Murrumburrah High School Stage 4: STEM- Rockets

**Rationale**

STEM is an interdisciplinary and applied approach that integrates Science, Technology, Engineering and Mathematics. It shows how scientific method can be applied to real life problem solving. “STEM is everywhere. Our nourishment, our safety, our homes and neighbourhoods, our relationships with family and friends, our health, our jobs, our leisure are all profoundly shaped by technological innovation and the discoveries of science.” <http://www.chiefscientist.gov.au> STEM is based on an authentic context that is relevant to the group, project- based learning. STEM promotes discussion and stimulates questions while encouraging sharing of personal experiences. All of this enable the student to connect to the task. STEM will be presented as a problem that requires a solution but will encompass a design brief that provides sufficient detail and information so the student knows what they are to do during the design process.

**Objectives**

**Knowledge, understanding and skills**

Students will develop:

1 knowledge, understanding and appreciation of and skills in design processes, design theory and the work of designers

2 knowledge of and skills in researching, experimenting, generating and communicating creative design ideas and solutions

3 knowledge and understanding of and skills in the responsible selection and safe use of materials, tools and techniques

4 knowledge, understanding and appreciation of the impact of innovation and emerging technologies on the individual, society and the environment

5 knowledge of and skills in managing quality solutions to successful completion

6 understanding and appreciation of and skills in evaluating and reflecting on the success of their own and others’ design activities.

**Unit Length**

10 weeks. 5 (1 hour) periods per fortnight.

**Syllabus Outcomes**

The outcomes used in this document are from the Board of Studies Teaching and Educational Standards (BOSTES) NSW. <http://www.boardofstudies.nsw.edu.au/syllabus_sc/>

**A note to teachers about practical experiences**

To satisfy the requirements of the syllabus students must undertake a range of practical experiences that occupy the majority of course time. Practical experiences will be used to develop knowledge and understanding of, and skills, in designing, producing and evaluating. Student capability, confidence and expertise at their current stage of development is an important consideration in determining the teaching and learning sequences in the course.

**Essential design-related content**

The essential design-related content assists students to understand the application of design processes in the completion of design projects. Structured design processes assist people to apply technological know-how in the creative development and production of quality solutions to identified needs and opportunities.

**General Capabilities:** *(See Teaching and Learning Program to identify links to General Capabilities)*

Learning Across the curriculum used in this document are from the Board of Studies Teaching and Educational Standards (BOSTES) NSW <http://syllabus.bostes.nsw.edu.au/mathematics/mathematics-k10/learning-across-the-curriculum/>

The cross-curriculum priorities:

* *Aboriginal and Torres Strait Islander histories and cultures Aboriginal and Torres Strait Islander histories and cultures*
* *Asia and Australia's engagement with Asia Asia and Australia's engagement with Asia  *
* *Sustainability* Sustainability

The general capabilities:

* *Critical and creative thinking Critical and creative thinking*
* *Ethical understanding Ethical understanding*
* *Information and communication technology capability Information and communication technology capability*
* *Intercultural understanding Intercultural understanding*
* *Literacy Literacy*
* *Numeracy Numeracy*
* *Personal and social capability Personal and social capability*

Other learning across the curriculum areas:

* *Work and enterprise* Work and enterprise

**Differentiation of learning**

This Unit can be differentiated by using the four classroom elements based on student readiness, interest, or learning profile. These being the Content, Process, Products and Learning environment. Examples may include:

* Summary of lesson structure on board each class
* Assessing prior knowledge and revision of last lesson
* Student’s given hard copies of material used on board
* Use peer support to assist students
* Research projects modification having only literal questions
* Allow for the different rate of learning for individual students
* Additional projects for higher achieving students
* Adjust the learning environment to assist student learning
* Delete already mastered material from unit
* Add new content, process, or product expectations to existing project
* Provide unit work for able students at an earlier stage than usual.

**Literacy**

During the planning, construction and evaluation of practical projects students communicate ideas in oral, written and graphical forms. The use of industrial terminology and technical language develop subject literacy. Some examples are:

* Work method statement
* Safe work method statement
* Parts list
* Design process folio
* Statement of intent
* Evaluation of project.

**Numeracy**

Numeracy skills are integral to the development of all practical projects through measurement, costing of materials, parts list and the interpretation and production of a variety of drawings. Some examples are:

* Cost cutting list
* Marking out the project
* Reading measurements from project drawings.

**ICT capability**

* Students are to access technologies to search for current information on rocket design and production.
* They are to use ICT to compile their portfolio and to assist with mathematical calculations.
* They are to utilise ICT to produce images of their rocket designs and print these for inclusion in their folios.

**Critical and creative thinking**

* Students are to use critically thinking in the estimation of expected results
* Creative thinking is used in the development of their rocket design and ongoing modifications.
* Students are to use critically thinking to interpret results and implement strategies to find solutions to their design project.
* Engage in first hand investigation and design projects.
* Posing questions and making predictions.

Course Content and Weighting Overview

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Course Content |  | Weightings | |
|  | **Yr 7/8** |  | |
| Theory Component20% | Health and Safety  Rocket and engineering physics terms  What is Design?  Elements of Design  The Design Process | **Unit 2 – Water powered rocket**  Practical  Folio  **Unit 3 – Air powered rocket**  Practical  Folio  TOTAL | 15  5  25  5  50 |
| Practical Component80% | Projects + Folio |
| Safety Component | General Workshop Safety  Timber and Metal work hand tools  Power Tool Safety & Main  General Machine Safety |

**Scope and Sequence**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| STEM – Rockets | | | | | | | | | |
| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 |
| WHS and  Risk Management | Water powered rocket design Build a launch system Design air rocket Testing Phase Competition phase | | | | | | | | |
| WHS | Metalwork hand tools | Types of engineering drawings | Design and construction | Design and construction | Design and construction | Engineering calculations | Theory of flight | Report writing | Filming |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Outcomes Mapping Grid Years 7 and 8 | | | | | |
| **Stage 4 outcomes** | WHS | Water powered Rocket | Air powered rocket | Portfolio | Film presentation |
| **TAS: Technology (Mandatory) outcomes.**  *A student:* | | | | | |
| 4.1.1 applies design processes that respond to needs and opportunities in each design project | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| 4.1.2 describes factors influencing design in the areas of study of Built Environments, Products, and Information and Communications |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |
| 4.2.1 generates and communicates creative design ideas and solutions |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| 4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the development of design projects | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |  |
| 4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |
| 4.5.1 applies management processes to successfully complete design projects | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| 4.5.2 produces quality solutions that respond to identified needs and opportunities in each design project |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| 4.6.1 applies appropriate evaluation techniques throughout each design project | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |
| **Science: Stage 4 outcomes.** *Students:* | | | | | |
| SC4-5WS collaboratively and individually produce a plan to investigate questions and problems |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |
| SC4-9WS presents science ideas, findings ad information to a given audience using appropriate scientific languages, text types and representations |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |
| SC4-10PW describes the action of unbalanced forces in everyday situations |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |
| **Mathematics: Stage 4 outcomes.**  *Students:* | | | | | |
| MA4-1WM a student communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |
| MA4-2WM A student applies appropriate mathematical techniques to solve problems- problem solving |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| MA4-4NA compares orders and calculates with integers, applying a range of strategies to aid computation |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| MA4-8NA generalises number properties to operate with algebraic expressions |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| MA4-19SP collects, represents and interprets single sets of data, using appropriate statistical displays | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |
| *Optional extensions outcome:*  MA5.1-10MG applies trigonometry, given diagrams, to solve problems, including problems involving angles of elevation and depression. |  | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** | **C:\Users\jyoung30\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\Y58P9LUJ\orange%20tick[1].jpg** |  |

**Quality Teaching Dimensions and Elements**

| **Dimension** | **Element** | **Teaching Strategies** (examples) |
| --- | --- | --- |
| **Intellectual Quality** | 1.1 Deep Knowledge | * Provide unit or module overviews for students so they can see how the concepts fit into the overall picture. * Use concept maps that explain relationships within a complex issue or topic. |
| 1.2 Deep Understanding | * Plan to do less better * Plan for sufficient time in a lesson or across a sequence of lessons for students to demonstrate deep understanding |
| 1.3 Problematic Knowledge | * Identify and explore the assumptions underpinning a variety of perspectives when presenting a theme or topic. Provide tools to support students to challenge and question knowledge in order to identify assumptions. * Include opportunities for students to construct their own knowledge by engaging in problem solving activities. |
| 1.4 Higher-order thinking | * Provide opportunities for students to construct meaning from information by classifying, summarising, inferring, comparing or explaining. * Pose questions that can have multiple answers or possibilities and ask students to justify their responses and/or evaluate information from a variety of sources. |
| 1.5 Meta-language | * Students develop word banks or subject glossaries, compare multiple meanings of a word in different subjects and contexts or identify key words and alternatives for Internet searches. * Explicitly discuss the way language works in the context of the lesson or activity – e.g. look closely at the differences that words, symbols or their ordering make. |
| 1.6 Substantive Communication | * Encourage students to generate questions about the topic for research and discussion and use these as a basis for lesson development * Teach and model skills and protocols for substantive communication, e.g. active listening, turn taking, open-ended questioning, giving constructive feedback, debating and using body language. |
| **Quality Learning Environment** | 2.1 Explicit Quality Criteria | * Provide students with clear criteria that explicitly describe the quality of work expected. * Assist students to use the quality criteria to reflect on and modify their work as it develops. |
| 2.2 Engagement | * Challenge students and build success by appropriately structuring learning – e.g. scaffolding for students who need more support and designing open-ended tasks that enable a range of responses or a variety of pathways. * Connect learning to what is meaningful and interesting to particular students – e.g. relate the significant ideas to, and include, people with expertise in the field, community events, issues or trends. |
| 2.3 High Expectations | * Ask: *What do I want the students to do to achieve deep understanding or to demonstrate their learning?* * Identify the prior learning of students and monitor their progress in order to support the development of appropriately challenging work for all students. |
| **Quality Learning Environment** | 2.4 Social Support | * Model language and behaviour, which demonstrate respect for others’ ideas, opinions and work. * Teach skills in teamwork, consensus building, active listening and positive feedback. |
| 2.5 Students’ self-regulation | * Ensure activities are purposeful and interesting with clear goals that students perceive to be worthwhile. * Encourage student self-evaluation of progress and achievement on learning tasks. * Ensure students understand the consequences of choices and their behaviours. |
| 2.6 Student direction | * Incorporate scaffolded choices within class learning activities – e.g. tiered activities with multiple entry and exit points so that students can determine where they begin and what challenges they will meet. * Negotiate learning tasks and be open to ideas suggested by students for learning activities. |
| **Significance** | 3.1 Background Knowledge | * Identify and acknowledge the out-of-school background knowledge of students by gaining familiarity with the students’ life outside school * Incorporate background knowledge in learning activities through reference to family, community, previous experience and popular culture. |
| 3.2 Cultural Knowledge | * Develop an understanding of diversity by using a range of resources (human and material) within and across social groups. * Provide opportunities for students to look beyond stereotypes used to describe different social groups. |
| 3.3 Knowledge integration | * Plan to make explicit the connections between topics within a subject using themes or large problems where they can strengthen the learning of key concepts. * Plan and/or teach collaboratively units of work and learning activities in cross-KLA tams – e.g. map common outcomes in order to promote links between subjects or lessons. |
| 3.4 Inclusivity | * Know and value the social and cultural backgrounds of students in your class * Make greater use of the cultural knowledge of the groups represented in the class in the design and development of learning activities. * Encourage students to examine the concepts of “inclusion” and “exclusion” particularly when embarking on group projects and group work. |
| 3.5 Connectedness | * When possible select topics more readily applied to contexts outside of school * Link learning to and encourage discussion about current issues in the local community or popular culture. * Incorporate resources beyond the classroom such as field experts, Internet searches, local community people and resources and the media. |
| 3.6 Narrative | * Recognise and use multiple sources of stories such as histories, biographies, documentaries, personal accounts, case studies, field reports and guest speakers where appropriate to the substance of the lesson. * Plan a variety of opportunities for students to construct their own stories related to the substance of the lesson. e.g. journal writing, diary entries, reflective journals, portfolios, e-mail, scenarios, case studies. |

**Unit 1: Safety**

|  |  |  |  |
| --- | --- | --- | --- |
| STEM-Rockets/ Area of study-Products. | | Unit Title: Safety | Timeframe: 2 Hours |
| Unit Description Students will be introduced into the workshop. Rules routines and expectations will be emphasised. Students are expected to reach personal safety standards acceptable in school and industrial settings.  Students will be introduced to hand and machine tools, equipment, materials, manual handling and techniques relevant to the STEM industry in the form of demonstrations, instruction and tests.  Safe working practices to industry standard are expected as a sound basis for those who will use tools and machines in their adult lives in unsupervised situations. | | Outcomes A student:  4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the development of design projects.  4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project.  SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually | |
| Resources Onguard safety tests.  Junior Workshop A+B, *Schlyder, 2nd Edition.*  Theory Booklets  Safety posters  Workshop and tools | **Background/Prior Knowledge**  Science and Technology K-6  And developing Stage 4 | Quality Teaching *This unit addresses the following elements within the Quality Teaching Dimensions:*  **Dimension**  Intellectual Quality  Quality Learning Environment  Significance | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| STEM: Safety component | | | | | |
| Time | Practical components | Associated theory | Evidence of achievement | QT | Sig |
| Week 1 | (4.3.1,4.3.2,SC4-6WS)   * Introduction to the learning environment for this elective as compared to less intensive mandatory courses. * Demonstrations at all machine points and on all portable machinery. * Introduction to the concept of PPE and how it extends into the industrial setting. | *Health and Safety Theory*   * Schools and the OH&S Act. Roles and responsibilities. * Safety quiz on the workshop and fixed machines that they will be using * Health and Safety Theory | Verbally discuss the safety hazards, requirements in the manufacturing and testing of rockets. | 1.5  2.3 |  |

**Unit 2: Water powered rockets**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| STEM-Rockets/ Area of study-Products. | | Unit Title: Water Powered Rockets | | Timeframe: 4 Hours |
| **Unit Description**  In this unit students learn about rocket science and design principles using Mathematics and Engineering problem solving techniques. Students are challenged to produce a rocket to outperform their peers. A portfolio is compiled by students to collect the information required to produce a safe and effective solution, in the form of a rocket, to the problem of obtaining the greatest height or flight time. | | Outcomes A student:  **TAS: Technology (Mandatory) Outcomes**  4.1.1 applies design processes that respond to needs and opportunities in each design project  4.1.2 describes factors influencing design in the area of study of Built Environments, Products, and Information and Communication  4.2.1 generates and communicates creative design ideas and solutions  4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the development of design projects  4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project  4.5.1 applies management processes to successfully complete design projects  4.5.2produces quality solutions that respond to identified needs and opportunities in each design project  4.6.1 applies appropriate evaluation techniques throughout each design project  **Science: Stage 4**  SC4-5WS collaboratively and individually produces a plan to investigate questions and problems  SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually  SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems  SC4-10PW Describes the action of unbalanced forces in everyday situations  **Mathematics: Stage 4**  MA4-2WM A student applies appropriate mathematical techniques to solve problems – problem solving  MA4-4NA Compares orders and calculates with integers, applying a range of strategies to aid computation  MA5.1-10MG applies trigonometry, given diagrams, to solve problems, including problems involving angles of elevation and depression | | |
| Resources  * Safety posters * Metal workshop and tools * Student folio * YouTube Clips of Water rockets * Water bottle launchers – purchased * Recycled water/soft drink bottles | **Background/Prior Knowledge**  Science and Technology K-6  And developing Stage 4 | | Quality Teaching *This unit addresses the following elements within the Quality Teaching Dimensions:*  **Dimension**  Intellectual Quality  Quality Learning Environment  Significance | |

|  |  |  |  |
| --- | --- | --- | --- |
| Time | Practical components | Associated theory | Evidence of achievement |
| Weeks 2-3 | * safety and tool equipment use * Reading and interpreting project drawings * Introduction to metal classroom safety and use of tools/ equipment. | *Background*   * Careers in Aviation, Engineering, Science/Technology and Mathematics * Introduction to graphics and working drawings. * Internet, Textbooks, STEM magazines | Students develop projects and folio.  Students complete Water Rocket project and folio including relevant theory. |

| **STEM: Water Rockets** |  |  |  |  |
| --- | --- | --- | --- | --- |
| Students learn about: | Students learn to: | Teaching strategies | QT | Sig |
| **(4.1.1,4.3.2,MA4-2WM,SC4-8WS,MA4-8NA/MA5.1-10MG)**   * The design principles of water rockets * Safety issues involved in firing rockets * Basic water/air ratios and effect on lift | * use tools, materials and techniques in a responsible and safe manner in the design project. * maintain tools and equipment including computer equipment * Design and produce their own rocket * Measuring and quantifying materials required * Select and correctly use appropriate hand and machine tools for a design project | * Students watch **YouTube** clips of Water Rockets to gather ideas * Working through project folio will cover propulsion theory, rocket parts, rocket science * Students will design their own rocket using everyday objects at hand * Students make basic calculations of rocket flights * Demonstrations are to be given to ensure that students maintain a safe environment. | 1.5  2.3  3.1 |  |
| **(4.1.1,4.3.2,MA4-2WM,SC4-8WS,MA4-8NA/MA5.1-10MG)**   * The design principles of water rockets * Safety issues involved in firing rockets * Basic water/air ratios and effect on lift | * use tools, materials and techniques in a responsible and safe manner in the design project. * maintain tools and equipment including computer equipment * Design and produce their own rocket * Measuring and quantifying materials required * Select and correctly use appropriate hand and machine tools for a design project | * Students watch **Youtube** clips of Water Rockets to gather ideas * Working through project folio will cover propulsion theory, rocket parts, rocket science * Students will design their own rocket using everyday objects at hand * Students make basic calculations of rocket flights * Demonstrations are to be given to ensure that students maintain a safe environment. | 1.5  2.3  3.1 |  |
| 4.1.1,SC4-5WS,MA4-2WM,4.2.1,MA4-1WM,SC4-8WS,4.6.1)Workplace Communication Skills  * methods used to generate creative design ideas including * mind mapping * brain storming * sketching and drawing * use of design folio to record and reflect on design ideas and decisions * communication methods including * drawings, sketches and models * written reports   **(4.5.1,4.5.2, MA4-4NA, MA4-19SP)**  **Production**   * successfully completes design project | * use a variety of methods to generate creative design ideas for each design project * use a design folio to record and reflect on design ideas and decisions * sketch, draw and model to aid design development * communicate information appropriate to specified audiences * assemble rocket as per design folio | Students will develop the folio of their Water Rocket project.  Students will participate in class activities that allow them to explore different ways of communicating information.  Students produce a successful rocket design | 1.4  1.2  1.5  3.3  2.2 |  |

|  |
| --- |
| **Evaluation** |
| Positive / Negative components within unit:  Changes made (additional resources, change of project etc.)  Assessments: A design- Sketches, design modification, justification of design, decisions and final design/ Design process (Criteria for success, Research, Experimentation, A product, Evaluation)  Teacher Name: Signature: Date: / /2016 |

**Unit 3: Air Powered Rocket**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| STEM-Rockets/ Area of study-Products. | | Unit Title: Air Powered Rocket | | Timeframe: 12 Hours |
| **Unit Description:** In this phase of the unit students are to add onto their acquired knowledge of rocket science by constructing both the launching system and the individually designed rockets. Students will be involved in the production of the trigger system but only one will be used to ensure student safety. Students will also learn more about calculations of height by going through a Clinometer exercise where they are able to calculate height from angles and distance landed from observer. The culmination of this activity is a competition for the best rocket in regards to height and time travelled as well as best overall design.    In | | Outcomes A student:  **TAS: Technology (Mandatory) Outcomes.**  4.1.1 applies design processes that respond to needs and opportunities in each design project  4.1.2 describes factors influencing design in the area of study of Built Environments, Products, and Information and Communication  4.2.1 generates and communicates creative design ideas and solutions  4.3.1 applies a broad range of contemporary and appropriate tools, materials and techniques with competence in the development of design projects  4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project  4.5.1 applies management processes to successfully complete design projects  4.5.2 produces quality solutions that respond to identified needs and opportunities in each design project  4.6.1 applies appropriate evaluation techniques throughout each design project  **Science: Stage 4 Outcomes**  SC4-5WS collaboratively and individually produces a plan to investigate questions and problems  SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually  SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems  SC4-10PW Describes the action of unbalanced forces in everyday situations  **Mathematics: Stage 4 Outcomes**  MA4-1WM A student communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols - communicating  MA4-2WM A student applies appropriate mathematical techniques to solve problems – problem solving  MA4-4NA Compares orders and calculates with integers, applying a range of strategies to aid computation  MA4-16MG Applies Pythagoras’ theorem to calculate side lengths in right-angled triangles, and solves related problems  MA4-19SP Collects, represents and interprets single sets of data, using appropriate statistical displays  MA5.1-10MG applies trigonometry, given diagrams, to solve problems, including problems involving angles of elevation and depression | | |
| Resources  * Safety posters * Metal workshop and tools * Student folio * NASA internet resources * Purchased launch kit materials * Air Rocket Posters * Safety Equipment i.e. Goggles and Hard Hats * Soft drink bottles and recycled materials | **Background/Prior Knowledge**  Science and Technology K-6  And developing Stage 4 | | Quality Teaching *This unit addresses the following elements within the Quality Teaching Dimensions:*  **Dimension**  Intellectual Quality  Quality Learning Environment  Significance | |

| **STEM – Air Powered Rockets** | | | | |
| --- | --- | --- | --- | --- |
| Students learn about: | Students learn to: | Teaching strategies | QT | Sig |
| **(4.3.2, SC4-6WS)**  **Occupational Health & Safety**   * risk management strategies * responsible behaviour in working environments * Occupational Health and Safety practices * the safe and responsible use of materials, tools and techniques in each design project | * use tools, materials and techniques in a responsible and safe manner in each design project. * maintain tools and equipment including computer equipment | Students will be conducted into the correct and safe use of all materials and tools and equipment.  Demonstrations are to be given to ensure that students maintain a safe environment. | 1.5  2.3  3.1 |  |
| **(4.3.1)**  **Tools & Equipment**   * specific tools relating to air rocket technologies * the function, selection and correct use of a range of contemporary tools used for construction of rocket and launch system | * select and correctly use appropriate hand and machine tools for a design project | Demonstrations during practical lessons.  Students manufacture a rocket using various tools they are competent with. Each rocket may require different tools to be used. | 1.5  1.2  2.1 |  |
| 4.2.1, 4.1.1, SC4-5WS, SC4-8WS, MA4-1WM, MA4-2WM)Workplace Communication Skills  * methods used to generate creative design ideas including * mind mapping * brain storming * sketching and drawing |  |  |  |  |
| **(4.2.1., 4.1.1, SC4-%WS, SC$-8WS, MA4-1WM, MA4-2WM)**  **Workplace Communication Skills**   * Methods used to generate creative design ideas including * Mind mapping * Brain storming * Sketching and drawing   **(4.6.1,SC4-10PW)**   * use of design folio to record and reflect on design ideas and decisions * communication methods including * drawings, sketches and models * written reports | * use a variety of methods to generate creative design ideas for each design project * use a design folio to record and reflect on design ideas and decisions * sketch, draw and model to aid design development * communicate information appropriate to specified audiences * assemble rocket as per design folio | Students will develop the folio of their STEM projects.  Students will participate in class activities that allow them to explore different ways of communicating information.   * Students watch **YouTube** clips of Air Rockets to gather ideas * Students are involved in construction of the launching system in small groups * Working through project folio will cover propulsion theory, rocket parts, rocket science, and mathematical calculations in relation to height, speed and trajectory. * Students will design and construct their own rocket using provided materials and workshop tools. * Students make calculations of rocket flights * Demonstrations are to be given to ensure that students maintain a safe environment.   Students produce a successful rocket design | 1.4  1.2  1.5  3.3  2.2 |  |

|  |
| --- |
| **Evaluation** |
| Positive / Negative components within unit:  Changes made (additional resources, change of project etc.)  Assessments: : A design- Sketches, design modification, justification of design, decisions and final design/ Design process (Criteria for success, Research, Experimentation, A product, Evaluation)  Teacher Name: Signature: Date: / /2016 |

**Project - Rockets**

Design situation:

In this unit you will learn about rocket science and design principles using Mathematics and Engineering problem solving techniques. You will be challenged to produce a rocket to outperform your peers. You will individually compile a portfolio of the information you collect to produce a safe and effective solution, in the form of a rocket, to the problem of obtaining the greatest height or flight time.

Design brief:

Working as part of a collaborative team complete the following:

1. Design and construct a device that maximises height or flight time. Your task will involve designing a rocket to be launched from a common launch pad.

\* Students explore variables in rocket design including fin design, shape of rocket, rocket size and material used to construct the rocket.

\* Students apply knowledge gained through research and experimentation to develop optimum rocket design using a commercial prototype.

\* Students make decisions and explain principles based on mathematical evidence.

2. Design and construct a rocket to measure height and speed.

\* Students explore variables in the design and construction of the rocket

\* Students apply knowledge gained through experimentation to develop a rocket that demonstrates the optimum height or time travelled.

\* Students explain principles based on mathematical evidence.

3. Use a clinometer to show how high the rocket travelled and a stopwatch to measure how long the rocket travelled.

Common assessment:

Each individual will produce a design folio documenting design, criteria for success, research, experimentation, production and evaluation.

\* Design – sketches, design modification, justification of design decisions and final design.

\* Criteria for success – will be established early in the project and be used as an ongoing evaluation tool to monitor progress and determine success.

\* Research – rocket designs.

\* Experimentation –Rocket flight times and heights, tools, materials and techniques.

\* Production – documentation from initial ideas to finished product (video, blogs, wiki, log book, webpage).

\* Evaluation – justification of decisions made to meet the need identified in the design brief.

An in-class assessment task allows you to reflect on your project.

## *STEM Project: Rockets*

## *Rubric: to assess folio and practical component of project*

| **Grade** | **Area** | **Criteria** |
| --- | --- | --- |
| **A** | Science | Demonstrates deep knowledge of renewable and non-renewable resources including current innovative technologies and applies this to problem solving.  Demonstrates a deep understanding of the underlying scientific principles relating to renewable and non-renewable resources. Demonstrates a thorough understanding of sustainability and relates this to current examples.  Clearly identifies all components of the scientific method. Analyses data from experiments and clearly presents findings using tables and/graphs.  Clearly justifies decisions made to design and clearly evaluates. |
| Technology | Analyses data from research and experimentation and uses this to justify decisions when following a design process to produce an efficient rocket.  Independently used tools to produce a rocket design that is produced in the classroom.  Demonstrates a deep understanding of the use of a design process to create good design solutions through a well-documented design portfolio. |
| Mathematics | Calculates heights and speed, solves real- life problems involving heights and speeds, and converts information into a simplified rate. Define and label angles. Recognises the basic trigonometry used in calculating height and can apply these to problem solving using formulas. Communicates mathematically, problem solves and reasons when justifying solutions to solve the problem. |
| **B** | Science | Demonstrates good knowledge of renewable and non-renewable resource including current innovative technologies.  Demonstrates a good understanding of the underlying scientific principles relating to renewable and non-renewable resources. Demonstrates a good understanding of sustainability and relates this to current examples.  Clearly identifies most components of the scientific method. Analyses data from experiments and presents findings using tables and/graphs.  Clearly justifies decisions made to design and evaluates. |
| Technology | Evaluates data from research and/or experimentation and justifies decisions when applying this through a design process to produce an efficient rocket.  Effectively uses tools to produce a rocket design that is produced in the classroom.  Demonstrates a good understanding of the use of a design process to create design solutions. |
| Mathematics | Calculate heights and speed, solves real- life problems involving heights and speeds Define and label angles. Recognises the basic trigonometry used in calculating height and can apply these to problem solving using formulas. Communicates mathematically, problem solves and reasons when justifying solutions to solve the problem. Communicates mathematically for some strategies and describes solutions to solve the problem. |
| **C** | Science | Demonstrates sound knowledge of renewable and non-renewable resource including a current technology.  Demonstrates sound understanding of the underlying scientific principles relating to renewable and non-renewable resources. Demonstrates sound understanding of sustainability and relates this to current examples.  Identifies some components of the scientific method. Analyses data from experiments and presents findings using tables and/graphs.  Shows some justification of decisions made to design and attempts to evaluate. |
| Technology | Uses data from research or experimentation and identifies reasons for decisions when using a design process to produce an efficient rocket design.  Used tools to produce a rocket design that is produced in the classroom.  Demonstrates a sound understanding of the use of a design process to create a design solution. |
| Mathematics | Calculates simple heights and speeds. Defines and labels angles. Recognises the basic trigonometry used in calculating height and can apply these to problem solving using formulas provided. Communicates the strategies used and describes a solution to solve the problem. |
| **D** | Science | Demonstrates a basic knowledge of renewable and non-renewable resource including a current technology.  Demonstrates a basic understanding of the underlying scientific principles relating to renewable and non-renewable resources. Demonstrates a basic understanding of sustainability.  Identifies some components of the scientific method. Attempts to analyse data from experiments and attempts to present findings using tables and/graphs.  Shows basic justification of decisions made to design and shows a basic evaluation. |
| Technology | Uses data and identifies some reasons for decisions when using a design process to produce a rocket design. Used tools to produce a rocket. Demonstrates a basic understanding of the use of a design process to create a design solution. |
| Mathematics | Calculates some heights and speeds. Defines and labels some angles. Communicates some information and shows the mathematics they are using to solve the problem. |
| **E** | Science | Demonstrates a limited knowledge of renewable and non-renewable resource including a current technology.  Demonstrates a limited understanding of the underlying scientific principles relating to renewable and non-renewable resources. Demonstrates a limited understanding of sustainability. Identifies some components of the scientific method. Shows a limited analysis of data from experiments. Shows limited justification of decisions made to design. |
| Technology | Produces a basic rocket design with limited justification of decisions.  Used tools.  Produced limited or no documentation of a design process. |
| Mathematics | Calculates some heights and speeds. Labels some angles. Communicates some information about the strategy used to solve the problem. |

**Water Rocket**

Purchased water rocket kit from science stores.

**Air rocket internet site:**

MAKE: Projects

[Compressed Air Rocket](http://makezine.com/projects/make-15/compressed-air-rocket/)

<http://makezine.com/projects/make-15/compressed-air-rocket/>

also, PDF download:

<http://makezine.com/2010/04/14/weekend-project-compressed-air-rock/>

links to <http://cdn.makezine.com/make/2010/04/compressedairrocket.pdf> [PDF]