School of **Engineering**



CREATE CREATING REAL ENGINEERING AND TECHNOLOGY EXPERIENCES

Theodore von Kármán was a Hungarian-born American research engineer best known for his pioneering work in the use of mathematics and the basic sciences in aeronautics and astronautics. His laboratory in the California Institute of Technology later became NASA's Jet Propulsion Laboratory. He once said that "A Scientist discovers that which exists; an Engineer creates that which never was".

Engineers today are involved in the design, fabrication and maintenance of a wide range of products and infrastructure that service the needs of humanity, of industry and business, and indeed of the global community. They are also socially aware and are involved in broader community issues associated with the environment, sustainable energy, health and safety, economics and finance, and are often called upon as consultants, advisers and expert witnesses to better inform social attitudes and public opinion.

CREATE is a "hands-on" experience offered by the School of Engineering at Edith Cowan University (ECU) that has been specially designed to introduce engineering and technology products and processes to young secondary school students who might be contemplating upper school subject choices in STEM (Science Technology Engineering Mathematics).

CREATE is a program of activities and supporting documentation developed in line with guidelines provided in the School Curriculum and Standards Authority of the Government of Western Australia Year 11 and Year 12 syllabus documents. The activities have been designed to be aspirational rather than functional, aimed to enthuse young

learners about a potential career as an engineer, not as support activities for any specific course material. However, strong linkages do exist to sections of syllabus documents in Engineering Studies, Physics, Chemistry, Computer Science, Applied Information Technology, Automotive Engineering and Technology, Building and Construction and Mathematics.

CREATE addresses the main teaching areas of the School of Engineering with the intention that students enrol in an on-campus program that would include a minimum of three of the listed activities. On-campus programs will be scheduled during after school hours or during school holidays. It is recognised that some students will have difficulty committing to an on-going program, so opportunities will exist for selected activities to be conducted at their school as negotiated between the School of Engineering and the student's school.

In any event, participants are invited to an introductory session and a closing session that will be held at ECU Joondalup campus to highlight the facilities on offer at the School of Engineering as well as to celebrate the achievement of those students who graduate from the **CREATE** program.

At all times, participating students will be supervised and assisted by staff and students from School of Engineering. Teachers and parents are invited to attend and participate in the program if they wish.

CREATE is funded entirely by the School of Engineering, ECU.

CREATE activities, not in any particular order include:

Physics – Get Your Body Movin' (#)

Students will explore Instrumentation and Introductory Physics of Motion using PASCO sensors to measure motion, temperature, light, sound. This activity introduces PASCO CAPSTONE and MATCHGRAPH software; students themselves become part of the experiment!

Civil Engineering – Mud Pies and More (*)

Engineering structures are often made from formed concrete and/or steel. This activity follows part of the coursework of our Civil Engineering course in which students will make their own concrete samples for subsequent compression and tensile testing. Students will be guided on the mix of sand, cement, aggregate and water to make a "high-performance" sample. This activity will occur over a period of time sufficient to allow the concrete samples to properly cure. Quantitative results from load testing will inform students' selection of the best choice of materials for specific applications. This activity introduces team play, record keeping, and is the first where students start to construct their Engineering Journey Journal.

Introductory Robotics and Automation – LEGO EV3 Construction and Programming

To introduce robotics and automation, elements of which permeate all ECU School of Engineering courses of study, students will use the "standard" LEGO EV3 Mindstorm robot build. Students will also learn how to use the EV3 Programming Software we have loaded on our dedicated set of lap-top computers.

Engineering Mechanics – Building Bridges

Based on the PASCO Large Structures Set and a set of load cells, students will conduct a series of experiments from the PASCO Digital Experiment Library to investigate forces in equilibrium, internal forces on bridge members, moments in equilibrium, strength of members, and finally the analysis of a simple truss bridge. This activity will use PASCO's CAPSTONE software loaded on to our lap-top computers



Introductory Programming - welcome to ARDUINO

Students learn the basics of programming in a "C-like" structured environment, the ARDUINO IDE, and develop their skills with a range of tasks involving inputs (push buttons and various sensors, analogue and digital) and outputs (LEDs, LED matrix displays, servos). This is an open-ended activity that can also link to additional ARDUINO modules, and other circuit components used in the Introductory Electronics activity.



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Control and Automation – Colour Based Particle Separation

An advanced LEGO EV3 Mindstorm activity where students will build a LEGO machine (not a robot!) designed to separate coloured beads. This activity, inspired by mineral separation processes in use at Argyle Diamonds and Iluka Mineral Sands, will build student's knowledge of LEGO structures, as well as developing their skills with EV3 programming. An introduction to process optimisation will inform students on how to make improvements on the basic design. Some numerical analysis using EXCEL spreadsheets will follow to collate and analyse student's test results.

Electrical Engineering - Introductory Electronics

Students will explore the basic principles of electrical/electronic circuit, using passive and active components including resistors, capacitors, diodes, transistors and special purpose integrated circuits. This basic knowledge will be used to extend students' learning as they build simple transistor circuits including multivibrators and amplifiers. Students will then build more challenging circuits to emulate the sights and sounds of a police vehicle complete with flashing lights and sirens.

Robotics – Hi "JD"

Students will explore the realm of robotics through the eyes of "JD", a low-cost user-friendly humanoid robot that walks, talks, and even responds to voice commands. Cutting edge technology will allow students to program behaviours, movements and other customization. This activity introduces multi-axis movement and more using the powerful BLOCKLY programming environment.

Civil Engineering - Hairy Sand (*)

Based on research being conducted at ECU, this activity is designed to explore the reinforcing nature of strands of shredded car tyres ("hair") when mixed with yellow sand. Students build sand castles of plain sand, then of sand with increasing concentrations of "hair". Each castle is tested to see what vertical load it can support and results are tabulated and graphed to determine the optimum hair-sand mixture.



Motorsports - Wonky Wheels (*)

ECU's Motorsports students will make minor adjustments to some, but not all, of a fleet of 1/16th scale model race cars, so that under strict performance monitoring conditions (time trials involving straight line acceleration, a 4WD "off road" track, a chicane circuit) the differences between the vehicles should become quantitatively evident. Students will analyse the time trial results and try to determine what has been done to create the differences in performance.

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WORLD READY -

Instrumentation and Data Processing - Hunt for MH370 (*)

An ultrasonic distance and motion sensor will be used to detect the presence of a hidden object on the "ocean floor" (1sq.m. of it anyway). The cart-mounted sensor operates on a precision track fitted with additional sensors that provide highly accurate "latitude" and "longitude" measurements relative to the origin. Students must determine a strategy to explore the ocean floor (search grid) and then use CAPSTONE to collect data from the three sensors. Captured data is then transferred to a computer where EXCEL is used to develop a 2-D and 3-D image of the "ocean floor". Students will explore echo patterns from some "regular" shapes before trying to locate and identify a model aircraft that may be partially buried on the "ocean floor". This is a computer intensive activity and will introduce students to some serious instrumentation technology as well as the flexibility of PASCO's CAPSTONE, MicroSoft EXCEL and VISUAL BASIC.



NOTES:

- 1. This activity (#) is a prerequisite for other activities using PASCO Hardware AND Software.
- 2. Items shown as (*) are only offered on ECU's Joondalup campus in the School of Engineering.
- 3. Activities are generally as described but may be substituted with others at ECU's discretion.

FURTHER INFORMATION

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WORLD READY -