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## Lesson Plans

### Lesson 1 – Design Challenge 1

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<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 1</th>
<th>Author: MacAskill &amp; Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Design Challenge 1 – Newspaper Table

**Lesson Intentions:**
- Outline the Apollo Design process and term outline
- Work together in group to create a newspaper table
- Communicate orally
- Analyse the resulting table

**Sequence/Strategies:**
- **Warm up:** Spend some time introducing yourself to the students and learning about them.
- Spend a few minutes explaining the outline of the term. Include the dates of their upcoming assessment (oral presentation) and excursions. Inform the students that we will be building the skills required for their oral presentation throughout the term.
- Introduce students to the Apollo Program design process and explain the aspects which they will be focussing on the most in this lesson. Highlight the importance of communication to the entire process [resource 1.1](#).
- **Design challenge:** Newspaper table. Split the students into small groups and provide them each with newspaper and tape. Challenge them to build a table out of these materials that is able to hold a textbook 10cm above the ground.
- Give clear time limits for three phases. Planning, constructing and analysing.
- Students finish the task by analysing their newspaper table. In their groups, have them use a plus, minus, interesting table to help them organise their observations.
- Ask each group to read and explain a point from their plus, minus, interesting table.
- **Closure:** Students take a few minutes to complete 3, 2, 1, go activity (3 things I have learnt, 2 things I enjoyed, 1 concern I have) and discuss with the person next to them.

**Resources/Materials/Weblinks:**
- Newspapers, tape, butchers paper

**Prior Knowledge:**
- None

**Homework/Assessment:**
- Students are to write an entry in the logbook/diary section of their notebook reflecting on the lesson, what they learn and what they enjoyed. They may use their completed 3, 2, 1 go activity to help them complete their entry.
### Lesson 2 – What is Energy

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 2</th>
<th>Author: MacAskill &amp; Moody</th>
</tr>
</thead>
</table>

#### Lesson Title: What is Energy

#### Lesson Intentions:
- Define energy
- Develop a basic understanding of different energy types

#### Sequence/Strategies:
- **Warm up:** Think, pair, share activity with the question “What do you know about energy?”
- In their books, students are to start a new page called Terminology. This is where they will be recording new words/terms and their meanings during the course.
- Introduce the new terms energy, kinetic, potential and conservation of energy. Ask students to give examples which fit with each word. Explore the meaning of conservation of energy and ask students if they think it is true all of the time, some of the time or none of the time. [Resource 2.1](#).
- Discuss the different types of energy that exist. Let the students know that they will be focusing only potential and kinetic energy this term.
- If you have access to computers, students can complete the online activity listed below. Otherwise play a variation of the game “Corners”. Give statements where students have to decide whether the energy type is kinetic or potential. Students then move to the side of the room representing either “Potential” or “Kinetic” energy.
- **Closure:** Make a list of key words from today’s lesson. Compare it with your neighbours.

#### Resources/Materials/Weblinks:

#### Prior Knowledge:
- None

#### Homework/Assessment:
- Students are to record five ways that they use potential or kinetic energy in their daily lives.
Lesson 3 – Energy Transfer

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 3</th>
<th>Author: MacAskill &amp; Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Energy Transfer

**Lesson Intentions:**
- Further develop the concept of the conservation of energy
- Develop a basic understanding of different types of energy transfers

**Sequence/Strategies:**
- **Warm up:** Ask students to complete several different physical activities (walking/running on the spot, clapping, etc). Ask them what happened to all the energy they just used?
- Ask the students what conservation of energy means. From this discussion introduce the concept of Energy Transfer. Ask students to add this term to their Terminology page along with a definition.
- Ask students to copy a table with columns labelled “Device” and “Useful Energy Transfer”. Give the students a selection of devices to consider, their goal is to write in the “Useful Energy Transfer” column the type of energy the device uses and the type of energy it puts out (these do not have to be limited to kinetic and potential energy).
- Set up a collection of experiments at different stations to demonstrate energy transfers and losses. Examples could include a phone-charger, pulley and weight, speakers, a flat surface to rub your hand against, etc. Set students up in small groups and rotate them through each. Ask students to discuss and record in their books the types of energy inputs, outputs and losses.
- Ask students to create a flow chart in their book showing three energy transfers. For example, a student might draw the sun (light) going to a solar panel (electrical) before ending at a stereo (sound).
- Have students compare their flow charts in pairs. Ask them to discuss how extra energy transfer steps could be added to their flow chart.
- **Closure:** Students spend five minutes completing a 3,2,1 go activity and discuss their points with a partner.

**Resources/Materials/Weblinks:**
- None

**Prior Knowledge:**
- Energy types

**Homework/Assessment:**
- Students are to create another flowchart showing at least three energy transfers.
Lesson 4 – Energy Efficiency

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 4</th>
<th>Author: MacAskill &amp; Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Energy Efficiency

**Lesson Intentions:**
- Energy losses to non-useful energy types
- Energy efficiency calculations
- Practical demonstrations of energy losses

**Sequence/Strategies:**
- **Warm up:** ‘Count off’ students sit in a circle so they can see each other’s faces, tell them they are going to count as high as they can as a class, sounds easy doesn’t it? Anyone can say a number, but if two or more say the number at the same time we have to start over. No more than 3 seconds can go by between numbers (Paterson, 2007). Spend a maximum of 5 min on this.
- Lead a discussion on energy losses during energy transfers. These losses could also be explained as “by-products”.
- **Explicit teaching:** Introduce and define energy efficiency. Explain the equation used to calculate it and what each part represents see. Complete some example calculations to complement the definitions resources 4.1.
- Provide students with another table (similar to last lessons) using four columns: “Device”, “Useful Energy Transfer”, “Non-Useful Energy” and “Efficiency”. Provide students with a selection of devices and efficiencies and ask them to calculate their energy efficiencies.
- Ask students if they can think of any situations where “Non-useful Energy” could be harnessed as a useful energy source.
- **Closure:** Students spend five minutes completing a 3,2,1 go activity and discuss their points with a partner.

**Resources/Materials/Weblinks:**
- None

**Prior Knowledge:**
- Energy types
- Energy transfers

**Homework/Assessment:**
- Provide students with a selection of practice problems on energy efficiency. Students are also to make an entry in their journal reflecting on how their learning of energy types, transfers and efficiencies is progressing.
Lesson 5 – Design Challenge 2

<table>
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<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 5</th>
<th>Author: MacAskill &amp; Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Design Challenge 2 - Boat

**Lesson Intentions:**
- Work in groups
- Communicate orally within groups
- Analyse prototype
- Attempt to explain how the prototype works

**Sequence/Strategies:**
- **Warm up:** ‘Time Machine’ ([Paterson, 2007](#)) Ask students to close their eyes and imagine they are entering a time machine. What time are they going to travel to, forwards or backwards in time? Who are they with? What do they see? Guide them through this for a maximum of three minutes. Ask the students to share what they imagined with the person next to them. Ask some students to stand up and share with the class (impromptu oral presentation)
- Inform students that their challenge is to construct a boat capable of supporting as much mass as possible without sinking. Give clear time limits for three phases. Planning, constructing and analysing.
- Finish the challenge with the analysis phase. Students can use a plus, minus, interesting table to organise the results of their construction. Ask the students to combine what they think are the most important points from each column of their table into a written paragraph (use a topic sentence, body sentences and a summarising sentence).
- Select several students at random to read one of their paragraphs. Use verbal scaffolding to elicit constructive feedback from the other students.
- **Closure:** Students are to make an entry in their journal reflecting on today’s experiment. Ask them to focus on the first few steps of the design process in their reflection.

**Resources/Materials/Weblinks:**
- Straws, sticky tape, cling wrap, masses (plasticine or small weights), containers to hold water

**Prior Knowledge:**
- None

**Homework/Assessment:**
- None
### Lesson 6 – Introduction to Forces and Motion

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<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 6</th>
<th>Author: MacAskill &amp; Moody</th>
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</thead>
</table>

**Lesson Title:** Introduction to Forces and Motion

**Lesson Intentions:**
- Developing student independent research abilities
- Develop a basic understanding of contact and non-contact forces

**Sequence/Strategies:**
- **Warm up:** Structured spelling activity covering terminology discussed in previous lessons.
- **Explicit Teaching:** Give students an overview of how to use Google searches more effectively resource 6.1.
- **Give students three minutes to Google “Mechanics” and find out as much about it as they can.**
- **Give students three minutes to Google “Forces” and find out as much about it as they can.**
- **Give students three minutes to Google “Work” and find out as much about it as they can.**
- **Explicit Teaching:** Give them a brief summary to type into their notes of what it is.
- **Explicit Teaching:** Give them a brief summary to type into their notes of what forces are and the different types of forces that exist (contact and non-contact).
- **Explicit Teaching:** Give them a brief summary to type into their notes of what work is.
- **Ask students to complete a think, pair, share activity with their partners where they are to categorise a series of contact forces (and which type, push or pull) or non-contact forces. E.g., tug of war, kicking a ball, the force stopping the moon from flying into space, the attraction or repulsion between magnets. Select some of the students to explain their why they classified them as they did.**
- **Explicit Teaching:** Give students a more detailed list of forces. Through discussion and questioning, explain generally how the different forces operate.
- **Explicit Teaching:** Balanced and unbalanced forces. Discuss with students the effect of balanced and unbalanced forces on an object.
- **Several simple demonstrations/activities could be given / discussed such as arm wrestling, two students pushing / pulling an object in opposite directions, objects sitting on a desk, etc.**
- **Direct students to follow the link given below. They are to look at the animations and quizzes relating to forces in the 6-7 and the 10-11 sections.**
- **Closure:** Students complete a 3,2,1, go activity for the lesson and compare it with their neighbour.

**Resources/Materials/Weblinks:**
- Computers/laptops, [http://www.bbc.co.uk/schools/scienceclips/index_flash.shtml](http://www.bbc.co.uk/schools/scienceclips/index_flash.shtml)

**Prior Knowledge:**
- None

**Homework/Assessment:**
- Make ten observations of forces that you have exerted on other things, or forces that have acted upon you.
- Add the new words from today’s lesson to your terminology page.
## Lesson 7 – Forces and Motion

**Topic:** Motion of Toys  
**Time:** 70 min  
**Lesson Number:** 7  
**Author:** MacAskill & Moody

### Lesson Title: Forces and Motion

### Lesson Intentions:
- Force arrows (as vectors with magnitude and direction)
- Balanced and unbalanced forces and their effects
- Force diagrams

### Sequence/Strategies:
- **Warm up:** Brain storm activity. Write down everything that you can remember from the last lesson about mechanics, forces or work. Compare with the person beside you. Do you agree with their all their points?
- Review balanced and unbalanced forces. Ask the students to consider the simplest way that we could represent the forces acting on an object. How could we represent all the forces, as well as their size and direction.
- Explain the concepts of scalar and vector quantities (add these to their terminology section). The arrows used on force diagrams represent both the direction and magnitude (size) of the force acting on the object. The longer the arrow is, the greater the magnitude of the force.
- Work through example problems with students where they must determine (using force diagrams) whether the forces acting on an object are balanced or unbalanced. As follow up questions, ask them whether this means the object will stay at rest or accelerate.
- **Explicit Teaching:** Normal force [resource 7.1](http://phet.colorado.edu/en/simulation/forces-and-motion-basics). Ensure students are including the normal force and weight (force due to gravity) on their diagrams. Get them to go back through their previous diagrams and add in vectors for the normal force and weight where appropriate.
- As an extension, discuss and draw force diagrams of objects moving at constant velocity (car, planes, etc), are these objects the subject of balanced or unbalanced forces? If there is no normal force acting on a plane it flight, what balances its weight to keep it in the air?
- If computers are available, the following online resource can be used as a practical activity.
- **Closure:** Make a list of key words and their meanings. Compare it with your neighbours and discuss any differences you may have.

### Resources/Materials/Weblinks:

### Prior Knowledge:
- Contact forces
- Balanced and unbalanced forces

### Homework/Assessment:
- Give students free body diagrams with some force vectors drawn on. Ask them which forces they would have to add/remove such that the forces are balanced/unbalanced.
Lesson 8 – Friction

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 8</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Intentions:**
- To be able to define friction
- To be able to give examples of friction and explain when friction has a positive or negative impact

**Sequence/Strategies:**
- **Warm up:** ‘Count off’ students sit in a circle so they can see each other's faces, tell them they are going to count as high as they can as a class, sounds easy doesn’t it? Anyone can say a number, but if two or more say the number at the same time we have to start over. No more than 3 seconds can go by between numbers (Paterson, 2007). Spend a maximum of 5 min on this.
- **Think Pair, share:** think of as many examples of friction as possible
- **Define friction:** See notes 8.1
- **Think Pair, share:** How can you decrease friction? What are the disadvantages of friction? What are the advantages of friction? Discuss this as a class some examples you may like to discuss include car control, using a pencil, using an eraser
- **Review homework from last lesson**
- **Closure:** Make a list of key words covered in class today. Compare it with your neighbours and discuss any differences you may have.

**Resources/Materials/Weblinks:**
- Images to support discussion topics would be an advantage

**Prior Knowledge:**
- Basic knowledge of motion and forces

**Homework/Assessment:**
- Ask students to start thinking about which toy they might like to investigate for their assignment. It must move and not be electrical.

Lesson 9 – Newton’s Laws of Motion

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 9</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Newton’s Laws of Motion

**Lesson Intentions:**
- Restate Newton's Laws of Motion
- Perform calculations using newtons 2nd law of motion

**Sequence/Strategies:**
- **Warm up:** Give student 5-10 minutes to write their own definitions for some of the key words they have collected through lesson closures.
- **Watch the YouTube clip:** [https://www.youtube.com/watch?v=danYFyGnFxQ](https://www.youtube.com/watch?v=danYFyGnFxQ)
- Go through notes on Isaac Newton (see Resource 9.1) and discuss as a group
- Go through Newton’s Laws of motion notes (resource 9.1), this can be supported by the YouTube clip: [https://www.youtube.com/watch?v=NWE_aGqfUDs](https://www.youtube.com/watch?v=NWE_aGqfUDs)
- Students log into [http://science.discovery.com/games-and-interactive/newtons-laws-of-motion-interactive.htm](http://science.discovery.com/games-and-interactive/newtons-laws-of-motion-interactive.htm) (suggest turning the sound off, complete interactives then complete the quiz)
- **Closure:** Students complete a 3,2,1, go activity for the lesson and compare it with their neighbour.

**Resources/Materials/Weblinks:**
- Access to internet or pre download videos and create a physical quiz.

**Prior Knowledge:**
- Motion and forces knowledge

**Homework/Assessment:**
- Ask students to start thinking about which toy they might like to investigate for their assignment. It must move and not be electrical.
### Lesson 10 – Gravity, Mass and Weight

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 10</th>
<th>Author: Moody</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesson Title:</strong> Gravity, Mass and Weight</td>
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<tr>
<td><strong>Lesson Intentions:</strong></td>
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</tr>
<tr>
<td>• Define the terms gravity, mass and weight</td>
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<tr>
<td>• Explain the difference between mass and weight using examples</td>
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<tr>
<td><strong>Sequence/Strategies:</strong></td>
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<tr>
<td>• <strong>Warm up:</strong> Ask students to write their own definition for the terms gravity, mass and weight. They do not discuss this or share with each other. Leave space below these definitions to complete them again at the end of the lesson.</td>
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<tr>
<td>• Ask students to go to the website: <a href="http://idahoptv.org/dialogue4kids/season12/gravity/facts.cfm">http://idahoptv.org/dialogue4kids/season12/gravity/facts.cfm</a></td>
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<tr>
<td>• Students work in pairs to create a list of 5 questions from this webpage, one question must be a true or false, one must involve a definition and one must involve a comparison. The other 2 can be their choice.</td>
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<tr>
<td>• Swap questions with another group, answer then give back for correction.</td>
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<tr>
<td>• <strong>Closure:</strong> Write new definitions of gravity, mass and weight below their initial ones. Discuss if these have changed since the start of the lesson.</td>
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<tr>
<td><strong>Resources/Materials/Weblinks:</strong></td>
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<tr>
<td>• Student computer access</td>
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<tr>
<td><strong>Prior Knowledge:</strong></td>
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<tr>
<td>• Nil</td>
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<tr>
<td><strong>Homework/Assessment:</strong></td>
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<tr>
<td>• Ask students to start thinking about which toy they might like to investigate for their assignment. It must move and not be electrical.</td>
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</tbody>
</table>

### Lesson 11 – Handout Assignments

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 11</th>
<th>Author: Moody</th>
</tr>
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<tbody>
<tr>
<td><strong>Lesson Title:</strong> Handout Assignments</td>
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<tr>
<td><strong>Lesson Intentions:</strong></td>
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<td></td>
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<tr>
<td>• Review assessment and allocate groups</td>
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<tr>
<td><strong>Sequence/Strategies:</strong></td>
<td></td>
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<tr>
<td>• <strong>Warm up:</strong> Give student 5-10 minutes to write their own definitions for some of the key words they have collected through lesson closures.</td>
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<tr>
<td>• <strong>Hand out assessment task</strong> (<a href="#">1. Multimodal Presentation</a>) Read through task together, make notes and assign pairs. Allow students to spend some time brainstorming.</td>
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<tr>
<td>• Discuss expectations for assessment journal, I recommend supplying students with small exercise books to complete this in</td>
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<tr>
<td>• <strong>Closure:</strong> Write first entry in assessment journal</td>
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<tr>
<td><strong>Resources/Materials/Weblinks:</strong></td>
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<tr>
<td>• Butchers paper for brainstorming</td>
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<tr>
<td><strong>Prior Knowledge:</strong></td>
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<tr>
<td>• Group work and reflective writing experience an advantage</td>
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<tr>
<td><strong>Homework/Assessment:</strong></td>
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<tr>
<td>• Assignment – decide on toy by next assignment lesson</td>
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<tr>
<td>Lesson 12 – Distance and Displacement</td>
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<tr>
<td><strong>Lesson Title:</strong> Distance and Displacement</td>
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<tr>
<td><strong>Lesson Intentions:</strong></td>
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<tr>
<td>- Explain the difference between distance and displacement</td>
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<tr>
<td>- Complete displacement calculations</td>
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<tr>
<td>- Extension: Complete displacement calculations using Pythagoras theorem</td>
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<tr>
<td><strong>Sequence/Strategies:</strong></td>
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<tr>
<td>- <strong>Warm up:</strong> ‘Buzz’ Students stand in a circle, the count by saying one number each moving in a clock wise direction. For each multiple of 3 or number containing a 3 they say ‘buzz’ instead of the number. Stumble and they are out. Requires students to think quickly and listen to others.</td>
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<tr>
<td>- <strong>Review:</strong> Have students answer some simple conversion questions, converting minutes to seconds, metres to kilometre etc.</td>
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<tr>
<td>- <strong>Explicit Teaching:</strong> Define distance and displacement (see notes Resource 12.1)</td>
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<tr>
<td>- This is a good opportunity to use Pythagoras theorem, this will depend on student prior knowledge however, I do not recommend doing this before algebra has been covered in Maths</td>
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<tr>
<td>- Have students complete practice questions (some have been included in resource 12.1 but ideally create your own with a local context)</td>
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<tr>
<td>- <strong>Closure:</strong> Students complete a 3,2,1, go activity for the lesson and compare it with their neighbour.</td>
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<tr>
<td><strong>Resources/Materials/Weblinks:</strong></td>
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<tr>
<td>- Develop some practice questions with a local context</td>
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<tr>
<td><strong>Prior Knowledge:</strong></td>
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<tr>
<td>- Algebra knowledge preferred</td>
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</tr>
<tr>
<td><strong>Homework/Assessment:</strong></td>
<td></td>
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</tr>
<tr>
<td>- Reminder that students must decide on toy by next assignment lesson</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
# Lesson 13 – Speed and Velocity

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 13</th>
<th>Author: Moody &amp; McNaughton</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesson Title:</strong> Speed and Velocity</td>
<td></td>
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<tr>
<td><strong>Lesson Intentions:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Explain the difference between speed and velocity</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Complete speed and velocity calculations</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Sequence/Strategies:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <strong>Warm up:</strong> ‘Countdown’ Give the students a scrambled up version of terms from the semester, countdown 20 seconds and then students have to hold up their mini whiteboard with the correct spelling on it.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <strong>Pair activity:</strong> Give students the following list and ask them to rank them from fastest to slowest. Go through the answers (resource 13.1) and discuss any that are surprising.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Speed of a F1 McLaren race car</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Speed of a space shuttle in orbit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Speed of Sound (sea level)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Speed of Light</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Speed of Usain Bolt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Speed of a cheetah</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Go through speed and velocity definitions, notes and calculations (see note Resource 13.2). I recommend changing questions to locally relevant contexts.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>- In pairs have students go outside, draw a wobbly line that they can run along with chalk (somewhere between 10 m and 20 m works well, make sure they are being realistic with size of wobbles). Use this line to calculate speed and velocity for a person to run along this line.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <strong>Assign homework</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <strong>Closure:</strong> Make a list of key words covered in class today. Compare it with your neighbours and discuss any differences you may have.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resources/Materials/Weblinks:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Locally relevant example questions</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- Chalk, stopwatches, compass (smart phones have these) and 30m measuring tape per pair of students.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prior Knowledge:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Algebra, unit conversions and direction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Homework/Assessment:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Have students write a journal entry on how much they have achieved on their assignment at home so far. This should hurry up those who have not put in enough effort to date.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Lesson 14 – Assignment Lesson**

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 14</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Assignment Lesson

**Lesson Intentions:**
- Create a list of strategies to use in multimodal presentations

**Sequence/Strategies:**
- **Warm up:** ‘Countdown’ Give the students a scrambled up version of terms from the semester, countdown 20 seconds and then students have to hold up their mini whiteboard with the correct spelling on it.
- Watch the following TED talks, during the talks students write notes in the note taking template ([Resource 14.1](http://www.ted.com/talks/nikolai_begg_a_tool_to_fix_one_of_the_most_dangerous_moments_in_surgery)). At the end discuss which modes of presentation are used and the strategies used by the speaker to engage the audience. These talks were selected by my students as they were interested in them, you could choose to set a homework task to select talks rather than using these.
  - [http://www.ted.com/talks/nikolai_begg_a_tool_to_fix_one_of_the_most_dangerous_moments_in_surgery](http://www.ted.com/talks/nikolai_begg_a_tool_to_fix_one_of_the_most_dangerous_moments_in_surgery)
  - [http://www.ted.com/talks/ze_frank_are_you_human#](http://www.ted.com/talks/ze_frank_are_you_human#)
  - [http://www.ted.com/playlists/155/calling_all_sports_fans](http://www.ted.com/playlists/155/calling_all_sports_fans)
- **Closure:** Write a journal article about the TED talks seen, are there any strategies that you would like to try in your presentation?
- Any remaining time can be spent working in pairs on planning for their assignment; students should have selected a toy by this stage.

**Resources/Materials/Weblinks:**
- Internet access or download videos beforehand
- Students should have decided on toy

**Prior Knowledge:**
- Nil

**Homework/Assessment:**
- Background research and investigation on how their toy works. A journal entry should be made on this.
# Lesson 15 – Simple Machines

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min</th>
<th>Lesson Number: 15</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Simple Machines 1

**Lesson Intentions:**
- List the common simple machines
- Explain how a simple machine makes work easier

**Sequence/Strategies:**
- **Warm up:** Write explanations in your own words for the following terms: Mechanics, Contact Force, Non-Contact Force, Distance vs Displacement and Speed vs Velocity
- **Explicit teaching:** Go through definitions and notes from resource 15.1. Do this quite quickly as students will cover each in more depth later
- **Arrange students into groups, allocate a type of simple machine for each group to research.** In 1 week these groups will need to present information to the rest of the class about their simple machine. They should include a video of a machine in action along with other examples of their use. Give time limits based on class size. This needs to be comfortably completed in one lesson.
- **Closure:** Journal entry, are there any simple machine present in your toy design

**Resources/Materials/Weblinks:**
- Images of models to accompany notes

**Prior Knowledge:**
- Mechanics basics

**Homework/Assessment:**
- Simple machine research

---

# Lessons 16 – Assignment Lesson

<table>
<thead>
<tr>
<th>Topic: Motion of Toys</th>
<th>Time: 70 min each</th>
<th>Lesson Number: 16</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Assignment Lesson

**Lesson Intentions:**
- Work in pairs on assignment

**Sequence/Strategies:**
- **Warm up:** ‘Buzz’ Students stand in a circle, the count by saying one number each moving in a clock wise direction. For each multiple of 3 or number containing a 3 they say ‘buzz’ instead of the number. Stumble and they are out. Requires students to think quickly and listen to others.
- Students work on their assignment, teacher gives one on one assistance where required
- **Closure:** Journal entry on today’s progress

**Resources/Materials/Weblinks:**
- Computer access

**Prior Knowledge:**
- Assignment should already be started

**Homework/Assessment:**
- Simple machines presentation and assignment
# Lessons 17 – Simple Machines

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time: 70 min each</th>
<th>Lesson Number: 17</th>
<th>Author: Moody</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesson Title:</strong> Simple Machines 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Lesson Intentions:
- Practice presentation skills in groups
- Develop understanding of simple machines

## Sequence/Strategies:
- Student’s present information on the simple machines allocated. Teacher uses this time to give feedback on presentation skills
- **Closure:** Journal entry, will you change anything about your presentation after feedback received today?

## Resources/Materials/Weblinks:
- nil

## Prior Knowledge:
- presentations prepared by students

## Homework/Assessment:
- Finish assignment
### Lessons 18 – Presentations

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time: 70 min each</th>
<th>Lesson Number: 18</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Presentations

**Lesson Intentions:**
- Students present multimodal presentations

**Sequence/Strategies:**
- Class members give feedback during presentation using [resource 18.1](#)

**Resources/Materials/Weblinks:**
- Print outs of feedback sheet

**Prior Knowledge:**
- Presentations

**Homework/Assessment:**
- Nil

### Lesson 19 – Presentations

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time: 70 min each</th>
<th>Lesson Number: 19</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Presentations

**Lesson Intentions:**
- Students present multimodal presentations

**Sequence/Strategies:**
- Class members give feedback during presentation using [resource 18.1](#)

**Resources/Materials/Weblinks:**
- Print outs of feedback sheet

**Prior Knowledge:**
- Presentations

**Homework/Assessment:**
- Nil

### Lesson 20 – Design Challenge 3

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time: 70 min</th>
<th>Lesson Number: 20</th>
<th>Author: Moody</th>
</tr>
</thead>
</table>

**Lesson Title:** Design Challenge 3 – Marshmallow and Spaghetti Tower

**Lesson Intentions:**
- Practice using the Apollo Design process
- Work together in group to create a tower
- Communicate orally
- Analyse the resulting tower

**Sequence/Strategies:**
- **Design challenge:** Spaghetti and marshmallow tower. Split the students into small groups and provide them each with 20 pieces of spaghetti and 5 marshmallows. Challenge them to build a tower out of these materials that is able to hold the most mass 20 cm above the table.
- Give clear time limits for three phases. Planning, constructing and analysing.
- Students finish the task by analysing their tower. In their groups, have them use a plus, minus, interesting table to help them organise their observations.
- Ask each group to read and explain a point from their plus, minus, interesting table.

**Resources/Materials/Weblinks:**
- Spaghetti, marshmallows, butchers paper and pens, a small take away container and weights.

**Prior Knowledge:**
- Nil

**Homework/Assessment:**
- Nil
2.1 Energy Notes

- Different energy types
  - Chemical
  - Electrical
  - Mechanical
  - Light
  - Sound
  - Heat
  - Kinetic
  - Potential

- Definitions
  - Energy – the capacity of physical systems to do work. Measured in Joules (J)
  - Kinetic Energy – the energy of motion
  - Potential energy – stored energy, or the potential for a physical system to do work
  - Conservation of Energy – the energy in a system remains constant. Energy cannot be created or destroyed, it is only transformed from one form to another.

4.1 Energy Efficiency Notes

Energy efficiency

- Not all energy transfers are 100% efficient. Not all the energy will go where you want it to.

- Energy Efficiency = \frac{\text{useful energy output}}{\text{energy input}} \times 100

Rough Energy Efficiencies

1. Petrol engine – 25%
2. Electric light – 5%
3. Fluorescent light – 20%
4. Solar cell – 21%
5. Battery – 85%
6. Electric motor – 90%
6.1 Notes

Effective Google Use
- Use quotation marks “ ” to locate an entire string of text
  E.g., “World continents” will only return results with that exact phrase
- Mark essential words with a + symbol
  If a search term must contain certain words or phrases, mark it with a + symbol. E.g., +“Bill Gates” will only return results containing the term “Bill Gates”
- For further information www.churchofgoogle.org/Scripture/how_to_use_google.html

Mechanics Notes
- a branch of physics or applied mathematics
- the study of motion
- the study of forces affecting motion

Forces Notes
- a branch of physics or applied mathematics
- the study of motion
- the study of forces affecting motion
- Two types: Contact forces (push & pull) and non-contact forces

Work Notes
- The product of the force and the displacement of an object.
  \[ W = \text{Force} \times \text{displacement} \]
  \[ W = Fs \]

Different Forces
- Gravity
- Friction
- Electrical
- Magnetic
- Mechanical
- Muscular
- Surface tension

Balanced and Unbalanced Forces
When forces acting on an object are balanced, there is no motion, the forces cancel each other. When forces acting on an object are unbalanced, there will be a change in motion.

7.1 Forces and Motion

Normal Force
The normal force is the component, perpendicular to the surface of contact, of the contact force exerted on an object.

8.1 Friction Notes
- Friction:
  - Force
  - Acts against motion
  - When surfaces are in contact
- Limiting friction is the force acting just before an object starts to move
- Sliding (rolling) friction is the force acting against a body that is moving at a constant speed
9.1 Newton’s Laws of Motion Notes

Who was Sir Isaac Newton?

The facts:
1. Born 1642 in England
2. Died 1727 (84 years old which is seriously old for someone living in the 17th and 18th centuries!)
3. Physicist, mathematician, astronomer, philosopher, chemist and theologian!
4. Developed scientific and mathematical theories that we still use today:
   1. Laws of motion
   2. Optics
   3. Gravity
   4. Planetary motion
   5. Calculus

Newton’s 3 laws of motion:

1st Law
An object at rest will remain at rest and an object in motion will stay in motion (with the same speed and in the same direction) unless acted upon by an outside force.

Examples:
1. When you throw a ball it will eventually hit the ground because the forces of air resistance slows it down and gravity pulls it towards the ground
2. If you throw a ball in space where there are no outside forces to act on the ball it will never slow down!

2nd Law
Force is equal to the mass of an object multiplied by its acceleration (or basically the higher the mass of an object the more force that is needed to move it).

F=ma

Example:
1. It takes a greater force to push your mum on a swing than it does to push your little sister.

3rd Law
For every action there is an equal and opposite reaction

Example:
1. When you walk your foot does not sink through the ground because the ground pushes back up on it.
12.1 Distance and Displacement

Distance is a scalar quantity
- How much ground has been covered

Displacement is a vector quantity
- How far away from the starting point is the object now?

If someone followed the path from the starting point what would the total distance be that they travelled?
Total Distance = 4m+2m+4m+2m
= 12m

What would be the total displacement be?
Displacement = 4m East + 2m South + 4m West + 2m North
= 0m

Questions

1. A Car moved 80km to the South. What is its displacement?
80km South

2. A car moved 60km East and 90 Km West. What is the distance?
150 km

3. A Car moved 60km East and 90km West. What is the displacement?
30km West
13.1 Speed answers
1. Speed of Light 299 792 458 m/s
2. Speed of a space shuttle in orbit 7860 m/s
3. Speed of Sound (sea level) 340.29 m/s
4. Speed of a McLaren F1 107.3 m/s
5. Speed of a cheetah 28 m/s
6. Speed of a person Usain Bolt 10.4 m/s

13.2 Speed and Velocity Notes

**Speed**

Speed is a scalar quantity that refers to “how fast an object is moving”.
Measured as a distance divided by a time
SI units are m/s more commonly km/hr
Speed can be calculated:
- Instantaneously (at one instance of time)
- Average (total time and distance for a journey).

**Average Speed** = \( \frac{\text{Distance Traveled}}{\text{Time of Travel}} \)

What would be the average speed if I travelled from Dalby to Toowoomba a distance of 85 km in 1 hour?
Average Speed = Distance traveled/Time of travel
Average Speed = 85 km/1 hour
Average Speed = 85 km/h

What would be the average speed in SI units if I travelled from Dalby to Toowoomba a distance of 85 kilometers in 1 hour?
Average Speed = Distance traveled/Time of travel
Average Speed = 85000 m/3600 s
Average Speed = 23.61 m/s

What would be the average speed in SI units if I travelled from Dalby to Chinchilla a distance of 81 kilometers in 50 mins?
Average Speed = Distance traveled/Time of travel
Average Speed = 81000 m/3000 s
Average Speed = 27 m/s

**Velocity**

Velocity is a vector quantity
Measurement (speed) and a direction

**Average Velocity** = \( \frac{\Delta \text{position}}{\text{time}} \) = \( \frac{\text{displacement}}{\text{time}} \)
14.1 Oral Presentation Note Taking Sheet
Make comments on each of the features listed below. Terminology has been taken from English marking criteria so should be familiar to you.

<table>
<thead>
<tr>
<th><strong>Voice</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pace</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Use of Pauses</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Expression</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Body Language</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hands</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Stance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Eye Contact</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Knowledge</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content of speech</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Use of Language</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Audience Responses</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asks Questions?</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Uses humour?</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Other interaction?</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Visual Aids</strong></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Did they use any?</strong></td>
<td>What were they? How much?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
15.1 Simple Machines Notes
Simple Machine – is any device which makes work easier.

Advantages achieved:
Force Advantage – move a large load with a small effort. E.g. A Car Jack
Distance Advantage – move the load through a longer distance than the effort moves. E.g. garden shears
Direction advantage – force acting in one direction moves an object in another direction. E.g. A pulley

Types of simple machines - Levers

![Diagram of Lever Class 1]

A lever is a stiff bar which can pivot about a point (fulcrum)
There are 3 classes of lever depending on the relative positions of the load, the fulcrum and the effort.

Class 1 - Where the fulcrum is between the effort and the load for example a see saw of a pair of pliers.
If the fulcrum is closer to the load, then the class 1 lever gives a force advantage. E.g. Pliers.
If the fulcrum is closer to the effort, then the class 1 lever gives a distance advantage. E.g. Scissors.

Class 2 - Where the load lies between the fulcrum and the effort.
This is always a force advantage. E.g. A wheel barrow.

Class 3 - Where the effort is exerted between the fulcrum and the load.
The load moves further than the effort therefore it can only be a distance advantage. E.g. Ice tongs.

Types of simple machines - pulley

A pulley consists of a rotating wheel mounted in a frame.
A single pulley can give a directional advantage (like in a flag pole) but used in combination with other pulleys it can give a force advantage.
Types of simple machines – inclined plane

Inclined planes provide a force advantage as the load moves through a greater distance. Some examples of inclined planes are ramps, screws and wedges.

Types of simple machines – wheel and axle or gears

The wheel and axle consists of two different sized wheels joined so that they turn together. It is similar to a first class lever which has a force advantage.

Other examples of wheel and axles are a key or a screwdriver.

A gear is a modification of the wheel and axle. In a series of wheels with teeth around them and are linked together. Gears provide a distance advantage.

Sometimes they can be linked with a chain.

Gears may change the direction in which a force is applied; or increase or reduce a force or the distance over which a force is applied.
## 18.1 Oral Presentation Feedback Sheet
Circle or highlight comments during each talk, you can select more than one from each column.

<table>
<thead>
<tr>
<th>Presenter Name: _________________________</th>
<th>Feedback given by: _________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Overall your presentation was</th>
<th>You spoke</th>
<th>Your body language was</th>
<th>Your visual aids</th>
<th>Your content knowledge was</th>
<th>Next time ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skilfully constructed</td>
<td>Clearly</td>
<td>With some eye contact</td>
<td>Helped to engage the audience</td>
<td>Incomplete</td>
<td>Practise your presentation to increase confidence and fluency</td>
</tr>
<tr>
<td>In need of a bit more work</td>
<td>Confidently</td>
<td>Without making eye contact</td>
<td>Contained carefully selected images</td>
<td>Thorough</td>
<td>Try to speak with more confidence and expression</td>
</tr>
<tr>
<td>Very engaging</td>
<td>Fluently</td>
<td>Rigid</td>
<td>Set out important points from your analysis</td>
<td>Exceeds expectations</td>
<td>Make sure that Powerpoint slides give information to your audience in a clear and simple way</td>
</tr>
<tr>
<td>Highly original</td>
<td>With expression</td>
<td>Open</td>
<td>Contained too much information</td>
<td></td>
<td>Aim to meet the time requirement of the task</td>
</tr>
<tr>
<td>Interesting</td>
<td>In a monotone</td>
<td>Relaxed</td>
<td>Looked very professional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well organised</td>
<td>With extended periods of eye contact</td>
<td></td>
<td>Were used effectively to support your presentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brief</td>
<td>A bit too quickly</td>
<td></td>
<td>No visuals used</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment Task

1. Multimodal Presentation

Background and Outline of the Task

The toy industry is a multibillion dollar industry worldwide. For example in 2005 $23 Billion dollars was spent on toys in the US alone and 75% of those toys were manufactured in China. Though many toys are now becoming computerised the older style toys that move without batteries are still popular.

Your task will be to give an oral presentation to the class on how a non-electrical moving toy works.

Key Points:

- Presentation will be conducted in pairs
- Presentation needs to include a PowerPoint presentation
- Each individual student will need to keep a Journal throughout the entire process (this will be submitted to your teacher at check date and also at the end of the assessment)
- The toy you select needs to move without electricity

Concepts that must be covered in the presentation:

- An image of the toy
- Explanation of what the toy is made from
- A force diagram of the toy at rest and a force diagram of the toy in motion.
- What form of energy is used to move the toy?
- How is the toy impacted by friction?
- What velocity does the toy move at? Can you increase the toy velocity?
- How long does the toy move for? Can you increase the time it moves?
- Any other interesting information

Formatting Information

Audience: Write your presentation assuming that the listeners have basic scientific knowledge. This means that any technical language specific to your design will need to be explained.

Language Features: The language of your presentation needs to be formal language. This means you need to use technical terminology.

Presentation: During the presentation all members of the group must speak. Try to engage your audience by using visuals or having ways to interact with the audience.
### Criteria Sheet

<table>
<thead>
<tr>
<th>Knowledge and application</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
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<tr>
<td></td>
<td>• accurate and consistent recall and comprehensive explanation of engineering knowledge, mathematical concepts and techniques relevant to complex engineering situations, across the areas of study</td>
<td>• accurate recall and explanation of engineering knowledge, mathematical concepts and techniques relevant to engineering situations, across the areas of study</td>
<td>• recall and explanation of engineering knowledge, mathematical concepts and techniques relevant to engineering situations</td>
<td>• recall of engineering knowledge related to engineering situations</td>
<td>• recall of basic engineering facts</td>
</tr>
<tr>
<td></td>
<td>• discerning selection and correct and efficient application of engineering knowledge, mathematical concepts and techniques to complex familiar and unfamiliar engineering problems.</td>
<td>• appropriate selection and correct application of engineering knowledge, mathematical concepts and techniques to complex familiar or simple unfamiliar engineering problems.</td>
<td>• selection and application of engineering knowledge, mathematical concepts and techniques to simple familiar engineering problems.</td>
<td>• application of basic engineering knowledge to situations.</td>
<td>• use of basic engineering knowledge.</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
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<tr>
<td><strong>Investigative and analytical processes</strong></td>
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<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
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<tr>
<td></td>
<td>• effective interpretation and thorough analysis of relevant engineering data</td>
<td>• correct interpretation and detailed analysis of obvious relevant engineering data</td>
<td>• interpretation and analysis of engineering data</td>
<td>• explanation of basic engineering data</td>
<td>• factual statements are made about data</td>
</tr>
<tr>
<td></td>
<td>• solutions are analysed in depth and detail from multiple perspectives to identify relevant engineering principles</td>
<td>• solutions are analysed in detail to identify relevant engineering principles</td>
<td>• solutions are analysed in relation to engineering principles</td>
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<tr>
<td><strong>Evaluation and technical communication</strong></td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
<td>The student work has the following characteristics:</td>
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<td></td>
<td>• valid, well-reasoned conclusions and recommendations based on investigations and justified by relevant engineering knowledge and data</td>
<td>• valid conclusions and recommendations based on investigations and supported by engineering knowledge or data</td>
<td>• conclusions and recommendations are based on investigations</td>
<td>• conclusions are stated and recommendations made</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• effective organisation and succinct presentation of information in the most appropriate modes relevant to engineering situations</td>
<td>• logical organisation and clear presentation of information in appropriate modes relevant to engineering situations</td>
<td>• organisation and presentation of information in modes relevant to engineering situations</td>
<td>• presentation of engineering information</td>
<td>• presentation of some information related to engineering.</td>
</tr>
</tbody>
</table>
Text References