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| **C:\Users\NELBATOORY\Desktop\2353_NSWED_STEM_LOGO.png**  Campbelltown Performing Arts High School  Stage 4 Integrated STEM Program Solar MOTO | | | | | | | |
| **Teacher: Various** | | **Class: Year 8** | | **Term: 1** | | **Year: 2016** | |
| Area of Study: Product | | Design Specialisation: Mixed Materials | | Duration: 10 to 11 Weeks  Timetable model: The suggested timeline is based on a 2 period a cycle allocated from each of Science and Mathematics with flexibility in allocation depending of stage of project based learning. | | | |
| **Big ideas/key concepts** | | | | **Why does this learning matter?** | | | |
| Technology Mandatory   * Students learn about the role of designers and are able to work to a design brief in the creation of design solutions. * Students are able to use the design process during the completion of a set task. * Students are able to choose appropriate technology in the completion of a design folio. * Students are able to research a specific culture of their choice. * Students to acquire skills in working with metals and other materials in the production of their design project.   Science  The key concepts I want students to learn:   * Forces can influence the motion of objects. * Energy exists in many forms and can transform from one form to another. * Technology has incorporated the fundamental concepts of forces and energy.   Mathematics  The key concepts I want students to learn:   * Data can be presented in a range of different ways, that enable us to communicate clearly what that data represents * Graphs, charts and tables can be interpreted and conclusions drawn about the information presented in them * Data can be analysed to give insight into measures of location and spread, and meaningful conclusions can be drawn from this * Percentages can be used to represent rational numbers so that comparisons can be made easily between numbers, and results can be generalized easily | | | | Technology Mandatory   * 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 that occur in manufacturing industries. * Students need to be able to follow a process to complete a design task that fulfills the design brief or project proposal. It also gives significance to the role of designers in society. * Students have the opportunity to learn about and apply various forms of ICT in real life situations. * Students have the opportunity to learn about a culture in greater depth and create a product that showcases that culture and convey their findings to other students within the class group.   Science   * Forces can affect our everyday lives. * Energy transformations occur around us continuously. * Humans need to utilise forces and energy to enrich their life but emphasis needs to be placed on sustainability.   Mathematics:   * Students will develop skills for organising data into categories, graphs and summaries so that results can be analysed, useful comparisons can be made and underlying trends determined. * Students will develop skills to communicate their understanding of data graphically, numerically and visually * Students will develop an understanding of representing proportion using percentages, and how to make proportional information more meaningful by expressing it as a percentage. Students will be able to generalize results. | | | |
| **Place in scope & sequence/Building the field** | | | | **Technology Focus outcomes** | | | |
| This is the first time students are completing stage 4 forces and energy topics in Science and Statistics and percentages in Mathematics. These topics have great applications in our everyday life. Students bring with them some knowledge on Solar Energy and its uses and build on this throughout the unit.  Students have to integrate scientific knowledge, mathematical concepts, ICT skills, technological know-how and practical work skills throughout the unit. They integrate this knowledge to produce not only a design Folio\* but also a creative, innovative and collaborative sustainable transport solution for an identified community group.  This is the first STEM PBL for stage 4. | | | | Technology Mandatory  A student:  4.1.1- applies design processes that respond to needs and opportunities in each design project  4.3.2- demonstrates responsible and safe use of a range of tools, materials and techniques in each design project  4.5.2- produces quality solutions that respond to identified needs and opportunities in each design project  4.6.2 identifies and explain ethical, social, environmental and sustainability considerations related to the design project | | | |
| **Science Outcomes** | | | | **Mathematics Outcomes** | | | |
| **SC4-5WS** collaboratively and individually produces a plan to investigate questions and problems  **SC4-7WS** Processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions.  **SC4-9WS** Presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations.  **SC4-11PW** Discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations | | | | **MA4-19SP** a student collects, represents and interprets single sets of data, using appropriate statistical displays  **MA4-20SP** a student analyses single sets of data using measures of location, and range  **MA4-5NA** a student operates with fractions, decimals and percentages  **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  **MA4-3WM** a student recognises and explains mathematical relationships using reasoning- reasoning | | | |
| **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 | | | | | | | |
| **Literacy areas for improvement:** | | | | | | | |
| Technology (Mandatory) students are provided with opportunities to develop literacy skills, particularly technological literacy: Writing – writing a recount, sequencing. Reading - inference, reading for meaning, subject-specific vocabulary in recording their project work as they complete their design projects.  *Students are supplied with a 48 page exercise book for this purpose. Students to use this as a resource to formulate there Record of Procedure.*  Students will be exposed to and learn common concepts and language associated with the “Super Six” comprehension program where six metacognitive thinking strategies assist students to actively process ideas while reading. This active processing allows students to move information into their long term memories and transform their new learning into personal insights, individual note making or new formats. Connecting, predicting, questioning, monitoring, summarising and visualising - these six 'super' skills form a repertoire for actively processing text and making meaning.  Students learn to include subject-specific vocabulary, to describe, classify, and interpret meaning in order to develop and present design solutions using a range of media, including word processing. They evaluate information and construct text for specific audiences at various stages of design development.  Students will continue to be explicitly taught ‘Paragraph Writing’ which is an initiative in the TAS department. TAS staff have developed and implemented recourses in their teaching to ensure students use the correct structure for formulating paragraphs. Teachers periodically collect and assess the work in student journals and offer feedback. TAS students are required to compose increasingly more complex paragraphs for short and long response questions in examinations, in various sections of Design Folios in all stages and class presentations. Students in all stages undertake journal writing to aid in the formation of a Record of Procedure for their folio. Once a week students reflect on the week in 3 areas:  I learnt, I Felt, I did …    Students are further exposed to the terms that aid in the formation of examination responses and report writing. Some of the terms included and examples of how are below:   * ***Identify*** and appropriate adhesive to glue Balsa wood. * ***Explain*** how you attached the electric motor to the chassis of your vehicle. * ***Analyse*** the gear system you used on your vehicle. * ***Describe*** how a solar panel converts sunlight into electricity. * ***List*** the tools required to construct your vehicle. | | | | | | | |
| **Numeracy areas for improvement:** | | | | | | | |
| In the development of solutions to design problems, students use numeracy concepts such as size, proportion and measurement as tools to assist in the development and communication of design ideas.    Students use numeracy to create simple mathematical models of some aspects of design and use these mathematical models to make predictions about their design and the behaviour of their prototype.    Students follow a sequence (PARDCEM Design Process) to design and construct their project.  Students interpret, collect and analyse data to develop their ideas relating to the motivation for the project. This may include: fossil fuel use, long term climate data and the need for sustainability, design properties of existing solar/electric cars.    Students develop their individual designs using 2D and 3D communication methods, including accurate diagrams and measurement calculations and develop these into a 3D prototype. Students accurately use various measuring tools in the design and construction of their project.    Students analyse their findings and present information related to the project using a variety of numeracy skills such as data analysis, presenting data in tables, charts and graphs, scale drawing, and flow charts.    Students follow a sequence to construct their design, visually deconstructing a sample to develop an understanding of the component parts shape, size and materials and the assembly of the project. In groups. They then construct an individual component employing the use of a 3D CAD program. Each of these is assembled to present a single completed design. | | | | | | | |
| **Valid improvement areas** | | | | | | | |
| Calculate the difference between data.  Distinguish types of argument and recognise a scientific argument  Draw a conclusion from collected data.  Apply definition of technology.  Apply information from a diagram. | | | | | | | |
| **Aboriginal 8 ways - four areas of focus** | | | | | | | |
| **Deconstruct, Reconstruct**  We work from wholes to parts, watching and then doing. Deconstruct/Reconstruct: Modelling and scaffolding, working from wholes to parts. Begin with the whole structure, rather than a series of sequenced steps  **Story Sharing** We connect through the stories we share. Story Sharing: Approaching learning through narrative  **Non- verbal** We see, think, act, make and share without words. Non-verbal: Applying intra-personal and kinaesthetic skills to thinking and learning  **Learning maps**  We picture our pathways of knowledge. Learning Maps: Explicitly mapping/visualising processes  [**https://intranet.ecu.edu.au/\_\_data/assets/pdf\_file/0016/510073/8-Aboriginal-ways-of-learning-factsheet.pdf**](https://intranet.ecu.edu.au/__data/assets/pdf_file/0016/510073/8-Aboriginal-ways-of-learning-factsheet.pdf)  [**http://8ways.wikispaces.com/**](http://8ways.wikispaces.com/) | | | | | | | |
| **ICT target areas** | | | | | | | |
| Projects will integrate a variety of ICT applications including:   * word processing to assist planning, data collection and recording, and specifically the presentation of design folios * graphics in the form of existing and created images in design development and presentation * electronic communication in the researching of information * software management in the efficient storage of electronic information. * efficient researching using the Internet as a research tool. * collection of ICT data, collected, tabulated and communicated in an ICT folio. * digitally photographing their work to evaluate progress and then uploading that to their digital folio. * create 3D designs of at least 1 component which is to be 3D printed and included in the working prototype | | | | | | | |
| **Assessment** | | | | | | | |
| Part A. Students are to, in a group, design a vehicle that is powered by solar energy and run by a 4 volt electric motor. The vehicle design must include the use of mixed materials. Students then create one of their design concepts in a workshop situation.  Part B. Students are to individually, complete a design folio which traces the design phase of their Solar Vehicle creation, including sections as follows:   * Introduction * Project Proposal * Research Section * Development of Concepts and Ideas (Includes the 3D component to be 3D printed)   Then students complete the recording phase of their folio with a:   * Record of Procedure and an * Evaluation   Students are to create their folio using a Slideshow, Video, Oral Presentation (ICT Accompanied), and PowerPoint or Word Processed document (Displayed to the class during presentation). Students are to present their folio to the class for peer and self-assessment. | | | | | | | |
| **Week 1** | | | | | | | |
| **TAS** | **Science** | | **Mathematics** | | **Integrated learning experiences** | | **Evidence of learning** |
| Students are to design a Solar Vehicle that is intended to be a functioning prototype to be raced against the solutions of their peers under controlled conditions. The Solar Vehicle must include the use of metal, timber (Balsa wood), a 3D printed polymer component, a solar cell and a 4 volt motor. Students are then to create one of their design concepts in a workshop situation.  The design process must be recorded in a digital design folio following the PARDCEM design process.  What is a vehicle?  Guide/lead students through the research items they need to consider and the affects and impacts they will have on their vehicle's results.\* | SC4-11PW A student discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations  The use of Science in the choice of   1. Materials and components of the solar car 2. Shape and placement of components 3. Testing   Specific science outcomes include:  PW1 Change to an object’s motion is caused by unbalanced forces acting on the object.  Students:  a. identify changes that take place when particular forces are acting  b. predict the effect of unbalanced forces acting in everyday situations (3 lessons) | | MA4‑19SP A student collects, represents and interprets single sets of data, using appropriate statistical displays    MA4‑5NA operates with fractions, decimals and percentages    Percentage composition, decreasing by a percentage | | **Mathematics**  Students interpret a range of data displays containing information about existing solar cars/electric cars, including performance, proportion of use, how use has changed over time etc. This lesson will help students understand the broader purpose of their project, and how it fills a real world need, as well as exposing them to a range of data displays and the numeracy skills necessary to interpret them (1 lesson)  **Science**  a) Choice of materials and components of the solar car. Students learn the following (1 lesson).   1. Define the term force as “a push, pull or twist in a given direction”. (basic) 2. Brainstorm the general effects forces may have on everyday objects. (basic) 3. Define the term “balanced and unbalanced forces “unbalanced force”. (core) 4. Predict what happens to objects that are exposed to unbalanced forces.    (core ) 5. Carry out investigations to determine the effect of unbalanced forces on everyday objects. (core)   This knowledge is used in the following inquiry task to allow the students to answer the question; Which combination of materials will allow my solar car to move the fastest? (2 lessons)   1. Inquiry practical: How does weight of material affect its motion and therefore force on a surface? (direct link to materials used on their TAS project)   **Mathematics**   1. Students use percentage composition to carry out "thought experiments" to determine the effect of varying mass of vehicle components, and generalise these results using percentages. Emphasis is on accuracy of calculations, and applications of results to all sizes 2. Extension- multiplicative percentages, e.g. if a component that was originally 20% if the total is reduced by 40% it will now be60% time 20&% = 12% of the total (one lesson)   **TAS**   1. Students given a copy of the two tasks to be completed for the term and are given guidelines to create a Project Proposal for the term’s work. Students to use ‘Super Six’ visualising template to help formulate a Project Proposal to the folio. (Students do a series of six sketches in boxes to depict the major points to be included in their Proposal)      1. Students to identify and research   A range of materials that could be used to build the chassis of the vehicle but must include Balsa Wood. Materials appropriate for axels but must include mild steel rod.  Solar panels  i) Types  ii) How they convert the sun’s  energy to electricity  iii) How they can be used as a  power source  Electric Motors  i) Electromagnetic technology  ii) Power ratings  Gear systems  i) Involute gears  ii) Spur gears  iii) Worm gears  iv) Pulley gears | | * + Students write their definition of a force, then evaluate it and correct it with class input.   + Students construct a brainstorm page to show effects of forces (change in magnitude and direction of motion, change in shape of an object).   + Students draw diagrams of everyday objects exposed to “balanced forces” and “unbalanced forces”.   + Students describe observations by sketching the effect of unbalanced forces on some everyday objects.   + Students record what force is required to move varied masses across a surface. * Students develop a comprehensive overview of the available designs. |

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| **Week 2** | | | | |
| **TAS** | **Science** | **Mathematics** | **Integrated learning experiences** | **Evidence of learning** |
| Rendering techniques  Google SketchUp saving as an STL file | PW1 cont.  d.analyse some everyday common situations where friction operates to oppose motion and produce heat  e. investigate factors that influence the size and effect of frictional forces  PW3 Energy appears in different forms including movement (kinetic energy), heat and potential energy, and causes change within systems  Students:  e. investigate some everyday energy transformations that cause change within systems, including motion, electricity, heat, sound and light | MA4‑19SPa studentcollects, represents and interprets single sets of data, using appropriate statistical displays    MA4‑20SPa studentanalyses single sets of data using measures of location, and range | **Science**  b) What is the best shape of materials that can be used in the solar car?  Hook lesson (1 lesson); Students research the shapes of various named models of cars e.g. Ferrari, van, 4wd, sedan and go karts and predict which ones would be fastest and give reasons.     1. Define the term “friction” and air resistance as the forces that oppose the motion of an object. (basic) 2. Analyse some everyday examples of friction that opposes motion and creates heat. (core) 3. Define the term “lubricant”. (basic)   This knowledge is used in the following inquiry task to allow the students to answer the question; Which is the best shape of materials that will allow my solar car to move the fastest? (2 lessons)  Inquiry practical:   1. Carry out an investigation to determine the factors that influence the magnitude of friction and the effects of this friction when a varied mass is dragged across various types of surface using a spring balance scale. (core/extension)   **Mathematics**   1. Students graph results of experiments relating shape of vehicle to air resistance, select the most appropriate display for the data, and use correct scales for axes (one lesson)   **TAS**   1. Students to complete a series of thumbnail sketches of their Solar Vehicle. At least 6 sketches depicting concept designs. Each concept design must include a range of different materials 2. Choose their favourite design and develop a fully rendered drawing of the Solar Vehicle 3. Complete a workshop drawing of the item they wish to manufacture. Must include overall dimensions 4. Completed 3D design of the component to be 3D printed. (Students may choose to design and print more than one component for their final design) | * Students construct a class definition of friction. * Students produce a brainstorm page on everyday situations involving friction. * Students construct a definition of the term “lubricant”. * Students tabulate type of lubricant and situation it is used in. * Students graph the results for friction on different surfaces * Students will complete each section and a final design will have emerged that the student can use to construct their final product. |

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| **Week 3** | | | | |
| **TAS** | **Science** | **Mathematics** | **Integrated learning experiences** | **Evidence of learning** |
| WHS training  Tool and machine instruction  Workshop procedures  Using the 3D printer  Using measurement | PW4 Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations.  Students:  a. identify that most energy conversions are inefficient and lead to the production of heat energy, e.g. in light bulbs | MA4‑19SP collects, represents and interprets single sets of data, using appropriate statistical displays | **Science**  Inquiry task; How does the shape of an object affect the amount of air resistance? (core) (1 lesson continuation from wk2)  C) Choice of bearing materials  Students carry out the following practical activity to allow them to answer the question; What is the best material that reduces friction on bearings? (1 lesson)  Inquiry practical:  1. Students use temperature probes on data loggers to test the amount of heat produced when different bearings are rubbed against other components of the solar car. (core)  2. Students are provided with a table scaffold that shows the combination of components to rubbed together (Basic)  D) Solar energy;  i) In which direction and at what angle should I place my solar panels? ( 1 Lesson)  Inquiry practical:  3. Students use solar kits to test the effect of changing the angle of placement of solar panels on the amount of energy production.  **Mathematics**  4. Students interpret a range of data displays from various sources to answer questions about renewable versus non-renewable energy  **TAS**   1. Students gather materials to build a 1:1 scale model of their design and complete. 2. Students evaluate the model and make recommendations to be included in the working prototype 3. Students begin the construction phase by calculating material quantities and collection of components for use 4. Student groups commence 3D printing their already designed components saved as an STL file. (Groups may print more than one component) 5. Students start to measure and mark chassis material and shape to drawing specifications. | * Students decide and justify their choice of shape for the solar car. * Students construct a table showing the combinations that they trialled and the change in temperature with time. * Students decide and justify their choice of angle for solar panels. . |

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| **Week 4** | | | | |
| **TAS** | **Science** | **Mathematics** | **Integrated learning experiences** | **Evidence of learning** |
| WHS training  Tool and machine instruction  Workshop procedures  Using the 3D printer  Using measurement | PW4 Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations.  Students:  a. identify that most energy conversions are inefficient and lead to the production of heat energy, e.g. in light bulbs | MA4‑5NA operates with fractions, decimals and percentages    MA4‑12MG calculates the perimeters of plane shapes and the circumferences of circles    MA4‑19SP collects, represents and interprets single sets of data, using appropriate statistical displays | **Science**  D ii) Should I store or not store the energy produced by the solar panels? (2 lessons)  Inquiry practical:   * Students use solar kits to test which arrangement gives the biggest number of rotations in a set time; * A) Direct energy from the solar panels? Or * B) Stored energy from 2, 1.5 V batteries? (Energy has to be stored from the solar panels they are using)   **Mathematics**  Students revise circumference of a circle and carry out practical activities with Spirograph/cut out circles etc. to demonstrate the relationship between diameter and distance travelled by a wheel in a revolution, Results are calculated and recorded for different wheel diameters and different gear ratios, and made more meaningful by conversion to percentages, e.g. an increase in diameter of driver gear by 15% leads to a decrease in distance travelled of 30%. Gear ratios can also be presented as percentages to facilitate calculation of driver gear RPM given pinion gear RPM and hence the distance the wheel travels, emphasis placed on accuracy of calculations and the use of percentages to generalise conclusions (two lessons).  **TAS**   1. Student groups decide on and delegate the creation of chassis components to individual members 2. Students create axel mounts/bearing blocks and attach to the vehicle to design specifications 3. Students create and attach mounts for electric motors and solar panel to design specifications | * Students decide and justify their choice of whether to directly or indirectly connect their solar panels. |

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| **Week 5** | | | | | | |
| **TAS** | **Science** | | **Mathematics** | **Integrated learning experiences** | | **Evidence of learning** |
|  |  | |  | **Mathematics**  Analyse data from friction experiments, select appropriate display for data, and analyse to find mean and range (two lessons)  **TAS**  Students fit electric motors and solar panel to design specifications  Students continue to print and fit 3D components as the printer becomes available (e.g. gears and pulleys). Some printing may need to take place outside of class time due to time demands. | |  |
| **Week 6** | | | | | | |
| TAS | Science | | Mathematics | Integrated learning experiences | | Evidence of learning |
| Soldering techniques |  | |  | * Students complete wiring of panel to switch/storage pack, switch/storage pack to electric motor * Students fit first set of gear pulleys for testing | |  |
| **Week 7** | | | | | | |
| TAS | Science | | Mathematics | Integrated learning experiences | | Evidence of learning |
|  |  | |  | * Students have a week to finalise the construction phase of their prototype | |  |
| **Week 8** | | | | | | |
| TAS | Science | | Mathematics | Integrated learning experiences | | Evidence of learning |
|  |  | |  | * Students complete a week of testing through changing gears and or power delivery.(Direct power supply/via a storage pack. (refer to Science inquiry, to store or not to store energy from solar panels) * Students ensure that their folios are current and include a preliminary evaluation | |  |
| **Week 9** | | | | | | |
| TAS | Science | | Mathematics | Integrated learning experiences | | Evidence of learning |
|  | **SC4-5WS** collaboratively and individually produces a plan to investigate questions and problems | | **MA4‑20SP** analyses single sets of data using measures of location, and range | **Science**   * Students go through an overview of fair testing in Science. Identify variables that include independent, dependent and controlled variable in preparation for the racing of their solar cars.   **TAS**   * Students prepare their vehicle for race day * Race day * Students undertake an in-depth analysis of their results and vehicle performance in comparison to that of their peers. * Form an evaluation for inclusion in the folio   **Mathematics**   * Analysis of test data to find mean, median and mode and range of speed and distance tests, under various conditions, and use that data to predict a winner on the final race (one lesson) | | Students construct a table where their results will be entered. This table is in the appropriate format and shows their variables. |
| **Week 10** | | | | | | |
| TAS | Science | | Mathematics | Integrated learning experiences | | Evidence of learning |
|  | SC4-7WS Processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions. | | MA4‑19SP collects, represents and interprets single sets of data, using appropriate statistical displays    MA4‑20SP analyses single sets of data using measures of location, and range    MA4‑5NA operates with fractions, decimals and percentages | **Science**Students go through the analysis of data from their race day to clarify and move towards creating a prototype of their sustainable transport solution.    **Mathematics**Use percentages to scale from prototype to design thinking model of a vehicle that uses sustainable energy and fits a community need Collects and presents data from project in final report, using tables graphs | |  |
| **Resources** | | | | | | |
| **TAS** | | **Science** | | | **Mathematics** | |
| Technology Mandatory: balsa wood, mild steel rod axles, solar panels,4 volt motor, iPads or computers with PowerPoint, excel, google sketch and word processing, 3D printer | | Science: Insight Science 8, solar kits, dynamic trolleys, friction boards, data logger with temperature and motion sensors.  Technology such as iPads with Sparkvue App | | | Mathematics: Cambridge Maths NSW syllabus for the Australian curriculum Year 8, cardboard gear templates, rulers, calculators, laptops with excel. | |

\*see appendix A for design process.

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| **Evaluation of STEM Unit** | |
| **Teacher Evaluation** | **Comments/Variations** |
| |  |  |  |  | | --- | --- | --- | --- | | How did the unit ‘rate’ in these areas? | C:\Users\NELBATOORY\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\KSC8AD1X\smiley-face-300x300[1].jpg | C:\Users\NELBATOORY\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PG8ZUBMK\sceptical[1].jpg | C:\Users\NELBATOORY\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\QMH87JD7\603px-Sad_face.svg[1].png | | Time allocated for topic |  |  |  | | Student understanding of content |  |  |  | | Opportunities for student reflection on learning |  |  |  | | Suitability of resources |  |  |  | | Appropriate sequence of activities |  |  |  | | Differentiation strategies used |  |  |  | | Variety of teaching strategies |  |  |  | | Variety of assessment for/as learning strategies |  |  |  | | Integration of Quality Teaching dimensions |  |  |  | | Integration of 21st century skills |  |  |  | | Literacy strategies used |  |  |  | | Numeracy strategies used |  |  |  | | VALID targets addressed |  |  |  | | After you have taught the unit of work, record in this section your evaluation of the unit and any variations you implemented or would choose to implement the next time you teach the unit. |

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| **Date commenced:** | **Date completed:** |
| Teacher’s signature | Head Teacher’s signature |

**Codes:**

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| Knowledge & Understanding  PW – Physical World | **Learning Across the Curriculum:**  Cross Curriculum Priorities:  ATSI Cultures & Histories ;  Asia & Australia’s Engagement with Asia ;  Sustainability  **General Capabilities for the 21st Century:**  Critical & Creative thinking ;  Ethical Understanding ;  ITC Capabilities ;  Intercultural Understanding ;  Literacy ;  Numeracy ;  Personal & Social Capabilities;  Civics & Citizenship;  Difference & Diversity ;  Work & Enterprise. |

**Quality Teaching Elements**

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| --- | --- | --- | --- | --- | --- |
| Intellectual Quality | | Quality Learning Environment | | Significance | |
| IQ1 Deep knowledge | IQ4 Higher-order thinking | QLE1 Explicit quality criteria | QLE4 Social support | S1 Background knowledge | S4 Inclusivity |
| IQ2 Deep understanding | IQ5 Metalanguage | QLE2 Engagement | QLE5 Students’ self-regulation | S2 Cultural knowledge | S5 Connectedness |
| IQ3 Problematic knowledge | IQ6 Substantive communication | QLE3 High expectations | QLE6 Student direction | S3 Knowledge integration | S6 Narrative |

**Aboriginal 8 Ways of Learning Codes & Symbols:**

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| Non-Verbal – Applying intra-personal & Kinaesthetic skills to learning & understanding | 3_non-verbal.jpg | Deconstruct/Reconstruct – Modelling & Scaffolding, working from wholes to parts. |  |
| Story telling: |  | Learning maps: |  |

**8 Aboriginal Ways of Learning**

<http://8ways.wikispaces.com>

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Story | Maps | Non verbal | Symbol | land | Non linear | Deconstruct | Community |
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8 Ways, Students to experience a variety of 8 Ways strategies in their learning including:

* Story Sharing – Class concept maps of teacher/student background knowledge/ideas, then add to individual research
* Community Links – Connect recycled timber with community needs.
* Deconstruct/reconstruct – Deconstruct a sample project to make connections to reconstruct their own individual project
* Non-Linear – Group work/Concept Maps/Independent Learning/Real-World Links
* Land Links – Use of recycled materials
* Symbols & Images –Map out the plan/scaffold the response - add ICT Research
* Non Verbal – Group deconstruction/ construction task. Individual research using ICT and apply to construction.
* Learning Maps – Concept maps and Flow Charts to develop ideas/understandings and explain researched information.

Campbelltown Performing Arts High School

Stage 4 Integrated STEM Program Solar MOTO

**APPENDIX A**

**Design Process**

Students groups are introduced to or reminded of the PARDCEM acronym, via a mind map, as steps to follow to develop a solution to the Design Situation they are presented with. (Problem, Analysis, Research, Design, Construction, Evaluation, Marketing)

The Design Brief is presented and discussed and a second brainstorm/concept map is created to document their initial concepts and ideas that relate to the Brief. This concept map will be recorded digitally for inclusion in their folios, together with their own individual research.

**Commence Design Folio**

**Introduction:**

Students given a copy of the two tasks to be completed for the term and are given guidelines to create an introduction to the term’s work. Students to use ‘Super Six’ visualising worksheet to help formulate an introduction to the folio (Students complete a series of six sketches in boxes to depict the major points to be included in their introduction).

**Project proposal:**

Students interpret the task given to them and formulate a proposal for the work to be carried out during the term. Students use ‘Super Six’ Prediction worksheet (Word Bingo) to help formulate proposal.

Example below:

You are to draw some sketches in the boxes of things you will need to include in your Project Proposal. Use the briefs you have been given to help you make those decisions.

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**Research section:**

1. Students are to design a Solar Vehicle that is intended to be a functioning prototype to be raced against the solutions of their peers under controlled conditions. The Solar Vehicle must include the use of metal, timber (Balsa wood), a 3D printed polymer component, a solar cell and a 4 volt motor. Students are then to create one of their design concepts in a workshop situation.
2. The design process must be recorded in a digital design folio following the PARDCEM design process. Students to construct a plan for their research section by identifying 15 words that explain or describe solar energy and its use in a vehicle
3. Students to use ICT to research their project.
4. Students to research: ideas, material qualities, techniques and tools related to the construction of their individual design using ICT based technologies. This research includes text, tables and visual images that relate to the design brief.
5. Students to commence research items in accordance with their plan. Which must include:
   * Materials, including: Different materials that could be used to build the chassis of the vehicle but must include Balsa wood.
   * Materials appropriate for axels but must include mild steel rod
   * Electric motors and their inherent properties
   * Solar panels
6. Types
7. How they convert the sun’s energy to electricity
8. How they can be used as a power source

* Electric Motors

1. Electromagnetic technology
2. Power ratings

* Forces that a moving vehicle is subjected to

1. Wind and air co-efficiencies (Down force and lift)
2. Friction in relation to the vehicle moving across ground and rotating parts
3. Torque pressure on rotating parts

* Gear systems

1. Involute gears
2. Spur gears
3. Worm gears
4. Pulley gears

* Appropriate tools used for these materials
* Techniques for using these tools for manufacture
* WHS considerations

**Design Section**

Concepts:

Students complete a series of thumbnail sketches of their Solar Vehicle. At least 6 sketches depicting concept designs. Each concept design must include a range of different materials.

* Choose their favorite design and develop a fully rendered drawing of the Solar Vehicle
* Complete a workshop drawing of the item they wish to manufacture. Must include overall dimensions.
* Completed 3D design of the component to be 3D printed. (Students may choose to design and print more than one component for their final design) (The drawings must be included in the digital folio, photo upload etc.)

Students can undertake some virtual prototyping of their gear systems using mathematical equations on circumference of drive and slave gears, and their relationship to movement across ground

**Construction Phase**

Students are to, as a group, construct a different individual component of the project following a drawing, which is then assembled using other respective sub-assemblies constructed by other groups.

Students:

* Calculate lengths of stock material required to construct their specific dimensioned/number parts.
* Measure, mark and cut various stock materials, including sheet metal, tube and quantify other materials.
* Use specific tools and techniques to reduce various stock materials to specific sizes and shapes as a series of sub-assemblies.
* Interpret information from researched information and a measured plan.
* Measure, mark and cut each sub assembly in a specific sequence using specific tools and techniques.
* Sequence their construction and present their work using various communication methods.

**Evaluation**

On completion of the Design Project, students will undertake an evaluation of the product, highlighting the good and bad points and any changes they would make before going into production. The project will be photographed during and at the end of construction for a final evaluation.

The prototype will also be videoed during the competition phase for peer and self-assessment purposes, another form of evaluation.

Students formulate a statement of what STEM education means to them.

**Marketing**

Students are to design and produce a poster advertisement for their product, which will be played displayed during the presentation of their folio to the class.

**Numeracy**

Students are to sequence their folios following PARDCEM.

**ICT**

Students are to use ICT in 3 different ways, create a digital folio, use the Internet as a research tool and use a digital camera to record the progress of construction and upload those pictures to their folios.