Liverpool Boys High School - Integrated STEM Project

Stage 4 Year 8 Project - Move Me

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| **Move me**  **Stage 4, Year 8**  **Semester: 1**  **UNIT DESCRIPTION**  The Year 8 students that have already completed 1 year of this type of project based learning taught by a team of teachers who have integrated all KLA areas into completing 2 projects per term with stand-alone numeracy, literacy and PD/H/PE classes. Comparatively these year 8 students will be taught 3 projects each term with stand-alone numeracy, literacy and PD/H/PE classes and be taught by teachers from within their field of expertise.  This project “Move Me” will incorporate learning outcomes from Technology-mandatory, Science and Mathematics, as well as meeting the cross curricular capability of Sustainability. The other two projects that will be attended are; Humanities (English, language and HSIE), TAS-CAPAC (Technology-mandatory, Visual Arts, Music, Engineering). In previous year 7 projects the students have been exposed to experimentation and science environments, to portfolios and the design process, having developed various products that required these skills.  In this unit students will design/develop/build products that focus on developing their knowledge of fluid mediums, environmental factors, forces, scale diagrams, speed/velocity, mass/volume/capacity, data collection and it’s representation, sustainable energy sources, portfolio development and the design process.  In this unit the students will have three products that they will have to complete;   * Students are to be given a piece of A4 paper and with this they must design and build a paper plane that can travel a distance of 20 metres. * Students are to be given a piece of A4 paper and with this they must design and build a paper boat that can stay afloat on water holding a mass of 30g. * Students are to design and build a mode of transport which can hold a mass of 30g and travel at a minimum of one metre, using a renewable energy source. [*Alternate task: can be powered by an elastic band]*   *Extension: Design can only be made using recyclable material*  **UNIT LENGTH**  1 Term (11 weeks)  **UNIT STRUCTURE**  A single teacher is timetabled for all eleven lessons of a STEM class. Two classes are timetabled for a Science teacher, one for a Mathematics teacher and the final also for a different Mathematics teacher. No Technology teachers appear on this team.  The students have a 10 day cycle, 48 lessons per cycle with 58 minute lessons. 11 lessons per cycle on each of the projects plus 5 lessons literacy, 5 lessons numeracy and 5 lessons Sport/PD/H/PE.  The unit is developed in steps. Steps may be a lesson length or many lessons in length, they are designed so that an area of study is covered in each one. Each step is sequential, but maybe somewhat re-shuffled if required.  Technology  AREA OF STUDY Built Environment  DESIGN SPECIALISATION X  TECHNOLOGY X  DESIGN PROJECT Design, produce and evaluate a vehicle which is powered by a renewable energy source  **Assessment:**  The students will be assessed progressively throughout the unit on their collaborative skills. In summation the individual’s portfolio and their collectively products will be assessed for meeting KLA outcomes  **Resources**   * Murphy, Gill. 2007. Achieve Science Energy Electricity and Movement. Blake Education. * Shadwick, Brian. 1987. Skills Through Science Book 1. Science Press. * Shadwick, Brian. 1988. Skills Through Science Book 2. Science Press. * Thickett, Geoffrey.2010. Core Science Stage 4 Student Workbook. Jacaranda plus. |

**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/>

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| **Science Outcomes** | **Technology Mandatory Outcomes** | **Mathematics Outcomes** |
| *Working Scientifically*  SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge (skills)  SC4-5WS collaboratively and individually produces a plan to investigate questions and problems (skills)  SC4-WS6 follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually  SC4-WS7 processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions  *Knowledge and Understanding*  SC4-10PW describes the action of unbalanced forces in everyday situations  SC4- 16CW describes the observed properties and behaviour of matter, using scientific models and theories about the motion and arrangement of particles  *Values and Attitudes*  SC4-2VA Shows a willingness to engage in finding solutions to science-related personal, social and global issues, including shaping sustainable futures | 4.1.1 applies design processes that respond to needs and opportunities in each design project  4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources  4.6.2 identifies and explains ethical, social, environmental and sustainability considerations related to design projects  Contributing outcomes  4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project  4.4.1 explains the impact of innovation and emerging technologies on society and the environment  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 | *Working Mathematically*  MA4-1WM: a student communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating (working mathematically)  MA4-2WM: a student applies appropriate mathematical techniques to solve problems – problem solving (working mathematically)  MA4-3WM recognises and explains mathematical relationships using reasoning  *Statistics and Probability*  MA4-19SP collects, represents and interprets single sets of data, using appropriate statistical displays  *Measurement and Geometry*  MA4-14MG: uses formulas to calculate the volumes of prisms and cylinders, and converts between units of volume  *Numbers and Algebra*  MA4-7NA operates with ratios and rates, and explores their graphical representation |

**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

| **Steps** | **Outcome** | **Content**  **Students learn about - Students learn to** | | | | **Integrated learning experiences** | **Evidence of learning/assessment strategies**  **Resources** | **Register**  **Evaluation** |
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|  |  |  |  | | | Hook Event:  Students Watch Paper Planes DVD | Paper Planes DVD |  |
| 1 | 4.1.1 applies design processes that respond to needs and opportunities in each design project. | design processes including   * analysing needs, problems and opportunities * establishing criteria for success * researching * generating creative ideas * communicating ideas * experimenting and testing ideas * risk management * managing resources * producing design solutions * evaluating ideas and solutions   needs and opportunities in the areas of study | establish a design process that responds to an identified need and opportunity  apply a design process when developing quality solutions for each design project  establish criteria for successful achievement of needs and opportunities  record design processes and decision making in a design folio for each design project.  consider short-term and long-term consequences of design in the design process  evaluate design processes  identify needs and opportunities that require solutions in the areas of study | | | Design Brief  You have to design and create a paper plane that will fly the furthest from a designated start point.  The teacher may decide to vary the brief to include the fastest, highest or most acrobatic!  Students may decorate the plane.  Constraints – It should only be made from paper, it cannot be larger than an A4 sheet of paper  *Exploring and Defining the task*  Class works through the stages of the design process together  Design Brief  Design Situation  As a class students brainstorm and document the constraints and criteria for success  Exploring and defining the task  Criteria for success  PRODUCT 1  Students create their plane  Have a paper plane flying contest!  Students evaluate their own planes and make changes where necessary and have another go at flying their improved planes | Students will successfully create a paper plane that meets the brief based on each student’s prior knowledge and practice.  Activity: Paper Plane  Students will: successfully create a portfolio using the proforma provided. |  |
| 2 | MA4 - 1WM  a student communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating  MA4-19SP  collects, represents and interprets single sets of data, using appropriate statistical displays | Develop understanding and fluency in mathematics through inquiry, exploring and connecting mathematical concepts, choosing and applying problem-solving skills and mathematical techniques, communication and reasoning  Define '[variable](http://syllabus.bos.nsw.edu.au/glossary/mat/variable-statistics/?ajax)' in the context of statistics as something measurable or observable that is expected to change over time or between individual observations  Investigate techniques for collecting [data](http://syllabus.bos.nsw.edu.au/glossary/mat/data/?ajax), including [census](http://syllabus.bos.nsw.edu.au/glossary/mat/census/?ajax), sampling and observation  Recognize variables as [categorical](http://syllabus.bos.nsw.edu.au/glossary/mat/categorical-variable/?ajax) or [numerical](http://syllabus.bos.nsw.edu.au/glossary/mat/numerical-variables/?ajax) (either discrete or [continuous](http://syllabus.bos.nsw.edu.au/glossary/mat/continuous-variable/?ajax) | | | | Explicit teaching on; measurement , tools of collection, practice worksheets for students to develop skills comparing data, the types of data, organisation and displaying of data, tabulating and graphing sector, bar, frequency, line graphs, analysing data mean median mode, comparing data. | Students will:  Successfully complete the worksheets and power points attached to this step |  |
| 3 | 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 | WS5.1 Students identify [data](http://syllabus.bos.nsw.edu.au/glossary/sci/data/?ajax) to be collected in an [investigation](http://syllabus.bos.nsw.edu.au/glossary/sci/investigation/?ajax) by:  a. identifying the purpose of an investigation  b. proposing the type of information and data that needs to be collected in a range of investigation types, including first-hand and secondary sources  NCCT  WS6 Students conduct investigations by:  a. collaboratively and individually conducting a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125, ACSIS140) PSCEU  b. assembling and using appropriate equipment and resources to perform the investigation, including safety equipment  c. selecting equipment to collect data with accuracy appropriate to the task (ACSIS126, ACSIS141) ICT  d. following the planned procedure, including in fair tests, measuring and controlling variables (ACSIS126, ACSIS141)EUPSC  e. recording observations and measurements accurately, using appropriate units for physical quantities L  f. performing specific roles safely and responsibly when working collaboratively to complete a task within the timelinePSC  g. assessing the method used and identifying improvements to the method (ACSIS131, ACSIS146) CCTWE | | | | Explicit teaching of experimental process; quantitative and qualitative data, inferring and predicting, variables, independent and dependent, controls, risk assessment and bias.  Explicit teaching on environmental factors, experimentation using light meter, wind and thermometers – the tools and their use. How these environmental factors may affect the flight of this plane.  Explicit teaching of mass, weight, volume, capacity and density. Experimentation. | Students will: successfully complete the power points and experiments.  Students complete the worksheet Core Science stage 4-Density pages 14/15 |  |
|  | *Numbers and Algebra*  MA4-7NA operates with ratios and rates, and explores their graphical representation  MA4-1WM communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols | Choose appropriate units of measurement for [volume](https://syllabus.bostes.nsw.edu.au/glossary/mat/volume/?ajax) and convert from one unit to another (ACMMG195)   * recognise that 1000 litres is equal to one kilolitre and use the abbreviation for kilolitres (kL) recognise that 1000 kilolitres is equal to one megalitre and use the abbreviation for megalitres (ML) * choose an appropriate unit to measure the volumes or [capacities](https://syllabus.bostes.nsw.edu.au/glossary/mat/capacity/?ajax) of different objects, eg swimming pools, household containers, dams LSEuse the capacities of familiar containers to assist with the estimation of larger capacities (Reasoning) CCT * convert between metric units of volume and capacity, using 1 cm3= 1000 mm3, 1 L= 1000 mL = 1000 cm3, 1 m3= 1000 L = 1 kL, 1000 kL = 1 ML   (these go in the box above for STEP 3) | | | |  |  |  |
| 4 | 4.1.1 Applies design processes that respond to needs and opportunities in each design project. | design processes including   * analysing needs, problems and opportunities * establishing criteria for success * researching * generating creative ideas * communicating ideas * experimenting and testing ideas * risk management * managing resources * producing design solutions * evaluating ideas and solutions   needs and opportunities in the areas of study | | establish a design process that responds to an identified need and opportunity  apply a design process when developing quality solutions for each design project  establish criteria for successful achievement of needs and opportunities  record design processes and decision making in a design folio for each design project.  consider short-term and long-term consequences of design in the design process  evaluate design processes  identify needs and opportunities that require solutions in the areas of study | | *Producing Solutions*  Each student completes the procedure text on the production of their plane  Highlight the technology process and the way it is followed du ring the paper plane activity as a class.  Get each student to complete the procedure text for the paper plane that they made. | Students will: successfully answer questions on the technology process and the procedural text. |  |
| 5 | 4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources | experimentation and testing of design ideas | | apply the results of experimentation to designing and making when developing each design project | | *Evaluation*  Students peer evaluate each other procedure text to see if they can follow the instructions easily and successfully | Students will: successfully create the plane and modified portfolio that meets the brief. |  |
| 6 | SC4-5WS collaboratively and individually produces a plan to investigate questions and problems  SC4-WS6 follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually  SC4-WS7 processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions | WS5.1 Students identify [data](http://syllabus.bos.nsw.edu.au/glossary/sci/data/?ajax) to be collected in an [investigation](http://syllabus.bos.nsw.edu.au/glossary/sci/investigation/?ajax) by  b. proposing the type of information and data that needs to be collected in a range of investigation types, including first-hand and secondary sources NCCT  WS6 Students conduct investigations by:  b. assembling and using appropriate equipment and resources to perform the investigation, including safety equipment  c. selecting equipment to collect data with accuracy appropriate to the task (ACSIS126, ACSIS141)  d. following the planned procedure, including in fair tests, measuring and controlling variables (ACSIS126, ACSIS141)  e. recording observations and measurements accurately, using appropriate units for physical quantities  g. assessing the method used and identifying improvements to the method (ACSIS131, ACSIS146) CCTWE  WS7.1 Students process data and information by:  a. summarising data from students' own investigations and secondary sources (ACSIS130, ACSIS145)  NCCT | | | | Explicit teaching of experimental process; quantitative and qualitative data, inferring and predicting, variables, independent and dependent, controls, risk assessment and bias.  Explicit teaching on environmental factors, experimentation using light meter, wind and thermometers – the tools and their use. How these environmental factors may affect the flight of this plane.  Explicit teaching of mass, weight, volume, capacity and density. Experimentation. | Students will:  State the definitions of each of the concepts covered and be able to represent information in a correct graphic way.  Worksheet (Core Science Stage 4, student workbook page 7).  Students will: Successfully carry out experimentation and the documentation of this process.  Practical: Measuring the mass of an object.  Practical: Measuring volume experiment.  Practical: Density experiment  Notes: Heaviness and mass.  Worksheet: Measurements (Skills Through Science book 1 page 30). |  |
| 7 | SC4-16CW describes the observed properties and behaviour of matter, using scientific models and theories about the motion and arrangement of particles | CW1 The properties of the different states of matter can be explained in terms of the motion and arrangement of particles.(ACSSU151)  Students:  a. describe the behaviour of matter in terms of particles that are continuously moving and interacting  b. [relate](http://syllabus.bos.nsw.edu.au/glossary/sci/relate/?ajax) an increase or decrease in the amount of heat energy possessed by particles to changes in particle movement  c. use a simple particle model to predict the effect of adding or removing heat on different states of matter  d. relate changes in the physical properties of matter to heat energy and particle movement that occur during observations of evaporation, condensation, boiling, melting and freezing  e. explain density in terms of a simple particle model  f. identify the benefits and limitations of using [models](http://syllabus.bos.nsw.edu.au/glossary/sci/model/?ajax) to explain the properties of solids, liquids and gases CCT | | | | Explanation of the water cycle-science of water,  Science experimentation +water.  What floats and what does not? Experimentation  Discussion Buoyancy,  Experimentation surface tension.  Discuss how boats float. | Students successfully learn  <http://www.coolaustralia.org/ca_topic/water/>  the states of matter and the changes of.  the definitions of all the vocabulary of the water cycle and be able to label all the areas at which the changes of state occur in the water cycle.  Water and it’s properties cohesion, surface tension, adhesions and capillary action <https://iyc2011jamaica.wordpress.com/water-games/>  Floats and does not float experimentation  Boat floating and building: <https://www.youtube.com/watch?v=CvWrkxzCiaY>, <https://www.youtube.com/watch?v=pnIlE1xD-yM> |  |
| 8 | SC4-10PW describes the action of unbalanced forces in everyday situations  SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge | PW1 Change to an object's motion is caused by unbalanced forces acting on the object. (ACSSU117)  Students:  a. identify changes that take place when particular forces are acting  b. predict the effect of unbalanced forces acting in everyday situations  PW3 Energy appears in different forms including movement (kinetic energy), heat and potential energy, and causes change within [systems](http://syllabus.bos.nsw.edu.au/glossary/sci/system/?ajax). (ACSSU155)  Students:  a. identify objects that possess energy because of their motion (kinetic) or because of other properties (potential)  WS4 Students question and predict by:  a. identifying questions and problems that can be investigated scientifically (ACSIS124, ACSIS139)  b. making predictions based on scientific knowledge and their own [observations](http://syllabus.bostes.nsw.edu.au/glossary/sci/observation/?ajax) (ACSIS124, ACSIS139) | | | | Forces push/pull, types, weight vs mass. Discuss type of forces: balanced or unbalanced.  Science Experimentation - simple science experimentation of spring balance, surface tension.  Spell and define: friction, magnetic, force field, Newton (unit), magnetite, gravity, buoyancy, electromagnet.  Describe a force as a push or a pull.  Identify everyday situations in which different forces are acting.  Quantitatively compare different forces through measurement.  Practical: Measuring forces using a spring balance. | Students will: successfully complete the worksheets:  <http://lrrpublic.cli.det.nsw.edu.au/lrrSecure/Sites/Web/science_04/documents/force.pdf>  What is a force? (Achieve Science Energy P17).  Find the force (Achieve Science Energy P21).  Students will: successfully complete the Practical Worksheets: Measuring force (Achieve Science Energy P18).  Measuring forces (Core Science Stg4 workbook P47). |  |
| 9 | MA4-7NA operates with ratios and rates, and explores their graphical representation | Recognise and solve problems involving simple [ratios](https://syllabus.bostes.nsw.edu.au/glossary/mat/ratio/?ajax) (ACMNA173)  use ratios to compare quantities measured in the same units  write ratios using the : symbol, eg 4:7 L  express one part of a ratio as a [fraction](https://syllabus.bostes.nsw.edu.au/glossary/mat/fraction/?ajax) of the whole, eg in the ratio 4:7 , the first part is 411 of the whole (Communicating)  simplify ratios, eg 4:6=2:3 ,   12:2=1:4 ,   0.3:1=3:10 | | | | Explicit teaching of scale drawing  Scale Drawing and similar figures.  Importance to have a plan drawn to scale. | Students will:  Successfully learn about scale drawing and drawing of similar figures. |  |
| 10 | SC4-10PW describes the action of unbalanced forces in everyday situations | PW1 Change to an object's motion is caused by unbalanced forces acting on the object. (ACSSU117)  Students:  a. identify changes that take place when particular forces are acting  b. predict the effect of unbalanced forces acting in everyday situations | | | | Boat Building - YouTube boat building.  Forces acting on boat  What materials needed to build a boat?  Discuss the design process involved in building a boat.  Discuss Different type of boats.  Material selection for boats  Technologies of the 21st century | Students will:  Successfully watch clips on the process, types and modern materials. |  |
| 11 | 4.1.1 Applies design processes that respond to needs and opportunities in each design project. | design processes including   * analysing needs, problems and opportunities * establishing criteria for success * researching * generating creative ideas * communicating ideas * experimenting and testing ideas * risk management * managing resources * producing design solutions * evaluating ideas and solutions   needs and opportunities in the areas of study | | | establish a design process that responds to an identified need and opportunity  apply a design process when developing quality solutions for each design project  establish criteria for successful achievement of needs and opportunities  record design processes and decision making in a design folio for each design project.  consider short-term and long-term consequences of design in the design process  evaluate design processes  identify needs and opportunities that require solutions in the areas of study | PRODUCT 2- boat  Design Brief  You have to design and create a paper boat that will float.  Students may decorate the boat.  Constraints – It should only be made from paper, it cannot be larger than an A4 sheet of paper  *Exploring and Defining the task*  Class works through the stages of the design process together  Design Brief  Design Situation  As a class students brainstorm and document the constraints and criteria for success  Exploring and defining the task  Criteria for success  Actual building of the boat and attempting to float it.  Visit by a real life engineer or biography of  Explanation of career opportunities  Discussion of ideas | Students will successfully create a paper boat that meets the brief based on each student’s prior knowledge and practice.  Activity: Paper Boat  Students will: successfully create a portfolio using the proforma provided. |  |
| 12 | SC4-10PW describes the action of unbalanced forces in everyday situations  SC4-WS7 processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions | PW1 Change to an object's motion is caused by unbalanced forces acting on the object. (ACSSU117)  c .describe some examples of technological developments that have contributed to finding solutions to reduce the impact of forces in everyday life, e.g. car safety equipment and footwear design  ICTCCT  WS7.1d accessing information from a range of sources, including using digital technologies ICTL | | | | Describe some examples of technological developments that have reduced the impact of forces in everyday life eg car safety devices (airbags, crumple zones, seatbelts, headrests) and sport footwear design. | Students will: successfully argue the importance of forces and safety devices that have been developed.  Information websites: <http://www.howsafeisyourcar.com.au/Safety-Features/Crash-Protection-Features/>  <http://www.ancap.com.au/understanding-safety-features> |  |
| 13 | 4.1.1 Applies design processes that respond to needs and opportunities in each design project. | design processes including   * analysing needs, problems and opportunities * establishing criteria for success * researching * generating creative ideas * communicating ideas * experimenting and testing ideas * risk management * managing resources * producing design solutions * evaluating ideas and solutions   needs and opportunities in the areas of study | | establish a design process that responds to an identified need and opportunity  apply a design process when developing quality solutions for each design project  establish criteria for successful achievement of needs and opportunities  record design processes and decision making in a design folio for each design project.  consider short-term and long-term consequences of design in the design process  evaluate design processes  identify needs and opportunities that require solutions in the areas of study | | PRODUCT 3  Brief: Build a vehicle that can travel 1 metre holding 30g  Research, generate ideas  Build  Critique  Refining  Testing  Justification |  |  |
| 14 | 4.6.2 identifies and explains ethical, social, environmental and sustainability considerations related to design projects | Ethical and responsible design  Environmental and sustainability considerations | | identify ethical, social, and environmental and sustainability considerations relevant to each design project  be responsible and ethical in the decisions made in the development and production of each design project | |  | students will: successfully debate the ethical, social and environmental reasons for sustainability.  <http://www.coolaustralia.org/ca_topic/waste/> |  |
| 15 |  |  | |  | | THE GREAT RACE  Product evaluation  Unit evaluation |  |  |