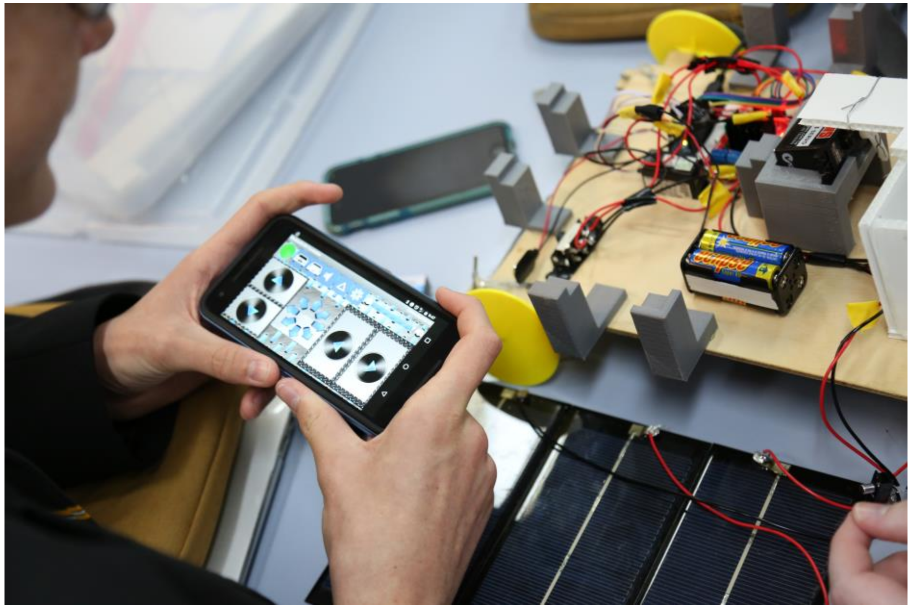
SAMPLE HIGH SCHOOL PROGRAM



SCHOOL DEVELOPED BOARD ENDORSED COURSE (SDBEC)
STAGE 5 TEACHING AND LEARNING PROGRAM
Year 9

SAMPLE HIGH SCHOOL

iSTEM LEARNING AND TEACHING PROGRAM

Rationale

Science, technology, engineering and mathematics are fundamental to shaping the future of Australia. They provide enabling skills and knowledge that increasingly underpin many professions and trades and the skills of a technologically enabled workforce. The iSTEM program utilises these knowledge sources in application to future focussed learning and teaching.

Australia's graduation rates in science, technology, engineering and mathematics are low by international standards. Yet a high output in these disciplines is seen to be a critical underpinning for the future of innovative economies. Policies are emerging around the world that focus on these fields and seek to grow the supply of graduates with the skills and knowledge developed through a quality education in STEM subjects. The reason is straightforward, the world's dependence on knowledge and innovation will grow and not diminish and to be ahead in the race, a community needs the skills to anticipate rather than follow.

It has been stated that 75% of the fastest growing professions will require STEM based skills and 65% of professions in the next 20 years do not exist yet. PwC have estimated that if we shift just 1% of our current workforce into STEM based professions it will have a massive $57.4b boost to gross domestic product.

When Australian Education Ministers signed up to the Melbourne Declaration on Educational Goals for Young Australians in 2008, they identified literacy and numeracy and knowledge of key disciplines as the cornerstone of schooling for young Australians. They also recognised that schooling should support the development of skills in cross disciplinary, critical and creative thinking, problem solving and digital technologies, which are essential in all 21st century occupations.

These objectives lie at the core of the national science, technology, engineering and mathematics (STEM) school education strategy. A renewed national focus on STEM in school education is critical to ensuring that all young Australians are equipped with the necessary STEM skills and knowledge they will need to succeed.

There are a number of highly successful STEM based intervention programs in operation across Australia, some international and national programs include; F1inSchools, the ME program, Science and Engineering Challenge, RoboCUP, Electric Vehicle Festival, Solar Car Challenge, Pedal Prix, Science and Technology Education Leveraging Relevance (STELR) program, and many others. The challenge for schools has been integrating these programs into their existing curriculum.

At ***Sample High***, we are currently involved in the following STEM intervention programs; the ME Program, F1inSchools, the Science and Engineering Challenge, RoboCUP, Electric Vehicle Festival, and STELR. Many of these programs are run partially within, but mainly outside the current school curriculum. The development of the iSTEM course is in part as a result of the need for the school to provide a more structured approach to gaining the most out of these intervention programs. Although components of the Board of Studies NSW, design & technology, graphics technology and industrial technology – engineering, syllabuses can be adapted to accommodate some parts of these STEM programs, none are suitable to implement the full program of study.

The proposed iSTEM program utilises a practical integrated approach with engineering and technology being used to drive interest in science and mathematics, through the development of technical skills, scientific, mathematical and engineering knowledge. Its purpose is to increase the numbers of students studying STEM based subjects in the senior years and ultimately the number of student matriculating to tertiary study and employment in the STEM areas.

Pure mathematics and science topics are not included in this course, it is not intended as being a vehicle to increase the number of hours in which students study pure science or mathematics in Stage 5. Instead students learn about technological and engineering concepts which by their very nature are scientific and mathematical in nature. Great effort has been taken to ensure that no specific content that appears in the upcoming science or mathematics NSW syllabuses incorporating the Australian Curriculum have been repeated in this course.

In the recent review of Science, Mathematics and Engineering (2012) by the Office of the Chief Scientist of Australia, it was commented that teaching needs to be high quality and inspirational while science and mathematics based content was generally seen as … "irrelevant to life after school." and "Content based teaching is seen as boring because so much is seen as knowledge transmission of correct answers with neither time nor room for creativity, reflection or offering opinions".

The development of effective and attractive STEM curricula and teaching methods, - are at the heart of the drive to make STEM studies and careers a more popular option for young learners. Inspiring students to engage with mathematics and science can be best achieved by teachers who are passionate about the subject and have the knowledge and confidence to present the curriculum imaginatively.

According to Sanders the integrative STEM education pedagogical model is best practice when delivered through technology education. In addition, over the past two decades, the technology education literature has been heavily populated with articles describing instructional materials designed to integrate technology, science, and mathematics and articles addressing issues associated with the integration of STEM concepts and practices. There is strong evidence to suggest that the approach taken in this course is "best practice" and will lead to advantageous outcomes for students.

This stage 5 iSTEM School Developed Board Endorsed Course is an attempt to provide an innovative curriculum which will engage and inspire students to take up the challenge of a career in STEM.

School Situation

Sample High School is a coeducational comprehensive High School in the ***sample*** district located in the lower Hunter Valley. The student enrolment stands at approximately ***900*** and has been growing steadily over the past few years. The school has a strong tradition within ***Sample Area*** being one of the oldest schools in New South Wales.

Resources

The school currently has seven PC based computer labs, six mobile computer banks with broadband Internet access via a wireless network. The PC's utilise Windows operating systems, using a large cross section of application software which can be utilised by students. The TAS faculty have a number of mechanical testing devices, a technology lab, a large array of technologies. Other resources include three 3D printers, a laser cutter, wind tunnel and smoke tunnel, and CNC router. In addition, the ME Program has provided a bottle rocket launcher, power anchor aeronautical testing device, EV3 robotics. In 2018 Samsung also provided the school a range of digital technologies including; tablets, 360 cameras and VR glasses. As a F1inSchools hub school we have access to a 25-meter track and timing equipment.

Course Structure

The iSTEM School Developed Board Endorsed Course covers a number modules in key STEM fields. This program covers the four compulsory core modules Module 1 and 2 (STEM Fundamentals 1 and 2), Modules 3 and 4 (Mechatronics 1 & 2) and a number of the elective modules to make up 200 hours of study. The program uses a themed approach and has four units of work that make up the iSTEM pattern of study. Some iSTEM modules over different units of work, however, all aspects of the module are completed by the end of the Sage.

Year 9 Pattern of Study **100 Hours**		**Year 10 Pattern of Study** **100 Hours**	
Unit of Work Introduction to STEM 50 Hours	**Unit of Work** Robotic Systems 50 Hours	**Unit of Work** Electric Vehicles 50 Hours	**Unit of Work** Design of Space 50 Hours
Modules/Suggested Hours	**Modules/Suggested Hours**	**Modules/Suggested Hours**	**Modules/Suggested Hours**
M1 STEM Fundamentals 1 (10h) *M2 STEM Fundamentals 2 (5h)* *M5 Aerodynamics (25h)* *M7 3D CAD/CAM 1 (5h)* *M9 STEM PBL Minor (5h)*	*M2 STEM Fundamentals 2 (10h)* *M3 Mechatronics 1 (10h)* *M7 3D CAD/CAM 1 (10h)* *M9 STEM PBL Minor (20h)*	*M2 STEM Fundamentals 2 (2h)* *M3 Mechatronics 2 (15h)* *M6 Motion (15h)* *M7 3D CAD/CAM 1 (5h)* *M9 STEM PBL Major (13h)*	*M12 Design For Space (25h)* *M7 3D CAD/CAM 1 (5h)* *M6 Motion (10)* *M9 STEM PBL Major (10h)*

Problem, Project and Inquiry - Based Learning

To satisfy the requirements of the course students must undertake a range of problem, project and inquiry-based learning activities which occupy the majority of course time. Problem, project and inquiry-based learning assists students to actively pursue and use technological knowledge rather than experience it as pre-packaged and complete – to be accepted and practised. Thus, in the course structure there are many points at which students raise questions, explore ideas and solve practical problems.

Aims

The aim of the iSTEM course is to engage students actively in the areas of science, technology, engineering and mathematics in order for them to develop the skills and knowledge required for the rapidly changing nature of the workforce.

Students will learn to use a range of tools, techniques and processes, including relevant technologies in order to develop solutions to a wide variety of problems relating to their present and future needs and aspirations.

iSTEM aims to reverse these lowered participation rates by inspiring and enabling secondary school students to appreciate the role and potential of science, technology, engineering and mathematics in the world in which they live, and to learn from their journey of technological inquiry, the essence of evidence-based critical thinking.

The iSTEM course aims to increase the number of students studying physics, chemistry, engineering, design and technology, computing and mathematics subjects at the upper secondary school level. This is to be achieved through an integrative course structure, which give practical relevance to scientific and mathematical concepts.

Secondary aims of the iSTEM course include;

1. Improve the level of STEM literacy and understanding,
2. Prepare students to engage with STEM ideas and be knowledgeable about the way STEM professionals work,
3. Increase the number of students choosing STEM careers to address the shortage of STEM graduates,
4. Increase students' awareness of careers in STEM areas including trades,
5. Improve the quality of classroom teaching practices and enable teachers to develop confidence and skills that will assist them in delivering the Australian Curriculum,
6. Improve teaching quality through a cross-curriculum approach to programming and lesson delivery.

Sample High School
Unit of Work – Introduction to STEM

Unit Title: Introduction to STEM	**Time:** 50 Hours	**Semester:** 1

Description: In this module students will develop an understanding of the basic principles associated with integrated STEM. This unit of work utilises aspects on STEM Fundamentals 1 and 2, Aerodynamics, CAD/CAM1 and Minor Project. Students will complete a wide range of STEM based problem solving activities in order to learn how to operate in an iSTEM classroom. Group work activities are to be wide utilised during this unit of work.

Objectives: Students will develop…	**Outcomes:** A student …
• initiative, entrepreneurship, resilience and cognitive flexibility through the completion of practical STEM based activities • skills in planning and managing projects using an iterative and collaborative design process • problem solving and decision-making skills in a range of STEM contexts • an appreciation of the importance of working collaboratively, cooperatively and respectfully	5.1.1 develops ideas and explores solutions to STEM based problems 5.1.2 demonstrates initiative, entrepreneurship, resilience and cognitive flexibility through the completion of practical STEM based activities 5.4.1 plans and manages projects using an iterative and collaborative design process 5.4.2 develops skills in using mathematical, scientific and graphical methods whilst working as a team 5.6.2 will work individually or in teams to solve problems in STEM contexts 5.8.1 understands the importance of working collaboratively, cooperatively and respectfully in the completion of STEM activities

Key:

NUM – Numeracy	ICT – Information and Communication Technologies
LIT – Literacy	AB ED – Aboriginal Education
FOR – Focus on Reading	IBL – Inquiry Based Learning

Quality Teaching Model Key:

Intellectual Quality	***Quality Learning Environment***	***Significance***
DK – Deep Knowledge	EQC – Explicit Quality Criteria	BK – Background Knowledge
DU – Deep Understanding	E – Engagement	CK – Cultural Knowledge
PK – Problematic Knowledge	HE – High Expectations	KI – Knowledge Integration
HOT – Higher-Order Thinking	SS – Social Support	I - Inclusivity
M – Metalanguage	SSR – Students' Self-Regulation	C - Connnectedness
SC – Substantive Communication	SD – Student Direction	N – Narrative

Evidence of Learning - Highlighted in Red	**Assessment -** Highlighted in Grey

Assessment

Pre-Assessment: Multiple Intelligences Survey
Progressive Assessment: Problem Solving Activities
Assessment: Aerospace Engineering Minor Project

Resources:

Websites
http://pbskids.org/designsquad
http://www.sciencefairadventure.com/ProjectDetail.aspx?ProjectID=61
http://www.atse.org.au
http://www.pbs.org/wgbh/buildingbig/lab/forces.html
Aerodynamics in Racing: http://www.f1technical.net/topics/5
Wind Tunnels How Wind Tunnels Work VideoNASA Link
Udemy: https://www.udemy.com/math-is-everywhere-applications-of-finite-math/
Bottle Rocket: https://www.facebook.com/exciteandeducate
http://www.thingiverse.com/
Rapid Prototyping: http://youtu.be/PDLOmoQj4H0

Texts/Materials
ATSE STELR *Core Program Student Book 2nd Edition*
PBS, *Design Squad guides*
Lynch, B. *Maths In Technology*
Thomson, S. & Forster, I. *Maths In Crime*
Multiple Intelligences Survey

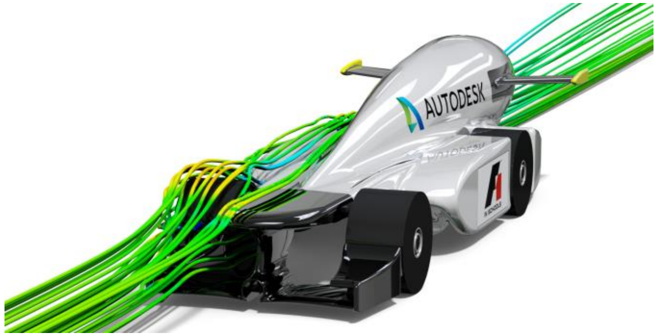
Students learn about:	Students learn to:	Level 1	Level 2	Level 3
		Pre-Knowing / Knowing	Understanding / Applying	Evaluating / Creating
1.1 STEM investigations - systematic observation - measurement - experiment - formulation, testing and modification of hypotheses	- design investigations which produce valid and reliable data - investigate STEM based problems using primary and secondary sources - use identified investigative strategies to develop a range of solutions to STEM based problems	**Measurement** P1: ***Teacher*** to discuss with ***students*** how to design experiments that produce valid and reliable data. **(BK, KI, M)**	**Measurement** U1: ***Students*** analyse several experimental designs and identify dependent, independent and controlled variables. **(DU, M)**	**Measurement** E1: ***Students*** evaluate several experimental designs and outline improvements that must be made in order for valid and reliable data to be obtained. **(DU, SC, EQC, KI)**
		Experiments Electrical Circuits P2: ***Teacher*** to discuss with ***students'*** prior knowledge of electrical circuits and introduce the multimeter as a tool for measuring current, voltage and resistance. ***Teacher*** to discuss multimeter use in everyday applications around the home and in trades. **(BK, KI, C) (ICT)**	**Experiments Electrical Circuits** U2: ***Students*** use the STELR kits to set up electrical circuits and demonstrate that they can use the multimeter to collect data, including voltage, current and resistance. **(DU, M) (ICT)**	**Experiments Electrical Circuits** E2: ***Students*** use the STELR testing station to evaluate which components use the most power. **(HOT, DU, SSR, KI) (ICT)**
		Problem Solving P3: ***Teacher*** to discuss with ***students*** STEM based problem solving: Discussion on; What is an Engineer/Scientist? What do Engineers/Scientists do at work? How do Engineers/Scientist make the world a better place? **(BK, KI)**	**Problem Solving** U3: ***Students*** to develop a flowchart which demonstrates the process to solve STEM based problems? Students to identify the problem, brainstorm, design, build, test, evaluate, redesign and share solutions (See PBS education guide) **(DU, M)**	**Problem Solving** E3: ***Students*** to follow the engineering design process to design and build a table out of newspaper tubes. It must be at least 200mm tall and strong enough to hold a heavy book (See PBS Activity Guide for details) **(BK, C, PK, HOT, IBL)**

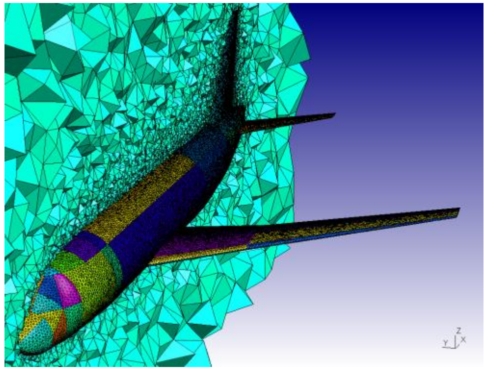
Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
1.2 the use of STEM in developing solutions to problems - hardware - software	- describe a range of technologies used to collect, organise and analyse data - use a variety of technologies which assist in investigations into engineered solutions - utilise various hardware and software technologies to solve a broad range of engineering problems	**Gardner's Multiple Intelligences** P1: ***Teacher*** to introduce Gardner's Multiple Intelligences and associated learning styles. ***Students*** to predict how they feel they learn best based on the evidence presented in the survey. **(SSR, HE)**		**Gardner's Multiple Intelligences** U1: ***Student's*** complete Multiple Intelligences (MI) survey and discover their optimum learning styles. ***Students*** to enter data into a table and create a basic bar graph of the data. **(KI, DU, C) (ICT, LIT, NUM)**		**Assessment** E1: ***Students*** enter their MI data into an appropriate software package and create a series of graphs. ***Students*** use information from Gardner's theory of MI sheets provided to evaluate their own individual strengths and weaknesses. ***Students*** analyse results in Assessment Task 1. **(DU, M, KI, LIT)**	
		Software P2: ***Students*** to learn how to use simulation software to solve engineering problems. ***Teacher*** to demonstrate the use of interactive ICT's to be used by ***students.*** **(DK, E, C) (ICT, LIT)**		**Software** U2: ***Students*** use iPAD's and the simple physics App to learn how to use interactive software. ***Students*** complete tutorials to develop an understanding of the software and problem solving. **(DU, BK) (ICT, IBL)**		**Software** E2: ***Students*** complete a series of problem solving scenarios' and try to bet previous best scores from previous classes. Tree House, staircase, snowy roof, Ferris wheel and windy city. **(PK, HOT) (ICT, IBL))**	
		Simulation Software P3: ***Teacher*** to demonstrate how to use structural analysis software using West Point Bridge Building Software. **(KI, M) (ICT)**		**Simulation Software** U3: ***Students*** use joints and members to design a basic bridge design in the West Point Bridge simulation program. ***Students*** test designs, using the animation feature. **(DU, SSR, BK) (ICT, IBL, NUM)**		**Simulation Software** E3: ***Students*** use one of the scenarios from the software and create a bridge which meets all criteria, which is cost effective and structurally sound. **(C, HOT, KI) (ICT, IBL, NUM)**	

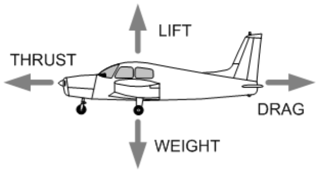
Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
2.3 problem solving - nature of - strategies to solve - evaluation - collaboration	- identify the nature of problems - use identified strategies to develop a range of possible solutions to every day STEM based problems - evaluate the appropriateness of different problem-solving strategies - work collaboratively to solve problems - draw information from a range of sources to aid in the solution of practical everyday problems - uses appropriate design processes and techniques in the context of developing STEM based solutions	**Strategies to Solve Problems** P1: ***Teacher*** to model a range of problem solving strategies. ***Teacher*** to demonstrate practical engineering problem solving. **(KI, C, DK)**		**Marshmallow Challenge** U1: ***Students*** to solve a range of STEM based problems using a problem-solving process. (E.g. Marshmallow Challenge). **(HOT, C, SD, DU) (IBL, NUM)**		**Collaboration & Assessment** E1: Students to evaluate the results of the marshmallow challenge. Students to include results and conclusions of Assessment Task 1. **Extension:** Add additional problems such as a fan simulating wind conditions. **(HOT, EQC, SD, PK) (IBL, LIT)**	
		Collaboration P2: ***Teacher*** to discuss advantages of teamwork vs working as an individual. Advantages and disadvantages of different problem-solving techniques discussed. **(DK, C)**		**Paper Table Challenge** U2: ***Students*** to complete a problem-solving exercise completed both as an individual than as a group. Paper table challenge. **(HOT, C, DU) (IBL, NUM, LIT)**		**Collaboration & Assessment** E2: ***Students*** to evaluate the success of the group work activities as part of Assessment Task 1. **(HOT, HE, PK) (LIT)**	
		Collaboration P3: ***Teacher*** to discuss and model collaborative work practices and discuss their importance. **(KI, C, E)**		**Hydraulic Lift** U3: ***Students*** to complete a collaborative problem-solving exercise using syringes to produce a hydraulic lift. **(DU, SD, EQC, HE) (IBL, NUM)**		**Assessment** C3: ***Students*** to record results of problem solving activities using a variety of ICT's and produce a report on its success and the learning involved. **(DU, SD, EQC, HE) (ICT, LIT)**	
		Problem Solving P4: ***Teacher*** to discuss engineering problem solving techniques. ***Students*** to investigate solutions for set engineering problems using a range of sources. **(DK, KI, HOT)**		**Egg Drop Challenge** U4: ***Students*** demonstrate a range of STEM problem solving techniques using a variety of strategies. ***Students*** to utilise skills in the egg drop challenge. **(DU, EQC, HOT, SSR) (IBL)**		**Evaluation and Assessment** E4: ***Students*** to document and evaluate solutions to a range of STEM based problems related to everyday practical problems. Assessment Task 1. **(DU, EQC, HE) (IBL, NUM, LIT)**	

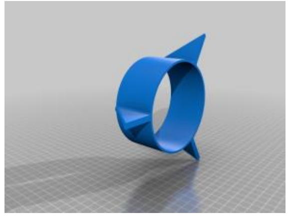
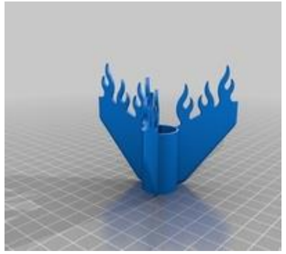
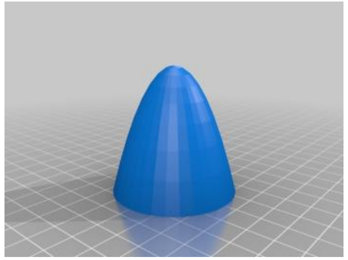
Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
9.1 design processes - identifying problems - project management - developing solutions to problems - generating ideas	- develop a project proposal, a design specification or design brief. - respond to the findings of experimentation and research - follow a process to identify and solve contemporary needs of society - formulate management plans including; i) action ii) time iii) finance - manage a minor project based learning task that successfully solves an identified problem - select and apply appropriate research methods to solve a minor STEM based problem - justify decisions made based on the analysis of data - identification and exploration of the research problem - areas of investigation	**Aerospace Engineering Task** P1: ***Teacher*** to explain how to define a genuine need or opportunity to an engineering design problem related to aerodynamics. **(DK, KI, M)**		**Aerospace Engineering Task** A1: ***Students*** to research different types of aircraft and rockets ***Students*** to form groups and brainstorm ideas for possible solutions to design problems related to aerodynamics. **(DU, PK, HOT) (LIT)**		**Aerospace Engineering Task** C1: ***Students*** to produce a simple report documenting the engineering design process used to determine solutions to aerodynamic problems. E.g. Skylap and/or Bottle Rocket. **(DU, HE, HOT, M, SC) (ICT, IBL)**	
		Project Management P2: ***Teacher*** to demonstrate how to produce a basic action, time and finance plan using appropriate ICT's. ***Teacher*** to demonstrate how to use a spreadsheet to produce a time plan and how to use functions to produce an effective finance plan. **(DK, M) (ICT, NUM)**		**Project Management** A2: ***Students*** to use a variety of software programs to plan the completion of a minor aerospace themed project. ***Students*** to utilise MS word, excel and/or one note to produce very basic action, time and finance plans. **(DU, E, KI) (ICT, NUM)**		**Project Management** E2: ***Students*** to evaluate the different aspects of their plan throughout the process. ***Students*** to provide evidence of finance, time and action plans with clear evidence of their application to the minor project. **(HOT, KI, PK) (ICT, NUM, LIT)**	
		Research P3: ***Teacher*** to explain how to undertake research which includes both primary and secondary data. ***Teacher*** to demonstrate how to apply experimentation and testing to the research process. **(DK)**		**Research** A3: ***Students*** to undertake a range of research tasks related to aerodynamics. **(DU, SSR) (ICT, NUM, LIT, IBL)**		**Research** C3: ***Students*** in groups are to thoroughly research relevant aspects of their aerodynamic minor project. **(EQC, HOT, SD) (ICT, IBL, LIT)**	
		Generating Ideas P4: ***Teacher*** to describe how to complete creative and innovative idea generation using a variety of techniques including; brainstorming, concept sketches and maps, modelling, interaction of hand and mind, observation, research and collaboration. **(DK, M) (LIT)**		**Generating Ideas** A4: ***Students*** to use idea-generation techniques to develop creative design solutions. ***Students*** to collaborate when developing design ideas and solutions. ***Students*** to use ICT tools to research and gather information when generating creative design ideas. **(DU, HOT, M, PK, SD) (ICT, LIT)**		**Generating Ideas** C4: ***Students*** to work in groups to produce a major research project in which creative and innovative solutions are produced. ***Students*** are to establish and document the requirements and design considerations for the major project. **(HOT, SD, PK, M, KI) (ICT, LIT, NUM)**	

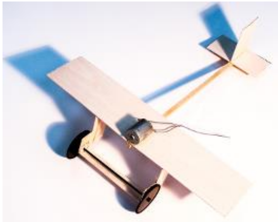
Students learn about:	Students learn to:	Level 1 Pre-Knowing / Knowing	Level 2 Understanding / Applying	Level 3 Evaluating / Creating
5.1 research and exploration - interpreting and analysing data - quantitative and qualitative research - surveys - interviews - observation - testing & experimenting  designability GROUP Pty Ltd	- analyse, interpret and apply research data in the development of aerodynamic projects - complete quantitative and qualitative research - use research techniques to develop design ideas by testing and experimenting - select and use a variety of research methods to inform the generation, modification, and development of aerodynamic projects - experiment to optimise solutions for aerodynamics related projects	**Working Scientifically** P1: ***Teacher*** to explain concepts of scientific method, hypothesis and how Scientist Work in order to analyse, interpret and apply research data introduced. (See notes STERL). **(KI, DK, M, C)**	**Working Scientifically** U1: ***Students*** to complete a range of experiments undertaken to determine how to work scientifically. ***Students*** to complete an investigation planner on each experiment undertaken. **(DU, HOT, KI)**	**Working Scientifically** E1: ***Students*** to evaluate the experiments undertaken. ***Students*** to design experiments related to aerodynamics. **(DU, HOT, KI, SSR) (IBL, ICT)**
		Research P2: ***Teacher*** to introduce different research methods which are used to solve STEM based problems.***Students*** to define quantitative and qualitative research. **(M, KI) (ICT, NUM)**	**Research** U2: ***Students*** to complete a range of scientific experiments in which qualitative and quantitative data is collected & analysed. **(DU, HOT, KI) (ICT, NUM)**	**Research** E2: Qualitative and quantitative data from a range of experiments is evaluated by ***students*** whilst undertaking a range of practical problem-solving activities**. (NUM)**
		Research & Exploration P3: ***Students*** to develop knowledge of the scientific method through exposure to a range of experiments related to aerodynamics. **(M, KI, DK)**	**Research & Exploration** U3: ***Students*** to analyse experiments with emphasis on data and statistics. **(DU, KI, SSR) (NUM)**	**Assessment Task** E3: ***Students*** to design their own experiments and produce a poster detailing their findings. **(HOT, PK, SD) (LIT, NUM, IBL)**
		Testing & Experimenting P4: ***Teacher*** to introduce skylap and bottle rocket activities. ***Students*** to research requirements of the Bottle Rockets and Skylap challenge. **(DK, E, C, EQC) (ICT)**	***Testing & Experimenting*** U4: ***Students*** form teams and identify learning which needs to be completed in order to compete in set challenges. Individuals assigned to learning tasks and start to complete research on specific areas of the program. **(DU, EQC, SD, SSR) (ICT, IBL)**	***Testing & Experimenting*** E4: ***Student*** to form teams and develop processes to solve set problems related to aerodynamics (i.e. Skylap, Bottle rocket) **(HOT, PK, SD) (ICT, IBL)**
		Testing & Experimenting P5: ***Teacher*** to set up and explain a range of experiments and testing processes related to aerodynamic projects. **(KI, DU, HOT)**	***Testing & Experimenting*** U5: ***Students*** to complete and document experiments related to the completion of the Skylap task then the BottleRocket. **(DU, PK, HOT) (IBL)**	***Testing & Experimenting*** E5: ***Students*** to evaluate experiments using the bottle rocket launcher and power anchor testing devices. ***Students*** to assess results and make improvements to their designs. **(KI, PK, HOT, SSR, SD) (IBL)**

Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
5.2 technologies related to aerodynamics - wind tunnels - smoke tunnels - computational fluid dynamics (CFD)	- describe a range of technologies used in aerodynamics - perform experiments using a range of aerodynamic technologies to solve STEM based problems - utilise modelling software to determine optimum aerodynamic conditions using CFD techniques	**Wind and Smoke Tunnels** P1: ***Teacher*** to led discussion on "What are Wind Tunnels? Show an example of a small wind tunnel. ***Students*** watch video on How Wind Tunnels Work. How Wind Tunnels Work Video NASA Link ***Teacher*** to discuss flow visualisation using smoke in a wind tunnel. Aerodynamics of F1 Cars Video ***Students*** to define CFD and how it used. Wikipedia **(M, BK, NUM)**		**Wind and Smoke Tunnels** U1: ***Teacher*** to demonstrate the use of a wind tunnel using a variety of models. ***Teacher*** to use visualisation techniques (Smoke/Vapour) to demonstrate flow lines around a variety of shapes. ***Teacher*** to show video of Paper Plane in smoke tunnel. ***Teacher*** cuts out on a band saw and ***students*** shape a balsa block using a variety of shaping tools. **(DK, DU, KI)**		**Wind and Smoke Tunnels** C1/2: **Design Challenge:** ***Students*** to design a 3 or 4 wheeled vehicle made from balsa. The vehicle must be at least 100mm long. The vehicle is to be tested in the wind tunnel and the value for drag recoded at a set fan speed. **(EQC, SSR, KI, C) (ICT, IBL)** OR C1: ***Students*** to create a cardboard wind tunnel. See Instruction http://www.instructables.com/id/How-to-make-a-wind-tunnel/ In groups ***students*** construct a wind tunnel using cardboard and a fan. **(EQC, SSR, KI, C) (ICT, IBL)**	
		**Design - Redesign** P2: ***Teacher*** to explain the concept of design and redesign via the use of prototyping. ***Class*** discussion on STEM problems which can be solved using technologies related to aerodynamics. **(BK, HOT)**		**Design - Redesign** A2: ***Students*** to complete a range of pre-designed experiments using technologies related to aerodynamics. Smoke tunnel utilised to show streamline and turbulent flows in aerofoils. Concepts of stall demonstrated in an aerofoil. **(DU, KI)**			
		Computational Fluid Dynamics P3: VWT F1inSchools. Go through introductory notes. ***Teacher*** to demonstrate use of software. OR P3: Project Falcon CFD software. ***Teacher*** to demonstrate use of software. http://labs.autodesk.com/utilities/falcon/download_choices Show skypod video from ME program. **(ICT, C, DK)**		**Computational Fluid Dynamics** A3: ***Student*** to load a model car into the VWT software. ***Students*** use a variety of post-processing activities. See VWT notes. **(ICT, SSR, KI, C)** OR ***Students*** to upload Skypod.obj file in to the Project Falcon VWT software. ***Students*** to analyse results using applied knowledge of CFD. **(ICT, SSR, KI, C)**		**Computational Fluid Dynamics** C3: ***Students*** to draw Bottle Rocket or Skylap plane in CAD and test in VWT. ***Students*** to test Bottle Rockets and Skylap plane in Wind/Smoke tunnels. OR C3: ***Students*** to use CAD software to upload Skypod file. ***Students*** to modify Skypod to make it more aerodynamic. **(KU, HOT, EQC, E, SD, BK, KI, C)**	

Students learn about:	Students learn to:	Level 1 Pre-Knowing / Knowing	Level 2 Understanding / Applying	Level 3 Evaluating / Creating
5.3 aerodynamics principles - dynamic, static friction - lift/drag ratios - lift, drag, weight, thrust - Finite Element Analysis (FEA) - flight	- explain aerodynamic principles - describe the effects of lift, drag, weight and thrust - design, construct or simulate solutions to problems related to friction - construct models for the purpose of solving aerodynamic problems - describe how Finite Element Analysis is applied aerodynamic systems	***Aerodynamics Principles*** P1: ***Teacher*** to define aerodynamics and why it is important. ***Teacher*** to introduce basic concepts of lift, drag, weight and thrust. ***Teacher*** to define Bernoulli's Principle and describe how a venturi works. (See Aerodynamics Notes) **(DK, BK, M) (NUM)**	***Aerodynamics Principles*** U1: ***Teacher*** to demonstrate types of airflows using smoke tunnel technologies. ***Teacher*** to demonstrate experiments related to aerodynamics. ***Students*** to complete a number of experiments to explain Bernoulli's Principle. See video for examples. **(DU, HOT, C) (NUM)**	***Assessment*** C1: **Option 1:** ***Students*** to work on F1inSchools program. ***Students*** break into groups and design a CO_2 Powered F1 car using CREO 3D CAD software. Design criteria is set each year by REA Australia. ***Students*** must meet all set criteria. See website for competition criteria. www.rea.org.au F1inSchools car designs are to be aerodynamically designed to reduce drag. **Option 2:** ***Students*** to design, construct, test and evaluate a bottle rocket and evaluate results. ***Students*** to design, construct, test and evaluate a Skylap plane and evaluate results. ***All Students*** need to demonstrate a detailed knowledge of the effects of the four forces of Lift, Drag, Weight and Thrust. ***Students*** to complete a portfolio of their work either from F1inSchools or Aeronautical Velocity Challenge. **(DK, DU, PK, HOT, M, EQC, E, SSR, SD, BK, KI, C) (ICT, NUM, IBL, LIT)**
		Lift, Drag, Weight and Thrust P2: ***Teacher*** to describe how an aircraft is able to fly as a result of the balance between all four forces of lift, drag, weight and thrust. Teacher to define parasitic and induced drag. **(DK, M)**	**Lift, Drag, Weight and Thrust** U2: ***Teacher*** to demonstrate the effects of the four forces related to aerodynamics when they are in equilibrium and when they are in dis-equilibrium. ***Teacher*** to use a model of an aircraft to demonstrate. Watch Flight video from VEA. **(DU, BK)**	
		**Dynamic and Static Friction** P3: ***Teacher*** to define static and dynamic friction. ***Teacher*** to explain concept of coefficient of friction as it relates to surfaces. **(M, BK)**	**Dynamic and Static Friction** U3: ***Students*** to complete a series of experiments related to friction. Use a variety of surfaces and demonstrate how they affect movement. **(DU, SD)**	
		Finite Element Analysis P4: ***Teacher*** to define Finite Element Analysis. ***Teacher*** to demonstrate use of CREO Simulate 2.0. **(HOT, C) (ICT)**	**Finite Element Analysis** A4: ***Students*** to import files from CREO and apply forces using Finite Element Analysis tools from CREO Simulate. **(ICT, NUM, HOT, KI)**	

Students learn about:	Students learn to:	Level 1	Level 2	Level 3
		Pre-Knowing Knowing	Understanding Applying	Evaluating Creating
5.4 aerodynamics forces - lift, drag, weight, thrust - simple vectors - efficiency  	- determine solutions using vector notation - perform simple calculations related to efficiency - apply mathematical and graphical methods to solve aerodynamic related problems - solve aerodynamic problems related to lift, drag, weight and thrust	**Simple Vectors** P1: ***Teacher*** to define scalar and vector quantities and identify components of vectors. ***Teacher*** to introduce vector terminologies (i.e. Terminal and initial points, Co-planner, Co-Linear and Concurrent. **(M, DK) (NUM)**	**Simple Vectors** U1: ***Teacher*** to demonstrate how to add and subtract vector qualities. ***Students*** to solve a number of engineering problems using vector quantities. **(DU) (NUM)**	**Simple Vectors** E1: ***Students*** to identify real life problem which could be resolved using vectors. ***Students*** to design problems related to vectors and produce solutions to such problems. **(DU, SD, HOT, KI, C) (NUM)**
		Efficiency P2: ***Teacher*** to introduce concepts of simple machines and efficiency. Concept of efficiency demonstrated using practical examples. **(KI, DK, M) (NUM)**	**Efficiency** U2: ***Students*** to complete simple questions related to efficiency. Efficiency related to simple machines. **(KI, DU) (NUM)**	**Efficiency** E2: ***Students*** to identify problems related to efficiency of machines. ***Students*** to design problems related to efficiency and produce solutions to such problems. **(DU, SSR, HOT, KI) (NUM)**
		Lift, Drag, Weight and Thrust P3: ***Teacher*** to define the 4 forces which effect flight. Lift, drag, weight and thrust. Video YouTube ***Teacher*** to define basic vectors **(M, DK, KI) (NUM)**	**Lift, Drag, Weight and Thrust** U3: ***Students*** to apply lift, drag, weigh and thrust as a vector quantity. ***Teacher*** to demonstrate how to add and subtract vectors using a graphical polygon method. **(M, DU, HOT) (NUM)**	**Lift, Drag, Weight and Thrust** E3: ***Students*** to solve a range of basic aerodynamic problems by adding and subtracting vectors using a graphical polygon method. **(M, DU, KI, HOT) (NUM)**
		Vectors P4: ***Students*** introduced to mathematical methods of solving problems with vectors. ***Students*** given instruction on how to resolve aerodynamic problems related to lift, drag, weight and thrust, using the triangulation method. **(DK) (NUM)**	**Vectors** U3: ***Students*** to solve a range of basic aerodynamic problems using vector arithmetic. **(DU, HOT, PK) (NUM)**	**Vectors** E4: ***Students*** to experiment and evaluate aircraft in terms of lift to drag ratios. ***Students*** to manipulate vectors to determine aerodynamic efficiency. **(KI, HOT) (NUM)**

Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
7.1 CAD/CAM - 3D drawing on an x, y & z axis. -basic commands in a 3D CAD package - CAM processes  	- use common features in a 3D CAD package to produce parts, products and assemblies in order to design 3D objects - use rendering techniques to represent 3D designs	**CREO Introduction** P1: ***Teacher*** to demonstrate the feature first processes for creating 3D CAD drawings using CREO. ***Students*** given an introduction to opening, and navigating through the CREO program. **(KI, DU) (ICT, NUM)**		**CREO** U1: ***Students*** to complete a range of activities from PTC tutorials "How to Model Almost Anything". ***Students*** to work at own pace and complete the units they wish to complete. **(DU, SD) (ICT, NUM)**		**CREO** C1: ***Students*** to create a photo realistic assembly of their name using CREO Parametric.  **(SD, C, E, KI, BK) (ICT, NUM)**	
		Introduction to 3D Printing P2: ***Teacher*** to introduce ***students*** to 3D Printing software. ***Teacher*** to demonstrate 3D printing technology. ***Students*** to access http://www.thingiverse.com/ website and investigate objects that can be printed using a 3D printer. **(E, SSR) (ICT)**		**Introduction to 3D Printing** U2: ***Students*** to create a nose cone for the bottle rocket using CREO Parametric. Nose cone file to be modified and printed using 3D Printer. **(DU, SSR, E, KI) (ICT, NUM)**		**3D Printing** C2/3: ***Students*** to design and produce of parts for engineering projects. ***Students*** to print out parts for their bottle rockets or skylap planes.  **(DU, E, SSR, KI) (ICT, NUM)**	
		CREO Advanced P3: ***Teacher*** to introduce ***students*** to developing advanced parts and advanced assembly. ***Students*** to design additional parts for their bottle rockets **(KI, DK) (ICT, NUM)**		**CREO Advanced** U3: ***Students*** to complete F1 R Type CO_2 racer tutorial by Tim Brotherhood or CREO F1Car tutorial by Smith and Sleap. **(SD) (ICT, NUM)**			

Students learn about:	Students learn to:	Level 1	Level 2	Level 3
		Pre-Knowing / Knowing	Understanding / Applying	Evaluating / Creating
5.5 aerodynamic design solutions 	- develop engineered solutions to meet detailed specifications - evaluate results from testing to improve aerodynamic performance of engineered solutions - uses appropriate design processes and techniques in the context of developing engineered solutions	**Rules and Regulations** P1: ***Students*** to investigate the rules and regulations for the F1inSchools competition OR the Aeronautical Velocity Challenge. General Information and specifications to be reviewed. **(BK, EQC) (ICT)**	**Rules and Regulations** U1: ***Students*** to work in groups to unpack the specifications for the design of the F1 car design, OR bottle rocket and Skylap plane. Using the specifications provided sketch a number of design solutions to the given problem. ***Students*** to develop a design portfolio of the work in either F1inSchools or Aeronautical Velocity Challenge. **(DU, EQC) (ICT)**	**Assessment** C1: ***Students*** to use a range of technologies to design solutions to aeronautical problems. E.g. F1inSchools OR Aeronautical Velocity Challenge. ***Students*** to complete design portfolio of design work. **(DU, HOT) (ICT, LIT, IBL)**
		**Design Process** P2: ***Students*** to investigate the design processes used for the successful completion of an engineered solution. ***Students*** to investigate project management techniques, such as creating Gannt charts. ***Students*** to develop criteria to evaluate the success of the engineered solution. **(DK, EQC, M) (ICT, LIT)**	**Design Process** U2: ***Students*** to document the design processes used to develop an engineered solution by producing a comprehensive design portfolio. **(ICT) (EQC, KI)**	**Design Solutions** E2: ***Students*** to use a range of technologies (e.g. 3D printers, Laser Cutter, CNC lathe) and materials to produce creative solutions to engineering problems. E.g. F1inSchools OR Aeronautical Velocity Challenge. **(PK, EQC, E, HE, SSR, BK, KI) (ICT)**
		**Design Testing** K3: ***Students*** to use an appropriate process to design a Bottle Rocket powered by compressed air which will achieve the longest distance. ***Student*** to break into groups and design 2 skylap planes one designed for speed and one designed for altitude.OR ***Students*** to design a F1inSchools CO_2 powered car. **(BK, SD) (ICT, IBL)**	**Design Testing** A3: ***Students*** to utilise a range of testing equipment to assess the aerodynamic performance of design solutions. ***Students*** to modify design solutions and re-test design to improve performance. **(SSR, DU) (ICT, IBL)**	**Assessment** E3: ***Students*** to complete final testing of solutions to design problems using a range of technologies. ***Students*** to evaluate the success of their designs in their portfolio. **(HOT, EQC, E, SSR, KI) (ICT, IBL, LIT)**

Unit of Work - Robotics Systems

Unit Title: Robotic Systems	**Time:** 50 Hours
Description: In this unit student learn how to use design, construct and program robotic system to solve a range of STEM based problems. Teachers can use or a range of robotic systems to deliver this unit of work including; Lego EV3, Makey, Makey, Tribotix, Ardunio based systems, Littlebits, Starlab, etc. Teachers can use this unit to prepare students for a range of external competitions such as; RoboCUP Junior, First Robotics League, Mars Rover, etc	
Objectives:	**Outcomes:**
• knowledge, understanding and application of cognitive processes to address real world STEM based problems • knowledge and understanding of STEM principles and processes • skills in communicating and critically evaluating • problem solving and decision-making skills in a range of STEM contexts • an appreciation of the value of STEM in the world in which they live	5.2.1 describe how scientific and mechanical concepts relate to technological and engineering practice 5.2.2 applies cognitive processes to address real world STEM based problems in a variety of contexts 5.3.1 applies a knowledge and understanding of STEM principles and processes 5.3.2 identifies and uses a range of technologies in the development of solutions to STEM based problems 5.5.1 applies a range of communication techniques in the presentation of research and design solutions 5.6.1 selects and uses appropriate problem solving and decision-making techniques in a range of STEM contexts 5.7.1 demonstrates an appreciation of the value of STEM in the world in which they live

Key:			**Resources:**
NUM – Numeracy LIT – Literacy FOR – Focus on Reading	ICT – Information and Communication Technologies AB ED – Aboriginal Education IBL – Inquiry Based Learning		**Websites** http://www.meprogram.com.au/istem/istem-modules/ *http://www.lego.com/enus/mindstorms/?domainredir=mindstorms.lego.com* http://www.atse.org.au https://www.lego.com/en-us/mindstorms http://www.thingiverse.com/ http://www.pbs.org/wgbh/buildingbig/lab/forces.html. http://www.learner.org/interactives/geometry/3d.html **Resources** Computer Bank or BYOD equipment EV3 Lego Mindstorms Kits Starlab Mars Rover Devices Robotic Arms Programmable Quad Copters Arduino Sets CAD Software 3D Printer(s) Laser Cutters
Quality Teaching Model Key:			
Intellectual Quality DK – Deep Knowledge DU – Deep Understanding PK – Problematic Knowledge HOT – Higher-Order Thinking M – Metalanguage SC – Substantive Communication	***Quality Learning Environment*** EQC – Explicit Quality Criteria E – Engagement HE – High Expectations SS – Social Support SSR – Students' Self-Regulation SD – Student Direction	***Significance*** BK – Background Knowledge CK – Cultural Knowledge KI – Knowledge Integration I - Inclusivity C - Connnectedness N – Narrative	
Evidence of Learning - Highlighted in Red	**Assessment -** Highlighted in Grey		
Assessment			
Pre-Assessment: Robotics Quiz **Progressive Assessment:** Practical coding tasks **Assessment:** Robotics Assessment, Mechanics, Electric Bike Portfolio			

Students learn about:	Students learn to:	Level 1	Level 2	Level 3
		Pre-Knowing / Knowing	Understanding / Applying	Evaluating / Creating
2.3 problem solving - nature of - strategies to solve - evaluation - collaboration	- identify the nature of problems - use identified strategies to develop a range of possible solutions to every day STEM problems - evaluate the appropriateness of different problem-solving strategies - work collaboratively to solve problems - draw information from a range of sources to aid in the solution of practical everyday problems	**Strategies to Solve Problems** P1: ***Teacher*** to model a range of problem solving strategies related to robotic systems. **(KI, C, DK)**	**Robotic Challenges** U1: ***Students*** to solve a range of problems using a problem-solving process related to robotic systems. **(HOT, C, SD, DU) (IBL, NUM)**	**Collaboration & Assessment** E1: ***Students*** to evaluate the results of their robotic exercises. ***Students*** to include results and conclusions of Assessment Task 1. **(HOT, EQC, SD, PK) (IBL, LIT)**
		Collaboration P2: ***Teacher*** to discuss advantages of teamwork vs working as an individual. Advantages and disadvantages of different problem-solving techniques discussed. **(DK, C)**	**STEM Problem Solving** U2: ***Students*** to complete robotic problem-solving exercises completed both as an individual than as a group. **(HOT, C, DU) (IBL, NUM, LIT)**	**Collaboration & Assessment** E2: ***Students*** to evaluate the success of the group work activities as part of Assessment Task 1. **(HOT, HE, PK) (LIT)**
		Strategies to Solve Problems P3: ***Teacher*** to model a range of problem solving strategies for robotic based systems. ***Teacher*** to demonstrate practical problem solving, whilst constructing and coding robotic systems. **(KI, C, DK)**	**EV3 Mindstorms Challenges** U3: ***Students*** to solve a range of simple coding problems using a problem-solving process. (E.g. algorithms, trouble shooting, experimentation). **(HOT, C, SD, DU) (IBL, NUM)**	**Collaboration & Assessment** E3: ***Students*** work in teams to solve a range of simple problems using a range of robotic systems and low-level programming languages (EV3, Sphero's, Tynker, etc). Students to record progress of problems solved. **(HOT, EQC, SD, PK) (IBL, LIT)**
		Collaboration P4: ***Teacher*** to discuss and model collaborative work practices and discuss their importance. **(KI, C, E)**	**Robot Wars – Battle Bots** U4: ***Students*** demonstrate a range of problem solving skills to design a battle bot. **(DU, EQC, HOT, SSR) (IBL)**	**Evaluation and Assessment** E4: ***Students*** to document and evaluate solutions for a battle bot design. **(DU, EQC, HE) (IBL, NUM, LIT)**

Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
2.2 fundamental mechanics - basic units - prefixes - statics - dynamics - modelling	- apply units to concepts of mechanics - utilise metric prefixes related to every day technologies - complete basic calculations related to statics - describe the difference between a static and a dynamic - simulate mathematical problems using appropriate modelling techniques.	**Basic Units** P1: ***Teacher*** to describe the difference between metric and imperial units of measurement and where they are used. **(DK, M) (NUM)**		**Basic Units** U1: ***Students*** use robotic systems and block programming to estimate distance in metric and imperial. ***Students*** to program a sphero, EV3 or Drone to move set distances. **(DU) (NUM)**		**Basic Units** E1: ***Students to*** program a sphero, EV3 or Drone to move set distances. ***Students*** to determine the area/volume (eg: courts or sporting fields where robotic systems will be used. **(DU, BK, KI) (NUM)**	
		Prefixes and SI Units P2: ***Teacher*** to define the International System of Units (SI units) and are familiar with the list of twenty common prefixes. **(M) (NUM)**		**Prefixes and SI Units** U2: ***Students*** use the metric prefixes to convert between common units of modern technology (eg: kB/MB/ GB computer files). (From 'Maths in Technology' by Barbara Lynch) **(M, DU) (NUM)**		**Prefixes and SI Units** E2: ***Students*** perform calculations in common coding situations utilising more than one metric prefix (eg: time taken to download 1.8 GB attachments at 512kB/s). **(KI, DU) (NUM)**	
		Maths in Problem Solving P3: ***Teacher*** to explain the role mathematics plays in solving problems. **(BK, DU) (NUM)**		U3: ***Students*** utilise different methods (written / technology / software) to solve problems. **(DU, PK, KI) (NUM, ICT)**		E3: ***Students*** apply a range of mathematical concepts of to solve coding based problems. (e.g. Circumference of a EV3 tire). **(HOT, M, DU) (NUM)**	
		Statics and Dynamics P4: ***Teacher*** to define the terms 'static' and 'dynamic. **(NUM, M)**		**Statics and Dynamics** A4: ***Students*** to apply knowledge of statics and dynamic to robotic systems (Force, Vectors, Momentum, friction, etc) **(KI, DU, HOT) (NUM)**		**Statics and Dynamics** E4: ***Students*** create a Computer Based presentation highlighting the differences between static and dynamic systems as they apply to robotics. **(M) (ICT, NUM)**	
		Modelling P5: ***Students*** identify a problem in which mathematics is able to aid in the solution. In small groups ***students*** are able to collaborate on strategies that will lead to an answer. **(SS, SSR, SC) (NUM)**		**Modelling** U5: ***Students*** to work together to solve mathematical problems and communicate their solutions in an appropriate and meaningful manner. **(SS, SSR, HOT) (NUM, IBL)**		**Modelling** E5: **Students** design their own group work activity (can be modelled on the cards already completed in class) that can be completed by other members of the class. (Maths in Crime) **(NUM, SS, SSR, SD, HOT, IBL)**	

Students learn about:	Students learn to:	Level 1	Level 2	Level 3
		Pre-Knowing / Knowing	Understanding / Applying	Evaluating / Creating
3.1 mechatronics - building mechatronic components - programming logic - writing macros - fault finding 	- build mechatronic components using a variety of electrical, and mechanical componentry - use a range of equipment to carry out experiments and construct projects in relation to mechatronic systems - use a programming language to control mechatronic devices - write macros to complete a variety of operations involving mechatronics	**Robotic Devices** P1: ***Teacher*** to demonstrate how to program basic logic operations using a robotic system. (e.g. EV3, Tribox, Sphero, Parrot Mambo, Startlab, etc) **(KI, DK, M)**	**Robotic Devices** A1: ***Students*** to experiment with the use of basic logic software to code robotic operations. **(DU, HOT, KI) (ICT, NUM)**	**Robotic Devices** E1: ***Students*** to solve a range of problems using basic logic software to operate robotic systems. **(DU, HOT, KI, SSR) (ICT, NUM)**
		Robotic Devices – Macro Coding P2: ***Teacher*** to demonstrate how to program logic operations to produce macros to simplify the use of robotic operations. **(KI, DK, M)**	**Robotic Devices – Macro Coding** U2: ***Students*** to experiment with the use of macros to code robotic operations. **(DU, HOT, KI) (ICT, NUM)**	**Robotic Devices – Macro Coding** E2: ***Students*** to solve a range of robotic problems using logic software and macros. **(DU, HOT, KI, SSR) (ICT, NUM)**
		Robotic Devices – Fault Finding P3: ***Teacher*** to model and demonstrate how to fix hardware and software issues related to the use of robotic equipment. **(M, KI, DK) (ICT, NUM)**	**Robotic Devices – Fault Finding** U3: ***Students*** to experiment with solving problems with hardware and software issues related to robotic systems. **(DU, KI, SSR) (ICT, NUM)**	**Robotic Devices – Fault Finding** E3: ***Students*** to problem solve and use troubleshooting processes to find and correct faults in robotic systems. **(HOT, PK, SD) (ICT, NUM)**
		Robotic Devices P4: ***Teacher*** to demonstrate how to construct mechatronic/robotic solutions to problems. **(DK, BK, KI, C) (ICT, NUM)**	**Robot Wars – Battle Bots** U4: ***Students*** demonstrate a range of problem solving skills to design and code a battle bot device. **(DU, EQC, HOT, SSR) (IBL)**	**Evaluation and Assessment** E4: ***Students*** to document and evaluate solutions for battle bot designs. **(DU, EQC, HE) (IBL, NUM, LIT)**

<table>
<tr><th rowspan="2">Students learn about:</th><th rowspan="2">Students learn to:</th><th colspan="2">Level 1</th><th colspan="2">Level 2</th><th colspan="2">Level 3</th></tr>
<tr><th>Pre-Knowing</th><th>Knowing</th><th>Understanding</th><th>Applying</th><th>Evaluating</th><th>Creating</th></tr>
<tr><td rowspan="3">3.2 technologies related to robotics
- sensors and transducers
- manipulators
- PLC’s</td><td rowspan="3">- apply and understand the uses of a range of sensor and transducer technologies
- incorporate mechatronic hardware to complete a variety of problem solving tasks
- utilise and program devices to perform a variety of control or monitoring tasks.</td><td colspan="2">Sensors and Transducers
P1: Teacher to demonstrate how to use sensors and transducers in robotic systems. Teacher to demonstrate the use of a range of robotic systems.
(DK, BK, KI, C) (ICT, NUM)</td><td colspan="2">Sensors and Transducers
U1: Students to complete experimentation on a range of sensors and transducers using a variety of robotic equipment.
(DK, DU, KI)</td><td colspan="2">Sensors and Transducers
C1: Students design and construct a simple robotic systems using a variety of robotic hardware and software.
(EQC, SSR, KI, C)</td></tr>
<tr><td colspan="2">Manipulators
P2: Teacher to explain the operation of electric motors used on robotic systems.
Students to watch video on how motors work and complete notes on its operation.
(DK, BK, KI, C) (ICT)</td><td colspan="2">Motors
A2: Students to experiment with using a range of motors. Students to work in groups and are to be challenged to complete the tasks using manipulators including motors.
(DU, PK, BK, KI, C) (ICT, IBL)</td><td colspan="2">Motors
C2: Students to design and construct a simple mechatronic system using a range of robotic systems. (DU, KI, M) (IBL, ICT, NUM)</td></tr>
<tr><td colspan="2">PLC’s
P3: Teacher to demonstrate how to use Programmable Logic Circuits.
(DK, BK, KI, C) (ICT, NUM)</td><td colspan="2">PLC’s
A3: Students to experiment with operating robotic equipment using Programmable Logic Circuits.
(DU, BK, KI, C) (ICT, NUM)</td><td colspan="2">PLC’s
C3: Students to design and construct simple robotic systems using Programmable Logic Circuits. (DU, KI, M) (IBL, ICT, NUM)</td></tr>
</table>

Students learn about:	Students learn to:	Level 1	Level 2	Level 3
		Pre-Knowing / Knowing	Understanding / Applying	Evaluating / Creating
7.3 CAD/CAM operations - Reading and interpreting engineering drawings - rapid prototyping - 3D CAD operations - Computer Aided Manufacturing (CAM) - 3D modelling	- read and interpret basic engineering drawing conventions - explain the operation of CAD/CAM software and hardware - describe how rapid prototyping works - design, construct parts, products or assemblies using CAD software and producing them using appropriate CAM software - produce practical solutions to set problems construct 3D models.	**Engineering Drawing** P1: ***Teacher*** to explain AS1100 standards and basic drafting techniques to be demonstrated. **(DK, KI)**	**Engineering Drawing** U1: ***Students*** to complete a range of pictorial drawing exercises (Isometric and perspective). **(DU, HOT, EQC, C) (NUM)**	**Engineering Drawing** C1: ***Students*** to take basic 3D objects and produce isometric and perspective drawings and produce 3D CAD drawings. **(DU, HOT, EQC, C) (ICT, NUM)**
		CAD/CAM P2: ***Students*** to investigate different technologies used in Computer Aided Drawing and Computer Aided Manufacturing. Robotics and mechatronic manufacture to be investigated. **(ICT, PK, E, C)**	**CAD/CAM** U2: ***Students*** to research how 3D printers work. Further investigations into CAM processes; CNC, mills, routers, lathes and laser cutters. **(DU, C) (ICT)**	**CAD/CAM** E2: ***Students*** to evaluate the operation of current CAD/CAM systems and predict future trends. ***Students*** to watch You tube Video 'How Robots Will Change the World' **(DU, KI, C)**
		Rapid Prototyping P3: ***Students*** to use a variety of software to design products using appropriate CAD software/E.g. CREO, Solidworks, Autodesk 123, Google Sketchup, etc. **(ICT, DU, HOT, E, SD, KI, EQC)**	**Rapid Prototyping** A3: ***Students*** to use a variety of technologies within and outside the school to produce 3D designed products for their robotic designs. **(EQC, HE, SD, KI, C) (ICT, NUM)**	**Rapid Prototyping** C3/4: ***Students*** to be given many opportunities to engage in rapid prototyping process for robotic designs. ***Students*** to design, construct parts, products or assemblies using CAD software and producing using appropriate CAM software. **(DU, HOT, EQC, HE, SD, KI, C) (ICT, NUM)**
		Problem Solving & Product Design P4: ***Teacher*** to introduce product design and revise problem solving processes related to engineering. **(DK, KI)**	**Problem Solving & Product Design** A4: ***Students*** to complete simple problems set which require the design and manufacture of 3D models. **(DU, EQC, HOT)**	

Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
7.4 3D environments - vectors - 3D Shapes - Computer Numerical Control - spatial comprehension - 3D Surface Modelling	- apply mathematical and graphical methods to solve questions related to 3D vectors - determine solutions to simple problems using vector notation - manipulate 3D shapes and objects - construct source code for 3D CAM operations.	**Coordinate Geometry** P1: ***Teacher*** to introduce coordinate geometry. Polar, absolute and relative coordinates related to CAD. **(HOT, KI, C) (NUM, ICT)**		**Coordinate Geometry** U1: ***Students*** to solve mathematical problems by plotting x, y and z coordinates. **(HOT, KI, C) (NUM, ICT)**		**Coordinate Geometry** E1: ***Students*** to use a 2D CAD package to produce 3D drawing using Polar, absolute and relative coordinates. **(HOT, C) (NUM, ICT)**	
		Vectors P2: ***Teacher*** to describe how to use vector quantities to solve simple STEM based problems. Identify components of vectors and introduce vector terminologies (i.e. Terminal and initial points, Co-planner, Co-Linear and Concurrent. **(M, DK) (NUM)**		**Vectors** U2: ***Teacher*** to demonstrate how to add and subtract vector qualities. ***Students*** to solve several simple robotic based problems using vector quantities. ***Students*** to resolve vectors into horizontal and vertical components. **(DU) (NUM)**		**Vectors** E2: ***Students*** to identify real life robotic problems which could be resolved using vectors addition and subtraction. ***Students*** to design solutions related to vectors based problems. **(DU, SSR, HOT, KI) (NUM)**	
		3D Shapes P3: ***Teacher*** to introduce a variety of 3D shapes identified and defined. Polyhedra, Prisms and Pyramids. Glossary of terms, apex, base, congruent, vertex. **(KI, C) (NUM, ICT)**		**3D Shapes** U3: ***Students*** to complete interactive activities from Annenberg Learner web site http://www.learner.org/interactives/geometry/3d.html 3D Shapes, Surface Area & Volume, Euler's Theorem, and Platonic Solids. **(KI, C) (NUM, ICT)**		**3D Shapes Assessment** E3: ***Students*** to complete online test of knowledge and complete exercises related to 3D geometry. **(KI, C) (NUM, ICT)**	
		Computer Numerical Control P4: ***Teacher*** to demonstrate G code programming language. Demonstrate simple G code expressions and what they do on a CNC machine. **(HOT, KI, C) (NUM, ICT)**		**Computer Numerical Control** U4: ***Students*** to complete exercises, construct sequences of G codes which complete simple tasks, such as move in x, y and z axis. **(HOT, KI, C) (NUM, ICT)**		**Computer Numerical Control** E4: ***Students*** to enter G codes into software to show the operations. (E.g. ME3D Printer) **(HOT, KI, C, HE, SD) (NUM, ICT)**	

Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
9.2 presentation and communication technologies	- select and use appropriate digital communication techniques for the development of a minor project based learning task - use appropriate technological processes in the completion of a minor project based learning task	**Presentation Technologies** P1: ***Teacher*** to demonstrate the use of a range of presentation and communication technologies to be used in the design portfolio. ***Teacher*** to explain the range of technologies that can be used to communicate design solutions. **(DK, KI) (ICT)**		**Presentation Technologies** U1: ***Students*** to communicate aspects of the design, production and evaluation process related to their Robotics Program. ***Students*** to work in teams to document their design process for a First Robotics/ RoboCUP portfolio. **(DU, E, BK, KI) (ICT)**		**Presentation Technologies** C1: ***Students*** to use a broad range of creative and appropriate communication and presentation techniques in order to compete in the first robotic or RoboCUP competition. **(DU, PK, HOT, EQC, E, HE, SD, C, KI) (ICT, LIT)**	
		Sketching and Drawing P2: ***Teacher*** to demonstrate the use of a variety of sketching and drawing techniques suitable for a design portfolio. **(KI, DK) (ICT, NUM)**		**Sketching and Drawing** U2: ***Students*** to complete a range of sketching and drawing exercises. **(DU, KI, C, E) (ICT, NUM)**		**Sketching and Drawing** C2: ***Students*** to sketch and draw solutions to robotic based problems suitable for inclusion in their design portfolios. **(EQC, C, E) (ICT, NUM)**	
		Rapid Prototyping Revision P3: ***Teacher*** to show Wired Video: http://youtu.be/PDLOmoQj4H0 3D printing services available and 3D scan technologies. ***Teacher*** to demonstrate how the milling machine, 3D printer and laser Cutter can be used for rapid prototyping. **(DK, BK, KI) (ICT, NUM)**		**Rapid Prototyping Revision** A3: ***Students*** to use a variety of technologies within and outside the school to produce 3D designed products. ***Students*** to use rapid prototyped product design to design parts for their robotic designs **(DU, EQC, EQC, KI) (ICT, NUM)**		**Rapid Prototyping** C3: ***Students*** to engage in rapid prototyping process by designing, manufacturing, and evaluating engineered products which meet an identified need for robotic competitions (e.g. First/RoboCUP) **(DU, PK, HOT, EQC, E, HE, SD, C, KI) (ICT, NUM, IBL)**	
		Technological Processes P4: ***Teacher*** to demonstrate a range of robotic based technological processes. **(HOT, KI, C) (NUM, ICT)**		**Technological Processes** U4: ***Students*** to complete coding and other technological exercises to develop the skills and expertise in order to solve STEM based problems. **(HOT, KI, C) (NUM, ICT)**		**Technological Processes** E4: ***Students*** to use coding and other technological processes to design solutions to problems set by First Robotics/RoboCUP. **(HOT, KI, C, HE, SD) (NUM, ICT)**	

Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
		Pre-Knowing	Knowing	Understanding	Applying	Evaluating	Creating
9.3 realisation, evaluation, research methods and experimentation	- test possible solutions to problems - use tools, materials and processes to produce a solution to an identified problem - develop methods to communicate solutions to problems through a visual display - conduct continual evaluations throughout the design and production of the minor project - evaluate the project in terms of the identified criteria for success.	**Research** P1: ***Teacher*** to direct students to where they might find information appropriate to finding solutions to STEM based Problems. ***Teacher:*** to provide a design brief based on the First Robotics/RoboCUP competition, and direct students to knowledge bases. **(DK, KI, C)**		**Research Methods** A1: ***Students*** to undertake research utilising a range of research methods including interviews, surveys, data analysis, and experimentation to research aspects of their Robotic design project **(DU, SSR) (ICT, NUM, LIT, IBL)**		**Research Methods** E1: ***Students*** to form groups and thoroughly research the requirments for the first robotic/RobCUP competition. Students to undertake research, experimentation and testing and document them in a design portfolio that include design ideas, materials, tools and techniques. **(HOT, SD, PK) (IBL, ICT, LIT)**	
		Experimentation P2: ***Teacher*** to describe how to undertake experimentation and testing to determine the most appropriate solutions to robotics problems. **(DK, HE, KI) (ICT)**		**Experimentation** U2: ***Students*** to conduct experimentation and testing, preparing for the First Robotics/RoboCUP competition that includes an Aim, Method, Result and Conclusion. **(DU, KI, C) (ICT)**		**Experimentation** E2: ***Students*** to document all experimentation and testing, record all results and make sure that they write down all conclusions from all tests under the headings: Aim, Method, Results and Conclusions. **(DU, KI, C) (ICT, IBL)**	
		Project Realisation P3: ***Teacher*** to explain how to document the project realisation including evidence and application of practical or research skills. **(DK, C)**		**Project Realisation** A3: ***Students*** to produce a research portfolio that clearly demonstrates the application of practical and/or research skills. **(EQC, HE, SD, KI, C) (ICT, NUM)**		**Project Realisation** E3: ***Students*** to work in teams to solve a robotic based solution to a set problem. **(EQC, HE, SD, KI, C) (ICT, NUM, IBL)**	
		Evaluation P4: ***Teacher*** to demonstrate how to effectively evaluate the processes and decisions made during the completion of a Robotics Project. **(DU, HOT, E, SD, KI, EQC) (ICT)**		**Evaluation** A4: ***Students*** to show evidence that evaluation has been applied to the completion of the Robotics Project. **(DU, HOT, KI, C) (ICT)**		**Evaluation** E4: ***Students*** to demonstrate that they have a clear understanding of their project's impact on society and the environment considering both local and global effects. **(HOT, EQC, HE, SD, KI, C) (ICT, IBL)**	

Students learn about:	Students learn to:	Level 1		Level 2		Level 3	
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9.5 Creative and innovative approaches to solve problems	- demonstrate creativity and problem-solving skills in the development of the STEM related Minor Project Based Learning Task	**First Robotic/RoboCUP Competition** P1: ***Teacher*** to explain the expectations and marking criteria for the completion of the Robotics design problem based on either First Robotics or RoboCUP Junior. **(DK, PK, HOT, M, EQC, E, SSR, SD, BK, KI, C)**		**First Robotic/RoboCUP Competition** A1: ***Students*** to work in teams of 2 - 3 to produce a Major Research Project utilising a design, plan, build, test and evaluate process. ***Students*** to identify a need as a group and produce a solution to a research or design problem. **(DK, DU, PK, HOT, M, EQC, E, SSR, SD, BK, KI, C)**		**First Robotic/RoboCUP Task** C1: ***Students*** are to forms groups of 3 – 4 students to develop a Robotics based solution to a set problem using an engineering design process. The task involves students researching the problem and producing innovative solutions to an identified problem. ***Students*** are to produce a portfolio of their work which is broken into three main areas; 1. Project Proposal and Management 2. Project Development & Realisation 3. Evaluation In the evaluation section, the contributions of all members of the group must be documented and proportions of the overall mark allocated. ***Students*** must follow the rules set by the competition organisers and will be assessed based on how well they solve the identified problem and how they worked as a team. **(DK, DU, PK, HOT, M, EQC, E, SSR, SD, BK, KI, C) (ICT, IBL, NUM, LIT)**	
		P2: ***Teacher*** to demonstrate how to present work for marking including how to display of their work effectively for assessment. **(DK, PK, HOT, M, EQC, E, SSR, SD, BK, KI, C) (ICT, LIT)**		A2: ***Students*** work in teams to complete an engineering design process to solve a robotics based problem. The problem will be determined each year by the design brief developed by First Robotics or RoboCUP junior. ***Students*** to present their work for marking and display for parents, teachers and the wider community. **(DU, HOT, M, EQC, E, SSR, SD, BK, KI, C) (ICT, IBL, LIT)**			