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SYDNEY ~ AUSTRALIA

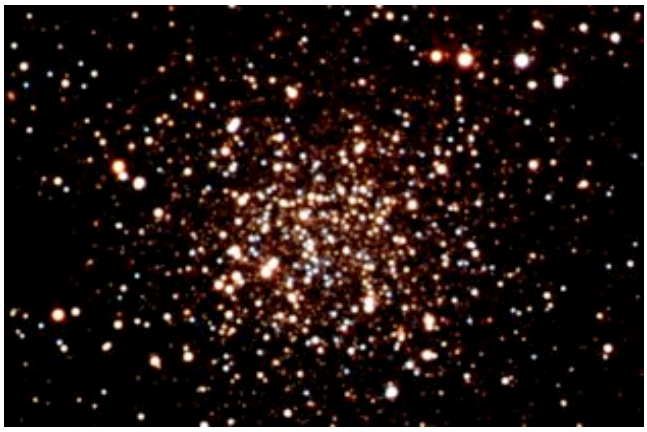
Charles Sturt University

ARC Linkage *Space To Grow* Project Newsletter Edition 11, March 2012

School student-researched science paper in print!

Inspired by *Space to Grow* to undertake an independent student research project with an astronomical focus, Josh Criss and Tom Lukaszewicz undertook a study of globular cluster NGC6101 for the first time in almost 40 years. This was an important contribution to our scientific and astronomical knowledge. Sandra Woodward, one of our 'early adopter' teachers in the project, encouraged the students to carry out the research as part of their HSC Physics assessment task in 2010. They continued their research outside of school hours, which finally led to a co-authored refereed *paper* in the Publications of the Astronomical Society of Australia (PASA) with Sandra and *Space to Grow* team members, Michael Fitzgerald, David Frew, Lena Danaia and David McKinnon.

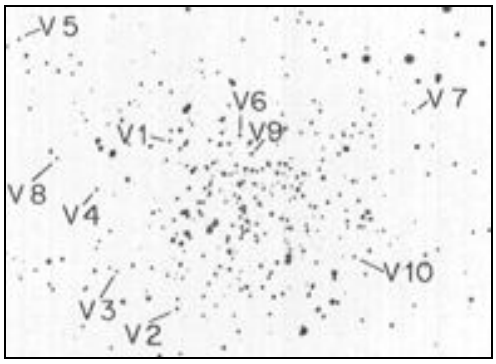
Josh, Tom and Michael with their research board



NGC6101, created with Blue, Green and Infrared light

NGC6101, in the very deep southern celestial sky, was selected by Michael and David Frew as comparatively poorly studied, and only through early observations taken on photographic plates in the 1970s (shown below). These preliminary observations were considered preliminary at best, and in need of further research. Although it is a globular cluster, the stars were also quite spread out and therefore star measurement was relatively easy.

They focussed on RR Lyrae stars, one type of **variable star* that changes in brightness over time. Josh and Tom measured this brightness variation within the cluster, using this data to estimate their rate of pulsation. Most of these stars pulsated faster than half a day, while becoming two to three times brighter. They also exploited a particular property of this certain type of star – they are known to be 'standard candle' stars which means that when they have a similar chemical composition and similar pulsation, they will have a similar brightness. This allowed them to estimate the distance to the cluster from us at 12800 parsecs or 41700 lightyears, as well as the amount of interstellar dust between the cluster and us using their infrared measurements.



Photographic observation from the earlier study of NGC6101 (Liller 1981)

*(see RR Lyraes and Cepheid article, graph and links on page 2).

Australian Government Australian Research Council · LCOGT.net · CatholicEducation · NSW Education & Communities · Catholic Education Office

Meet the *Space to Grow* Team

David McKinnon, Associate Professor in the Faculty of Education at Charles Sturt University (CSU) is a Chief Investigator of *Space to Grow* through previous links with Quentin Parker, plus his work in science education and the Faulkes Telescopes. Passionate about astronomy, he leads the professional learning program, conducting the bulk of the training sessions with other main focuses on the data research and publishing the results with *you* (students and teachers) as co-authors for continued development.

Having a degree in Physics and Astronomy from the University of Glasgow in Scotland, he took up teaching science and mathematics in Australian schools, becoming a head of department for 5 years. With a Diploma of Education plus a Master of Education added to his credentials, he was appointed as a lecturer of technology education and science education at the Mitchell College of Advanced Education (now CSU). A PhD followed and then an Associate Professorship, during which time he also coordinated the HSC Cosmology Distinction Course for 15 years and is still inspired by the joy of teaching all age groups. David built and 'mans' the first remotely controlled telescope (shown below right), used by students in Australia, Canada, USA, UK and the Netherlands, and known as the CSU Remote Telescope project. Operational since 2000, it continues to be used by many students worldwide from primary through to high school.

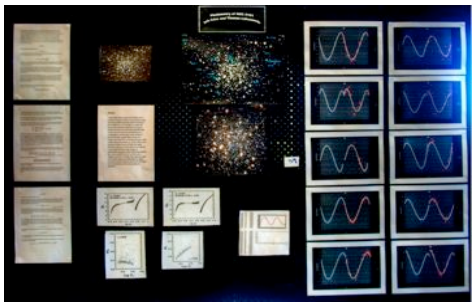
David's ongoing contributions to teacher professional development include writing a program for primary and middle school teachers plus advising on the development and implementation of research programs designed to assess the impact on high school physics teachers and their students for the Faulkes Telescopes UK project. He is also involved with educational interventions in Australia, Canada, USA, UK and the Netherlands, special education and speech pathology.

He generously devotes time to his fellow staff, teachers and students (mentoring, challenging and encouraging), rewarded by achievements such as his team's Carrick Citation for University Teaching award. An Australian Learning Teaching Committee University Teaching Excellence Award (a national award), Academic Excellence and Faculty of Education Team Teaching award is also shared with fellow team member Dr Lena Danaia. Among his invitation list of professional commitments is a Directorship of Faulkes Telescopes Australia, one of three international education advisors to the Las Cumbres Global Observatory Telescope Network and Chair of the International Astronomical Union's Working Group on School Astronomy Education, including Teacher Education and local Patron of the Mitchell Science Teachers' Association.

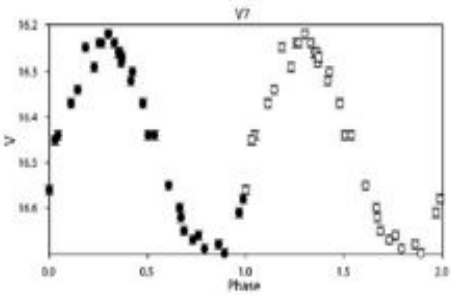
The next of David's frequent video conferencing national and international webcast presentations on astronomical events to schools is the Transit of Venus on June 6 from http://www.csu.edu.au/telescope.

RR Lyraes and Cepheid Stars and their instability

While Cepheid stars are much more massive, well-known and shorter-lived than their RR Lyrae cousins, they follow the same general principle in that they are in a particular cycle of their evolution and actually physically pulsate due to their nature. When the star is small and compact a layer or 'shell' in the star is not transparent to light so the energy coming from the interior of the star cannot pass through it. As the energy pushes on this shell, the star is forced to expand, making it bigger and brighter. At a certain point this expanding shell becomes transparent, allowing light through, relieving the outward pressure on the shell. The shell then contracts due to gravity, again becoming smaller, dimmer and losing transparency, thus continuing the cycle.



Full Research display board of NGC6101
2011 Oakhill College Science Fair (see page 1)



Graph of one star's brightening and dimming in NGC6101 (see story page 1)

M31 with V1 in its various states of brightness, Hubble Telescope images

Henrietta Leavitt discovered the relationship between the period and luminosity of Cepheid stars famously used by Shapley, Hubble and Hertzsprung. The Cepheid named V1 (Variable 1) by its discoverer, Edwin Hubble, in 1923 altered the course of modern astronomy as it proved that the Andromeda Galaxy M31, where it is located, is beyond our own Milky Way. By the end of 1924, he had discovered 36 variable stars in the galaxy, 12 of which were Cepheids. The Hubble telescope restudied and researched V1 for six months plotting its light curve and capturing images (above right) to commemorate this discovery.

View more: Henrietta Leavitt - http://www.youtube.com/watch?v=E9gvk_OkrPw plus an animation of variable stars in the globular cluster M3 - https://www.tinyurl.com/778hsxf

Read more: Hubble's V1 - http://hubblesite.org/newscenter/archive/releases/2011/15/image/a/ variable stars - http://www.youtube.com/watch?v=2TtDi1at3Eo&feature and RR Lyraes - http//:en.wikipedia.org:wiki:RR_Lyrae_variable

Feature Teacher - 'Going the distance'

Colin McKay finds working in the School of Distance Education in Dubbo for around 14 years a fulfilling experience, teaching high school students in Science, Physics and Information Technology. Colin started teaching in the Sydney area, then took up an opportunity to teach in Nigeria at a school of around 1000 pupils for 2 years. While a few old computers were available, mobile phone and internet coverage were not. Witnessing his son having in-house distance education by his wife inspired an interest in distance education when he returned to Australia. His 'class' could be connected from such far-flung places as Balranald near the Victorian border to Bundarra in the New England tablelands to Tibooburra in the top north western corner of the state in groups of up to 6 students at a time.

Subject classes are taught within Year groups, with the lessons generally limited to 40 minutes due to the high demand on the technology for teaching all of the subjects. One challenge is overcoming the distance hurdle by navigating various methods of connectivity, depending on availability and reliability, from Video Conferencing to internet-based programs and satellite-links. Naturally interested in Astronomy, Colin saw *Space to Grow* as a alternative to engage students in 'hands on' investigations. By joining DEC Western and CEO Bathurst trainees at Orange in 2011 and then linking into Video Conference training, he is pondering what adaptations are needed to the project resources for practical adoption, possibly across year groups.

Teacher Scholarship in Science Education

Applications close on 4 May 2012 for the Premier's Macquarie Capital Science Scholarship of $15,000 to spend up to five weeks involved in a study program in any aspect of Science Education. All teachers currently teaching Science in primary or secondary schools or TAFE NSW Institutes are eligible to apply.
https://www.det.nsw.edu.au/what-we-offer/awards-scholarships-and-grants/scholarships/premier-s-teacher-scholarships

2012 Training schedule begins

There was a high ratio of team members to participants at the first 2012 training session at the LEX, and this 'knowledge bank' was well utilised, particularly as the astronomical terminology came into play. Participants were introduced by Paul Stenning, Teaching Educator, CEO Parramatta to *Space to Grow* Chief Investigators Prof. Quentin Parker and A/Prof. David McKinnon, Post-Doctoral Research Fellow Dr. Lena Danaia, PhD research student Michael Fitzgerald and Project Manager Carolyn Dow. Attendees came from schools who had teachers in the 2011 'Clusters' training (to learn, support and reinforce those teachers) and others from 'new' schools not familiar with the rewritten training methods and resources. An injured leg did not deter Dr Alexandra Hugman from joining the training as she aims to offer lots of stimulating and engaging science activities in the Northern Beaches Christian School.

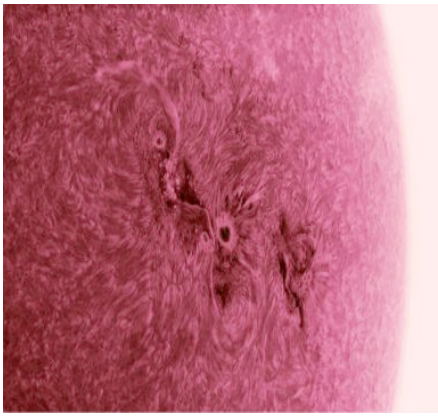



After the initial welcome by Quentin, Lena explained how crucial both Pre and Post data completion is to the research study and as teacher feedback via sample analysis reports. David led the training, drawing on his 37 years' experience of combined teaching and teacher education in science and (see his story on page 2).



A working demonstration of 'Jigsawing' demonstrated one of the many inbuilt teaching techniques in the resources developed by David and Michael. Colour Imaging rated highly as an activity that students should master and enjoy. Any frustration in conquering the software was overtaken with excitement in the 'ah hah!' moment of when it all came together. The initial feedback has been positive and we eagerly await 'homework' results before moving deeper into the science of Star Cluster photometry.

Our star - Flares, Aurorae and the Transit of Venus



Our sun's Active Region 1429 has been erupting with some of the fastest clouds of energy in recent years. The 11-year solar cycle of maximum and minimum of flare activity is due to peak again in 2013, and while the Earth's magnetosphere usually provides protection, X-class flares can trigger radio blackouts and disrupt satellite navigation, communications and transport.

Aurorae that are most often seen occur about 100-160 km above the Earth, with different atmospheric gases emitting different colours, caused when the charged particles from solar flares associated with sunspots flow toward the Earth in what is called the solar wind. The particles collide with atoms in the atmosphere and release visible light, ultraviolet and X-ray radiation energy, usually following the Earth's magnetic fields. Surf suitable websites for solar alerts.

Image left: Active Region 1429 of our sun by Alan Friedman in Inverted false colour, Astronomy Photo of the Day (APOD) 14 March 2011

Keep a lookout on 6 June 2012 as Venus passes in front of the sun - the last "transit of Venus' for over a century.
Macquarie University event details of a live projected image of the sun and telescope viewing with astronomers available to answer questions, 8am-3pm
http://www.mq.edu.au/pubstatic/events/2012/06/06/the_department_of_physics_and_astronomys_transit_of_venus/?page=24011
Charles Sturt University event details - Video Conferencing and Polycom broadcast at http://www.csu.edu.au/telescope

Read the fascinating history behind the many scientists who came together to observe the last complete Transit of Venus in 1874 at Hawaii and Captain James Cook's observation from Tahiti in 1769, which helped measure the distance to the sun and provided the key scientific reason for the voyage at: http://www.transitofvenus.org/history/1874-1882/278-between-captain-cook-and-mauna-kea Seeking the postulated *terra australis incognita,* Cook also mapped New Zealand before he and his fellow *Endeavour* crew members became the first Europeans to discover Eastern Australia. Other stories are on the transit of venus.org site and read more at http://science.nasa.gov/science-news/science-at-nasa/2004/28may_cook/

Sparking curiosity and undertaking research

More and more media articles discuss the skills shortage in maths and science and the need to maintain Australia's strong record in science and innovation through deeper subject knowledge. Teachers have an opportunity to win the *$15,000 Premier's Macquarie Capital Science Scholarship* (details and link, page 3) and your students could undertake authentic astronomical research and scientific enquiry like Tom and Josh (and others). You don't have to be an 'astro-nut' like Sandra Woodward to encourage your students to participate. All you really need is the desire to offer some ideas for sparking curiosity for further exploration online and in the media (activities, demonstrations, discoveries, documentaries, experiments, quizzes). Use some of the (advertisement-free) links below to inspire and extend your students' curiosity and suggest they embark on a science research project. Contact us for help, advice and knowledge on suitable targets for those students interested in undertaking an independent research project through *Space to Grow*.

ABC Science **http://www.abc.net.au/science/**	Quizzes, demonstrations, scientific discoveries and stories on *Space, Climate, Animals, Health*
CSIRO **http://www.csiro.au/**	Australia's national science agency information and links - *Explore, Media, Events, Education, Publications*
Hubble Site **http://hubblesite.org/**	Get a bigger view of the cosmos from the telescope in the air - *News, Gallery, Discoveries, Explore*
NASA **http://www.nasa.gov/**	Space, Space exploration and Space travel - *Astronomy Picture of the Day (APOD), Multimedia, News, Missions*
NASA Science **http://science.nasa.gov**	'Citizen science' - *Earth, Heliophysics, Planets, Astrohysics, Gallery, Missions, Technology, Science News, NASA Science for… (kids to researchers)*
Power House Museum **http://www.powerhousemuseum.com**	Displays and collections on science and technology - *Exhibitions, Workshops, Education, Research*
Questacon **http://www.questacon.edu.au**	Australia's national Science and Technology Centre -*Canberra Questacon, Exhibitions on tour*
Zooniverse **https://www.zooniverse.org/**	'Citizen Science' involvement, Education and resources - *Space, Climate, Humanities, Nature*

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