

Preparing Students for a Future Linked to Space.

by

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"Earthrise" NASA image taken from Apollo 8 in 1968

"I never knew the moon looks like this," the elderly lady said as she peered in the telescope. How had she lived almost a lifetime and not seen the surface of the moon in a photo, let alone through a telescope? By comparison, today a bright year 12 student aspires to study astronomy, then join the Australian Space Agency.

These are actual events. Our Macarthur astronomy group is helping these people to enjoy and marvel at the night sky. They do show the generational gap, but also a new student-led demand for knowledge of the night sky and we should expect it to grow.

Lay astronomers know how effective astronomy is in making junior students comfortable with physics - they see and 'touch' it, then understand it. It warms them to science in the senior school.

"Astronomy is the gateway to science," a motto from the England and Wales school system.

Remarkable changes are occurring in air and space propulsion that will engage us all in the near future, especially the school students of today. In their immediate future:

Hypersonic flight where Sydney to London becomes a 2.5 hour trip. Space craft powered by an ion engine on a six day round trip to land on the Moon to visit a museum constructed at the Apollo 11 landing site of 50 years ago. Test flights of a British hypersonic plane are expected next year. NASA has announced a return to the Moon in 2024 to establish a base there. NASA plans a multi-nation venture. Australia could be a possible partner. MARS is on the agenda for around 2035.

To contribute to this progress, activity in the Australian space industry is expected to treble from 10,000 jobs to 30,000 by the year 2030 and from \$1 billion to \$3 billion in revenue. This trebling speed matches the growing space industry among all countries.

To assist teachers in this environment, where they present astronomy-space studies to their students, there are aids available for use. A selection is set out here.

Among the aids are more than 50 amateur astronomy organisations in Australia and local tourist astronomy services such as Alice Springs, Broken Hill and Dubbo. The members enjoy their interest, know its many facets in various ways, and usually like to share it with others.

Maths and English

What captures the young mind more than 'strange new worlds,' space exploration and adventure, weird alien species? Some of the greatest science fiction writers of the past (and the present) were also professional scientists and engineers. As they let their imaginations delve into speculative realms of the future, building on their scientific knowledge, they also indulged in highly creative story telling. Science fiction no longer has the 'pulp fiction' stigma of the past but is now main stream. When exploring writing at school, the subject of astronomy may inspire creativity whilst informing and building a knowledge of space and the universe in a student. English teachers, using their students' basic knowledge of science and astronomy, and wishing to encourage creative writing skills, could invite them to imagine 'what if?' Build on it, developing plots, societies and characters to populate their imagined world. It frees them from the restrictive bounds of stories in their real world, allows new elements of un-Earthbound adventure and allows their imaginations to soar.

Space can make maths exciting. Maths for maths sake can soon lose the interest of many young people. What use is it? But show them how the maths can explain, even calculate some realistic and 'cool' space and planetary scenarios will surely engage them. There are calculations they can easily do themselves with hand calculators or simple spreadsheets. Simple equations are available that allow a student to calculate, among other things:

- The escape velocity of a rocket from a planet (such as Earth) or a moon, or a neutron star;
- The mass of a planet, simply by knowing the orbital period and diameter of any one of its moons. Image – using the orbital diameter and period of, say, Ganymede to calculate the mass of the gas giant Jupiter. Or the mass of the Sun from Earth's period and orbital diameter;
- The height of orbit above the Earth of a satellite (or space craft) travelling at a given speed. Or vice versa;

- How far and high an object would travel when thrown (or kicked or fired) from the surface of the Moon, or Mars as compared to on Earth. This is basic Newtonian mechanics using different values for the local gravity but adds a new dimension when imagined on an exotic world. What teenager wouldn't want to know how far he could hit a cricket ball on the Moon?

All the equations for these examples and others are readily available off the internet.

School Incursions.

A realistic planetarium is available to use in a classroom at a modest cost. It comes from Sega Toys. It uses photos of the night sky, whereas light points usually represent the stars. Features of the night sky can be highlighted with a laser pointer. A local lay astronomer might have a role here.

<https://www.segatoys.space/en/public/discs.html>

Some lay astronomers could be invited to show a class, during day school hours the Sun and the Moon from their playground. A solarscope with its special filters makes the Sun with its sunspots and prominences safe to view. A normal telescope views the Moon. This would add realism to a talk given to the class during the same visit.

A night time sky viewing for students and parents by lay astronomers could be held in a school's grounds. This could coincide with the study of the solar system in the classroom. A teacher would be in charge of the night viewing.

An added attraction might be a sausage sizzle provided by the P and C and/or a fee charged for the school's funds. A high school teacher has done this to fund a science excursion to a primary school science week event.

Another option in the classroom has pupils directed by handout to the parents, to visit a prearranged night sky viewing with an astronomy group where the student would achieve certain aims. They might identify the Sea of Tranquility on the moon, certain planets (Saturn is always popular), the Southern Cross, the Andromeda galaxy. The next day in class a discussion would be held to reinforce the learning objectives.

School Excursions.

Your local lay astronomers are likely to have scheduled their dark sky viewing nights through the year. They might also have public viewing nights. Contact them to inquire what might be arranged for your students. This could begin with a web search for a local group.

Our Macarthur astronomy group holds four public viewing nights in the winter months. Up to 400 visitors a night attend. We find a sausage sizzle enhances the pleasure of the planets for the young guests.

Mentoring senior school students in astronomy assignments is a very rewarding experience for our astronomy group's members. Some of the students have won science awards and all are enthused by astronomy with its tangible science.

To accomplish mentoring, a menu of projects is compiled by a teacher with the astronomers. From this the students each choose a project that interests them. The three

parties work together over several months toward the students producing scientific reports as part of their curriculum work AND making brief presentations on their findings to a meeting of the club members. The teacher manages the students' work, the astronomers lend their astronomy knowledge, guidance and telescopes to the students, and the parents (not the teacher) attend the dark sky viewing nights with their children.

Online Applications.

There is a plethora available to use, but, you are best to stay with these sources: ABC News Services, Royal Museums Greenwich, NASA and Youtube.

The ABC Pocket Guide to the Moon. This is just magic. <https://www.abc.net.au/news/2019-07-16/pocket-guide-to-the-moon/11260558>

Royal Museum Greenwich. Learning resources. They are curriculum-linked learning resources designed to work in the classroom. Search the learning resources by Key Stage, subject and resource type. As well, the Museum offers online FREE teacher training courses compiled by educators.

The NASA (National Aeronautics and Space Administration) Goddard Space Flight Center. Search: StarChild.

StarChild is a learning center for young astronomers ages 5-13 to learn about the solar system, the Milky Way galaxy, and the universe beyond. Use the links above to explore the site's topics.

If you are looking for something a bit more advanced (ages 14+), then head on over to Imagine the Universe!

Wishing you good dark nights sky watching.

The Macarthur Astronomical Society has served the region of Macarthur on the South West of Sydney for more than 20 years. We offer the public and schools an outreach service to enjoy the night like its members do.

For inquires and outreach go to www.macaastro.org.au.