

# THE SCHOOL OF ASTRONOMY & ASTROPHYSICS

## PREAMBLE

After ten years developing course material to deliver university level education to accelerated high school students in Senior Astronomy and Senior Astrophysics courses, “The School of Astronomy and Astrophysics”, a virtual campus attached to Atherton State High School, reached a milestone in 2013 when it launched its website (<https://learnastro.eq.edu.au/Pages/default.aspx>) as a focal point for its educational delivery.

Networked with leading local and international professionals in the fields of astronomy, mathematics, physics and astrophysics, the school has lead youth engagement in astronomical event-based learning experiences in Australia. The challenges of providing this contemporary form of learning and engagement has seen the partnering of an innovative digital educational delivery model with university options that fast track students into Science, Technology, Engineering and Mathematics (STEM) careers.

Astronomy education encapsulates a broad context of science that continues to challenge our way of understanding and processes of thinking. Astronomy is an exciting, visual science that stirs up scientific curiosity in young people and incorporates a wide range of physical sciences, including mathematics, physics, chemistry, geology, engineering and computer science.

TSAA’s online astronomy education program allows students to engage in full, real-life learning while applying skillsets learned in mathematics and physics to synthesise, generalise, explain and hypothesise observed phenomenon outside of our atmosphere. These higher-order thinking operations inherent in the nature of the topic transform students from passive learners of knowledge, to that of producers of knowledge.

Our advanced senior school curriculum in astronomy and astrophysics is now available for online delivery to students nationally and internationally through Blackboard (Bb) via the ‘[Learning Place](#)’:

- Our courses are registered by the [Queensland Curriculum and Assessment Authority](#) (QCAA) as Recognised Advanced School-based Subjects and contribute credit towards the Queensland Certificate of Education (QCE) for Queensland students;
- Each course is based on tertiary level astronomy and astrophysics content that is rich in higher-order thinking concepts related to STEM education;
- Students have the opportunity to interact directly with professional academics & astronomers from astronomical institutions world-wide.

The school’s vision is to create a sustainable but tangible and meaningful nexus between student, teacher and professional academics while studying Senior Astronomy and Senior Astrophysics online. These ‘connections’ are carefully negotiated through networking partnerships developed over a period of 13 years, taking into account the student’s learning capacity and interests.

The School of Astronomy & Astrophysics is committed to supporting the future development of teacher expertise and astronomy education curriculum for middle and junior secondary schooling throughout Australia.

# Curriculum & Resources

## COLLABORATIVE PARTNERS IN INNOVATION

TSAA recently received \$500 000 through a Collaboration & Innovation Fund (CIF) initiative to develop additional online STEM related curriculum and materials through partnerships with the University of Southern Queensland (USQ), the Australian Digital Futures Institute (ADFI), the University of California, (Lawrence Berkeley Laboratories) Berkeley and EQ eLearning. The aim of these collaborative partnerships is to:

- Continue development of online STEM related curriculum in Astronomy and Astrophysics (Yr. 4 to 12) incorporating the Global Hands-On Universe (GHO�) project and remote access to the Las Cumbres Observatory Global Telescope (LCOGT) Network and Skynet;
- Develop **STEM** related syllabus and online curriculum materials in:
  - **Data Science through Applications in Astronomy;**
  - **Fundamentals of Coding;**
  - **Scientific Literacy;**
- Access digital instructional design and editing for courses delivered through Blackboard;
- Develop quality editable mathematics assessment banks using **SageTEX** to enhance authenticity of responses and provide instant feedback online;
- Coordinate school-based research projects and academic mentoring utilising facilities at Mt Kent Observatories, the LGOCT Network & Skynet ;
- Develop QCAA authorised OP subjects for online delivery through QCAA approved workprograms (Physics, Mathematics B & C);
- Installation of a remote-access telescope in TSSA's clam-shell dome (Atherton SHS).

## CURRENT ONLINE TSAA COURSES

### SENIOR ASTRONOMY & SENIOR ASTROPHYSICS

(INTENDED COURSE DURATION IS 1-FULL SCHOOL YEAR FOR EACH COURSE)

**Senior Astronomy** (Yrs. 11 & 12 or Yr. 10 accelerated) & **Senior Astrophysics** (Yr. 12 or Yr. 11 accelerated) are high-end courses that have been developed using introductory to advanced astronomy and astrophysics content studied at universities. Rich in STEM related concepts, these courses have been developed through extensive consultation with senior lecturers in Mathematics, Physics and Astronomy. Contributing institutions include **James Cook University (JCU)**, **University of Southern Queensland (USQ)**, **Monash University**, **Swinburne University of Technology**, **University of California – Berkeley**, **Gettysburg College**, and **CSIRO's Australian Telescope National Facility (ATNF)**.

Both courses underpin many of the concepts covered in senior mathematics and physics. This gives students a meaningful understanding in how these concepts are applied in a tangible way that relates to an appreciation of where our place is in the universe.

Students will learn how to quantitatively model and apply laws of physics to a wide range of astronomy related topics which will empower them as rational and creative thinkers, engage them in the acquisition of knowledge and the development and understanding of the physical aspects of astronomy through active processes of scientific investigation & research.



## MIDDLE & JUNIOR SCHOOL ASTRONOMY EDUCATION

Astronomy education communicates basic science to all people. We are currently working with the University of California, Berkeley to develop astronomy curriculum for the middle & junior school levels based on their extremely successful “Global Hands-On Universe™” (GHO) astronomy education program. GHO allows teachers to develop innovative pedagogical & learning methods related to the context astronomy in mathematics, science and technology. Classroom activities are easily adopted to facilitate enriched scientific thinking in students of all ages:



- Students can model astronomical phenomenon in the classroom to explain how, why and when they occur.
- Using GHO images from professional telescopes along with image processing software developed for use in the classroom, students engage in and learn key concepts in science, mathematics, and technology.
- Students can communicate with participating GHO students from other countries as they collaboratively work on GHO projects (e.g. using astronomical databases and images to search for minor planets and asteroids).
- Using ground-based telescopes, students can participate in recording and streaming astronomical events visible in their region to institutions and astronomical societies at locations where the event is not visible.

Through qualified GHO facilitators, TSAA plans to develop, maintain & provide quality face-to-face and online professional development workshops for teachers to learn how to engage students in the classroom through GHO. Curriculum materials will become available for students and teachers to download from the school’s website.

## FACILITIES

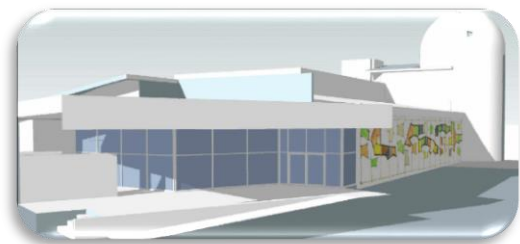
### ROBOTIC SOLAR TELESCOPE

The School of Astronomy & Astrophysics has been gifted a fully operational robotic telescope and dome from the University of California, Berkeley and James Cook University. We plan to have this facility operational for solar imaging and research from 2016.



### ONLINE CONFERENCING FACILITY WITH EDUCATIONAL & RESEARCH OBSERVATORY

Architectural drawings have been completed for our proposed Online Conferencing Facility & Observatory that will allow for the delivery of online lectures and web conferencing and for students to conduct regular public observation evenings and meaningful research activities.





## Additional Partnerships

### EDUCATIONAL RESEARCH AND OUTREACH PARTNERSHIPS

The school has partnered in educational research and/or outreach activities (e.g. Occultation of Hydra, Transit of Venus and the 2012 Total Solar Eclipse) with the following institutions:

- University of California - Berkley, USA;
- Charles Sturt University - Wagga Wagga;
- Pierre and Marie Curie University – France
- Kagoshima University, Japan



Pierre & Marie Curie University – France showing the “live” stream of the Transit of Venus provided by our Astro students



Our Annual Astro Conference 2012. Over 100 national & international students & astronomers celebrate after just witnessing the Total Solar Eclipse from the totality centre-line.

Other research and outreach partnerships are currently being developed. Students will have a greater opportunity to engage in real-time astronomy after the completion of our robotic optical and Solar Telescope. This will be further exemplified through an Educational and Research Observatory & Conferencing Facility. Possible ongoing projects might include:

- Occultation projects
- NASA Lunar Meteorite Impact Monitoring
- Monitoring of Solar Activity (white light, H-alpha and Ca II k-line)
- Streaming of events such as lunar eclipses and extreme solar activity
- Other research partnership projects



### EDUCATION & SUPPORTING PARTNERSHIPS

#### SOLAR IMAGING AND PROCESSING

‘Eyes on the Sun’ is a robotic solar observatory based in Warren, NSW, which is run by owner and developer Capt. Ralph Smith. Ralph is an extremely experienced and accomplished solar photographer whose work has been acknowledged and published world-wide. Ralph is an instructor for our Solar Imaging and Processing units and has been working with the school for many years now.





## ONGOING ACADEMIC SUPPORT

Academic support through webinars and vignettes, mentoring, access to resources, professional experience placements, software applications, robotic telescope access and possible direct entry and subject credit for graduating students are examples of the type of support provided by the following institutions.

- CSIRO's Australian Telescope National Facility (ATNF)
- James Cook University
- University of Southern Queensland
- University of Queensland
- Queensland University of Technology
- University of California – Berkley (USA),
- Monash University – Clayton, Melbourne
- Centre for Astrophysics & Supercomputing - Swinburne University of Technology
- Charles Sturt University - Wagga Wagga (Prof Graeme White – Private Observatory)
- University of New South Wales
- ARC Centre of Excellence for All-sky Astrophysics - CAASTRO
- University of Western Sydney
- ANU Research School of Astronomy and Astrophysics – Mt Stromlo

Many of these institutions have contributed to the development of our astronomy education program. Professional astronomers volunteer to interact and/or work with our students on a regular basis.

## PROFESSIONAL EXPERIENCE OPPORTUNITIES

The school negotiates professional experience placements with our partnering institutions. This has proven to be a life-changing experience for the students who take up this opportunity.

## INTERNATIONAL VISITS

We recently negotiated a visit to UC Berkeley's Space Science Laboratories in the US for one of our Senior Astrophysics students. The student was taken on a tour of their facilities by Dr Carl Pennypacker, the co-founder of the project that won the 2011 Noble Prize for Physics. Dr Pennypacker has since offered to mentor him if he was to study through that institution.



Senior Astrophysics (Advanced) student  
Grace Lawrence at ANUs RSAA



Senior Astrophysics (Advanced) student  
Chris Dilger at Swinburne's Centre for  
Astrophysics & Super Computing with  
Prof Chris Fluke



## Student Testimonials

**BEN RUSCOE & JAMES SELLARS - 3RD YEAR MEDICAL STUDENTS - JCU**

After studying the senior astronomy course in grade 10, the transition into senior Mathematics B and Physics was not as difficult as we expected and there was a vast difference in how other students were coping with the advancement in content and heavier workload.

The subject also enriched our modelling and problem solving skills, especially in physics related questions, but has been just as useful in understanding other procedures involved in advanced mathematics through an effective extension of all areas of mathematics, as astronomy combines many aspects and actually puts them into practice.

The opportunities that have been presented to those who have taken the astronomy and astrophysics courses have been once in a lifetime experiences. The opportunity to take a field trip into outback FNQ and research the optimum location for viewing the total solar eclipse in November 2012 as well as the chance to travel to Charters Towers and be a part of aligning Blackheath and Thornburgh College's telescope.

The courses have also provided the opportunity to work with professional astronomers. We had the pleasure of working with the former Director of Astronomy at JCU Townsville on a number of occasions.

We've thoroughly enjoyed the two years studying the Senior Astronomy and Astrophysics subjects while at Atherton SHS and have certainly reaped the benefits in all of our mathematics and science subjects.

We would thoroughly recommend the Senior Astronomy & Senior Astrophysics courses to anyone with a strong interest in mathematics and science, especially if they are interested in extending their knowledge and learning advanced mathematics and science skills.



## GRACE LAWRENCE - CURRENT 1<sup>ST</sup> YEAR UNDERGRAD - SWINBURNE UNIVERSITY OF TECHNOLOGY (ASTROPHYSICS – VC SCHOLARSHIP)

As a Year 9 student at Atherton State High School, I knew that I liked science, but I didn't realise what a big part it would play in my life. I entered the second year of intake into TSAA's accelerated course in Astronomy and Astrophysics over grades 10 and 11. As I learned everything from the basics of planetary motion to the details of supernova remnants, I was introduced to a pioneering initiative in the field of science education; The School of Astronomy and Astrophysics (TSAA).

As I progressed through these courses, I was astounded by how it improved my understanding of senior physics and mathematical concepts. Having explored their real-world applications in astronomy and astrophysics, senior science and maths studies were a breeze. The learning experience was enhanced by a modern, online approach to self-paced learning on Blackboard. With lecture notes, tutorial help and online, progressive assessments, these courses cater to every learning style and location and lets everyone move at their own pace, with opportunities for one-on-one help if needed.

Studying these courses gave me the opportunity to communicate and network with industry professionals, world-renowned professors of astrophysics and like-minded young scholars. Hands-on work at real observatories and interacting with scientists from all over the world really solidified the fact that I could turn my passion for science into a career. Studying through TSAA played a large part in being accepted into the Professor Harry Messel International Science School 2 week intensive. Overall the connections that I made helped direct me to Swinburne University in Melbourne, where I have just commenced my tertiary studies.



TSAA's comprehensive program has also enabled me to connect with established physicists in Melbourne, expanding my professional networks.

These courses have worked wonders and I truly believe that TSAA is at the forefront of moulding the scientists of the future. I would recommend TSAA courses and activities to any students who have a passion to excel in science; it will change your life and send you ad astra - to the stars!



## SAM PHIPPS - 2<sup>ND</sup> YEAR ENGINEERING STUDENT

We studied the science and mathematical applications in astronomy and astrophysics for 2 years and found the courses to be extremely beneficial both as a head-start in Mathematics B and Physics topics and as an extension for modelling and problem solving skills. Senior Astronomy and Senior Astrophysics has not only extending my knowledge on maths and physics concepts but also provided a real life appreciation for the application of the concepts”.



## ELLIOT COUPE – CURRENT 1<sup>ST</sup> YEAR UNDERGRAD – UQ PHYSICS (VC SCHOLARSHIP)

"The school of Astronomy and Astrophysics is really fantastic. It's opened my eyes to brilliant concepts that I couldn't have dreamed of seeing anywhere else other than university, and I haven't even begun to study the Astrophysics course yet! Personally I've always been interested in Astronomy; but the layout of this course has probed my curiosity further. The online style allows for a 'work at your own rate', which is great because you're not smothered by information and turned off by the topic (How I feel with almost all of my school based subjects).



It was not long before I came to realise the true value of this course; It drastically helped me with my other three mathematics based subjects (Math B/C, Physics and from some parts Chemistry) and it will definitely broaden my horizon for the future as. I totally recommend these courses to others that have an interest in science and are serious about strengthening their mathematical skills”.





## Contact and Enrolments

### WEBISTE

You can visit our website at [www.learnastro.eq.edu.au](http://www.learnastro.eq.edu.au)

### ENQUIRIES & ENROLMENTS

Head of School:

Mr David Platz

Telephone: 0427 445 296

Facsimile: (07) 4091 3847

Email: [learnastro@athertonshs.eq.edu.au](mailto:learnastro@athertonshs.eq.edu.au)

Online Enrolment:

Website: [www.learnastro.eq.edu.au](http://www.learnastro.eq.edu.au)

Email: [learnastro@athertonshs.eq.edu.au](mailto:learnastro@athertonshs.eq.edu.au)

### PHYSICAL ADDRESS

Resource Centre

Atherton State High School

Maunds Road

Atherton Qld 4883

### POSTAL ADDRESS

PO Box 574

Atherton Qld 4883

