JAMES COOK BOYS TECHNOLOGY HIGH SCHOOL

Stage 4 Integrated STEM Program

Teacher: **Class:** **Semester: 1 - Term 1 2016** **Year: 8 - Stage 4**

UNIT DESCRIPTION – Catapulting into Success **UNIT LENGTH 6.5 Weeks**

This STEM project involves the planning and construction of a **catapult** to foster engagement and achievement in stage 4 Science (especially Physics), Mathematics, Engineering and Design & Technology. This will be accomplished through the implementation of a self-contained unit of work with integrated authentic assessment tasks. The outcomes are driven by the NSW Science Syllabus for Australian Curriculum with a focus on scientific inquiry, data processing and analysis to identify trends as applied to the action of unbalanced forces. The students' work will culminate in a day of activities where the built catapults are assessed for their effectiveness via an agreed set of criteria.

Performance Task:
The whole class will work as a team of engineers to apply the knowledge they have learnt during the "catapulting into success" program to build a full size catapult. Students will need to consider the goal and any constraints they will face during the build. They will have to work collaboratively to design, build, test and refine the catapult.

This performance task will provide evidence of understanding via transfer of the key concepts learned during the "catapulting into success "unit of work. Building the catapult provides a real world challenge where the students will be engaged and motivated to apply their knowledge. This performance task allows for critical thinking, creativity, collaboration, communication and use of technology.

Prior Knowledge

Measurement

TIMETABLING:

The unit of will have 55 periods dedicated to this integrated STEM project designed to develop students skill and knowledge by integrating the Technology (mandatory) course.

Syllabus Outcomes

SCIENCE

A student:
SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge
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
SC4-7WS processes and analyses data from first hand investigations and secondary sources to identify trends, patterns and relationships to draw conclusions
SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems
SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations
SC4-10PW describes the action of unbalanced forces in everyday situations

MATHEMATICS

A student:
MA4-1WM: communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating
MA4-2WM: applies appropriate mathematical techniques to solve problems – problem solving
MA4-3WM: recognises and explains mathematical relationships using reasoning – reasoning
MA4-4NA compares orders and calculates with integers, applying a range of strategies to aid computation
MA4-11NA creates and displays number patterns; graphs and analyses linear relationships; and performs transformations on the Cartesian plane

It comprises of 55 minute periods:

Year 8 Science – 6 periods

Mathematics – 5 periods

Year 7 Science – 5 periods

Mathematics – 6 periods

AREA OF STUDY Physical World (Science)
Mechanisms (Technology)
Graphs and Tables (Mathematics)
Statistics and Probability (Mathematics)
Angle Relationships (Mathematics)
Data Collection and Representation (Mathematics)

COLLABORATIVE GROUP WORK Randomised teams of 2/3 students are utilised throughout Lessons 1 to 67. At the teacher's discretion, students select their own group for the performance task.

RESOURCES

iPad, marble launcher, stroboscope , iPhone/Android, camera, catapult kit, household items

Websites

Fun with STEM: The Catapult Project
Catapult Crazy!
PHYSICS PROJECTILE MOTION EXPERIMENT MONKEY AND HUNTER PHYSICS HIGH SCHOOL
How to Build a Strong Catapult
Catapult Trick Shots | Legendary Shots
Assessment Notification Physics- Preliminary Assessment Report

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/

Abbreviations

HOT – Higher Order Thinking
PSC – Personal and social capacity
EU – Ethical Understanding

MA4-18MG identifies and uses angle relationships, including those related to transversals on sets of parallel lines
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

TECHNOLOGY (MANDATORY)

A student:
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 areas of study of Built Environments, Products, and Information and Communications
4.1.3 Identifies the roles of designers and their contribution to the improvement of the quality of life
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
4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources
4.4.1 explains the impact of innovation and emerging technologies on society and the environment
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
4.6.2 identifies and explains ethical, social, environmental and sustainability considerations related to design projects

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*
- *Asia and Australia's engagement with Asia*
- *Sustainability*

The general capabilities:

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

Other learning across the curriculum areas:

- *Work and enterprise*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Sequence 1 **Week 1** **Lesson 1**	A student: SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations 4.1.3 identifies the roles of designers and their contribution to the improvement of the quality of life MA4-1WM **communicates and connects mathematical ideas using appropriate terminology, diagrams** and symbols- **communicating** SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually 4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources	**Introduction** • Outline project scope over 5.5 weeks and Challenge Day Activities for the catapult **Focus** What is STEM? Why is STEM important? **Activity 1** **Working with printed images** • Organise students into teams of 3. Students will remain in these teams until the end of Lesson 4. (Ensure that at least one of the students per group has a smartphone/BYOD) • Give out butchers paper and stimulus images. • Direct students to make a poster using the images that illustrates knowledge, skills and occupations connected to the images. • Briefly share posters • Ask students what do you think the acronym STEM stands for? **Activity 2** **Working with digital images** • Students repeat Activity 1 using the internet to find a set of images that relate a product to knowledge, skills and occupations. • In a word document they save the URL for each image along with title/brief description. • Student ICT competence reflected in this activity will inform explicit instruction required beginning of lesson 2.	• Form teams of 3 • Produce the poster • Contribute to class discussion • Define STEM • Complete scaffolded writing answers to focus questions: What is STEM? Why is STEM important? • Create and save a word document with appropriate file name and at least 4 URLs and descriptions.	*Poster assessment for learning* • **HOT:** students make clear links between skills, knowledge, occupation and product. *Scaffolded Writing* • **Literacy:** students complete scaffolded writing (differentiated) *Literacy* *Word document (Student title)* • **ICT**: Students search internet, select images, create and save file. *Information and communication technology capability*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 1 **Lesson 2**	A student: SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually. **Graphs and Tables** A student: MA4-11NA creates and displays number patterns; graphs and analyses linear relationships; and performs transformations on the Cartesian plane MA4-19SP collects, represents and interprets single sets of data, using appropriate statistical displays	***Focus*** *When is a graph better than a table?* ***Activity 3*** ***Spread sheet (Excel)*** • Provides a projectile scenario and table (printed) with data (angle and range) to students. • Instructs students to enter data in Excel worksheet and to represent data in graphical form (column, line). • Students save work with meaningful naming convention e.g. "*Activity 3*" into digital portfolio • Pose the questions o *"What is the trend shown from the graph?"* o *"What is the relationship between angle and range?"* • Teacher records answers on whiteboard and assists students recast using technical vocabulary.	• Enter data into excel worksheet from a given scenario • Selects cells to highlight data range to graph table producing a column graph labelling all axes • Uses correct naming convention to save file. • Collaborative develop a statement of the relationship between angle and range. E.g. as the angle (of projection) increases the range (of the projectile) increases (proportionally).	NOTE: Adjust this wording once we find syllabus outcome *Excel spreadsheet* • **Numeracy:** students use Excel to tabulate and chart data • **Literacy:** students state a relationship between angle and range using appropriate technical terminology *Literacy* *Numeracy*
Week 1 **Lesson 3**		***Activity 4*** ***Uploading & smartphones*** • Students asked to photograph their poster design from Activity 1 with their smartphones. • Each team member will photograph each other • Instructions given on how to upload their images from their smartphones to digital portfolio	• Upload their poster design	*Poster* • **ICT:** students use BYOD to upload photos to digital portfolio *Information and communication technology capability*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 1 **Lesson 4**	**SC4-9WS presents** science ideas, findings and **information to a given audience using appropriate** scientific language, **text types and representations**	***Activity 5*** ***Word processing (Digital Portfolio)*** • Students asked to integrate the pictures of their poster and team members, graphs and tables into digital portfolio • Students to name team and identify the names of their team member. • Check digital portfolios to ensure all entries are present.	• Integrate the poster picture, team member incorporates photographs and table into digital portfolio.	**PSC:** Students interact with each other collaboratively to work in teams and organise data in the portfolio. **ICT:** Integrated document with different types of data input **AssessPoint:** Digital portfolio Activity 3 team images and poster. *Information and communication technology capability* *Personal and social capability*
Week 1 **Lesson 5**	SC4-5WS collaboratively and individually produces a plan to investigate questions and problems **4.2.2 selects, analyses, presents** and applies research and experimentation from a variety of sources	***Focus*** *What is the difference between a catapult and trebuchet?* ***Activity 6*** ***Research Task*** • Organise students into new pairs/threes. They stay in these teams until the end of lesson 11 • ***Task brief 1 issued***. • Explains the task brief, hints and checkpoints • Research task to be done at school and if incomplete done as homework • Work saved in digital portfolio as *"Activity 6"*	• Researches and chooses 2 catapults from different periods • Provides images • Description of main design features including main materials, range, speeds of launch.	Prior knowledge: PowerPoint presentation **ICT:** research catapult images and information addressing task brief Compiled presentation *Information and communication technology capability* *Literacy*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 1 **Lesson 6**	SC4-5WS collaboratively and individually produces a plan to investigate questions and problems 4.4.1 explains the impact of innovation and emerging technologies on society and the environment	***Activity 7*** ***Research Task*** • Checkpoint applied for activity 6 as per task brief. • Students given feedback regarding the catapult. • Students move on to the next stage of task researching the trebuchet • Research task to be done at school and if incomplete done as homework • Saved in digital portfolio as *"Activity 7"*	• Researches and chooses 1 trebuchet from a different period • Provides image • Description of main design features including main materials, range, speeds of launch. • Highlights the features that make trebuchet different from catapult.	Prior knowledge: PowerPoint presentation **ICT:** research trebuchet image and information addressing design brief Compiled presentation *Information and communication technology capability*
Week 1 **Lesson 7**	SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge SC4-5WS collaboratively and individually produces a plan to investigate questions and problems **Angles** MA4-18MG **identifies and uses angle relationships**, including those related to transversals on sets of parallel lines	***Focus*** *How can the firing angle can be changed?* *Where is the force applied to the projectile?* *Where is the point about which rotation occurs?* ***Activity 8*** ***Research Task*** • Checkpoint applied for activity 7 as per task brief. • Students given feedback regarding the trebuchet. • Students move on to the next stage of task labelling each image of the catapult and trebuchet • Research task to be done at school and if incomplete done as homework • Saved in digital portfolio as "*Activity 8*"	• Labels each of the catapult and trebuchet: ○ How the firing angle can be changed ○ Where the force is applied to the projectile. ○ The point about which rotation occurs	Prior knowledge: PowerPoint presentation **ICT:** labelling of catapult and trebuchet in digital portfolio. *Information and communication technology capability* *Numeracy*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 1 **Lesson 8**	SC4-4WS **identifies questions and problems** that can be tested or researched and **makes predictions based on scientific knowledge** 4.6.2 **identifies and explains ethical, social**, environmental and sustainability considerations **related to design projects**	***Focus*** *Identify and explain at least one ethical and social implication of the historical use of the catapult and trebuchet as weapons* ***Activity 9*** ***Research Task*** • Checkpoint applied for activity 8 as per task brief. • Students given feedback on the labelling • Students move on to the next stage of task labelling each image of the catapult and trebuchet • Research task to be done at school and home for home work if incomplete • Saved in digital portfolio as "Activity 9"	• Identifies and explain at least one ethical and social implication of the historical use of the catapult and trebuchet as weapons	**EU**: Students can identify one ethical and social issue of the catapult and trebuchet. **Literacy:** labelling diagrams, formulating written explanations *Literacy*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 1 **Lesson 9**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge 4.2.1 generates and communicates creative design ideas and solutions	***Activity 10*** ***Research Task*** • Checkpoint applied for activity 9 as per task brief. • Students given feedback on the ethical and social implications. • Students move on to the next stage of task make selections appropriate diagrams and text and prepare PowerPoint for final presentation. • Research task to be done at school and home for home work if incomplete • Saved in digital portfolio	• Work on PowerPoint to provide a detailed answer to the question that is supported by evidence.	**ICT:** Students work on PowerPoint with appropriate text and diagrams selected. *Information and communication technology capability*
Week 1 **Lesson 10**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge MA4-1WM communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating 4.2.1 generates and communicates creative design ideas and solutions	***Activity 11*** • Students to give 3 min oral presentation • Teacher marks oral presentation	• Present culmination of research task as a Power Point	• Oral presentation with Power Point **PSC:** Students work collaboratively with partner to allocate and complete tasks *Personal and social capability*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 1 **Lesson 11**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge MA4-1WM communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating 4.2.1 generates and communicates creative design ideas and solutions	***Activity 11 continued*** • Students to give 3 min oral presentation • Teacher marks oral presentation • Students given a series of definitions to research for homework in the context of the catapult: ○ Pivot (Fulcrum) ○ Lever ○ Tension ○ Stored Energy (Potential energy) ○ Range • Research task to be done at school and home for home work if incomplete • Saved in digital portfolio as "*Activity 11*"	Defines ○ Pivot (Fulcrum) ○ Lever ○ Tension ○ Stored Energy (Potential energy) ○ Range Saves work in digital portfolio	**AssessPoint:** Digital portfolio Activity 11 presentation. **ICT:** researches uses online Dictionary the definition of the given words. **Literacy:** developing technical vocabulary *Information and communication technology capability* *Literacy*
Sequence 3 **Week 2** **Lesson 12**	**Balanced and unbalanced forces** A student: SC4-10PW describes the action of unbalanced forces in everyday situations MA4-1WM communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating MA4-3WM recognises and explains mathematical relationships using reasoning – reasoning 4.5.1 applies management processes to successfully complete design projects	***Focus*** *Identify, define and describe the function of the main parts of a projectile device.* ***Activity 12*** • Class discussion about the definitions • ***Task 2 brief issued*** • Explains the nature of the task, naming of parts, features and description of functions • Explain that this task must be completed by the end of lesson 14. Students to determine what they need to do for homework in order to finish on time • Organise students into new teams of 3. They stay in these teams until the end of lesson 15 • Saved in digital portfolio as "*Activity 12*"	• Labels, define, explain features and functions of each of the parts of the catapult. • Set own homework	• **PSU:** plan homework in order to complete task *Personal and social capability*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 2 **Lesson 13**	A student: MA4-11NA creates and displays number patterns; graphs and analyses linear relationships; and performs transformations on the Cartesian plane	***Activity 13*** • Students individually prepare a table with 4 rows and 3 columns in digital portfolio with given headings to enter definitions and title • Students label 3 important features of projectile device diagrams • Encourage discussion of projectile devices known to students particularly as related to different cultures • task to be done at school and home for home work if incomplete • Saved in digital portfolio as "*Activity 13*"	• Construct and complete table • Set own homework • Save work to digital portfolio	• Activity 13 saved to digital portfolio *Numeracy*
Week 2 **Lesson 14**	A student: SC4-10PW describes the action of unbalanced forces in everyday situations SC4-10PW describes the action of unbalanced forces in everyday situations MA4-1WM **communicates and connects mathematical ideas using appropriate terminology**, diagrams and symbols- communicating	***Focus*** *Compare the similarities and differences of the structure and functions of the objects that model a catapult.* ***Activity 14*** • Organise students into teams of 3. Students will remain in these teams until the end of lesson 15. (Ensure group all have BYOD for document sharing) • Students in their teams compare the following items to catapult: bulldog clip, marble launcher, plastic spoon • Saved in digital portfolio as "*Activity 14*"	• Construct and complete comparison table • Save work to digital portfolio	**ICT:** merging tables **HOT:** analysing using similarity and differences **AssessPoint:** Digital Portfolio Activity 12,13, 14 *Critical and creative thinking* *Information and communication technology capability*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 2 **Lesson 15**		***Activity 15*** • Explains file sharing option with class. Members of each group must edit the document. • Students in their teams setup a shared document in their digital portfolio • Use of merge function to avoid unnecessary duplication of information • Saved in digital portfolio as "*Activity 15*"	• Complete file sharing activity and save as Activity 15	• **ICT:** File sharing • Activity 15 saved to digital portfolio
Sequence 3 **Week 2** **Lesson 16**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge MA4-18MG **identifies and uses angle relationships**, including those related to transversals on sets of parallel lines	***Focus*** *Describe how the angle of launch and spring tension affects the range of a marble launched from spring launcher.* ***Activity 16*** • **Task brief 3 issued** and explained • Organise students into new teams of 3. Students will remain in these teams until the end of lesson 22. • Explanation of risk assessment activity • Students read procedures of "hazard identified and risk minimised" • Students asked to prepare and record a risk assessment in their digital portfolio • Saved in digital portfolio as "*Activity 16*"	• Consider experimental hazards and prepare a risk assessment • Save risk assessment as Activity 16	• **PSC:** Students consider safety of themselves and others • Activity 16 saved to digital portfolio *Personal and social capability*
Week 2 **Lesson 17**	A student: SC4-6WS follows a sequence of instructions to **safely undertake a range of investigation types, collaboratively** and individually 4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project	***Activity 17*** • Checkpoint applied for activity 16 as per task brief. • Students given feedback on risk assessment • Students move onto the next stage of the task observing and explain in writing the steps to operating (safely) the marble launcher • Ask students to modify their risk assessment in green to include further relevant information after inspecting the launcher	• Modify risk assessment • Explains the steps required to operate the marble launcher safely	• Students self and peer assess Activity 16

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 2 **Lesson 18**	A student: MA4-18MG **identifies and uses angle relationships**, including those related to transversals on sets of parallel lines SC4-9WS **presents** science ideas, findings and **information to a given audience using appropriate scientific language, text types and representations**	***Activity 18*** • Checkpoint applied for activity 17 as per task brief. • Students given feedback on recorded observations • Students move onto the next stage of the task to take picture of their launcher and upload into digital portfolio and label some of previously used words e.g. stored or potential energy. • Students will need to describe angle, force, potential energy, and energy given to marble • Saved in digital portfolio as "*Activity 18*"	• Label and upload image of marble launcher indicating where energy transfers/transformations happen	• Saved Activity 18 to digital portfolio
Week 2 **Lesson 19**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge MA4-3WM recognises and explains mathematical relationships using reasoning – reasoning	***Activity 19*** • Checkpoint applied for activity 18 as per task brief • Students given feedback on labelling of diagram and description • Explain range • Ask students to relate the effect of the change of tension and angle on the range of the projectile • Discuss the need to "repeat" for "reliability" • As per Task 3, students measure the range at 3 different tensions and identify the independent, dependent and control variable	• Identify the dependent, independent and controlled variables. • Save data as Activity 19	**PSC:** Students work collaboratively to make decisions and gather empirical data *Numeracy* *Personal and social capability*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 2 **Lesson 20**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge MA4-3WM recognises and explains mathematical relationships using reasoning – reasoning	***Activity 20*** • Checkpoint applied for activity 19 as per task brief • Students given feedback on description and identification of variables		• Correct identification of independent, dependent and controlled variables
Week 2 **Lesson 21**		***Activity 21*** • Checkpoint applied for activity 20 as per task brief • Class discussion on definition of average • Students move onto the next stage of the task launch marble at different angles keeping tension constant • Each student to be assigned different role • Ask students to measure the horizontal distance (range) travelled by marble • Students to record data in tables saved in digital portfolio as "*Activity 21*"	• Conduct experiment to investigate angle changes • Save data as Activity 21	• Activity 21 saved to digital portfolio
Week 2 **Lesson 22**	A student: SC4-7WS processes and analyses data from first hand investigations and secondary sources to identify trends, patterns and relationships to draw conclusions MA4-3WM: a student recognises and explains mathematical relationships using reasoning – reasoning MA4-11NA creates and displays number patterns; graphs and analyses linear relationships; and performs transformations on the Cartesian plane 4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources	***Activity 22*** • Checkpoint applied for activity 21 as per task brief • Students move onto the next stage of the task and graph the results, describe the trends and state the relationships between the variables • Students to record data in graphs saved in digital portfolio as "*Activity 22*"	• Identify the dependent and independent variables. • Graphs independent variable (*X-axis*) and dependent variable (*Y-axis*). • States the relationship (trend) between the angle and the distance travelled. • Save graphs as Activity 22	• Activity 22 saved to digital portfolio *Numeracy*

Week 3 **Lesson 23**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge SC4-7WS **processes and analyses data from first hand investigations** and secondary sources **to identify trends, patterns and relationships to draw conclusions**	***Activity 23*** • Checkpoint applied for activity 21 as per task brief • Feedback given to students • Class discussion on hypothesis • Students move onto the next stage of the task to formulate hypothesis or conditional proposition for each experiment • Students to write hypothesis and save in digital portfolio as "Activity 23" • Checkpoint applied for activity 23 as per task brief • Feedback given to students	• Generates a maximum of 3 hypotheses • States the relationship (trend) between the angle and the distance travelled • Identify angle for maximum distance	• Activity 23 saved to digital portfolio • **AssessPoint:** Digital portfolio • Task 3 as per marking rubric

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Sequence 4 **Week 3** **Lesson 24**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually SC4-7WS processes and analyses data from first hand investigations and secondary sources to identify trends, patterns and relationships to draw conclusions SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations SC4-10PW describes the action of unbalanced forces in everyday situations MA4-11NA creates and displays number patterns; graphs and analyses linear relationships; and performs transformations on the Cartesian plane MA4-3WM recognises and explains mathematical relationships using reasoning – reasoning	***Focus*** *Identify the common features of the paths followed by all projectiles* ***Activity 24*** • **Task brief 4 issued** and explained • Organise students into new teams of 3. They stay in these teams until the end of lesson 28 • Ask students to research a list of key words in a table required as foundational work: ○ projectile, air resistance, parabolic, launched, trajectory, path, X-Y plane (axes), stroboscope, analyse, symmetry • Checkpoint applied to activity 23 for table structure • Students to construct table of definitions and save in digital portfolio as "Activity 24"		**Literacy:** Develop technical vocabulary Activity 24 saved to digital portfolio
Week 3 **Lesson 25**		***Activity 25*** • Show YouTube video showing projectile motion • Provide an image showing the path of a projectile (ball) • Students individually asked to describe the path as accurately as possible using technical language • Organise students into teams of 3 to compare their findings with other students. • Students to record descriptions and save in digital portfolio as "Activity 25"		**Literacy:** incorporate technical language in written description **ICT:** use a variety of techniques to record and analyse motion Activity 25 saved to digital portfolio *Literacy*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 3 **Lesson 26**		***Activity 26*** • Class discussion about demonstration • Demonstrates projectile launched at 45^0 against butchers paper using a stroboscope. • Demonstration to be repeated so students can capture on iPhone/Android/ or using tradition photography methods • Students to upload images to digital portfolio and save as "Activity 26"		Activity 25 saved to digital portfolio
Week 3 **Lesson 27**		***Activity 27*** • Students to playback recorded motion and investigate and analyse the motion. • Use questioning and class discussion to encourage observations regarding patterns in the vertical and horizontal "spaces" between images • Direct students to measure and record vertical and horizontal "spaces" between the images • Students to describe the features of this motion and save this in the digital portfolio as "Activity 27"	● State the trends in both the vertical and horizontal motions. ● Observe and measure patterns in the vertical and horizontal "spaces" between images ● Tabulate results ● Write description of motion of a projectile	Activity 27 saved to digital portfolio *Literacy* *Numeracy*
Week 3 **Lesson 28**		***Activity 28*** • Students are to label the provided projectile motion with as many features • Students are asked to summarise the projectile path and explain why a small smooth object is the preferred projectile **Note to student:** the closer the spacing the slower the ball • Students to describe the features of this motion and save this in the digital portfolio as "*Activity 28*"	Given a constant flash rate, students need to look at critical features, e.g. there is a - ● maximum height ● symmetry (vertical axis at maximum height), ● constant horizontal spacing ● vertical spacing decreases more and more as it approaches the top	**AssessPoint:** Digital portfolio *Literacy* *Numeracy*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Sequence 5 **Week 3** **Lesson 29**	A student: SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations MA4-2WM: a student applies appropriate mathematical techniques to solve problems – problem solving 4.2.1 generates and communicates creative design ideas and solutions 4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design project 4.6.1 applies appropriate evaluation techniques throughout each design Project	***Activity 29*** • **Task brief 5 issued** and explained • Revision of preliminary work on range, pivot, arm/lever from previous work • Revise risk assessment analysis (Hazard, Assess Risk, Minimise Risk) • Organise students into new teams of 2. Students will remain in these teams until the end of lesson 34. • Students to prepare and complete a table for materials and function and save this in the digital portfolio as "*Activity 29*"	• Prepare and complete table of for materials and function • Saves table as Activity 29	Activity 29 saved to digital portfolio **PSC:** Students interact with each other collaboratively to prepare and organise table for materials and functions *Personal and social capability*
Week 3 **Lesson 30**		***Activity 30*** • Checkpoint applied for activity 21 as per task brief • Students to prepare a risk assessment and save it in digital portfolio as "*Activity 30*" • Feedback given to students about the obvious hazards with high velocity projectile and scissors.	• Prepare risk assessment in a table • Saves risk assessment as Activity 30.	Activity 30 saved to digital portfolio
Week 3 **Lesson 31**		***Activity 31*** • Ask students to sketch the design of the catapult and label key features. • Feedback to student about their design • Modifications made to the sketch • Can scaffold samples of catapults • Students photograph sketch and upload to digital portfolio and save as "Activity 31"	• Sketches and modifies the design • Photograph and upload to digital portfolio and save as Activity 31	Activity 31 saved to digital portfolio

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 3 **Lesson 32** **Week 3** **Lesson 33**		***Activity 33*** • Class discussion on flowcharts in construction testing, refinement and design adjustment • Students to construct model catapult by assembling the necessary materials • Repeated testing and refinement for catapult to achieve the greatest range	• Applies design process to construct a model catapult	• A functioning model constructed consistent with task brief attempting to achieve the greatest range
Week 4 **Lesson 34**		***Activity 34*** • **Competition:** Which team catapult will have the greatest range? • Students will photograph catapult and video the projectile in motion and save into digital portfolio as "Activity 34" • Determine which team has achieved maximum range • Class debrief about what features of a catapult achieves maximum range	• Upload photographs and video to digital portfolio and save as Activity 34	**AssessPoint:** Digital portfolio and construction of model *Critical and creative thinking*

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Sequence 6 **Week 4** **Lesson 35**	A student: SC4-4WS identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge 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 SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations MA4-1WM communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating MA4-2WM applies appropriate mathematical techniques to solve problems – problem solving	***Activity 35*** • Distribute materials, tools, checklist and design of catapult prior to class commencing • **Task brief 6 (a) issued** and explained • Revise risk assessment analysis (Hazard, Assess Risk, Minimise Risk) • Organise students into new teams of 3. Students will remain in these teams until the end of lesson 67 • Students prepare a risk assessment and save in digital portfolio as "Activity 35"	• Complete the checklist of materials and tools • Prepare a risk assessment in their digital portfolio and save as Activity 35	• Risk assessment saved in digital portfolio • Activity 35 saved to digital portfolio
Week 4 **Lesson 36**				
Week 4 **Lesson 37**		***Activity 36*** • Checkpoint applied to Activity 35 • Modifications to risk assessment as a result of teacher feedback • Students move onto the next stage of the task to label key features on the diagram of the catapult in their digital portfolio and save as "Activity 36"	• Modification of risk assessment saved as Activity 35 • Labelling of diagram in digital portfolio saved as Activity 36	• Risk assessment for construction phase is prepared • Activity 36 saved to digital portfolio
Week 4 **Lesson 38**		***Activity 37*** • Discuss different roles as part of the team • Discuss the plan and outline instructions • Remind students of safety and encourage to approach teacher if concerns or questions arise • Students commence assembly of base of catapult • Checkpoint applied to Activity 37 to produce a sturdy base with right angles	• Allocate roles to the team members • Assemble the base of the catapult	**PSC:** Students work collaboratively to build a sturdy base with right angles *Personal and social capability*
Week 4 **Lesson 39**		***Activity 38*** • Remind students about possible hazards • Ask students follow a : **construct → test →refine →adjust process**	• Progressively produce a functioning, safe and sturdy catapult	
Week 4 **Lesson 40**				
Week 4 **Lesson 41**				

Week 4 Lesson 42 **Week 4 Lesson 43** **Week 4 Lesson 44** **Week 5 Lesson 45** **Week 5 Lesson 46** **Week 5 Lesson 47** **Week 5 Lesson 48** **Week 5 Lesson 49** **Week 5 Lesson 50**	MA4-4NA compares orders and calculates with integers, applying a range of strategies to aid computation MA4-11NA creates and displays number patterns; graphs and analyses linear relationships; and performs transformations on the Cartesian plane MA4-18MG **identifies and uses angle relationships**, including those related to transversals on sets of parallel lines 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 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 areas of study of Built Environments, **Products**, and Information and Communications 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	• Students to keep digital records of their construction on a daily basis • Closely monitor the safety and progress of students • Instruct students to upload a photo of the team with their catapult into the digital portfolio save as "Activity 38"	• photo of the team with their catapult into the digital portfolio save as "Activity 38"	

	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 4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources 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			
Week 5 **Lesson 51**	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 SC4-7WS processes and analyses data from first hand investigations and secondary sources to identify trends, patterns and relationships to draw conclusions	***Activity 39*** • Teach measures of dispersion. ie mean mode median, and simple probability	• Understand and apply measures of dispersion to analyse simple measurements	*Numeracy*
Week 5 **Lesson 52**		***Activity 40*** • Teach and model reliability and accuracy (bullseye model)	• Understand and apply reliability and accuracy to simple measurements and by using measures of dispersion	**AssessPoint:** Digital portfolio risk assessment and assembly
Week 5 **Lesson 53** **Week 5** **Lesson 54** **Week 5** **Lesson 55**		***Activity 41*** • **Task brief 6 (b) issued** and explained • Remind students about possible hazards • Ask students follow a : **test →refine →adjust process**	• Adjust catapult to launch a projectile at a bullseye to assess both accuracy and reliability	• **HOT:** Correlate observations/ completed sentences from data in their spreadsheets *Critical and creative thinking*

Week 6 Lesson 56 **Week 6 Lesson 57** **Week 6 Lesson 58** **Week 6 Lesson 59** **Week 6 Lesson 60**	SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems SC4-9WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations MA4-1WM communicates and connects mathematical ideas using appropriate terminology, diagrams and symbols- communicating MA4-2WM applies appropriate mathematical techniques to solve problems – problem solving MA4-3WM recognises and explains mathematical relationships using reasoning – reasoning MA4-4NA compares orders and calculates with integers, applying a range of strategies to aid computation MA4-18MG **identifies and uses angle relationships**, including those related to transversals on sets of parallel lines 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 4.1.1- applies design	• Closely monitor the safety and progress of students ***Activity 42*** • **Task brief 6 (c) issued** and explained • Remind students about possible hazards • Ask students follow a : **test → adjust process** • Closely monitor the safety and progress of students ***Activity 43*** • **Task brief 6 (d) issued** and explained • Remind students about possible hazards • Ask students follow a : **test → adjust process** • Closely monitor the safety and progress of students ***Optional Activity Extension*** • **Task brief 6 (e) issued** and explained • Remind students about possible hazards • Ask students to aim a paint-filled balloon at a grid-lined paper to produce a *"splattergram"* at 2 different tension settings: low and high. • Students will photograph the two 'splattergrams' and upload them into their digital portfolios. • Students will measure the area of each splattergram and deduce the connection between area and impact force. • They then have to suggest limitations to the proposed correlation between area and force (is it valid to connect these two?) and answer questions according to the task brief.	• Adjust catapult to maximise the range of the projectile	• Increased range during: **test → adjust process** **AssessPoint:** Assembly and achievement of task brief *Literacy* *Numeracy* *Personal and social capability*

	processes that respond to needs and opportunities in each design project 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 4.2.2 selects, analyses, presents and applies research and experimentation from a variety of sources 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			

Week Lesson	Outcome	Teacher	Students	Evidence of learning/student indicators
Week 6 Lesson 60 **Week 6 Lesson 61** **Week 6 Lesson 62** **Week 6 Lesson 63** **Week 6 Lesson 64** **Week 6 Lesson 65** **Week 6 Lesson 66**	A student: SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually 4.3.2 demonstrates responsible and safe use of a range of tools, materials and techniques in each design **SCHOOL** **INCURSION**	***Activity 44*** ***Challenge Day Competition (Fun)*** • Risk assessment will be followed and all students will wear safety goggles • Teams and their functioning catapults are positioned in the corners of a square on the oval. • Each team will shoot different coloured paint at a team in the centre of the square. • The team with the most hits wins.		

APPENDIX

Catapulting

Task 1 for Year 8 STEM students

Hints

Checkpoints

Task brief: Your task is to develop a PowerPoint presentation that provides a detailed answer, supported by evidence, to the question:
"What is the difference between a catapult and a trebuchet?"

Use words and diagrams as appropriate in the description. Ensure that your words relate to the structure.

Choose two catapults from different identified historical periods. For each catapult
Include images
Describe when and where each was built and the main design features such as: materials, range, speeds of the launched projectiles

Check your choices and descriptions with your teacher.

Highlight features of the trebuchet that make it different from a catapult.

Choose a trebuchet used in the past. For this trebuchet:
Include an image
Describe when and where it was built and the main design features such as: materials, range, speeds of the launched projectiles

Check your choice of trebuchet with your teacher.

On a copy of each catapult and trebuchet image label

- how the firing range angle can be changed
- where the force is applied to the projectile
- the point about which rotation occurs

Show one of your completed diagrams to your teacher for feedback before continuing

Identify who and what was affected and how when these were used as weapons.

Define *ethical* (from the noun *ethics*). Record your source/dictionary.
Identify and explain at least one ethical and one social implication of the past use of catapults as weapons.

Check your definition of *ethical* with your teacher.

Hints

Checkpoints

Your PowerPoint must provide a detailed answer to the question. Your answer must be clearly supported by evidence.

Make selections of diagrams and texts from your research to prepare your final PowerPoint presentation.

Ensure your slides are clear and not to crowded with text

Marking Rubric for Research on Catapults

	Criteria	Mark	Achieved
Historical	Two historical periods are identified: one for each catapult.	**2**	
	Only one historical period identified for one catapult or both catapults	1	
Images	Two clear images of catapults and 1 image of a trebuchet with information about where produced	**3**	
	Only two clear images of a catapult/trebuchets with information about where produced	2	
	Only images are provided OR Only information about where produced	1	
Catapult features	Three or more different features	**3**	
	Two features	2	
	One feature	1	
Trebuchet features	Three or more different features	**3**	
	Two features	2	
	One feature	1	
Labelling of catapult and trebuchet	All appropriate labelling shown	**3**	
	Most appropriate labelling shown	2	
	Some labelling shown **OR** Mostly incorrect labelling	1	
Definition: Ethical	Definition provided and reference acknowledged	**2**	
	Either the definition or the reference provided	1	
Ethical Implications	Identifies **and** explains an ethical implication of the use of a catapult or trebuchet as a weapon	**2**	
	Identifies an ethical implication of the use of a catapult or trebuchet as a weapon	1	
Social Implications	Identifies **and** explains a social implication of the use of a catapult or trebuchet as a weapon	**2**	
	Identifies a social implication of the use of a catapult or trebuchet as a weapon	1	
PowerPoint	A presentation that coherently and comprehensively addresses the requirements of the task	**4**	
	The presentation is mostly comprehensive (but fragmented)	3	
	Some parts of the presentation are easily followed	2	
	The presentation is submitted but it lacks organisational structure	1	
			24

Catapult Features

Task 2 for Year 8 STEM students

Pre-learning (homework): You have defined the following key terms:

- Lever,
- Pivot (fulcrum) and
- stored energy (potential energy), tension
- Range

Task brief: You will label, define and describe the function of the main parts (features) of each device on given images (Activity 12). You will compare features of various projectile devices with a catapult structure.

Save as Activity 12

Hints

Checkpoints

Ensure that your table has 4 rows and 3 columns.

Prepare a table in your digital portfolio with headings 'Feature/Name', 'Definition' and 'Function'. There will be 3 main parts Features/Names: **Lever**, **Pivot** and **Stored energy** part/Tension. Enter your definitions in the table. Give your table a title.

Check your table structure and definitions with your teacher.

Use an arrowed line.

Label 3 key features of the catapults in your digital portfolio with the names used above. Indicate the chosen sections accurately.

Check the labelling with your teacher.
Save as Activity 13

Compare means to describe **similarities** and **differences**

In a group organised by your teacher, compare the structure and function of the objects that model a catapult. The comparisons will be in terms of the three main parts described above. The objects are: a pair of compasses, bulldog clip, a marble launcher and a plastic spoon.

Use the 'merge' function in your table to avoid unnecessary duplication of information. For example:

	Catapult	Bull Clip
differences		
similarities	Both have stored energy and pivot points.	

From the group activity, prepare a table in your digital portfolio with appropriate headings. Give your table a title.

Check your table structure and comparisons with your teacher.
Save as Activity 14

Marble Launcher

Task 3 for Year 8 STEM students

Task brief: Your task is to qualitatively describe how the **angle** of launch and spring **tension** affect the **range** of a marble launched from a spring loaded launcher. You will safely conduct an investigation in a group to collect data and quantitatively analyse them by graphing and describing any trend(s) using appropriate scientific and mathematical terminology.

Hints		***Checkpoints***
Use the words **hazard**, **identified risk** and **minimise risk.** One hazard could be *'a high speed projectile may cause eye damage'*.	After your teacher describes your investigation and after reading the procedure in your digital portfolio, you will prepare and record a **risk assessment** in the portfolio. Tabulate this information. You should use 'safety glasses' as part of you assessment.	Check your tabulated risk assessment with your teacher for feedback.
Use words and diagrams as appropriate to describe the dimensions, colour and material. Other features may be included such as 'number of different parts'.	Observe and explain the marble launcher you will use. Record your observations in your digital portfolio. You may want to modify in green your risk assessment after inspecting your launcher.	Check your recorded observations (and modifications) with your teacher.
Use words as appropriate in the labelling. Some of the words were used previously, e.g. 'Stored energy' (or 'Potential energy').	Take a picture of the launcher and upload it to the digital portfolio • how the firing angle can be changed • where the force is applied to the marble • where the potential energy is stored • where the energy changes happen?	Show your labelled diagram to your teacher for feedback before continuing.
You should consider how your measuring equipment will be used to enhance accuracy. Also, think of the variables as those that are changed, those that are measured and those that are kept the same.	You will, with your group, describe how you would perform the following accurately: • Launch a marble for three different spring tensions: low, medium and high (at one angle, preferably between 40° and 50°). • Measure the horizontal distance travelled by the marble from launch to first contact point with the ground (range). • Repeat 3 times and average You will, with assistance, also identify the following: **independent variable**, **dependent variable** and **controlled variable**.	Check your descriptions and identifications with your teacher. Make any necessary changes after the feedback.

Hints		Checkpoints
Ensure that each group member has a specified role.	After reading your risk assessment and those of other groups, you will conduct the investigation described above. You will conduct three repetitions. Your teacher will also state some necessary precautions. You will also record the data and averages in the relevant table in your digital portfolio.	Check your data from one trial with your teacher before continuing.
Ensure that each group member has a specified role.	You will, perform the following accurately: • Launch a marble at different angles keeping the spring tension constant at the 'high' setting • Measure the horizontal distance travelled by the marble from launch to first contact point with the ground (range). You will identify the following: **independent variable**, **dependent variable** and **controlled variable**. Conduct three repetitions for each angle. You will also record the data and averages in the relevant table in your digital portfolio.	Check your data from one trial with your teacher before continuing.
Ensure that graph the independent variable on the X-axis and the dependent variable on the Y-axis.	For each of the two experiments above, **graph** the results using the averaged data from each experiment. Title the graphs and enter them in your digital portfolio.	Check your graph for one experiment with your teacher before continuing to the next.
For trends you want to use words like 'gradually/sharply increases/decreases'. For expressing relationships: 'As A increases/decreases, B decreases/increases rapidly'.	You will analyse the data from each experiment by • Describing the **trends** in your data • Stating the **relationship** between the independent and dependent variable. Record your analyses under the 'Discussions' sections of your report.	Check your analysis of one experiment with your teacher before continuing to the next.
An hypothesis is a statement that predicts the relationship between the independent and dependent variables.	With your teacher's assistance formulate a hypothesis for each of the experiments. Record each hypothesis under the 'Hypothesis' sections of your report. **Note**: For all experimental work in the future a hypothesis is formulated first and then an experiment is conducted to prove or disprove it.	Check the hypothesis of one experiment with your teacher before continuing to the next.

Marking Rubric for Marble Launcher Investigation

	Criteria	Mark	Achieved
Risk Assessment	A structured assessment with *hazard*, *identification of risk* and *minimisation of risk* categories clearly related.	**3**	
	A clearly stated minimisation of risk based on a well-formulated hazard or identification of risk.	2	
	An unstructured assessment with no clear link between the categories.	1	
Operation of launcher	Clear descriptions of a wide range of features.	**2**	
	Descriptions are not clear or a limited range of features are described.	1	
Labelling the Launcher	All 4 features are clearly indicated and labelled with non-intersecting lines.	**2**	
	At least 2 features are indicated and labelled.	1	
Enhancing accuracy	Three or more unambiguously described strategies, that include at least one measuring device, clearly associated with an appropriate variable.	**3**	
	Limited described strategies.	2	
	The use of one measuring device is described.	1	
Experiment 1: Tension v Range	Identifies the 3 variables, **and** conducts experiment safely to record data and calculated averaged data. Evidence of 3 repeated tests	**3**	
	Conducts experiment **and** records data with at least one identified variable.	2	
	Conducts experiment **and** records most data.	1	
Experiment 2: Angle v Range	Conducts a safe experiment demonstrating that the dependent variable is the same as that in Experiment 1 **and** records all collected and calculated data. Evidence of 3 repeated tests	**2**	
	Conducts experiment **and** records data	1	
Graphs	Presents 2 appropriately titled graphs clearly labelling the X and Y axes with the independent and dependent variables respectively, units included.	**3**	
	Presents 2 graphs with only one of the following features missing: title, units or one variable (or mismatched variables).	2	
	Presents only 2 graphs.	1	
Trends	Clearly states the correct trends from the graphs of both experiments using verbs and descriptive adverbs such as gradually, steadily or constantly.	**2**	
	States a correct trend from the graph of one experiment using verbs and adverbs **or** states a correct trend using verbs only from the graphs of both experiments.	1	
Relationships	Accurately relates 2 variables from at least one of the graphs.	**3**	
	Relates 2 variables from at least one of the graphs but does not describe how they are related.	2	
	Relates 2 variables incorrectly	1	
Hypothesis	Presents a predictive cause-effect relationship between the independent and dependent variables for at least one of the experiments using key terms such as 'causes' and 'because'. For example: 'The increased tension in the spring causes the marble to go further' or 'The marble travels a greater distance because of the increased tension in the spring'.	**2**	
	Only relates the independent and dependent variables for one or both experiments	1	
			25

An example of a risk assessment

Note to teacher: It is a good idea to tabulate the information. The one risk should relate to the hazard at a time

Identify hazards	The marble is moving fast enough to cause injury to eyes (there is much kinetic energy/momentum).
Assess risks	If the marble launcher is not directed correctly and if students in the vicinity are not wearing safety glasses permanent injury to the eyes is possible.
Minimise risks	Ensure that marble launcher is directed well away from any individual. Warnings are given before the launch. All students conducting the experiment or in the vicinity must wear safety glasses.

A hazard is a general and universally known problem than can injure or negatively affect the health of an individual.

A risk is consistent with 'what could probably/possibly happen to an individual based on the hazard at a specific time and place'. A risk is based on its corresponding hazard.

Minimising (or controlling) a risk means to lessen the probability of a risk. It is a precaution that will assist in keeping

Projectile path features

Task 4 for Year 8 STEM students

Hints

Checkpoints

Preliminary work: Prepare a table in your digital portfolio with two column headings 'Term' and, 'Definition'. Enter the definitions of the words that follow in the table.
Words: projectile, air resistance, parabolic, launched, trajectory, path, X-Y plane (axes), stroboscope, analyse, symmetry

Check your table structure and definitions with your teacher.

Task brief: You will identify common features of the paths (trajectories) followed by all projectiles (assuming that there is very little air resistance).

Consider the shape of the path or any trends. Imagine it to occur in a two dimensional X-Y plane. If you were hovering like a bird over the X-axis, what world you see? Apply the same type of observation to the Y-axis.

You will be shown a video showing projectile motion and you will be provided with an image showing the path of a projectile (ball). Its position at equal time intervals is shown – this is done by flashing light at it repeatedly (say every 0.1 second) and recording the various lit positions by camera.
Describe the path as accurately as possible using technical language. Compare your descriptions with two other students. Edit your description as required
Record your descriptions in your digital portfolio.

Check your descriptions with your teacher and make any necessary modifications, deletions or additions.

If you do not have a mobile phone with slow motion, partner with someone who has.

Observe the demonstration of a projectile launched at 45° to the horizontal (X-direction) against a very large piece of 'butcher's paper' (1.5 m × 1.5 m) with a drawn grid. A stroboscope with an appropriate flash rate will be used and the path will be photographed. The demonstration will be repeated so that you can capture the motion on your mobile phone. Transfer the video to your digital portfolio.

Some features you may want to consider are: the symmetry of the path, the location of the axis of symmetry and the spacing between the images vertically and horizontally.

Play back you recorded motion again and again to analyse the motion use the video and still images to describe features of the motion of a projectile.

Label your provided projectile motion in your digital portfolio with as many features as you can describe.
Write two sentences that summarise the projectile path and explain why a small, smooth spherical object is preferred as a projectile.

Check your descriptions of the features and trend analysis with your teacher.

Use the appropriate words from the definitions covered earlier.

Making a model catapult

Task 5 for Year 8 STEM students

Hints

Checkpoints

Preliminary work:
Review the meanings of *range*, *pivot*, *arm/lever* and *stored energy/tension* from your previous work. Revise risk assessment analysis (*Hazard*, *Assess Risk*, *Minimise Risk*) – you will prepare a risk assessment for this activity.

Check your definitions with your teacher.

Task brief: You will (with your partner) design a basic catapult to launch a small marble with the greatest possible range. Groups of two will compete – hopefully your group design will lead to the greatest range.

Associate *pivot*, *arm/lever* and *stored energy/tension* with specific materials from the list.

You will be provided with the following materials: measuring tape or ruler, protractor, safety glasses, a pair of scissors, a small marble, 10 elastic bands, 15 'paddle-pop' sticks, 10 straws, sticky tape, a bottle cap and a cardboard box (one that holds photocopy paper: 31 cm × 22 cm × 7.5 cm) with lid. The completed catapult must fit in the box.
Prepare and complete a table with the following headings: Material/equipment and Function. Complete the table. Present the information in you digital portfolio.

Check your table with your teacher and make any necessary modifications before you enter the table in your digital portfolio.

The most obvious hazards will be associated with a high velocity projectile and scissors.

Prepare a tabulated risk assessment. Enter it in your digital portfolio.

Check your risk assessment with your teacher.

One feature you may want to consider is: 'stored energy' in association with the elastic band(s).

Sketch the design of your catapult and label any features that are necessary. After your teacher's advice modify your sketch and enter it into your digital portfolio.

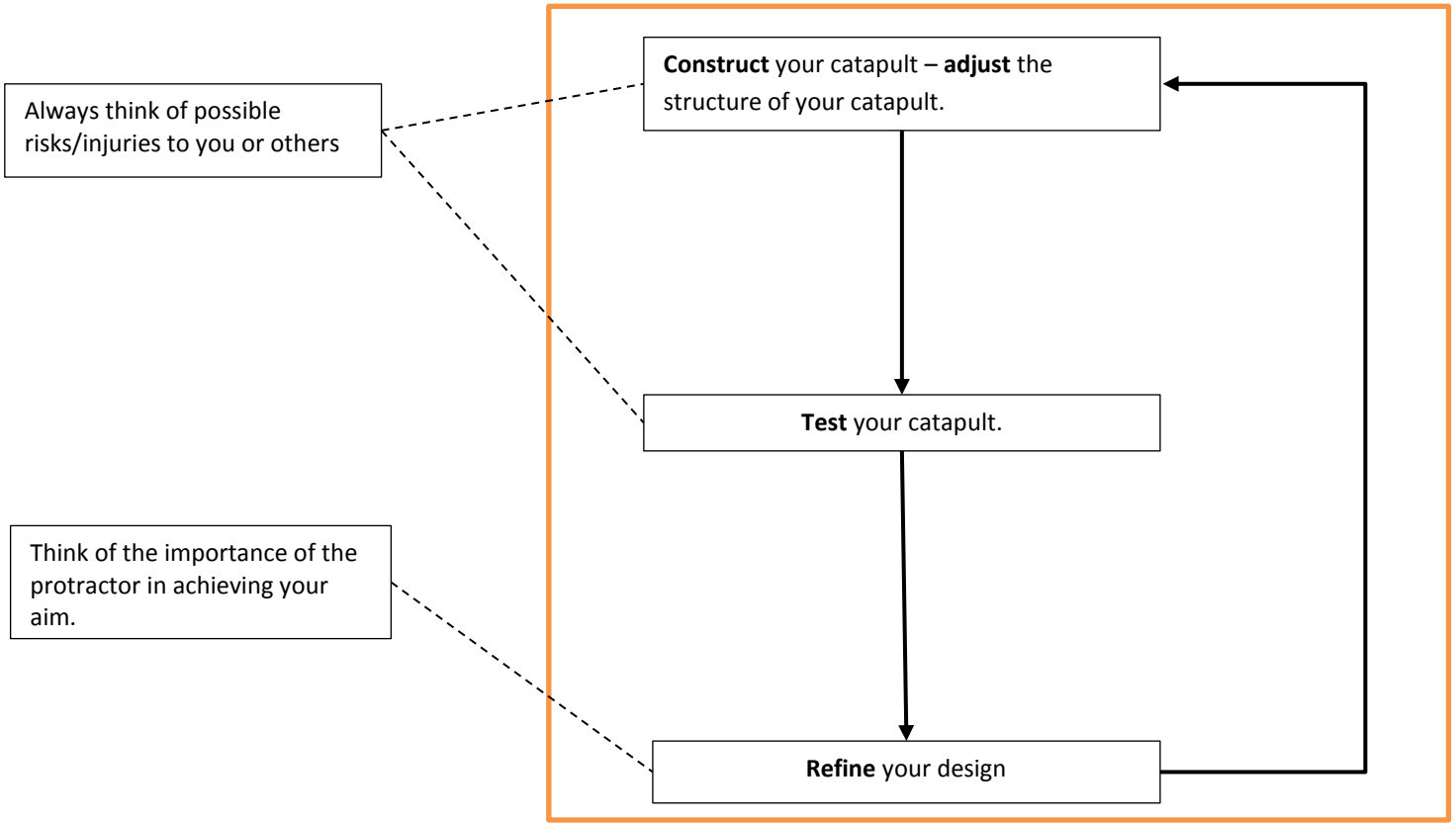
Check your sketch with your teacher.

Apply your risk assessment strategies. Wear your safety glasses when you are testing your catapult or when other groups are testing their own catapults.

Construct your catapult by assembling the necessary materials.
Follow the procedure that is in the flowchart

Hints

Checkpoints



You may test, refine and re-test several times. At each stage ask your teacher for advice. Do not forget: the aim is to get the greatest possible range.

Photograph your completed catapult and place in digital portfolio. List the features that were adjusted.

Competition: which group's catapult will have the greatest range?

Marking Rubric: Making a model catapult

	Criteria	Mark	Achieved
Preliminary work	Appropriate definitions for most to all terms presented	**2**	
	Only some definitions are presented	1	
Functions	The correct functions for most to all equipment/materials are described	**2**	
	Only some functions are accurately described	1	
Risk assessment	All 3 features are accurately described.	**3**	
	Minimising risk and one other feature are accurately described.	2	
	Only 1 feature is accurately described.	1	
Labelling	All or most labelling correct	**2**	
	Some of the labelling is correct	1	
Building the catapult	Builds a functional catapult using safe work practices (employing risk assessment) that gives the greatest range	**5**	
	Builds a functional catapult using safe work practices (employing risk assessment) that gives the range in the top 10%	4	
	Builds a functional catapult but some important safety practices were not adopted.	3	
	Builds a functional catapult but most safety practices were not adopted.	2	
	Builds a non-functional catapult	1	
			14

Constructing a big catapult

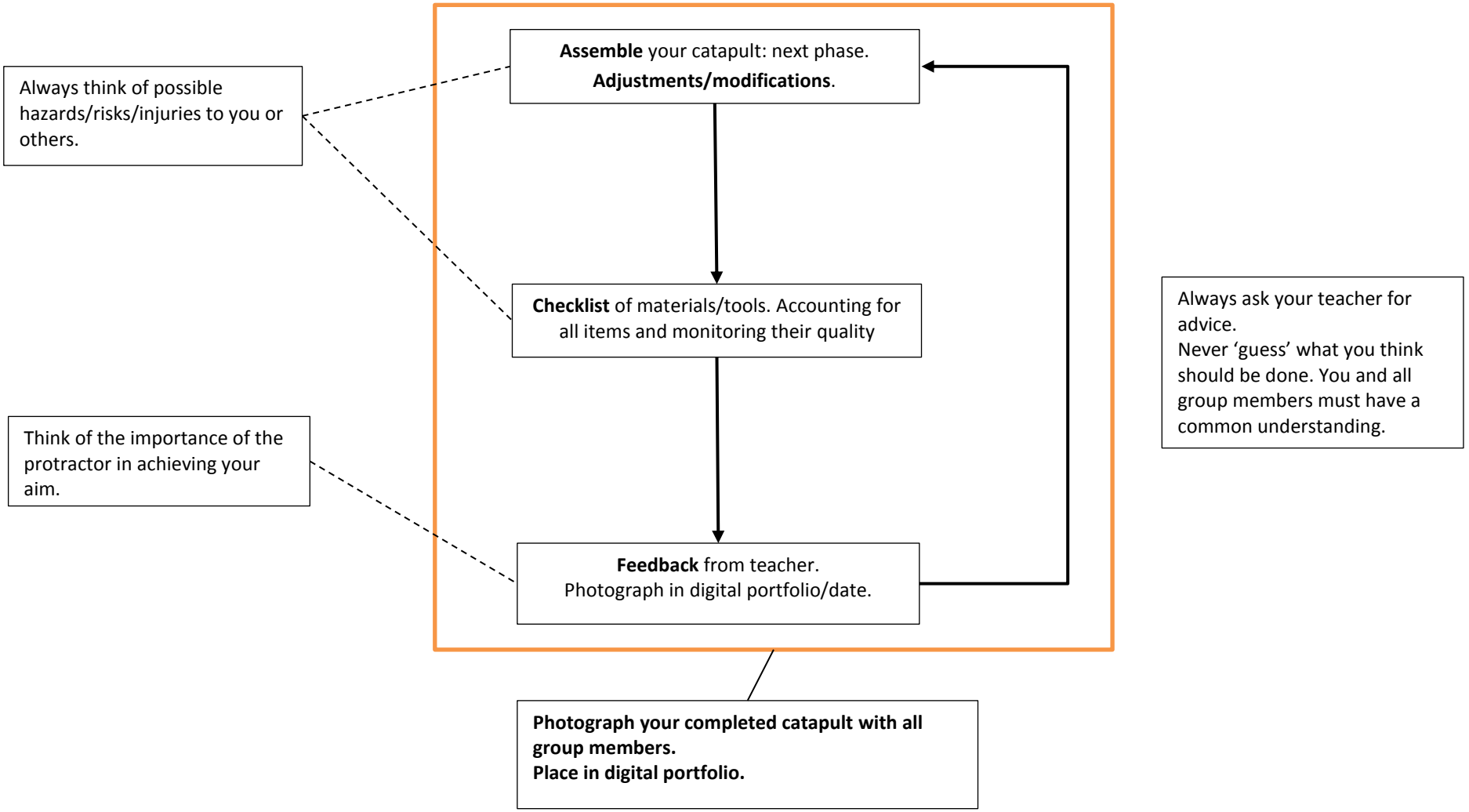
Task 6 (a) for Year 8 STEM students

Task brief: Your task is to construct a large catapult from a given design and diagram. You will safely conduct this in groups of three. (After this, you will test the launch of a projectile from your catapult in terms of: reliability, range and projectile impact force.)

Hints		***Checkpoints***
Check that all materials and tools have been provided. Check for faults or any other problems.	Check the list of materials and tools that you will need by completing the checklist in your digital portfolio. Inspect the diagram and design plan of the catapult you will make: its approximate dimensions (with the extending lever-arm) will be 2 m × 1.2 m × 1.5 m.	Show your teacher the check list – all materials and tools should be accounted for. You will be responsible for checking, and maintaining the quality and all items throughout the construction phase.
Use the words **hazard**, **identified risk** and **minimise risk.** One hazard could be *'The Stanley knife can cut skin deeply.'*	After accounting for all tools and items and after inspecting the diagram of the final, constructed catapult, prepare a risk assessment of the principal hazards (with teacher assistance) in your digital portfolio.	Check your tabulated risk assessment with your teacher for feedback.
Use words as appropriate in the labelling. Some of the words were used previously, e.g. 'Stored energy' (or 'Potential energy').	On the provided diagram of the catapult in your portfolio you will clearly label - • how the firing angle can be changed • where the force is applied to the projectile • where the potential energy is stored • the pivot point	Show your labelled diagram to your teacher for feedback before continuing.
You should follow and understand the **sequence** of instructions. Ensure that your group has a **common understanding** of how to proceed. Remember your safety and those of others should always be considered.	Your teacher will describe the design plan and the instructions for constructing the catapult. With your group, assemble only one section your catapult: the base. Ensure that you know your role as part of your group. After feedback, photograph your initial assembly and include it in your digital portfolio with an appropriate heading – date should be shown. You will repeat this for each phase of the construction process.	Check your assembled section with your teacher or raise any concerns. Make any necessary changes after the feedback.

Hints

Checkpoints



Marking Rubric: Task 6(a) constructing a big catapult

Task 6 (a)	Criteria	Mark	Achieved
Checklist of Materials	All materials accounted for on checklist	**1**	
	Checklist incomplete.	0	
Risk Assessment	A structured assessment with *hazard*, *identification of risk* and *minimisation of risk* categories clearly related.	**3**	
	A clearly stated minimisation of risk based on a well-formulated hazard or identification of risk.	2	
	An unstructured risk assessment with no clear link between the categories.	1	
Labelling of Catapult	Clear labelling of all 4 important features –where the firing angle can be changed, where the force is applied, where the potential energy is stored and the pivot point	**4**	
	Clear labelling of 3 important features –firing angle, force, energy, pivot	3	
	Clear labelling of 2 important features –firing angle, force, energy, pivot	2	
	Clear labelling of 1 important features –firing angle, force, energy, pivot	1	
Construction	Accurately following a set of instructions to construct a functioning catapult with all pieces aligned.	**4**	
	Follows a set of instructions to construct a functioning catapult with most pieces aligned.	3	
	Constructs a functioning catapult.	2	
	Constructs a non-functioning catapult.	1	
			12

Testing the big catapult

Task 6 (b) for Year 8 STEM students

Hints

Checkpoints

Preliminary work: Learn about (or revise) ways in which sets of numbers/measurements are analysed: we will be using **average** (or **mean**), **mode** and **median**.

Task 6 (b) brief: You will safely test the launch of a projectile from your catapult in terms of: reliability and accuracy

Reliability is the same as **consistency** or **repeatability** (sometimes the word **precision** could also be used). **Accuracy** will be gauged by distance from the actual bull's-eye

Be mindful of any hazards. Safety glasses should be worn.

You will test the **accuracy** and **reliability** of your projectile launching. You will aim your projectile at a large piece of paper with a bull's-eye and a series of concentric circles.
Dip the projectile in thick water-soluble paint to produce a uniform layer. After fixing tension, launch angle and distance from the target (bull's-eye), launch your projectile 10 times making sure a mark is visible each time. Photograph the bull's-eye scatter and upload it into your digital portfolio. Also complete the following sentences (include them also in your portfolio) after looking for trends:
"My projectile launch was accurate/inaccurate because …"
"My projectile launch was reliable/non-reliable because …"
"The more 'bunched up' (compressed) the marks the more … is my launching."

Show your teacher the bull's-eye and check that you have written appropriate statements.

The 'chart' option from the menu in Excel will allow you to do this (with teacher assistance).

Measure the distance from (the centre of) each mark and record in a spreadsheet. With teacher assistance, determine the **average** (or **mean**), **mode** and **median**. Upload your spreadsheet to your digital portfolio.

Check your tabulated and processed data with your teacher for feedback.

Do you expect the median and mode to be similar for a reliable set of numbers?

Extension work: Correlate your observations/sentences above with the numerical data from your spreadsheet.

Submit your response to your teacher after you have more time to analyse your data.

Testing the big catapult continued

Task 6 (c) for Year 8 STEM students

Hints

Checkpoints

Task 6(c) brief: You will safely test the launch of a projectile from your catapult in terms of: **range**

Be mindful of any hazards. Safety glasses should be worn.

Use appropriate scientific terminology like 'pivot', 'tension' etc.

Use the 'sort' option from the menu in an Excel spreadsheet.

You will maximise the **range** of your projectile. This is a competition between groups. Summarise how this was achieved.

Record the groups' ranges from lowest to highest by assigning numbers to the groups and indicating the students in each group. Points will be awarded on the basis of maximising range: the greater the range, the higher the points.

Check your summary with your teacher.

Check your tabulated and processed data with your teacher for feedback.

Testing the big catapult

Task 6 (d) for Year 8 STEM students

Hints

Checkpoints

Task 6 (d) brief: You will safely launch a projectile from your catapult so that it goes through a hoop. This is also a competition.

Be mindful of any hazards. Safety goggles must be worn at all times during the testing.

Position your catapult exactly 30 metres from the base of a hoop-and-stand.
Adjust the following features to finally get the projectile through the hoop: tension, firing angle and lever-arm length.
You will have to allow for wind velocity on a windy day. You will be given a maximum of 10 trials to achieve your aim.

The increased accuracy of the projectile launch could be recorded as 'close', 'very close', and 'almost in' etc. Alternatively, you could use a semi-quantitative scale 1 – 5 (from least to most accurate.

List what was done to get the projectile closer and closer to the target, and record your results in your digital portfolio.

Check your results and list with your teacher for feedback.

Marking Rubric: Task 6 (b), (c), (d) Testing

Task 6 (b)	Criteria - Accuracy and Reliability	Mark	Achieved
Bullseye scatter	Produces and uploads a bullseye with their results represented.	**2**	
	Produces a bullseye with results represented	1	
Bullseye scatter result statement	Accurate completion of all 3 statements based on their results.	**3**	
	Accurate completion of all 2 statements based on their results.	2	
	Accurate completion of l 1 statement based on their results.	1	
Spreadsheet	Upload of spreadsheet with correct calculation of mean, mode and median	**3**	
	Upload of spreadsheet with correct calculation of 2 measures of dispersion.	2	
	Incomplete spreadsheet and calculations	1	
Extension	Accurate correlation of observation with numerical data	**2**	
	Shows some correlation of observation with numerical data.	1	
			10

Task 6 (c)	Criteria- Range	Mark	Achieved
Testing for maximum range	Catapult launches the furthest distance. First place.	**5**	
	Second place.	4	
	Third place	3	
	Fourth place	2	
	Fifth place	1	
			5

Task 6 (d)	Criteria – Adjusting variables	Mark	Achieved
Hoops challenge	Detailing at least 2 adjustments made to hit the target.	**2**	
	Describing 1 adjustment made.	1	
			2

Testing the big catapult

Task 6 (e)for Year 8 STEM students

Hints

Task 6 (e) brief: **OPTIONAL (EXTENSION)**
You will safely launch a projectile from your catapult so that it produces a 'splattergram' as a measure of the force of impact. You will then be asked to analyse and explain the results.

Be mindful of any hazards. Safety goggles must be worn at all times during the testing.

1. Position your catapult exactly 20 metres from a grid-lined piece of butcher's sheet paper.
2. Adjust the tension at 'low' and direct a paint-filled (50 mL) balloon at the sheet of paper.
3. Photograph the resulting 'splattergram' and upload it into your digital portfolio.
4. Allow the paint to dry.
5. Measure the area covered by the paint.
6. Repeat steps 1. to 5. but for 'high' tension.

Answer the following

1. What is a suitable hypothesis for this experiment?
2. What is a suitable controlled variable for this experiment?
3. Identify the independent and dependent variables.
4. Write a suitable conclusion for this experiment.
5. Suggest any modifications to the design of the experiment that will lead to more accurate results.

APPENDIX

Describe the main functions for everyday items as aspects of a catapult.

	peg/rubber band	compasses	spoon	bulldog clip	tweezers	Launcher	scissors	slinky
Fulcrum								
Stored Energy								
Arm/Lever								

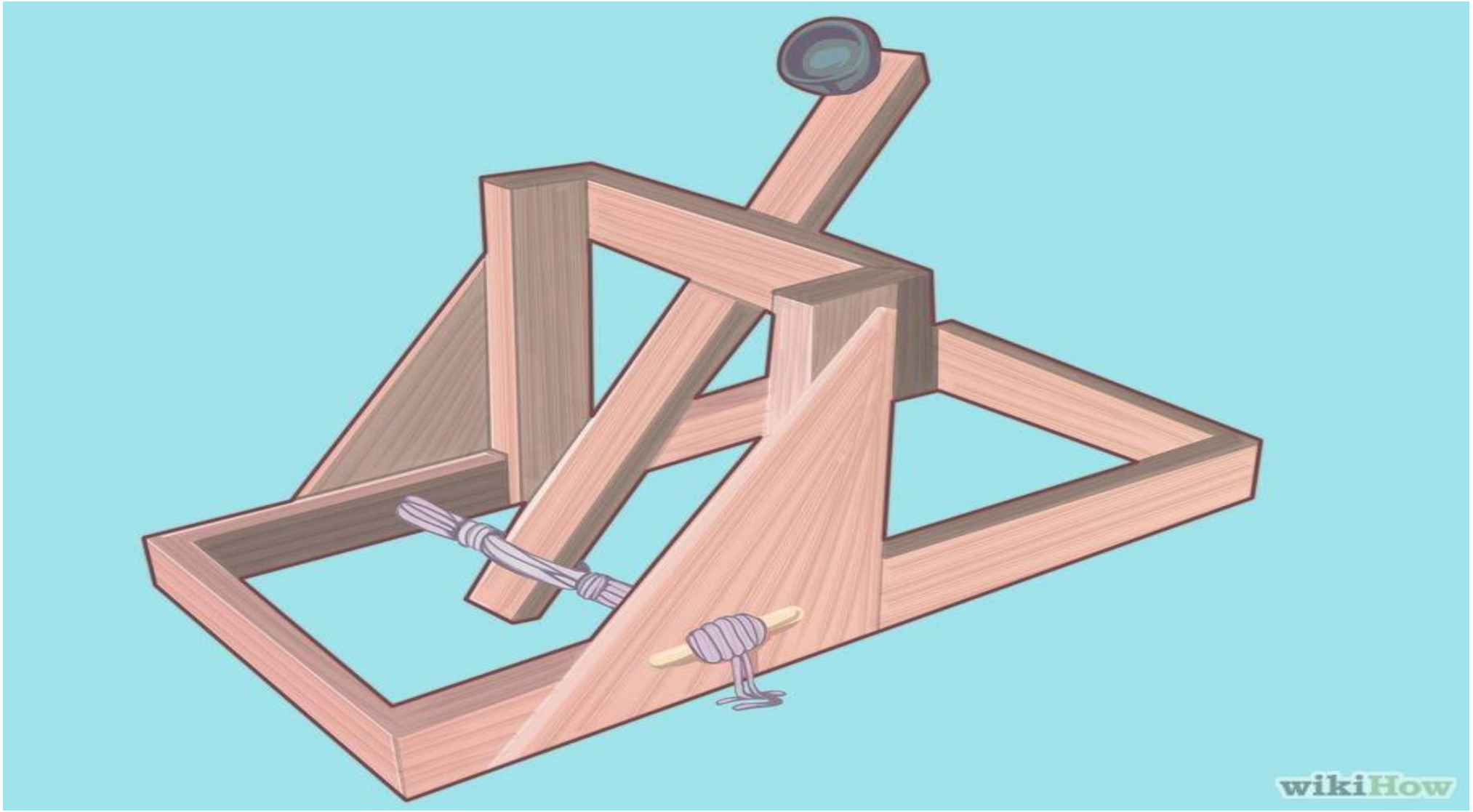
Measure the distance travelled when the angle is varied. Tension will be a fixed variable at medium setting on the Projectile Launcher.

Angle (X-axis)	**15^0**	**30^0**	**45^0**	**60^0**	**90^0**
Distance (cm) (Y-axis)					

Measure the distance travelled when the tension is varied. Angle will be the fixed/constant variable at 45^0.

Tension (X-axis)	**low**	**medium**	**high**
Distance (Y-axis)			

CATAPAULT DESIGN



This image is from the following educational websites
http://www.wikihow.com/Build-a-Basic-Catapult

TENSION (number of turns)	ANGLE (degrees)	RANGE (metres) Dependent Variable
1	40	
2	40	
3	40	
4	40	

TENSION (number of turns)	ANGLE (degrees)	RANGE (metres) Dependent Variable
2	20	
2	30	
2	40	
2	50	