



Education
Public Schools



STEM | SCIENCE
TECHNOLOGY
ENGINEERING
MATHEMATICS
NSW Department of Education



STEM ACTION SCHOOL MENTORING PROGRAM

NSW DEPARTMENT OF EDUCATION

Introduction

The NSW Department of Education has established seven STEM Action Schools to mentor and share innovative STEM practice and programs with schools. STEM Action Schools implement curriculum programs designed to develop students' foundational knowledge and skills in STEM subjects as well as skills of collaboration, critical and creative thinking and problem solving.

The schools have taken the opportunity to foster and nurture students' curiosity towards STEM and used this to develop deeper engagement and learning. They inspire students to take more challenging STEM subjects in senior years and to follow pathways for STEM related careers. They share and support effective STEM pedagogy, illustrate innovative practice for student engagement in STEM and demonstrate successful leadership, professional learning and industry partnerships.

STEM ACTION SCHOOLS

The seven STEM Action Schools are:

- East Hills Girls Technology High School
- Hastings Secondary College
- Macarthur Girls High School
- Maitland Grossmann High School
- Narara Valley High School
- Riverside Girls High School
- The Canobolas Rural Technology High School.

ACTION SCHOOL STRENGTHS AND EXPERTISE

Each Action School has staff with individual strengths and particular expertise. A goal of this program is to facilitate these experienced staff to lead a community of practice in the teaching of STEM across NSW. You can read about each STEM Action School in the profiles following this introduction.

STEM ACTION SCHOOLS MENTORING PROGRAM

NSW Public Schools are able to collaborate with STEM Action Schools and receive mentoring through an application process. To be part of the mentoring program schools are required to complete an expression of interest form which is available electronically on www.stem-nsw.com.au (LEADING STEM / Action School Mentoring). Schools are required to select from the seven schools when completing the expression of interest to receive mentoring. For further information or enquiries please contact stem@det.nsw.edu.au.



East Hills Girls Technology High School

East Hills Girls Technology High School is a technology high school with over 1000 students. As an **Apple Distinguished Program School 2016-2017**, every student from Years 7 to 11 and all teachers use iPads. Students are proficient users of many applications and as they progress from Year 9 to 12 the use of technology is integrated. All students experience a diverse range of technology from data logging devices to 3D printers.

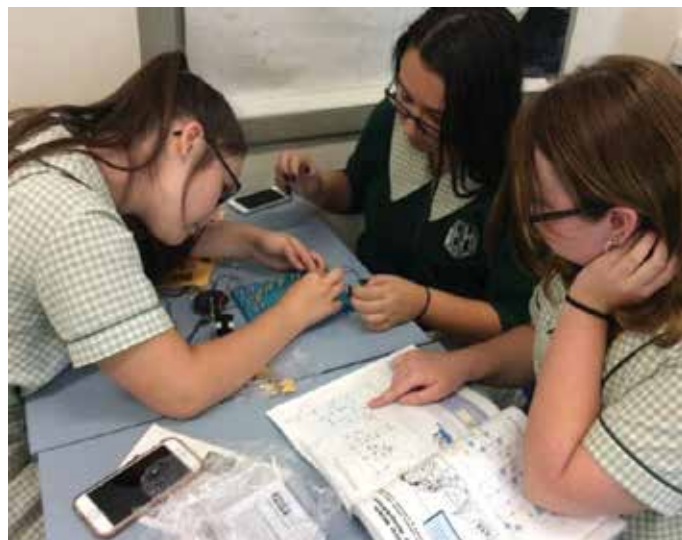
The use of technology is presented to the wider educational community through the **Technology Expo and Educational Innovation** tours. East Hills Girls frequently supports and hosts visiting educators from Australia and internationally, showcasing our integrated use of technology. The annual Technology Expo provides an exciting opportunity for teachers to share their teaching practice while showcasing student outcomes to visitors.

Through delivering all courses with iTunes U, **technology is integrated into teaching and learning**. iTunes U provides students with course overviews, syllabus information, course outcomes and assessment task information while connecting students with resources to complete tasks and classroom work. This has transformed the way students engage with learning materials, access resources and receive feedback. Students in Year 7 and 8 create a Digital Learning Portfolio using iTunes U. In these courses students upload assignments and reflect on their learning using guided focus questions.

East Hills Girls has a dedicated **ICT Centre**, a Head Teacher of ICT and an ICT faculty comprising of industry qualified professionals. The Coding Club is well attended by students, who gain a deeper understanding of the writing of computer code and its application. Students participate in the University of *Sydney Girls Programming Network* which has allowed some of the students to be selected for the National Computer Science School. All students in Years 9 and 10 study **information software and technology**. East Hills Girls offers a wide variety of curriculum for girls in courses including **Electronics, Graphics and Engineering**. These subjects are offered as Stage 5 electives and Stage 6 HSC courses.

Partnerships have been created with industry through Teacher Earth Science Education Program to build curriculum links to sustainability and earth science, CSIRO, Australian National University.

East Hills Girls participate each year in the **NASA Space Camp**. A group of students attend Space Camp at NASA in the USA engaging in STEM challenges and developing an understanding of space engineering and technology.



Hastings Secondary College

Hastings Secondary College was created in 2015 by combining Westport High School and Port Macquarie High School (now campuses of the college). The college prides itself on its ability to cater for student choice. Students can access STEM electives from the beginning of Year 7 through Academy and Personal Interest Project (PIP) courses. CAPA and Sport Academies run parallel to STEM. This allows students to satisfy their individual interests and encourages engagement with purpose built facilities.

The **Stage 4 STEM Academy** integrates science, technology, engineering and mathematics into a single elective course that provides: challenging, practical activities; mentoring and support from local industry, universities and government agencies; access to specialised STEM spaces on each campus; participation in STEM challenges and excursions. The PIP course in agriculture, environmental science and media provide STEM learning opportunities for students of all abilities.

Stage 5 STEM electives allow students to pursue their interests and passions at a much deeper level in up to three electives: BOSTES electives in agriculture, marine studies, industrial technology timber, metal, electronics, multimedia, graphics, information software technology, food technology and textiles; an iSTEM content endorsed elective with cross curricula content; Mad Scientist and engineering interest electives.

Stage 6 curriculum is shared across campuses. This allows more subjects to run meeting student needs by increasing student choice and catering for each student's differing interests and abilities. Post school pathways into university, TAFE and the workforce in STEM related careers is highlighted to students.

Hastings Secondary College provides opportunities for the development of academic excellence and inspires students to pursue tertiary education through partnerships with several universities, providing workshops for teachers and students and participation in a number of programs. Primary school links allow mentoring and learning opportunities for both staff and students.

Industry and local government partnerships deliver real world learning and practical application of STEM. Port Macquarie Hastings Council provides mentoring and expertise. Industry connections provide the opportunity for excursions, traineeships and work placement.



Macarthur Girls High School

Macarthur Girls High School is a comprehensive girls high school of 1000 students situated in Parramatta. Macarthur Girls High School encourages young women to achieve their personal best and beyond, empowering them with the skills to be successful citizens in an ever changing world. Students are offered a curriculum directed towards the Higher School Certificate with a combination of traditional and vocational education courses, ensuring that the needs and interests of all students are met.

Through **strategic leadership**, in 2014 Macarthur Girls High made significant reforms to curriculum pattern, flexible learning spaces and the global staffing matrix to effectively implement Integrated Curriculum and STEM education. Integrated learning, including STEM, is a component of the pattern of study for all students from Years 7-10. For example, in Year 7 students study a semesterised program of STEM and Integrated Curriculum for two and a half hours per week. A holistic professional learning focus on STEM, Integrated Curriculum and 21st Century learning skills has been delivered across the school to build the capacity of teachers in meeting the needs of students.

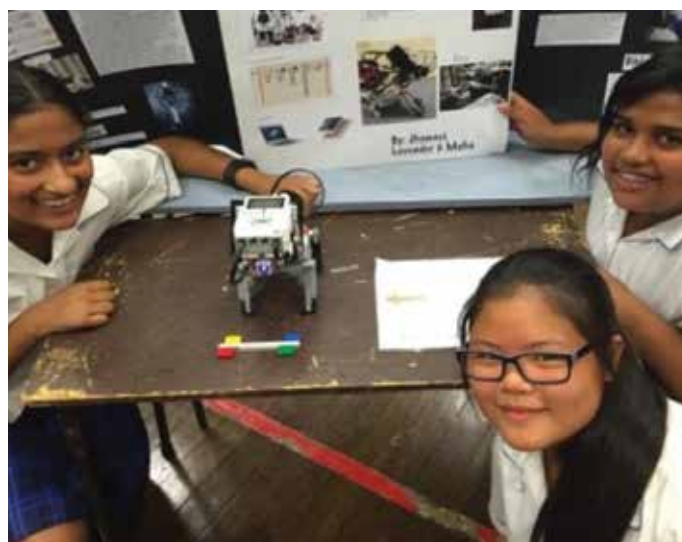
Macarthur Girls has implemented a **Stage 4 Year 7 integrated STEM program**. In this project students were required to identify a disability and design a robot which would support someone with this disability to perform an everyday task, such as a robotic hand. Survey data showed that 86% of students have been able to make meaningful connections between mathematics, science and technology as a result of participating in this project. 86% of students also stated that they have developed their collaboration and communication skills in completing a major project. Following this program, Macarthur Girls will include STEM as a future subject.

The Science faculty has been involved in cross-curricula projects and activity based programs to extend and engage students in science. Activities include, NSW Mechatronics competition, Robogals, UNSW Girls in Engineering initiatives, University of Newcastle engineering competitions, school robotics project based learning, science competitions, Lachlan Macquarie College extension activities and School Science Fair.

Technical components of the Performing Arts have required a strong STEM focus in which students are involved in the design and construction of sets and theatrical equipment, design and programming of lighting systems including robotic lighting, design and control of sound and audio visual systems.

The TAS faculty have implemented **STEM teaching and learning programs** which have included bridge building engineering, coding game development linking to robotic design, architecture home design, product development utilising CAD and 3D printing facilities.

The **Mathematics faculty is developing problem-solving skills** of students in Stage 4 by investigating evidence-based strategies to increase their understanding of mathematics. In Stage 5, students are solving open-ended questions and developing critical thinking, reasoning skills to deepen their knowledge of mathematics. Stage 6 students attend Maths Inspiration in Term 3, a mathematics lecture that inspires students to study mathematics and other STEM subjects. All staff have undertaken professional learning in the use of the Numeracy Skills Framework in order to effectively integrate numeracy in all teaching and learning programs, including STEM subjects.



Maitland Grossmann High School

Maitland Grossmann is a comprehensive coeducational school with 1300 students. The school offers a wide variety of STEM courses for students to study in Stages 5 and 6. The school has made strong sustainable partnerships with local STEM industries and tertiary institutes to develop students STEM skills and inspire students to pursue STEM related career pathways. As the founder and initiator of the iSTEM Stage 5 Elective, Maitland Grossmann has led the way in developing and inspiring many engineering and technology students.



The **iSTEM Program** is a School Developed Board Endorsed Course created by Maitland Grossmann High School as part of a Regional Development Australia – Hunter, ME Program grant. Maitland Grossmann identified the need for contextualised STEM curriculum to better engage students. It is unique in its cross-curricula approach which truly integrates STEM with an emphasis on project based and inquiry based learning pedagogies. Since its introduction in 2010, the school has experienced significant improvements in student participation in physics, engineering studies and mathematics in both Preliminary and HSC Years. It is now a central component of the Hunter's ME Program and over 70 schools across NSW have sought endorsement.



The **Stage 4 iSTEM program**, implemented in 2016, has achieved high acclaim from the Office of the Chief Scientist; *"[iSTEM] is one of the great examples of STEM (science, technology, engineering and mathematics) education and exactly captures the practical nature of science and engineering"* Ian Chubb AFR July 2015.

ME Program is a STEM-focused school and industry partnership program. The program aims to prepare the workforce of the future by linking schools and industry to increase the uptake of science, technology, engineering and mathematics subjects. Maitland Grossmann High School has been a leading contributor to the success of the ME Program which has been recognised as an exemplar in the National Innovation and Science Agenda. The program has led to outstanding success in external competitions such as **F1 in Schools** at regional, state, national and, for the first time in 2016, international levels. The program has led to an increase in female participation in STEM, including 50% of the iSTEM cohort.



Narara Valley High School

Narara Valley High School is a comprehensive high school of 1110 students on the NSW Central Coast. The school caters for the needs of a diverse student population through excellent learning initiatives based on quality teaching and innovative STEM teaching programs that emphasise 21st century learning. Narara Valley's teachers have extensive experience in the delivery of innovative curriculum models that enhance student engagement through transdisciplinary inquiry based learning.

The Middle School has been established for 12 years and is driven by **integrated curriculum**. Within the Middle School model two core subjects are taught by two core teachers. Humanities integrate English, geography and history which is taught over 14 hours per fortnight. Measuring Physical Sciences integrates mathematics, science and PDHPE and is taught for 20 hours per fortnight. These subjects are heavily centered on inquiry based learning activities and the transference of cross curricular skills and concepts.

The middle school teaching and learning faculty comprises of 9 to 12 staff that are trained across mathematics, science, PDHPE, English, geography and history subject areas. Teachers work together as a **cross curricular team** to program, implement and deliver integrated curriculum.

Narara Valley High School implements an **accelerated program**. Students complete Stage 4 and 5 in three years within a stand-alone accelerated class of 20 to 25 students in each cohort. The core curriculum is integrated and centred on project based learning. The program has a strong technology focus and incorporates STEM units in mathematics, technology and science.

The Survivor Maths Challenge is a project based learning STEM initiative conducted with Year 6 gifted and talented students. Mathematics students from primary schools work through challenges over 6 weeks and are able to meet and collaborate with and learn from high school students as mentors and teachers.

Mathematics and science programs incorporate **STEM projects and initiatives** which increase student engagement and success through project based learning. The enrichment technology program is designed for all Year 7 and 8 students and is timetabled as two periods per fortnight. Students learn fundamental skills and undertake project based learning activities in technology. The TAS faculty has implemented STEM initiatives which include computer coding, 3D printing for design, engineering and science projects, Raspberry Pi, engineering courses, electronics, LEGO Mind Storm and NXT software to program robots to perform various tasks.

In addition Narara Valley implemented **Big History**, a transdisciplinary subject that incorporates mathematics, science, history, geography and social science into a project based learning, technology focused course about the history of the universe, the Earth and humanity. Narara Valley High School was one of two pilot schools in Australia and one of seven across the world to first implement Big History in high schools.



Riverside Girls High School

Riverside is an inner city comprehensive girls school of 970 students with a well-established reputation for innovation in curriculum design and delivery. Faculty programs, enriched with STEM skills, have enhanced student engagement in cross-curricular projects with real world relevance. Extra-curricular opportunities with UTS:Hatchery, UNSW and the University of Wollongong are sparking much interest from students and parents keen to support their daughters in pursuing STEM careers. Collaborations continue to energise teaching practice and professional learning and drive the school's STEM plan and vision.

Riverside has been showcased nationally at the ACARA conference, regionally and in partnership with the **University of Sydney's STEM Teacher Enrichment Academy** and their Faculty of Education for pre-service trainees. The school has strong support from the parent community and links with industry. Riverside Girls is currently establishing the Stage 5 iSTEM elective and Stage 6 engineering studies.

At Riverside Girls, programs and teaching have strong cross-curricular collaborations. **STEM-enriched programs** have been developed within each faculty by integrating technology via coding, robotics, CAD, 3D printing & electronics in textiles; enhancing scientific literacy via argumentation, a Stage 5 simulated ecology unit based on Harvard University's *EcoMUVE* and the integration of electronics into our Stage 4 & 5 Science: *Physical World* along with challenge-based problem solving in mathematics.

In the **Stage 4 integrated cross-curricular STEM unit Post Earth Pioneers**, students 'explore' space, statistically analyse the necessities for life and design a space colony using Sketchup & 3D printing. This includes assessment milestones, peer and self-assessment and is showcased to parents.

The school developed cross-faculty project involving science, mathematics and PDHPE, **Stage 4 Frequency, Intensity, Time and Type (F.I.T.T.) principle**, allows students to work in collaborative teams to develop and test a personal fitness program to explore the F.I.T.T. principle through inquiry, scientific methodology and argumentation.

Riverside Girls has developed **flexible 21st century learning spaces** within existing structures by employing designs by student-led teams. The Robotics Lab, C21st Learning Hub and STEM Project Room accommodate cross-faculty and interdisciplinary projects within our STEM-designated timetable allocation.



The Canobolas Rural Technology High School

The Canobolas Rural Technology High School is a comprehensive coeducational school situated in Orange.

STEM at Canobolas involves teaching science, technology, engineering and mathematics holistically in project based activities. STEM is an interdisciplinary and applied approach to learning and aims to engage students and give clearer meaning and purpose to science and mathematics skills and knowledge. STEM involves a real-world problem solving approach where students apply their knowledge and skills through project based engineering challenges.

The motto at Canobolas is **Students Thinking, Exploring and Making**. The aim of developing STEM skills is to nurture a passion for learning, make our students candidates of choice for future employment and provide them with an asset in tertiary study. An innovative STEM strategy has been implemented that features a school-designed STEM course for all Stage 4 students and the School Developed Board Endorsed Course **iSTEM** for Stage 5 students.

Students study two ten week **integrated STEM units**, each school year, in **Stage 4** (four units by the end of Year 8).

The content of each unit aligns with the topics being studied in mainstream science classes, allowing students to apply their scientific knowledge to real world applications. Knowledge and skills from mathematics is embedded within the project work in the STEM units to give authentic learning experiences.

STEM classes are delivered in our **innovative STEM Centre**. This repurposed library was developed through a design thinking process to determine the best way to use the space for 21st Century learning activities. It features, the **Thinkerspace**, a flexible space for collaborative learning and designing using critical thinking; the **Explorerspace**, a knowledge area featuring traditional books and an eLibrary accessed on class sets of iPads, and the **Makerspace**, a practical space for crafting prototypes with traditional tools and advanced manufacturing using computer aided design and rapid prototyping tools like 3D printers.

