



Australian Government
Department of Defence
Defence Materiel Organisation



**Regional
Development
Australia**
HUNTER



me
program

**ASSESSMENT NOTIFICATION
PHYSICS- PRELIMINARY
ASSESSMENT REPORT**



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Weighting: 25%

Due Date:

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ME CATAPULT PROGRAM

Introduction:	<p>To provide students with a hands-on unit of work that will aim to:</p> <ol style="list-style-type: none"> i. Engage students in work based on simple machines and forces which form a substantial part of the draft copy of the Science National Curriculum ii. Give meaningful links and opportunities to engage in similar activities to the ME programs already embraced by the College for stage 4 and 5 students iii. Facilitate work which will involve student problem solving, team work, measurement and data analysis iv. Provide students with activities which may lead to a life time interest in engineering and design
Possible stage 5 Science outcomes	<p>Knowledge and understanding</p> <p>5.6.2 - Newton's laws of motion d) Analyse qualitatively common situations involving motion in terms of Newtown's laws</p> <p>Skills</p> <p>18f - select and draw the appropriate type of graph or diagram to convey information and relationships clearly and accurately 5.13 - a student identifies a problem and independently produces an appropriate investigation plan 5.15 - a student gathers first hand data accurately 5.20 - a student selects and uses appropriate strategies to solve problems</p>
Possible stage 4 Science outcomes	<p>Knowledge and understanding</p> <p>4.6 - identifies and describes energy changes and the action of forces in common situations 4.6.1 - c) identify object that possess energy because of their motion (kinetic) or because of other properties (potential)</p>

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Skills

- 4.13 - a student clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem
- 4.15 - a student uses given criteria to gather first hand data
- 4.20 - a student uses an identified strategy to solve problems

Teacher Resources:

Lesson Sequence

1. Science of the catapult theory.
2. Design and start to build catapult experiment
3. Test, refinement and scoring

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THE SCIENCE OF THE CATAPULT

Forces - Inertia

Objects tend to "keep on doing what they're doing." In fact, it is the natural tendency of objects to resist changes in their state of motion. This tendency to resist changes in their state of motion is described as inertia.

Newton's first law of motion states that "An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force."

In a car crash, the persons in the car are moving at the same speed as the car before it crashes. When the car stops the people continue to move forward. An unrestrained person in the front seat of a car will often go through the windscreen in a crash resulting in severe injuries. This is why seatbelts are needed to restrain people in cars to reduce the risk of injury in a crash.

Energy – potential and kinetic energy

Catapult physics is basically the use of stored energy to hurl a projectile (the payload), without the use of an explosive. The three primary energy storage mechanisms are tension, torsion, and gravity. The catapult has proven to be a very effective weapon during ancient times. The main types of catapults used were the trebuchet, mangonel, onager, and ballista.

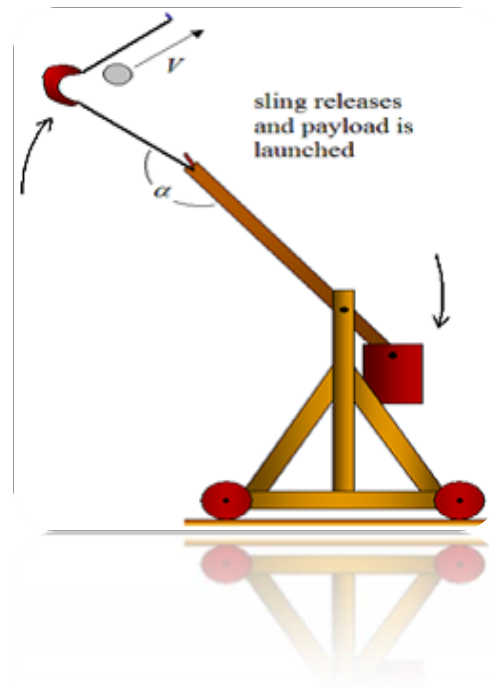
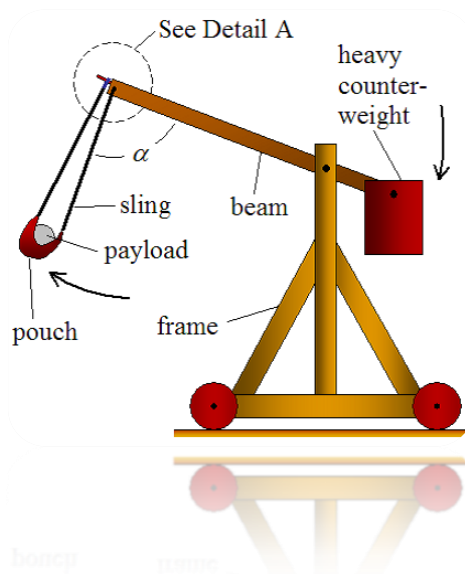
A trebuchet is a battle machine used in ancient times to throw heavy payloads at enemies. The payload could be thrown a far distance and do considerable damage, either by smashing down walls or striking the enemy while inside their stronghold. A trebuchet works by using the energy of a falling counterweight to launch a projectile (the payload). For maximum launch speed the counterweight must be much heavier than the payload, since this means that it will "fall" quickly.

Energy and Force in the catapult

A basic catapult works on the principle of converting potential energy (stored energy) into kinetic energy (movement). The stored energy in a stretched rubber band is

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referred to as elastic potential energy. When the arm of the catapult is released the energy is converted to kinetic energy causing the projectile to move. When the arm of the catapult stops moving forward the unrestrained projectile continues to move forward. This is where inertia comes into effect.



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QUESTIONS

1. Define inertia
2. Write Newton's first law of motion
3. Describe how inertia affects a person in a car crash
4. Describe how you feel inertia when travelling in a school bus
5. Why are seatbelts in cars called inertia seat belts?
6. What type of energy is used in catapult? _____
7. Where is the energy stored? _____

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8. What type of energy is produced? _____

9. The energy conversion in a catapult is from _____ energy to _____ energy.

10. Describe how inertia works in a catapult

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EXPERIMENT: BUILDING A CATAPULT

Scenario

Her Royal Highness, Queen Julia I, has issued a royal request. The Royal Army needs a new War Machine – a catapult – to defeat her enemies.

Aim

The aim of this full-day activity is to design and build a catapult that can fire a tennis ball accurately over a long distance.

What to do

Each team has approximately 2 hours to build a catapult from wooden dowel fastened together with string and packing tape. Its swinging arm receives energy from elastic bands. (Short lengths of wire and cloth are available for teams who wish to construct a trebuchet.) Toward the end of the session, teams will be given a projectile (a tennis ball) and have their catapult tested for distance and accuracy on the firing range.

Rules

All power must be provided by the rubber-bands. Catapults must have a swinging arm. Slingshots and ballista are not allowed. Firing can only be carried out on the firing range under the direction of a volunteer. Your team will be given five minutes to set up, fire and relocate your catapult. There are heavy fines for people who work dangerously. Do not dismantle your catapult until the end of the session. The poles are to be cleaned up and returned in one piece at the end of the session.

Scoring

After calibration, each team will take three shots at the 12m target. This process will be repeated for the 25m target. (The most points are scored for a bulls eye at 12m.) Your team will also be allowed three distance attempts. The greatest range (to the first bounce) will be rewarded with 2 points per metre.

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The final score is calculated by adding the sub-totals for these 3 tests together, and deducting any fines.

Tips

There are several sample catapult designs in the notes. They work, but they may not work well enough to win you the competition; use your imagination!

Experimentation is very important!

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SCORE SHEET CATAPULT

School name: _____

Accuracy at 12 meters

Add the scores for each attempt

Attempt	Short of Target	Past Target	Hit Net	Circle 1	Circle 2	Bulls Eye	Score
One	10	12	15	20	25	30	
Two	10	12	15	20	25	30	
Three	10	12	15	20	25	30	
Sub-total A							

Accuracy at 12 meters

Add the scores for each attempt

Attempt	Short of Target	Past Target	Hit Net	Circle 1	Circle 2	Bulls Eye	Score
One	10	12	15	20	25	30	
Two	10	12	15	20	25	30	
Three	10	12	15	20	25	30	
Sub-total B							

Distance

multiply best distance by 2

Attempt	Distance (metres)	Distance X 2	Highest Score
One			Sub-total C
Two			
Three			

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Fines

Circle all fine that apply and add together

Reason	Penalty
Extra time taken to complete your test (per minute)	1
Break, damage or cut a pole	2
Cheating (e.g. extra push by hand)	4
Fire in an area other than firing range	6
Dangerous behavior (e.g. use sticks as swords, no safety glasses)	8
Deliberately fire without supervision or toward a person	10
Not cleaning up and returning equipment at the end of session	5
Sub-total D	

(A+B+C)-D= FINAL SCORE _____

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CATAPULT DESIGN BRIEF

Materials needed

List the materials you will need to build your catapult

Diagram

Draw a diagram of your catapult design

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Description

Write a description of how your catapult will work.

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PROBLEMS AND REFINEMENT

List problems or faults with your design and ideas for how you could improve the design or fix the problem

PROBLEM	IMPROVEMENT

Diagram

Draw a diagram of your **improved** catapult design

