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SciTalk

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Number 4 – October 2015

Australia stakes claim to longest continental volcano chain

Scientists have discovered that Australia is home to the longest chain of continental volcanoes in the world. This volcano chain has been named the 'Cosgrove hotspot track' after the youngest volcano at the southern end of the chain in Victoria.

This volcano chain stretches almost 2000 km down Australia's east coast from Cape Hillsborough in Central Queensland to Cosgrove in Victoria. It consists of 15 extinct volcanoes that geologists previously knew about and had linked to hotspot activity. However, new research has revealed that they all formed as they passed over the *same* hotspot in the Earth's mantle. This hotspot is currently thought to be located below the Bass Strait, between King Island and Tasmania.

Gradual north-northeast movement of the Indo-Australian continental plate over this hotspot created these 15 volcanoes over the past 33 million years. It is three times longer than the Yellowstone hotspot track in USA.

The volcanoes in the chain are spread along a straight line and get progressively younger to the south. They had not been previously linked, as until now they appeared to be two geochemically distinct groups separated by a gap of 700 km from Buckland, the youngest of the central Queensland group, to Byrock the site of the oldest in the group from NSW down to Victoria with no apparent surface volcanism (see Figure 8).

Figure 1 Cape Hillsborough in Qld shown above is the most northerly point on the volcano chain.

[Credit: Richard Stanley]

Scientists at the Australian National University (ANU) have conducted a study that links the two groups of extinct volcanoes and explains why no volcanoes occur in the geographic gap between the two groups. Using seismic studies, they mapped the thickness of the Earth's lithosphere (the crust and mantle) beneath eastern Australia. They found that the central Queensland volcanoes had erupted through

... continued page 11

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

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Winner for *SciTalk 3/15*

Ken Larsen, Trinity Anglican College, won *Chemistry Past HSC Papers & Worked Solutions 2001-2014 (rrp $39.95)*, published by Odlum & Garner.

Diary Dates

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

For Shell Questacon Science Circus 2015-2016:
www.questacon.edu.au/outreach/programs/science-circus

OCTOBER 2015

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)

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

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/

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

JUNE 2016

3, 6, 10, 17, 20 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, www.odlumgarner.com

5 World Environment Day

21 Winter Solstice (8:35 am AEST)

tba NSW Schools Titration Competition: www.nswtitration.com/ (? 30 May/11 June)

JULY 2016

3–6 CONASTA 65 in Brisbane: 'Superheroes of Science: Unmask your potential', asta.edu.au/conasta

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

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

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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:

- Personalised HSC timetables
- Scientific calculators for use in 2015 HSC
- New/revised personalised HSC materials (BOS 15/15)
- Multiple Choice in HSC Examinations
- Stage 5 & Preliminary course student work samples to be retained
- Revised Stage 5 Course Performance Descriptors (CPDs) (BOS 04/15)

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

2015 Science HSC Examination Dates

15 Oct	Earth & Environmental Science: 1.55 pm–5 pm
19 Oct	Biology: 9.25 am–12.30 pm
22 Oct	Senior Science: 1.55 pm–5 pm
23 Oct	Chemistry: 9.25 am–12.30 pm
27 Oct	Physics: 9.25 am–12.30 pm

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.

* * * * *

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A child's life is like a piece of paper on which every person leaves a mark.

… Chinese proverb

OUT AND ABOUT

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A BEAUTIFUL PLANET 3D

From Toni Myers, the director of *Space Station 3D*, comes a remarkable new film, *A Beautiful Planet 3D*. This film is due to release at IMAX Sydney in April 2016. It depicts the raw beauty of our planet from a vantage point in space that few have ever experienced.

The picture depicts a breathtaking pass at night over North America's NE coast with the Aurora Borealis on the horizon. It was shot from the ISS by Commander Butch Wilmore in late November. If you look carefully, you can pick out the Great Lakes and some cities on the NE Coast.

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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 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

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

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Further information and bookings:

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W www.diseasemuseum.unsw.edu.au

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- **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

Plan now for the 2016 National Science Week

Another successful National Science Week was held this year, with thousands of teachers and students participating from early childhood to senior secondary levels by organising and participating in a diverse range of activities and events. So, it is now time to start some forward planning and put the 2016 National Science Week from 3–21 August 2016 into your school calendar.

Next year's theme is 'Drones, Droids and Robots', to embrace the 'technology' component in STEM (see Box 1). The theme will centre on the real-world application of autonomous technologies in areas including agriculture, mining, manufacturing, medicine and space and deep ocean exploration. It will also be a chance to look at how this technology has transformed our day-to-day lives – from robot vacuum cleaners and lawn mowers to automated pool cleaners.

What is National Science Week?

National Science Week is an annual festival of Science that takes place in August each year. This celebration aims to raise the profile and increase the public understanding and public appreciation of Science, innovation, engineering and technology, and their role in maintaining and improving our society, economy and environment.

It provides an opportunity to acknowledge the contributions of Australian scientists' to the world of knowledge. It also aims to encourage an interest in Science pursuits among the general public, and to encourage younger people to become fascinated by the world we live in. Keep this address for details: *www.scienceweek.net.au*

> **Box 1 What is STEM?**
>
> STEM is an acronym referring to science, technology, engineering and mathematics; often used when addressing education policy or curriculum choices in schools.

> Success is a journey, not a destination. The doing is usually more important than the outcome. Not everyone can be number 1.
>
> ... Arthur Robert Ashe, Jr (1981)

New elements set to fill the spare seats at the Periodic Table

The May 2013 version of the IUPAC Periodic Table added element 114, flerovium and element 116, livermorium. Claims for the discovery of all the remaining elements in the seventh period of the Periodic Table, namely elements with atomic numbers 113, 115, 117 and 118 are now being considered by IUPAC. When these additional four elements are ratified, all spaces in the present table will be occupied and element 119, if found, will start a new 8th period with the next Group 1 alkali metal.

The new 'super-heavy elements' (SHE) have been synthesised in a laboratory by fusing atoms together to create larger nuclei. This is performed in cyclotrons by smashing a high-energy beam of ions such as Ca-48 into a particular target, such as americium-243 (Am-243) or berkelium-249 (Bk-249):

$$^{48}_{20}\mathrm{Ca} + {}^{243}_{95}\mathrm{Am} \rightarrow {}^{291}_{115}\mathrm{Uup}$$

$$^{48}_{20}\mathrm{Ca} + {}^{249}_{97}\mathrm{Bk} \rightarrow {}^{294}_{117}\mathrm{Uus} + 3\ {}^{1}_{0}n$$

[Note: Uup and Uus are temporary symbols while IUPAC considers claims for the new elements.]

Most of the collisions are unsuccessful. However, occasionally the products of such fusion reactions are SHEs. It is hard to track the formation of SHEs because they decay in a few milliseconds or less. Scientists detect them by identifying the energies and masses of the decay products they produce as they break down.

Laboratories such as the Lawrence Livermore National Laboratory (USA) and the Flerov Laboratory for Nuclear Reactions in Dubna, Russia work co-operatively with several other institutions on experiments to produce and detect these SHEs. The elements 114 (flerovium) and 116 (livermorium) were named after these American and Russian institutions where they were first made. These laboratories have now claimed credit for producing elements 113, 115, 117 and 118.

IUPAC will not accept the new SHEs for inclusion in the Periodic Table until their existence has been verified by a laboratory that is quite independent of the group making the claim for the new element. The Centre for Heavy Ion Research in Darmstadt, Germany, itself responsible for synthesising several SHEs, has recently verified the existence of element 117. A group at Lund University in Sweden has verified the existence of element 115 with the creation of 30 atoms of the element.

Once the claims and verifications are accepted by IUPAC, the laboratory that is accepted as first synthesising the new element will be granted naming rights by IUPAC and the new element will be added to the Periodic Table.

References:

- *www.iupac.org/*
- *www.phys.org*
- *Wikipedia*

STEM X Academy: 2016 – a residential teacher professional learning experience

Teachers have the opportunity to be a part of the inaugural STEM X Academy, a joint teacher professional learning opportunity run in partnership between Questacon and the Australian Science Teachers Association (ASTA).

From 10–15 of January 2016, you will meet in Canberra with 50 like-minded teachers of Science (both primary and secondary) and will work with scientists, media and Questacon educators to strengthen your Science teaching, improve your pedagogy, develop resources for your classroom and be exposed to the latest cutting edge Science that Australia has to offer.

You will undertake work with Questacon on a hands-on STEM pedagogy-based program designed to give you practical resources and ideas to take back to your classroom and share with your colleagues. You will meet with scientists, learn about their research and develop a suite of activities you can use with your students when you return to your classroom.

The program will involve scientists currently working in various fields of Science and education who have been invited to discuss their research including work on flipping the physics classroom, performing photosynthesis experiments using household objects, research into physical and chemical properties of proteins and performing Science demonstrations on a limited budget.

You will take tours of cutting edge Science facilities like the Heavy Ion Accelerator Facility, which currently supports Australia's only experimental nuclear physics program; the John Curtin School of Medical Research; and the National Computational Infrastructure Facility which houses the Virtual Geophysics Laboratory and the Biodiversity and Climate Change Virtual Laboratory. Old favourites like Mt Stromlo Observatory and the CSIRO Discovery Centre at Black Mountain are also on the visiting list.

The cost to participants for this week-long experience is $350. This will include all travel to Canberra, accommodation, meals, transport and all activities.

The draft program and official application form will be available by 9 October. If you are interested, you can get more information at *http://asta.edu.au/programs/stemx*

STEM X academy
EXCELLENCE IN TEACHING

National Science Teachers' Summer School – 2016

Applications are open now for the National Science Teachers' Summer School (NSTSS) 2016 and teachers of Science at primary, secondary and senior secondary level are invited to apply.

The National Youth Science Forum (NYSF), with backing from The Australian National University (ANU), has been running NSTSS as a professional development program for experienced Science teachers within primary, secondary and senior secondary schools across Australia for many years. The aim of NSTSS is to reignite the participant teachers' passion for Science, and to engage them in a professional dialogue about teaching and learning and exploring ways of engaging students within science, technology, engineering and mathematics.

NSTSS 2016 will be held in Canberra at the ANU from 11–15 January 2016. It coincides with the second week of Session A of the NYSF January Sessions and the synergies between the two programs are obvious. At NSTSS 2016 you will:

- learn about the latest developments in science from world-leading researchers
- visit first-class laboratories and teaching facilities at The Australian National University and other sites in Canberra and the region, including the Tidbinbilla Deep Space Tracking Station and Geoscience Australia
- get up-to-date on the latest hands-on exhibits at Questacon
- spend an evening looking at the stars at the ANU Mount Stromlo Observatory
- network with like-minded peers
- interact with 200 of Australia's leading science students, participating in the National Youth Science Forum 2016.

The cost of the NSTSS for 2016 is $950 and limited to 50 places only.
Further info at: *www.nysf.edu.au/other/teachers*

Where our coffee comes from

Coffee is a brewed drink prepared from roasted coffee beans, which are the seeds of berries from a flowering plant that belongs to the genus Coffea. The white Coffea flowers are highly scented. Even though the coffee beans are seeds, they are referred to as 'beans' because of their resemblance to true beans.

When the green coffee berries ripen to a red or purple colour they are usually hand picked. After applying either a wet or dry processing method to remove the outer pulp and mucilage, coffee beans can then be roasted.

Coffee drinkers around the world enjoy their coffees – however, the caffeine in coffee 'beans' is actually toxic. But don't panic … it would require around 50–100 ordinary cups of coffee to reach a lethal dose. Caffeine confers a survival advantage on the Coffea plant as it is toxic to some insects and so acts as a natural plant defence against the beans being eaten by insects such as the coffee borer beetle and coffee leafminer. Also, droppings from the plant infuse the surrounding soil with caffeine, which helps to inhibit the growth of and kill competing seedlings. Interestingly, caffeine can enhance the reward memory of pollinators such as honey bees, thus increasing the numbers of its progeny.

Coffee was first grown in North Africa in Ethiopia and then in Yemen. While apocryphal stories suggest coffee has been used as a beverage since the year 850, there is no reliable evidence for its use before the 1400s. By the mid 1500s, coffee was being used as a drink at Mocha in Yemen. Trade with Africa and the Middle East soon saw coffee introduced to Venice, Italy and the rest of Europe. By the early 1700s, the Dutch had taken over the coffee market with plantations in Sri Lanka and Java. By 1727, coffee had been introduced to Brazil.

Today, around 24 million kilograms of coffee are consumed each day. Coffee ranks as one of the world's most valuable and widely traded commodity crops and is an important export product of several countries. Brazil produces 33% of the world's coffee while Vietnam produces 19%. These along with Indonesia, Columbia and Ethiopia produce two thirds of the world's coffee.

Figure 2 Unripe Coffea berries are a green colour.

Figure 3 Ripe Coffea berries are a red to purple colour.

Figure 4 The familiar brown of roasted Coffea seeds that are used to brew coffee

References:

- *National Geographic, 15 September 2015*
- *Wikipedia*

Less thirsty tomatoes

Commercial tomato crops are typically grown in glasshouses or in hot dry climates using a lot of irrigation water – sometimes as much as 50 L of water per tomato. Scientists at the Donald Danforth Plant Science Centre in St Louis, USA are crossbreeding commercial tomato plants with a wild relative from the Atacama Desert, high in the Peruvian Andes that is one of the driest places on the whole Earth. Their aim is to produce less thirsty varieties of tomato.

Reference:

- *National Geographic, 14 October 2015*

Homo naledi – an early species of *Homo* genus?

The story of human evolution is continually being revised as a result of new fossil discoveries. The fossil record still has many secrets it is yet to release.

Recently, the discovery of skeletal remains in the Rising Star cave system near Johannesburg in South Africa has added a whole new chapter to this story. Since 2013, paleoanthropologists have recovered about one and a half thousand bones and 140 teeth belonging to at least 15 different individuals. A large amount of fossil material is still to be recovered. Many of the recovered fossils are already on display at Marapeng, The Cradle of Humankind World Heritage Site, Gauteng, South Africa.

Homo naledi has a brain less than half the size of the modern human brain. The body has an interesting mixture of primitive and more modern features.

Reference:

- *NewScientist, 12 September 2015*

New species of miniature frogs

Seven new species of tiny frogs have been discovered living on separate mountain tops in the southern Brazilian state of Parana. All of the frogs are closely related genetically.

These tiny frogs have been geographically isolated by being restricted to mountain top cloud forest habitats that are separated from one another by warm humid tropical valleys. This has allowed the frogs on each mountain to radiate and evolve into seven separate species. The new species belong to the genus *Brachycephalus*, a group of frogs known for their minuscule size and bright colours.

The frogs are all around 10 mm long with coloured skin that contains a powerful neurotoxin, tetrodotoxin. The brighter the colour of the frog's skin, the higher the level of toxin in its skin. This toxin makes them deadly for animals that eat them. The different species vary in colour and in the roughness of their skin. Some have quite bumpy skin.

As some of the very smallest land-dwelling vertebrates, much of their anatomy is adapted to this tiny size. For example, they typically have three toes and two fingers, instead of the five toes and four fingers found in most frogs.

References:

- *NewScientist, 13 June 2015*
- *National Geographic, June 2015*
- *www.bbc.com/news/science-environment-32991586*

Figure 5 One of the species of tiny frogs discovered in Brazil.
[Credit: Luiz Fernando Ribeiro, CC BY SA]

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3/15.CLO

Impressive medal tally at International Science Olympiads

After competing in the 2015 International Science Olympiads held during July in Denmark (Biology), Azerbaijan (Chemistry), India (Physics) and Brazil (Earth Science), Australia's 17 students returned home with an impressive tally of 14 medals, one honourable mention and one merit certificate. This year was the first time that Science students represented Australia in an International Earth Science Olympiad.

The Australian Science Olympiad (ASO) program has been running since 1987 – it enables bright young minds to extend their scientific knowledge, understanding and skills. After battling through the ASO National Qualifying Exams, they went on to be ASO Scholars and attended a residential training school in Canberra. The teams were selected from these scholars after completing a final exam and eventually 17 talented students represented Australia, of which almost half were girls. Their success in this tough competition reflects their hard work and dedication.

Australia's talented students competed against hundreds of other students from all over the world in the Biology, Chemistry and Physics Olympiads. The Earth Science Olympiad had 91 students from 22 countries.

The Science Olympiads provide gifted students with the opportunity to further develop their skills and be exposed to new ideas and technologies.

Congratulations to these students:

- **BIOLOGY** (in Denmark):
26th International Biology Olympiad

2 Silver Medals – Keita Richardson, Normanhurst BHS; Liam Murphy, Girton Grammar, VIC; *Bronze Medal* – Houston Xue, Baulkham Hills HS, NSW; *Merit Certificate* – Simran Rajpal, MacRobertson GHS, VIC.

- **CHEMISTRY** (in Azerbaijan):
47th International Chemistry Olympiad

4 Bronze Medals – Zane Zhang, James Ruse Ag HS, NSW; Lachlan Wilson, Wesley College, VIC; Hui Min Tay & Hyerin Park, Perth Modern School, WA.

- **PHYSICS** (in India):
46th International Physics Olympiad

4 Bronze Medals – Joshua Lin, James Ruse Ag HS, NSW; Sudarshan Ravi, Baulkham Hills HS, NSW, Yinuo Han, Southport School, QLD; Shiye Su, Brisbane Girls Grammar, QLD; *1 Honourable Mention* – Janet Zhong, MacRobertson Girls HS, VIC.

AUSTRALIAN SCIENCE OLYMPIADS

- **EARTH SCIENCE** (in Brazil):
10th International Earth Science Olympiad

1 Gold Medal – Zoe Thompson, SCECGS Redlands, NSW; *2 Silver Medals* – Sacha Mann, Girton Grammar, VIC; Tim Hume, Mansfield Secondary College, VIC; *2nd place in poster project* – Jade Pham, James Ruse Ag HS, NSW.

* * * * *

Enquiries: ph 6201 2552
or *www.asi.edu.au*

Hubble celebrates 25 years in space

When the Hubble Space Telescope was launched on 24 April 1990, it was initially thought to be a failure. The telescope mirror was incorrectly shaped. It trembled and shook instead of locking onto its targets in space and its electronics did not fully operate as intended. However, after five space shuttle trips to Hubble during which astronauts repaired or replaced all the faulty components, Hubble has since operated perfectly. Hubble's spectacular images of the Universe over the last 25 years continue to amaze both astronomers and the general public. The Hubble website (*www.hubblesite.org/gallery/album/*) provides access to a vast collection of these images.

Recently, Hubble detected several Kuyper objects in orbit beyond Pluto providing additional targets for NASA's New Horizons spacecraft to explore following its fly-past of Pluto last July and Pluto's moon Charon in September. There are some good 'close-up' images and more information on this in the New Horizons section on NASA's website.

Reference:

- *National Geographic, 24 April 2015*

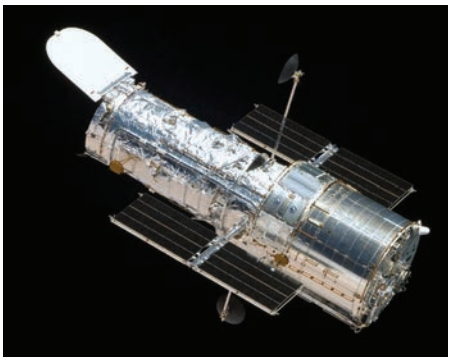

Figure 6 Hubble Space telescope [NASA]

Giraffe communication

Experiments by scientists at Stanford University over 15 years ago proved that elephants use foot stamping and low-frequency rumbling to generate seismic waves that elephants in other herds can detect through their feet from up to 30 km away. Such sounds only travel up to 4–5 km through the air. Elephants can also detect distant thunder rumbling and have learnt to head towards such storms in their search for water.

Giraffes live in herds with a structured social system. Until recently, observations failed to show how they communicate. Giraffes are mostly quiet and the majority of their communication takes place on a non-verbal level, e.g. necking. However, they do make some noises that have been observed both in the wild and in captivity. Their vocalisation becomes more prevalent during the mating season. Males will make noises that appear to be similar to human coughing in order to attract a female. A low but constant soft whistling sound is a female communicating with her offspring.

After making sound recordings over extended periods, a University of Vienna scientist has found that giraffes also make low frequency humming sounds to communicate.

Figure 7 Male giraffes engage in necking to establish dominance. [Luca Galuzzi, www.galuzzi.it]

These low volume sounds at around 92 Hz and lower are at the lower boundary of human hearing and below it in the infrasound band (opposite of ultrasound) and are transmitted through the ground. This research was conducted with captive giraffes at three different zoos in Europe. The giraffes in the various zoos only communicated this way when they were not able to see one another, for example after they were put into separated stalls overnight. This way the members of each zoo herd were able to remain in contact even though not able to see one another.

Reference:

- *NewScientist, 26 September 2015*
- *www.giraffeworlds.com*

Science units available – at Science Web Australia

The Australian Science Teachers Association in partnership with Education Services Australia has prepared 15 units of work to support teachers in the implementation of the Science Australian Curriculum. The 15 units available cover 3 topics for each of the years F–2, 3–4, 5–6, 7–8 and 9–10. The current topics for 7–8 are: Mixing and Separating, Classification and Cells. The current topics for 9–10 are: Ecosystems, Plate Tectonics and Our Universe. All the units have been written by experienced teachers using resources that are available online. Each unit consists of an overview, five lesson plans, and additional links and resources.

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 18 December 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: Will Muir, Trinity Anglican College, won an IMAX Sydney family pass for *SciTalk No. 3–2015.*

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 in your name, school, & school address on an envelope **by 18 December 2015** to:

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

WINNER: Kayleen Jones, Ambarvale High, won a Luna Park Sydney family pass for *SciTalk No. 3–2015.*

Astronomy

Sky gazing during Term 4

... Robert Garner

As spring progresses towards summer, the nights will be warmer and so more pleasant for viewing the evening and pre-dawn skies.

The Planets

During this part of year, the naked eye planets, Mercury, Venus, Mars and Jupiter are all visible in the pre-dawn eastern sky. Only Saturn is visible in the evening sky and can only be seen close to the western horizon until mid-November. From mid-October and in early November, the bright planets Venus, Mars and Jupiter dance around each other in the eastern morning twilight. The crescent Moon will join these planets in the eastern twilight sky on 7 and 8 November.

Mercury, the innermost planet, will be at inferior conjunction (between the Earth and Sun) at the start of October and so not visible then. By the second week of October, it appears in the eastern dawn sky, but will be hard to see as it is barely above the horizon at sunrise. After 16 October, Mercury sinks closer to the Sun again and will not be visible again until the second half of December, when it will be seen in the early evening sky.

When Venus appears as the morning star, it always rises within three hours of sunrise and when it is the evening star, it always sets within the three hours after sunset. During Term 4, Venus will always be the 'morning star'. It will rise in the east a little earlier with each passing day. It rises around 4 am during October and around 3:20 am by the end of December. During the last 10 days of October, Venus will be very close to Mars and Jupiter in the pre-dawn sky. Being closer to the Sun than Earth, Venus is like Mercury and cannot ever be seen high in the sky at night.

Mars is also in the pre-dawn sky in this period. It is rising around 5 am in early October and a little earlier each morning, until it rises around 1 am at the end of December. Mars will be less than 1° away from Jupiter on 18 October.

Jupiter is with Venus and Mars in the pre-dawn sky. It rises around 5 am in early October. Jupiter will also rise earlier with each passing day. It is very close to Mars during October and will be less than 1° away from Mars on 18 October. However, during November and December, Jupiter will gradually move to become higher in the sky than Mars and then Venus.

Saturn is the only naked eye planet visible in the evening sky over this period. It is low in the western sky in October. On 16 October, Saturn will be very close to a crescent Moon. It sets earlier each night and will disappear into the twilight during November. It will re-appear in the dawn sky in late December. It will be below and slightly north of Venus and close to Antares in *Scorpius*. On 7 January 2016, the crescent Moon, Venus, Saturn and Antares will all be together in the eastern sky in the hour before sunrise.

Constellations

As we move into Spring, the prominent Winter constellations, *Scorpius* and *Sagittarius* are setting around sunset or soon after, so they will be low on the western horizon. As the Summer constellations, *Taurus* and *Orion*, are rising earlier each day in the east, they will be easily found overhead from late Spring and into Summer.

Crux, the Southern Cross and the two Pointers, α Centauri and β Centauri, are low in the south-eastern sky. *Crux* is now upside down with the two Pointers to the west, on the right of *Crux*. This means that the Magellanic Clouds, the two closest galaxies to our Milky Way, appear higher above *Crux* as two fuzzy patches in the sky. The very bright star Canopus lies to the east on the left of *Crux*.

Solstice

The summer solstice occurs at 3:48 pm (AEDT) on 22 December.

Earth's tides

When the Earth, Moon and Sun are in a straight line, the tidal changes are greatest. The Earth will be at perihelion (at its closest distance to the Sun) on 3 January 2016 at 9:49 am (AEDT). So the gravitational effect of the Sun will be greater at this time. Therefore, with the full Moon that occurs on Christmas Day, the high tide will be very big and low tide will be very low.

Comets

Several comets are crossing the night sky during the last quarter of the year. Usually they are too faint to be seen except with a telescope. However, Comet Catalina is bright enough to see with binoculars as it is around magnitude 6, or even with the naked eye under ideal conditions. It is in the evening sky in early October but will be difficult to see because of the bright Moon. It will then swing around the Sun to appear in the pre-dawn sky, and will be easy to find below Venus and the waning crescent Moon on 8 December.

Meteor showers

- Orionids: 2 Oct–7 November ... peak rate on 22 October
- Geminids: 4–17 December ... peak rate around 12–14 December.

When looking for meteor showers, you usually need to look north after 1 am in the morning. However, the rate of the Geminids will probably be better around 3-4:00 am. This year promises to be good for both these showers, as the peak for the Orionids corresponds to a first quarter Moon and the peak for the Geminids has a new Moon. So, there will be darker skies allowing better viewing conditions for both showers.

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 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 (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 **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 at: *physics.mq.edu.au/community-schools/planetarium/*

... continued from page 1

about 80 km of crust and mantle, while those in NSW and Victorian had erupted through about 100 km. They also found that the lithosphere between Buckland and Byrock was at least 150 km thick.

Volcanoes were found to only occur in places where the Earth's lithosphere is thinner than 130 km. Hence the 150 km thick lithosphere between Buckland and Byrock was too thick for the hot spot plume to penetrate. This explains why no volcanic activity occurred on the surface between these locations.

The thickness of the crust and mantle also accounts for the differences in the chemical composition of the volcanic rocks at different locations. As the magma plume moved upwards at the hotspot, it dissolved materials in the overlying lithosphere. The minerals that go into the melt at a depth of 130 km are different to the additional elements that enter the melt at a shallower depth of say 100 km. This led to changes in the chemical composition or geochemistry of the rocks at various locations along the volcanic chain.

The ANU researchers also looked at the current movement of the Australian continent – about 7.5 cm north-northeast per year. This is the greatest rate of plate movement so far measured on Earth. They used this data to predict that the current location of the hotspot that formed the volcanic chain is below Bass Strait. No volcanic activity has been detected there, but it is quite active seismically. Further research is planned to determine the thickness of the lithosphere around this area to determine whether this is a factor in the lack of recent volcanism.

References:
- *ABC News 15/9/15*
- *http://volcano.oregonstate.edu/oldroot/volcanoes/volc_images/australia/volc_australia.html)*
- *www.nature.com/nature*
- *www.ga.gov.au/scientific-topics/hazards/volcano*
- *www.volcanolive.com*

Figure 8 The Cosgrove volcano chain extends 2000 km from Cape Hillsborough in Qld to Cosgrove in Victoria

[Credit: Drew Whitehouse/NCI National Facility]

DID YOU KNOW? The Australian continent is located well away from the Indo-Australian plate boundaries and so active volcanoes would not be expected in Australia. There are no active volcanoes on the Australian mainland today. However, there are two active volcanoes located 4000 kilometres south west of Perth on the Australian territories, Heard Island and the nearby McDonald Islands. Australia's most recent volcanic eruptions were around 3000 BC at Mt Burr, Mt Schank and Mt Gambier in SA. Most Australian volcanoes are extinct, but there is a province in Victoria which is dormant, and may erupt in the future.

Plastics are not so fantastic as once thought

Plastic lasts forever — or so we have been taught in anti-littering campaigns. However, while the plastics industry searches for solutions to the problem of plastic waste disposal, there is, surprisingly, a growing band of people trying to save plastics.

London's Victoria and Albert Museum is now striving to save many of its most prized 20th-century works that are made of plastics or polymers, ranging from furniture and acrylic-based paintings worth millions of pounds to clothes and toys. Various plastic artefacts have been physically changing, showing signs of acid vapour, tackiness, warping, embrittlement and crazing. The artworks are suffering discolouration, cracking and greyness due to the absorption of dust and atmospheric pollutants and to date, no method has been found to clean them. Archive photographs on nitrate stock are decomposing and having to be transferred to more stable polyester materials.

The problem is that plastic is not as stable as many once thought, and is now decaying. It is a problem faced by museums worldwide. There are lots of techniques available to conserve traditional materials such as metals, wood, glass and other materials that we understand. On the other hand, plastics and polymers are quite modern materials in terms of humans. People have wrongly assumed that plastic is stable when actually it is not.

Conservators in museums worldwide are now endeavouring to understand at a really microscopic level what is happening to these polymers so they can determine what is best for their conservation.

Reference:
- *www.arcsinfo.org/news-events/entry/793*
- *NewScientist 23/5/2015*
- *www.dailymail.co.uk/news/article-3096784*
- *www.azom.com/article.aspx?ArticleID=1655*

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rrp: $39.95

Also available as a 2009-2014 book (rrp $27.95) ... see page 7

HOW TO ENTER: Send an answer to the Quiz Question, your name, school and school address on an envelope to: Competition Corner, PO Box 442 Freshwater 2096 – by 18 December 2015.

QUIZ QUESTION: Name the process in plants that uses CO_2 and makes glucose.

SciTalk 3/15 answer: Respiration

***SciTalk 3/15* winner:** Lesley Parker, Vincentia High, won *Senior Science 2001-2014 Past HSC Papers with Worked Solutions* (rrp $39.95), published & donated by Odlum & Garner.

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SciTalk

SciTalk **is a quarterly newsletter for secondary Science educators. Now in its 21st year, it has been produced by Odlum & Garner as a service to Science teachers since 1995. It is sent FREE-of-charge to all secondary Science faculties in schools and TAFEs throughout NSW and the ACT.**

SciTalk **aims to provide science teachers with up-to-date information, important dates, the latest products available, plus 'what's on' in various excursion venues, and more.**

Please pass *SciTalk* on to all Science teachers at your school so they can benefit from it – or put it up on your notice board for reference.

Contributions, advertising and inserts are welcome.

Copies of *SciTalk* are also available at:

www.odlumgarner.com

CONTRIBUTIONS

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CLOSING DATES

- ***SciTalk*** **No. 1–February 2015 ... Dec 19**
- ***SciTalk*** **No. 2–May 2015 ... April 2**
- ***SciTalk*** **No. 3–August 2015 ... June 26**
- ***SciTalk*** **No. 4–October 2015 ... Sept 18**

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All enquiries to the *SciTalk* Editor:

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