water distribution across its surface due to precipitation and evaporation. When snowpacks and accompanying rainfall in the Northern Hemisphere are at their peak, their weight is strong enough to shift Earth’s centre of mass closer to Europe. Then six months later, the centre of mass moves closer to the southern Pacific Ocean as much of the snow has melted and been evaporated along with the rainwater into the atmosphere. These changes cause quite a detectable, sizeable deformation in Australia with the seasons.

All continents move slightly with this change in the centre of Earth’s mass. However, the effect is greater in Australia due to its position between Europe and the South Pacific Ocean.

To determine how much the continent was moving, Han and his team monitored changes in the location of 14 land-based GPS stations across Australia between 2003–2015. These could detect changes in land position of less than 1 millimetre. Then they compared their results

with satellite data on Earth’s gravitational pull throughout the year. Hence they could measure where water was across the planet.

While such changes are far too small to be felt by people, they can be detected by satellites and so GPS measurements for Australia could be a millimetre or two off. This could cause problems if you are relying on GPS measurements to track things, e.g. rising sea levels, or self-driving cars. Before there can be any major changes

made to GPS, this study needs to be replicated by independent teams.

Han’s team is now hoping that their research will make GPS more accurate and help scientists to better track the precise location of Earth’s centre of mass, which is important for GPS and other satellite measurements.

Reference:

‘Seasonal clockwise gyration and tilt of the Australian continent chasing the center of mass of the Earth’s system from GPS and GRACE’. *Journal of Geophysical Research: Solid Earth*, a journal of the American Geophysical Union – Shin-Chan Han (30 Oct 2016)

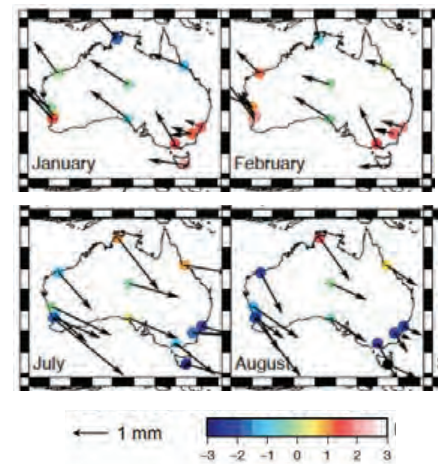


Figure 4 GPS stations across Australia reveal how Australia moves with the seasons

[vertical and horizontal displacements are shown with coloured dots and solid black arrows, respectively.]

[Credit: Shin-Chan Han]

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HSC statistics: Science entries in the 2016 HSC

The total number of entries for HSC Science courses* in 2016 was 46,372 and the total number of HSC entries for the 2016 HSC was 76,199. So Science entries were 60.9% of the total entries.

The number of HSC Science entries as a % of the total HSC entries from 1992–2016 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

Biology	
Total 2016 candidature	17,735 (♂ 6851 ♀10,884)
Communication	73.5%
Biotechnology	5.4%
Genetics: The Code Broken?	16.9%
The Human Story	4.1%
Biochemistry	0.2%
	100.1%

Chemistry	
Total 2016 candidature	10,554 (♂ 5837 ♀4717)
Industrial Chemistry	59.6%
Shipwrecks, Corrosion and Conservation	25.1%
The Biochemistry of Movement	0.8%
The Chemistry of Art	3.5%
Forensic Chemistry	11.0%
	100.0%

Physics	
Total 2016 candidature	9156 (♂ 7156 ♀2000)
Geophysics	0.6%
Medical Physics	30.7%
Astrophysics	18.1%
From Quanta to Quarks	49.8%
The Age of Silicon	0.8%
	100.0%

Entries for HSC Science courses 1992–2016 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	'16
%	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	60.9

These tables were prepared by Robert Garner using data from the NSW Board of Studies, February 2017.

to only 55.8% in 2002. Since 2011 until now, it has hovered around 60–62%, 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 2016. 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.

Earth & Environmental Science	
Total 2016 candidature	1592 (♂ 895 ♀697)
Introduced Species & the Australian Environment	80.2%
Organic Geology – A Non-renewable Resource	2.9%
Mining and the Australian Environment	0.5%
Oceanography	16.4%
	100.0%

Senior Science	
Total 2016 candidature	6657 (♂ 3591 ♀3066)
Polymers	4.9%
Preservatives and Additives	4.5%
Pharmaceuticals	22.4%
Disasters	59.8%
Space Science	8.4%
	100.0%

* 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 1 September 2016. There is usually a difference between these two sets of figures because some students have illness/misadventure/unexplained absences/answers for more than one option, and so do not sit for the examination.

[Note: Individual option percentages are rounded to the nearest 0.1%, so from year to year the totals in these tables are not exactly 100.0% for some courses.]

Science Life Skills:

Total 2016 Candidature was 678 (443 males, 235 females).
(This course is part of the total science entries.)

The goal of education is not to increase the amount of knowledge, but to create the possibilities for a child to invent and discover, to create men who are capable of doing new things.

... Jean Piaget
(1896–1980)

STOP PRESS: Winner of the IMAX Sydney family pass for *SciTalk* No. 3–2016 was Mike Taylor, The Forest High School.

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WINNER: Amy Homola, The Jannali High School, won a Luna Park Sydney family pass for *SciTalk* No. 3–2016.



Autumn is a great time to view the night skies ... Robert Garner

The night skies will be dark earlier now that it is autumn. The weather should not be too cold yet, thus making for comfortable viewing of the planets and stars.

Our southern skies are full of interesting objects for your students to observe. For a good night's viewing they need to know the compass directions (these are on most mobile phones) and a star chart (see Box 1). Optional extras are a small pair of binoculars and a torch covered with red cellophane to read and record their notes.

The Planets

Looking for a planet that is near the Moon is a great way to help you locate the planet. Remember, when looking for a planet, Venus and Jupiter are the two brightest celestial objects after the Sun and the Moon. Some good dates to go out looking for planets are:

- *Mercury*: 29 March and 25 July (low in the twilight). However, Mercury is always low in the sky and so difficult to see.
- *Venus*: near the crescent Moon on 24 April (in morning sky), 23 May, 21 June and 21 July.
- *Mars*: 30–31 March.
- *Jupiter*: 14–15 March, 10–11 April, 7–8 May, 4 June and 1 July.
- *Saturn*: 20 March, 16 April, 13 May, 9–10 June and 7 July.

Constellations

The best constellations to look for will be *Scorpius* (the scorpion), with its hook-shaped tail and bright, red heart Antares, and *Sagittarius* (the archer) with its teapot shape. These will be overhead each night. *Crux* (Southern Cross) will be high in the south-west. Within *Crux* look for the Coalsack Nebula between the two brightest stars (α Crucis and β Crucis). The Jewel Box, an open cluster in *Crux*, should also be visible (although hazy) to the naked eye – about 1.0° southeast of β Crucis and northeast of the Coalsack. With binoculars it will appear as a group of stars that show quite different colours.

Above the Southern Cross is ω Centauri, the largest and brightest globular cluster in the sky. To the naked eye, this appears as a faint fuzzy patch – but it actually is a cluster of about a million stars.



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Meteor showers

The best time to look for meteors is after 1 am or even later, in the early morning hours, before the onset of morning twilight. It is good to get away from city lights and to avoid a bright moon. Meteors tend to come in spurts that are interspersed by lulls. Also, it can take as long as 20 minutes for your eyes to adapt to the dark.

The eta-Aquarids (in *Aquarius* constellation) will be active from 19 April–28 May, peaking around 6 May. They may be difficult to see this year, as a Full Moon occurs on 11 May. Associated with Halley's Comet, their hourly rate is often around 30 per hour.

Solstice

Our winter solstice occurs at 14:24 pm (AEST) on 21 June. The Sun will appear to reach its most northerly position relative to the Equator, and will be directly above the Tropic of Cancer. Although the term *solstice* only strictly applies to an instant, the term is usually applied to the whole day. It is derived from Latin: *sol* (= Sun) and *sistere* (= stand still). A winter solstice is often the shortest day of the year, but not always – as the day before or following is sometimes just as short.

Autumn equinox

Our autumn equinox occurs at 21:29 pm (ADST) on 20 March. At this time, the Sun will shine directly on the equator and there will be nearly equal amounts of day and night throughout the world.

Despite claims that there is equal length of the day and night at an equinox, this is not true. The daytime will actually be about 9-10 minutes longer than the hours of darkness. Daylight and night-time hours will actually be equal about three days after the equinox. 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 in the evening, will be 12 hours.

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>

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

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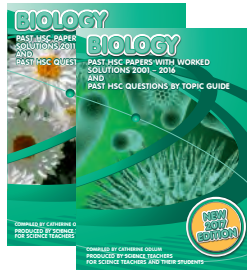
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TO ENTER: Send an answer to the Quiz Question, your name, school & school address on an envelope to: Competition Corner, PO Box 442 Freshwater 2096 (or send by email to cathie@odlumgarner.com) – by 11 April 2017

QUIZ QUESTION:
In which cellular organelle does aerobic respiration occur?

SciTalk 3/16 answer: Chloroplast

SciTalk 3/16 winner: Sally Pankhurst, GRC Oatley Campus, won *Biology 2001-2016 Past HSC Papers with Worked Solutions* (np \$39.95), published & donated by Odlum & Garner.

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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.

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- SciTalk No. 1 – March 2017 ... 19 Dec 2016
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