

# SciTalk

ISSN 1323-7667

Number 2 – May 2014

## International Year of Crystallography 2014

Crystals are everywhere in nature – as mineral grains in rocks, gemstones, graphite, snowflakes, ice, grains of salt, sugar crystals, etc. Humans have long admired the beauty, colour and symmetrical shape of crystals. For example, gemstones have been used as jewellery for thousands of years. Giant crystals of gypsum selenita (known as lapis specularis, or ‘light stone’) were used as windows by the Romans from around 100BC-200AD, before their invention of glass sheets. The mines for this gypsum contained huge crystals that could be easily split into separate sheets for window panes, skylights, carriage windows, etc. A spectacular video showing these huge gypsum crystals can be found at [www.youtube.com/watch?v=0OLdSJmvcUs](http://www.youtube.com/watch?v=0OLdSJmvcUs).

Crystallography is the study of the arrangement of atoms in crystals. This field of science began one hundred years ago with the discovery by Max von Laue and subsequently by William Henry Bragg and William Lawrence Bragg, that X-rays are diffracted by crystals due to the regular arrangement of atoms in them. This discovery has enabled 3D images to be made of the atomic or molecular structure of crystals.

To commemorate the centenary of this discovery, the UN has proclaimed 2014 as the International Year of Crystallography (IYCr2014). For more information on IYCr2014, go to: [www.iycr2014.org](http://www.iycr2014.org). This has a great video to introduce IYCr2014 to your students at: [www.iycr2014.org/about/video](http://www.iycr2014.org/about/video). There is also a booklet, ‘Crystallography matters!’ (a download in ‘promotional materials’). This booklet describes the role of crystallography in the modern world and the significance of IYCr2014.

The use of X-ray crystallography has allowed scientists to study the internal structure of crystals and the chemical bonds between their atoms, thus helping them to understand the properties and functions of materials. Crystallography has led to advances not only in chemistry and physics, but also in biology, geoscience and medicine. For example, crystallography has shown the structure of DNA, vitamins and proteins such as myoglobin, haemoglobin and insulin. Crystallography has also allowed us to understand and develop computer memories, helped in the design of new materials and medicines, assisted in dating artefacts, and been used in space science and technology, as well as in bio- and nanotechnology.

The development of new sources for intense short wavelength X-rays, e.g. synchrotrons, has enabled crystallographers to obtain much greater resolution when observing crystal structure. Today, crystallographers can even study liquid crystals. Liquid crystal displays are used for flat screen televisions, computers, cell phones, digital clocks, and so on.

... continued on page 4



### ★★ ATTENTION ★★

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

- 1. ....
- 2. ....
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- 4. ....
- 5. ....

Please return to file or noticeboard.

### PRIZES TO WIN!

★★ See pages 1, 9 & 12 ★★  
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★★★

**Winner for SciTalk 1/14**

Kelly Mather, Dapto HS, won *Core Science Stage 5* (rtp \$79.95), published & donated by Jacaranda.

### ★ 2014 editions Past HSC Questions & Worked Solutions ... see p7 ★

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# Diary Dates



## Update on BOSTES matters

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

Note: The NSW Board of Studies (BOS) is now the Board of Studies, Teaching and Educational Standards (BOSTES).

### Implementation of NSW syllabuses for the Australian curriculum

Implementation of the new Science syllabus is to occur as follows:

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

For Years 8 and 10 in 2014, schools are to continue using the existing *Science Years 7–10 Syllabus* (updated in 2009).

### Program builder for the new NSW K–10 syllabuses

Select outcomes and content to create your scope and sequences and units instantly, using the Board's online tool 'Program Builder'.

### Record of School Achievement (RoSA)

Remember, this is for eligible students who leave school before receiving their HSC.

### BOSTES enquiries

Ph: 9367 8111, fax: 9367 8484  
[www.boardofstudies.nsw.edu.au](http://www.boardofstudies.nsw.edu.au)  
 and [www.bostes.nsw.edu.au](http://www.bostes.nsw.edu.au)

## 2014

For Shell Questacon Science Circus 2014: [sciencecircus.questacon.edu.au/](http://sciencecircus.questacon.edu.au/)

### MAY 2014

2, 23, 26 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, fax (02) 9939 6105  
 b/w 21–28 Big Science Competition: [www.asi.edu.au/bigscience/](http://www.asi.edu.au/bigscience/) Ph: 62012552

### JUNE 2014

2, 6, 13 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, [www.odlumgarner.com](http://www.odlumgarner.com)  
 5 World Environment Day  
 various dates Nyholm Youth Lectures (metro & country): [raci.org.au/branches/nsw-branch](http://raci.org.au/branches/nsw-branch) (in 'Events')  
 13, 14 NSW Schools Titration Competition. [www.nswtitration.com/](http://www.nswtitration.com/) (see website for regional dates)  
 19 National Chemistry Quiz. [www.raci.org.au/](http://www.raci.org.au/) in 'Events'. Details: ph (02) 6331 5125  
 21 Winter Solstice (8:51 pm AEST)  
 27 Closing date RACI Crystal Growing Comp: [www.raci.org.au/branches/nsw-branch](http://www.raci.org.au/branches/nsw-branch)

### JULY 2014

various dates Nyholm Youth Lectures (metro & country): [raci.org.au/branches/nsw-branch](http://raci.org.au/branches/nsw-branch) (in 'Events')  
 6–9 CONASTA 63 in Adelaide: 'The human faces of Science', [conasta.edu.au](http://conasta.edu.au)  
 19–26 National Chemistry Week. [www.raci.org.au/national/events/chemistryweek.html](http://www.raci.org.au/national/events/chemistryweek.html)

### AUGUST 2014

1 Jeans for Genes Day. [www.jeansforgenes.org.au/](http://www.jeansforgenes.org.au/)  
 6 Chemistry Olympiad Exam. [www.asi.edu.au/olympiads/](http://www.asi.edu.au/olympiads/) Close date: 6/7/14. Ph: 6201 2552  
 11 Biology Olympiad Exam. [www.asi.edu.au/olympiads/](http://www.asi.edu.au/olympiads/) Close date: 6/7/14. Ph: 6201 2552  
 13 Physics Olympiad Exam. [www.asi.edu.au/olympiads/](http://www.asi.edu.au/olympiads/) Close date: 6/7/14. Ph: 6201 2552  
 15, 18, 22 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  
 16–24 National Science Week. 'Food for our future: Science feeding the world' [www.scienceweek.net.au](http://www.scienceweek.net.au)

### SEPTEMBER 2014

8, 12 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, [www.odlumgarner.com](http://www.odlumgarner.com)  
 13 (tbc) National Schools Titration Competition (Sydney): [www.nswtitration.com/](http://www.nswtitration.com/)  
 23 Spring Equinox (12:29 pm AEST)

### OCTOBER 2014

12–18 Earth Science Week. [www.earthsciweek.org](http://www.earthsciweek.org) & [www.ga.gov.au/education/public-events](http://www.ga.gov.au/education/public-events), ph 6249 9111  
 17, 20, 24, 27, 31 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, [www.odlumgarner.com](http://www.odlumgarner.com)

### NOVEMBER 2014

3, 10, 14 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, [www.odlumgarner.com](http://www.odlumgarner.com)  
 17, 21, 24, 28 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, [www.odlumgarner.com](http://www.odlumgarner.com)

### DECEMBER 2014

2–17 Physics is Fun at Luna Park Sydney. Enquiries: ph (02) 9939 6107, [www.odlumgarner.com](http://www.odlumgarner.com)  
 22 Summer Solstice (10:03 am AEDT)

**JANUARY 2015** National Youth Science Forum. Forms to local Rotary club by 31/5/14, interviews from July. Only for Yr 11 in 2014. Enquiries: 6125 2777, email: [nsss@anu.au](mailto:nsss@anu.au), [www.nysf.edu.au/](http://www.nysf.edu.au/)

*While all dates have been checked to ensure that information in DIARY DATES is correct, no responsibility will be accepted by the publisher or Editor for any omissions or inaccuracies in it.*

## Night Stalk | September–16 October 2014

Sponsored by **TRONOX**

Night Stalk is easy, fun and something everyone can do. All you need is a torch and a copy of the Spotter's Log. Schools can participate by focussing on the numbers and distribution of native animals and feral pests. Choose a night or number of nights between 1 September–16 October and spotlight in your local forest/bushland. Record all of the mammals, birds, reptiles and frogs that you find, then send your Spotter's Log to Perth Zoo.



You can request a Night Stalk pack from the program coordinator. Student Activity Sheets are available online. Night Stalk has been running for over 15 years, collecting information about wild animals living near urban areas. For information: Night Stalk, PO Box 489 South Perth WA 6151. E: [nightstalk@perthzoo.wa.gov.au](mailto:nightstalk@perthzoo.wa.gov.au) Visit [www.perthzoo.wa.gov.au/nightstalk](http://www.perthzoo.wa.gov.au/nightstalk) to download a Spotter's Log.

### 2014 HSC Examination Dates

A PDF version of the HSC examination timetable will be on the BOSTES website for looking up and/or downloading at: [www.boardofstudies.nsw.edu.au/events/](http://www.boardofstudies.nsw.edu.au/events/)

**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 their Past HSC books for Earth & Environmental Science and Senior Science.**

\*\*\*\*\*

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## International Year of Crystallography 2014 ... from page 1

### IYCr2014 crystal-growing competition

To celebrate IYCr2014, schools are encouraged to enter their students into the worldwide IYCr2014 crystal-growing competition. This will introduce them to the exciting, challenging and sometimes frustrating world of growing crystals.

The aim of the competition is 'to grow your own crystals (whether involved in a state or national competition or not) and to convey your experience through a video or essay'. The winners will be those who most successfully convey their experiences to the panel of judges through videos or essays.

For information about this competition, go to: [www.iycr2014.org/participate/crystal-growing-competition](http://www.iycr2014.org/participate/crystal-growing-competition). This has a short video showing 'How to grow a single crystal'. The closing date for submissions is 15 November 2014. Another useful video 'How to grow a large alum crystal by crystallization' is at: [www.youtube.com/watch?v=RnjiEdoSEvA](http://www.youtube.com/watch?v=RnjiEdoSEvA)

If you are also entering your state Crystal Growing Competition (see [www.raci.org.au/branches/nsw-branch](http://www.raci.org.au/branches/nsw-branch)), but please note that the closing date for this is 27 June 2014 and ideally you need to allow 4–5 weeks to grow your crystals.

### Alum crystals

Most students will be growing crystals of alum for their state Crystal Growing Competition.

Alum is a safe, non-toxic chemical and the crystals grow quickly and reliably. Potash alum is potassium aluminium sulfate dodecahydrate,  $KAl(SO_4)_2 \cdot 12H_2O$ . Some useful sites for growing alum crystals are:

- [www.iycr2014.org/participate/crystal-growing-competition/info-for-newcomers/how-to-grow](http://www.iycr2014.org/participate/crystal-growing-competition/info-for-newcomers/how-to-grow)
- [skywalker.cochise.edu/wellerr/crystalgrow/list.htm](http://skywalker.cochise.edu/wellerr/crystalgrow/list.htm)
- [chemistry.about.com/cs/howtos/ht/alumcrystal.htm](http://chemistry.about.com/cs/howtos/ht/alumcrystal.htm)



Figure 1 A single octahedral potassium alum crystal, sitting on a mirrored surface

... by Christian Ude [from Wikipedia]

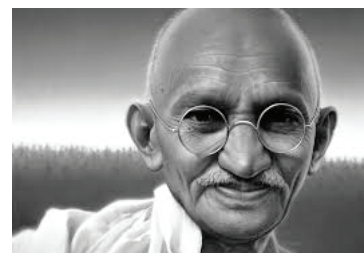
### NSW Australian Curriculum Science K-10 Syllabus links

Crystallisation is one of the separation techniques to be investigated in CW3 for Chemical World (Stage 4). Students will learn about crystal formation when investigating igneous rocks in ES1 for Earth and Space (Stage 4).



Your beliefs become your thoughts, your thoughts become your words, your words become your actions, your actions become your habits, your habits become your values, your values become your destiny.

... Mahatma Gandhi



## NSW Schools Titration Competition 2014

Amended dates  
for Sydney venues  
13 & 14 June,  
country venues (tba)



For more information:

[www.nswtitration.com](http://www.nswtitration.com)

E: [ajhey@nswtitration.com](mailto:ajhey@nswtitration.com)

M: 0400 370 963

PO Box 306, Camden 2570

## New Periodic Table song

In secondary science classes, students are often encouraged to memorise the first 20 elements of the periodic table. At university, chemistry students are sometimes encouraged to memorise the whole periodic table.


The NEW Periodic Table Song (in order) by AsapSCIENCE is a catchy, fun rendition of the Periodic Table set to music and can be found on YouTube at: [www.youtube.com/watch?v=zUDDiWtFtEM](http://www.youtube.com/watch?v=zUDDiWtFtEM)

It's a chemical adventure that romps along to a section of 'Infernal Gallop' (otherwise known as the 'Can-Can' music) from Offenbach's opera *Orpheus in the Underworld* and goes up to element 112 (copernicium).

This song will encourage students to sing along and learn the elements. Although it progresses at a fast gallop, if you listen to it a few times you'll soon find yourself confidently singing along.

For a slower version (with the lyrics captioned) to ease memorisation, go to: [www.youtube.com/watch?v=-1718TgtuLQ](http://www.youtube.com/watch?v=-1718TgtuLQ) The words alone can be found at: [io9.com/learn-the-periodic-table-of-elements-with-this-handy-so-508351608](http://io9.com/learn-the-periodic-table-of-elements-with-this-handy-so-508351608)


The Periodic Table is now taught in Stage 5 Chemical World (NSW Australian




MUSEUM OF  
**HUMAN  
DISEASE**

# Zombie Day

*Perfect for Stage 5 students studying disease*





UNSW  
THE UNIVERSITY OF NEW SOUTH WALES

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**W** [www.diseasemuseum.unsw.edu.au](http://www.diseasemuseum.unsw.edu.au)

Curriculum Science 7-10 Syllabus) in CW2: The atomic structure and properties of elements are used to organise them in the Periodic Table.

### Old Periodic Table song

Some teachers will still prefer the Tom Lehrer song 'The Elements' sung to 'The Major-General's Song' from Gilbert & Sullivan's opera *The Pirates of Penzance*. This has the elements in an order that fits with the metre

A Zombie day will provide students with the chance to learn about infectious (and some non-infectious) diseases, while investigating a scenario of an outbreak of a possible real Zombie disease.

Dates: 26 and 27 June 2014

Time: 2 hr sessions, available from 9–4pm

Cost: \$5 per student

For information and bookings:

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**E** [diseasemuseum@unsw.edu.au](mailto:diseasemuseum@unsw.edu.au)

**W** [www.diseasemuseum.unsw.edu.au](http://www.diseasemuseum.unsw.edu.au)

of the song. Written in 1959, it recites all the elements known at that time, up to element 102 (nobelium) – but cleverly allows for others not yet discovered.

A good animated version of this song is on YouTube at: [www.geekosystem.com/periodic-table-song/](http://www.geekosystem.com/periodic-table-song/). BOTH songs are here on the one site, which is great for comparing them. The words alone are at: [lyrics.wikia.com/Tom\\_Lehrer:The\\_Elements](http://lyrics.wikia.com/Tom_Lehrer:The_Elements).



## Fun Park Excursions

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E: [robert@odlumgarner.com](mailto:robert@odlumgarner.com)

## New type of matter may affect our understanding of neutron stars

Although physicists have developed the Standard Model of Matter to explain the fundamental particles of the universe (see Box 1), there are still some glaring holes in this understanding. Quarks are a good example of this.

Scientists know that all matter is made up of quarks, and about how two quarks interact at close range. Quarks are subatomic particles that are the fundamental building blocks of matter. They are known to exist either in groups of two, forming short-lived mesons, or in threes, forming the protons and neutrons that make up atomic nuclei. Researchers have suspected for decades that quarks might also bind together in quartets, forming tetraquarks ... but have not been able to test this idea until recently.

Scientists at CERN (European Organisation for Nuclear Research) have now confirmed that a strange particle known as Z(4430) does exist. Over 4000 such particles have been discovered using the Large Hadron Collider (LHC) accelerator (see Box 2). This may be the strongest evidence yet for a new form of matter called a tetraquark. Scientists think it is

made up of two quarks and two anti-quarks, showing that four-quark particles exist.

This 'discovery' is actually a confirmation of earlier results by the BESIII Collaboration at the Beijing Electron Positron Collider in China, and also by the Belle Collaboration at the High Energy Accelerator Research Organisation in Tsukuba, Japan in 2013. Both of these labs accelerated electrons and positrons to nearly the speed of light, then smashed them into each other and carefully analysed the resulting debris. Taken together, the two collaborations have uncovered 466 events that appear to have a tetraquark, known

as Zc(3900) in their debris.

The results are still young, but if this discovery holds up it could have implications for our understanding of neutron stars. Very simply, the traditional model of a neutron star is that it is made of neutrons. Neutrons consist of three quarks (two down and one up), but it is generally thought that particle interactions within a neutron star are interactions between neutrons. With the existence of tetraquarks, it would be possible for neutrons within the core to interact strongly enough to create tetraquarks. This might even lead to the production of pentaquarks and hexaquarks, or to quarks interacting individually. This would produce a hypothetical object known as a quark star.

This is all hypothetical at this point, but verified evidence of tetraquarks will force astrophysicists to re-examine some of the assumptions they have about the interiors of neutron stars.

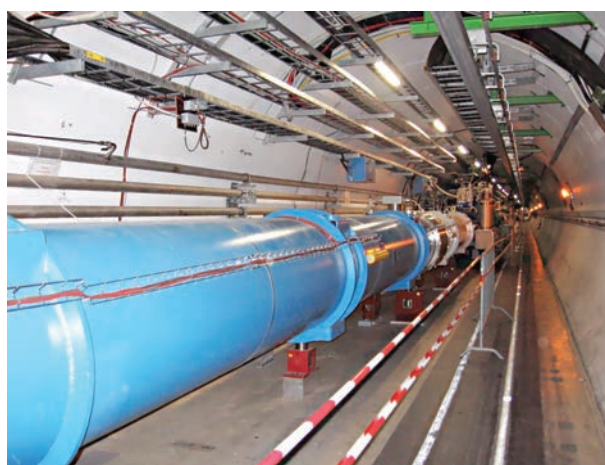


Figure 2 Tunnel of Large Hadron Collider at CERN, showing the access track, and some of the magnets and instruments

### Box 1 – Model of structure of matter: sub-atomic particles

The simple ideas of atomic structure that are still being taught at the junior science level ignore particle physics discoveries of the past 50 years. The terms that students are familiar with from sci-fi movies, e.g. quarks and leptons, do not usually get a mention.

At a simple level, matter is 'everything around you' or 'anything made of atoms and molecules' or 'anything that has mass and takes up space'. Atoms are said to consist of protons, neutrons and electrons.

Given the advances in scientific knowledge, due to all the developments in technological devices, the world inside protons and neutrons should not be ignored when teaching about 'the structure and properties of elements' as required in Stage 4 Chemical World CW2 (NSW Australian Curriculum Science 7-10 Syllabus).

Since the 1930s, physicists have used an increasing variety of technological devices such as bubble chambers, spark chambers, wire chambers, synchrotrons, and particle accelerators to investigate the structure of matter. From their discoveries, it is now known that all matter in the Universe is made from a small number of fundamental particles – *quarks* (6 different

kinds) and *leptons* (6 different kinds). Protons and neutrons are each made up of distinct combinations of three quarks. Electrons are one type of lepton.

Such discoveries led to the development of the Standard Model of Matter by physicists in the 1970s – this explained interactions between fundamental particles (quarks and leptons) and the forces interacting with them.

There are four fundamental forces (the strong force, the weak force, the electromagnetic force and the gravitational force) that affect how fundamental particles interact, but only the first three forces are included in the Standard Model, along with their corresponding force-carrying particles (photons, gluons, W bosons and Z bosons). Physicists are yet to discover how gravitational forces can be incorporated into the Standard Model of Matter.

Through many experiments over time, the Standard Model of Matter has become established as a well-tested physics theory.

This model is taught in depth in the HSC Physics option: 'From Quanta to Quarks' – however, junior Science students should be able to appreciate a simplified form of this model.

### Box 2 – Large Hadron Collider (LHC)

Extending beneath the border of France and Switzerland, the LHC built by CERN is the world's largest and most powerful particle collider. The LHC tunnel is a 27 kilometre circumference, almost circular tunnel. The same tunnel also contains the LEP (large electron positron) synchrotron.

The LHC is used to explore the building blocks of matter and the forces that act between them. Physicists are trying to study conditions close to those just after the big bang, hoping to solve some of the mysteries about the origin of mass, dark matter and more.

The LHC sets protons or lead ions travelling at 99.9999991% of the speed of light around the circular tunnel. It then smashes them together at four points on the ring, each of which are surrounded by huge experiments.

References: (last accessed 28-4-14)

- [www.newscientist.com/article/dn23726](http://www.newscientist.com/article/dn23726) (24 June 2013)
- [www.newscientist.com/article/dn25402](http://www.newscientist.com/article/dn25402) (10 April 2014)
- [physics.aps.org/articles/v6/69](http://physics.aps.org/articles/v6/69)
- [www.universetoday.com/111110](http://www.universetoday.com/111110)
- [scitechdaily.com/new-subatomic-particle-zc3900-hints-at-four-quark-matter/](http://scitechdaily.com/new-subatomic-particle-zc3900-hints-at-four-quark-matter/)
- [home.web.cern.ch/about/physics/standard-model](http://home.web.cern.ch/about/physics/standard-model)
- Fig 2: Julian Herzog [Wikimedia Creative Commons]

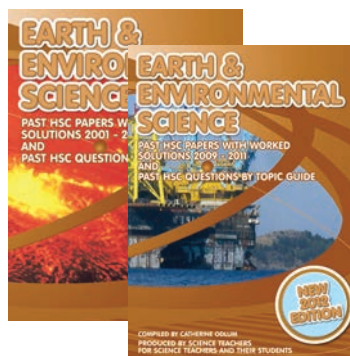
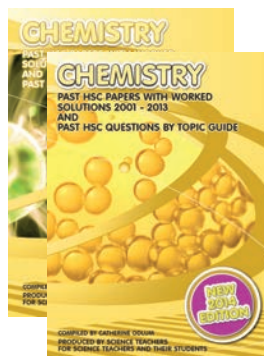
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## Marine wildlife rapidly disappearing

Great white sharks, killer whales, and other large ocean predators are disappearing at alarming rates. It is thought that nearly 90% of all large fish have disappeared. Our oceans need to be protected, so they will remain healthy enough to support life across the planet.

Marine Protected Areas (MPAs) are a proven solution to many such problems threatening our oceans today. They may be the most powerful tool for ocean protection and restoration that we have.

MPA is an umbrella term to describe a wide range of areas, important for marine conservation worldwide. A global definition of MPAs was first adopted by the International Union for Conservation for Nature in 1988. An MPA is a section of the ocean where a government (or a local, regional or national authority) has placed limits on human activity. MPAs include marine reserves, fully protected marine areas, no-take zones, marine sanctuaries, ocean sanctuaries, marine parks, locally managed marine areas, to name a few. Many of these have quite different levels of protection, and the range of activities allowed or prohibited within their boundaries varies considerably too.

MPAs are the ocean equivalent of the national parks and reserves that we have on land. Yet at present, less than 2% of the oceans is designated as an MPA, and the vast majority of existing marine parks and reserves suffer from little or no effective management.

Scientists have been monitoring MPAs using remote sensing – this uses advances in aerial photography image capture, satellite imagery, acoustic data, and radar imagery.

These essential marine sanctuaries not only protect threatened species, but also help to restore biodiversity and establish larger, healthier fish populations. They have had a huge impact in the areas where they have been established. The current number of MPAs is inadequate to preserve the ocean's wildlife and marine resources. No part of the ocean today is safe from potential overexploitation of its resources. Current data suggests that approximately 100 million tons of fish are known to be removed from the ocean annually. At this level of exploitation, sustainability of particular fish populations is questionable.

Only recently have people started to realise the potential catastrophic nature of marine resource exploitation. The world

needs many more MPAs – and before it is too late.

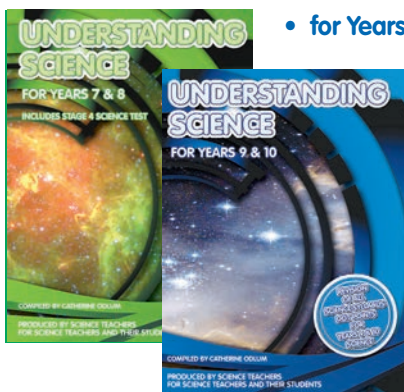
National Geographic Explorers Enric Sala and Mike Fay recently undertook an expedition to the wildlife Eden of West Africa – Gabon – as part of the Pristine Seas program, where they undertook an underwater survey of the MPA that was established there in 2002. Its coastal waters are now teeming with healthy populations of endangered reef sharks and grouper fish. Enric and Mike's goal was to provide the scientific evidence needed to convince the Gabonese leaders to expand their national park system to include more MPAs and protect the vital marine wildlife living along their coastline. Balancing the need for sustained economic development with conservation of the marine environment remains a formidable challenge for places like Gabon.

References: [last accessed 28-4-14]

- Smith, D; Miller, KA (2003). 'Safe Harbours for our Future: An Overview of Marine Protected Areas.' (at [archive.rubicon-foundation.org/4759](http://archive.rubicon-foundation.org/4759))
- [www.biodiversity-z.org/areas/46/](http://www.biodiversity-z.org/areas/46/)
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## Science Snippets

### Drama helps kids with autism

A small but promising pilot study placed groups of four children with autism-spectrum disorder into drama workshops, in an enclosed themed environment, such as a forest or outer space, for a 45-minute session every week for 10 weeks. These environments were designed to engage all senses simultaneously, using lights, sounds, puppetry and interactive digital elements.

Trained performers used improvisation techniques to encourage the children to engage creatively with the environment and each other, both physically and verbally. The hope was that the sessions would help develop the children's communication, social interaction, and imagination skills – the 'triad of impairments' seen in autism. Children were assessed before intervention, and again between two and six weeks after the end of the sessions.

The small size of the pilot study and the lack of a control group meant that the study was not sufficient from which to draw conclusions. However, the most significant change was in the number of facial expressions recognised – a key communication skill. Nine children improved on this. Six children improved on their level of social interaction. The majority of these changes were also seen at the follow-up assessments. So 'hope might be at the end of the tunnel' for autism-spectrum sufferers.

[Reference: *NewScientist*, 19 April 2014]

### Spinal cord reawakened with implant

A new pioneering technique that uses electrical implants in the spines of paralysed patients can help them move their legs again, and could perhaps one day allow them to walk again.

This new research by scientists at the University of Louisville's Kentucky Spinal Cord Injury Research Centre, saw four wheelchair-bound men, who were completely

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paralysed below the waist, fitted with an array of electrodes in the lumbosacral region of the spinal cord. This enabled all four patients to move their legs and toes, and some could even lift up to 100 kilograms with their legs.

The implant works by restoring the resting potential of the spinal cord. This is the baseline electrical activity that keeps the cord alert, but which wanes through lack of use in people who are paralysed. Once this background electrical impetus is restored artificially, the cord reawakens and can register the brain's 'intent' to move and convert this into fine movement at the motor neuron level. By modulating the voltage for each individual and for each task, algorithms that optimise delivery of electrical activity for specific movement can be worked out and applied at will by the patients.

These implants also helped the men, to varying degrees, to recover some bladder, bowel and sexual function.

[Reference: *NewScientist*, 12 April 2014]

### Telomeres age on children's chromosomes

Inside a cell's nucleus, genes are located on chromosomes. At the ends of each chromosome are stretches of DNA called telomeres. These protect our genetic data from damage, make it possible for the cells to divide, and hold some secrets to how we age and get cancer.

Each time a cell divides, the telomeres get shorter. When they get too short, the cell can no longer divide. The cell becomes inactive or 'senescent', or dies. This shortening process is associated with aging, cancer, and a higher risk of death. Events such as living in deprived backgrounds, mothers not being educated to college level, and mothers having changes of partners more than once, etc. have all been shown to shorten telomeres in children. This could result in adverse health outcomes.

Scientists have concluded that the social environment really conditions the way that children are living and affects their health.

[Reference: *NewScientist*, 12 April 2014]

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**WINNER:** David Creevey, Ambarvale HS, won a *Luna Park Just for Fun* book by Sam Marshall from *Physics is Fun* for *SciTalk* No. 1-2014.



## Autumn and winter night skies

... Robert Garner

Autumn and winter bring longer nights with low humidity. This results in clearer air that provides better viewing. So rug up and head out with your binoculars to observe the night sky.

### The Planets

**Mercury** is setting soon after the Sun at the beginning of May. By 20 May, it is setting around one hour after the Sun and is visible in the western early-evening twilight sky. Mercury will be highest in the sky at the end of May and early June. After this, it will be lower in the sky, sinking towards the horizon as it approaches inferior conjunction (between Earth and the Sun) on 20 June. Mercury will reappear in the eastern pre-dawn sky in late June, reaching its highest point, 21° above the horizon, on 13 July.

**Venus** is a brilliant morning star throughout the autumn period, appearing in the ENE sky. On 16 May, Venus is only 1.2° away from the distant planet, Uranus. The two can be seen together easily with binoculars. Venus gradually gets lower in the sky as its orbit will take it behind the Sun by October. July will provide the last chance to see Venus against a dark sky background. Later in the year, Venus will only be visible in the twilight period before sunrise during August and then will be unable to be seen until its return as the evening star in November.

**Mars**, the red planet, was at opposition on 9 March (when the Earth and Mars were on the same side of the Sun), but is now receding from Earth. So its disc is gradually appearing smaller and its brightness is decreasing. In May, however, it remains the brightest object in the northern sky. In early May, Mars is still undergoing apparent retrograde motion and so will be seen getting progressively further west of the bright star, Spica. This period of retrograde motion comes to an end with Mars appearing to be stationary on 21 May. After this, Mars will resume its normal apparent motion from west to east and move back closer to Spica until mid-July when Mars and Spica will be only 1.4° apart. Mars subsequently continues motion against the background stars moving to the east past Spica.

**Jupiter**, the gas giant planet will be setting earlier each night over the coming months. It will be low in the NW sky in May and early June. Jupiter will become a twilight object later in June, but will disappear in the glare of the setting Sun as it approaches conjunction on 25 July. Jupiter will reappear in August and will be seen rising in the eastern pre-dawn sky, close to the planet Venus.

**Saturn** will be low in the ENE May sky, just after evening twilight. On 14 May, Saturn will be occulted (hidden) by the rising full Moon. This will commence just before 9 pm, with Saturn reappearing about 10 pm. The precise time of Saturn being fully occulted depends on your location. Saturn ends 4.5 months of apparent retrograde motion on 23 July, when it resumes normal west to east motion across the sky.

### Meteor showers

Meteor showers are mostly caused by the trails of dust and debris left in the wake of a comet. When Earth moves through such debris, a meteor shower results. Because this debris is moving in roughly the same direction, meteors that strike the atmosphere all 'point' back to the direction of the comet's path. Individual meteors during a shower appear to originate from a common point in the sky, known as the radiant. Remember, meteors are better seen pre-dawn than in the evening, as the morning sky is facing the Earth's motion in space.

The *eta-Aquarids* meteor showers, well-known as they are linked with Halley's Comet, will be visible pre-dawn until around 28 May. They peak around 6–7 May, when the Moon is at first quarter. Meteor showers to look out for from mid-July until mid-August include *Piscis Austrinids*, *Southern delta-Aquarids* and the *alpha-Capricornids*. These will all show peak activity around 28–30 July, when the Moon-free sky is dark, thus providing good viewing conditions.

### Earth's winter solstice and aphelion

At the winter solstice, the daylight hours are at their shortest and the Sun is at its furthest position north. This occurs at 8:51 pm on 21 June.

On 4 July, Earth will be at aphelion, which is when Earth is furthest in its orbit from the Sun (at a distance of 152,096,454 km or 1.016702 au).

### Constellations

The summer constellations, *Orion* and *Taurus*, are now setting around sunset and so have disappeared from view for the winter months. *Scorpius*, the prominent winter constellation, is now rising each evening in the east and is one of the few constellations that is easy to identify, with its stars spreading across the sky just like a scorpion. It contains the orange red star, Antares – the 'heart' of the scorpion. This star is a dying red supergiant at the end of its life cycle. Antares is about 600 light years away, has a mass of 15 solar masses and is about 800 times the Sun's diameter. Below *Scorpius*, the teapot shape of *Sagittarius* (the archer) can be seen. The region around *Sagittarius* is a rich area of the sky to explore with binoculars, as it contains many globular clusters and nebulae. Around 26,000 light years away in this direction is the centre of our galaxy, the Milky Way.

### Using a Sky Chart / Planisphere

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

#### Box 1: Sky Charts & Planispheres

- You can download free sky charts each month to explore the night sky from: [www.skymaps.com/downloads.html](http://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 two **planetarium sessions** per semester on Friday nights from 6–7 pm, in the E7B Courtyard at Macquarie Uni. Tickets must be booked online at: [physics.mq.edu.au/community/planetarium/#sessions](http://physics.mq.edu.au/community/planetarium/#sessions)

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