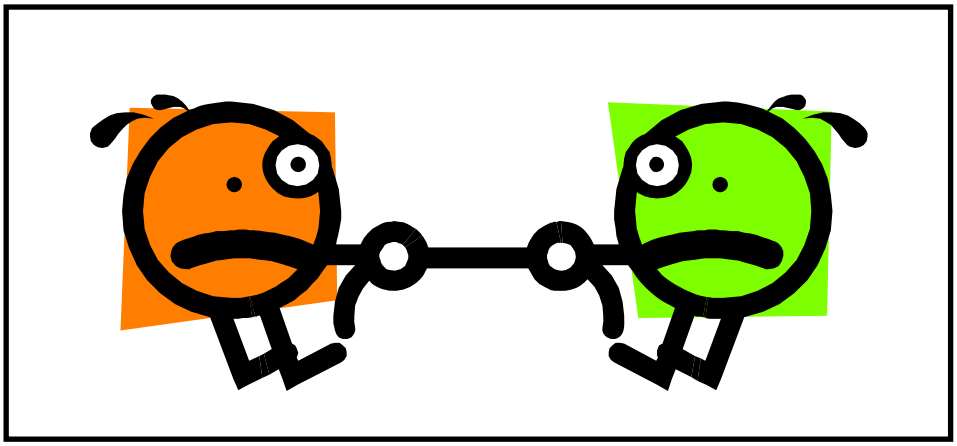
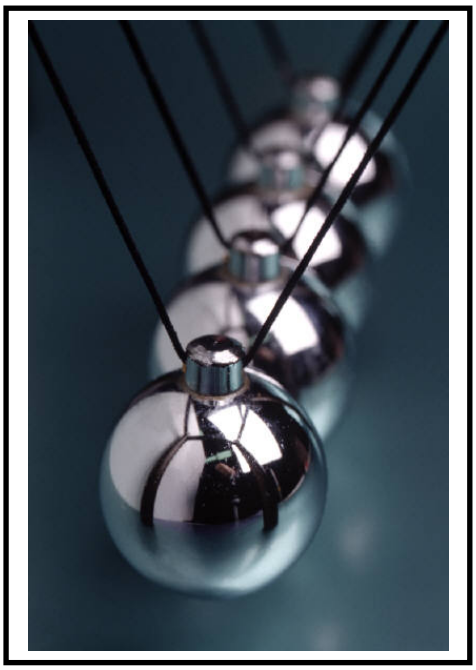
"Forced to.."
Physical Sciences
Year 7





This unit has been developed to meet the needs of Year 7 teachers. It is currently in draft form. Any feedback via the Moodle is appreciated.
http://dlb.sa.edu.au/pmssmoodle/

Science: Year 7 Unit – Physical Science

"Forced to"

Australian Curriculum

Achievement Standard

By the end of Year 7, students describe techniques to separate pure substances from mixtures. ***They represent and predict the effects of unbalanced forces, including Earth's gravity, on motion***. They explain how the relative positions of the Earth, sun and moon affect phenomena on Earth. They analyse how the sustainable use of resources depends on the way they are formed and cycle through Earth systems. They predict the effect of environmental changes on feeding relationships and classify and organise diverse organisms based on observable differences. ***Students describe situations where scientific knowledge from different science disciplines has been used to solve a real world problem. They explain how the solution was viewed by, and impacted on, different groups in society.***

Students identify questions that can be investigated scientifically. They plan fair experimental methods, identifying variables to be changed and measured. They select equipment that improves fairness and accuracy and describe how they considered safety. Students draw on evidence to support their conclusions. They summarise data from different sources, describe trends and refer to the quality of their data when suggesting improvements to their methods. They communicate their ideas, methods and findings using scientific language and appropriate representations.

Science Understanding

- Change to an object's motion is caused by unbalanced forces acting on the object
- Earth's gravity pulls objects towards the centre of the Earth

Science as a Human Endeavour

- Scientific knowledge changes as new evidence becomes available and some scientific discoveries have significantly changed people's understandings of the world
- Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations

Science Inquiry Skills

- Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge
- Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed
- In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task
- Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate
- Summarise data, from their own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions
- Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method
- Use scientific knowledge and findings from investigations to evaluate claims
- Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate

Links to General Capabilities

Literacy

The interdependence of science and literacy is demonstrated throughout this unit as students engage in a variety of different everyday literacies and literacies of science. (these specific links are identified at the start of each lesson)The language and literacy demands specific to the study of science develop along with scientific understanding and skills. This unit provides opportunities for students to develop their literacy skills as they:

- Engage in discussions and record their thinking, ideas and questions in journals,
- Draw labelled diagrams and force arrow diagrams
- Write written explanations of their science understandings
- Complete movement stories

Numeracy

Within this unit students engage in tasks involving practical measurement and the collection, representation and interpretation of data from investigations. This unit provides opportunities for students to develop their mathematical understanding in the following ways:

- Measuring time, length, mass (depending on investigation chosen)
- Collection and recording of data
- Analysis of data and drawing of conclusions
- Problem solving

Information and Communication Technology (ICT) Competence

Within this unit students information and communication technologies are used to research a science concept and present their understandings. Communication technologies offer opportunities for the communication and sharing of students' ideas and results both within and beyond the classroom. This unit provides opportunities for students to develop their ICT skills in the following ways:

- Use digital photographs / video recordings to present information and understandings

Critical and Creative Thinking

Within this unit students are asked to pose questions, make predictions, solve problems through investigation, analyse and evaluate evidence and summarise information. Students plan and conduct practical investigations. Students are asked to think in new ways about observations of the world. This unit provides opportunities for students to develop their critical and creative thinking skills in the following ways:

- Students thinking about 'what if?' possibilities when exploring the equipment.
- Solving problems associated with investigation organisation. How to successfully achieve the outcomes required?
- Trying to explain their thinking behind what happened and why?

Ethical Behaviour

Ethical behaviour is relevant to experimental science and the use of scientific information. Within this unit students apply ethical guidelines in the gathering of evidence, including, considering the implications of their investigation on others, the environment and on other living organisms. This unit provides opportunities for students to develop their ethical behaviour in the following ways:

- Gathering evidence to support their claims
- Investigating and applying ethical guidelines in the gathering of evidence.
- Completing risk assessments with regards to the practical investigation

Personal and Social Competence

Within this unit students further develop their teamwork skills by working together, sharing ideas and discussing their work. They develop self management skills such as planning effectively, following procedures and working safely. This unit provides opportunities for students to develop their personal and social competence in the following ways:

- Working together in teams to complete tasks such as filling in tables, organising and conducting investigations
- Working with others to develop an investigation and then successfully present their results

Primary Connections Unit Overview – Physical Sciences

Unit at a glance		Physical Science
Phase	Lesson	At a glance
ENGAGE	**Lesson 1** Water carrying	To capture students' interest and find out what they think they know about forces in action
	Lesson 2 Thinking about movement	
EXPLORE	**Lesson 3** Move that ball	To provide opportunities for students to explore different ways to get a ball to move
	Lesson 4 Gravity in action **Session 1** – falling cup of water **Session 2** – catching coins	To provide hands on, shared experiences of gravity in action
EXPLAIN	**Lesson 5** Newton's Laws **Session 1 -** Law of Inertia **Session 2** – Acceleration **Session 3** – Action and reaction **Lesson 6** Laws in Action **Lesson 7** Understanding movement **Lesson 8** Understanding Movement Parachutes and / or marble tracks and inclined planes	To support students understanding of the science behind moving objects
ELABORATE	**Lesson 9** Investigating force in action **Session 1-3** Planning and investigating	To provide students with the opportunity to develop an investigation into forces in action
EVALUATE	**Lesson 10** **Session 1 and 2** Showing the learning	To provide opportunities for students to represent their understandings about balanced and unbalanced forces

"Forced to"
Lesson 1: Water Carrying

ENGAGE

At a Glance:
To capture students' interest and find out what they think they know about forces in action

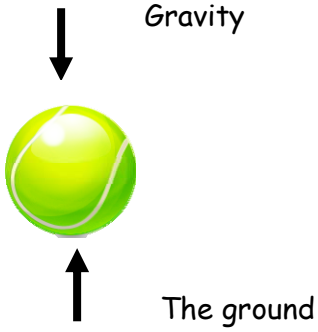
Assessment Focus:
Diagnostic Assessment is an important aspect of the Engage phase. This lesson will elicit what students already know and understand about forces in action. This allows teachers to take into account students' existing ideas when planning future learning experiences.

Assessment Opportunities: Diagnostic Assessment
- Participation in discussions
- Journal entries

Science Outcomes:
Students will be able to:
- Make predictions around what they think will happen
- Describe their understanding of the science behind the water activity

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind the water activity
- Use written text to record their experiences and current understandings
- Begin to develop an understanding of the key science words

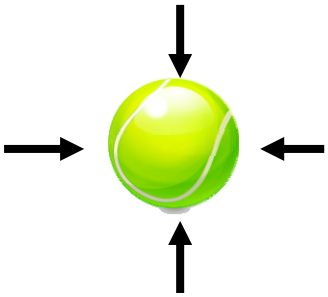
Teacher background information
A force is a push or a pull and by applying a force to an object you may cause a change in the object's motion: you may speed the object up, slow the object down or cause it to change direction. Types of forces include: push, pull, gravity, friction, air resistance and magnetism. Consider a foam ball sitting at rest: it has no unbalanced forces acting on it (the force of gravity is balanced by the upwards force from the Earth.)



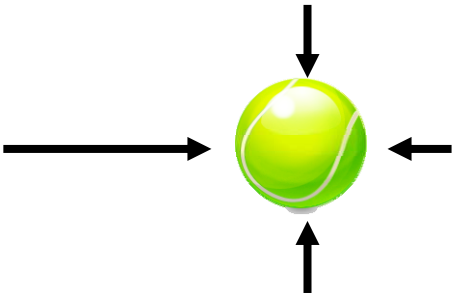
Balanced forces occur when all the forces enacting on an object cancel to zero. E.g. with the ball sitting on the ground the 'balanced forces' on the ball are the downwards force of gravity on the ball and the upwards force of the Earth on the ball.

If equal forces were applied to either side of the ball (as shown in the first figure below) the forces would remain balanced and the ball would not move. If the forces were unbalanced (a greater force were applied to one side of the ball than the other) then a change in the object's motion would occur and the ball would roll along the ground.

Balanced forces
The ball will not move.



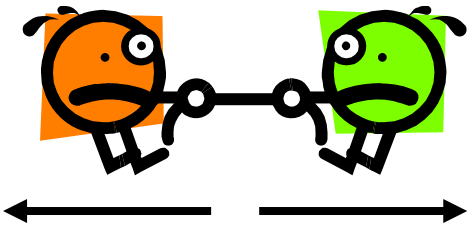
Unbalanced forces
The ball will roll.



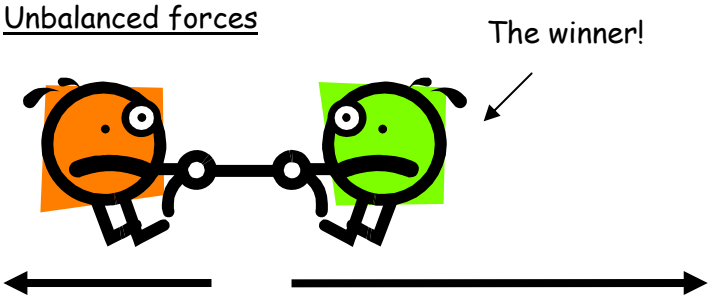
In the unbalanced situation the force arrows show that a greater force is being applied to the left hand side of the ball (the longer the arrow, the greater the force). This results in the ball rolling to the right.

In a tug of war if the forces are balanced then the two teams are pulling against each other and pushing against the ground with equal force. This means the teams do not move either forwards or backwards. If one team is managing to pull another team forward it is because of unbalanced forces. The team that is pulling the other forward is exerting greater force on the ground with their feet. This results in unbalanced forces which causes the teams to move.

Balanced forces



Unbalanced forces



When the students are carrying the water through the obstacles different forces will be acting on them and the water at different stages. When the forces are balanced the water will remain in the container and will not move. This would be at the times in the course when the student is standing still or travelling in a straight line at a steady speed. At this time the force of gravity pushing down on the water is equal and opposite to the force of the container pushing up on the water. When students run with the water and then stop suddenly the law of inertia comes into effect. Although the student stopped moving the water continued moving forward as there was insufficient force being applied to stop it. This causes water to spill over the top of the container.

It is not the speed that they are moving at that affects how much water spills out, but the rate of 'change in speed'. One student could have been running faster than another but stopped at a much slower rate, so that the deceleration was less and therefore less water spilled out.

Stopping slowly causes less water to splash out

Stopping suddenly causes more water to splash out

Lesson 1: Water Carrying

ENGAGE

Equipment for the class:

- Class science journal (optional)
- Word Wall and Glossary

Equipment for each team:

- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Bucket / container of water

Equipment for each student:

- Unit Record Sheet
- Science journals
- Change of clothes / wet weather gear (optional)

Preparation

- Introduce a copy of the unit record sheet to the class (Resource Sheet 1). This sheet can be used as a summary of each activity undertaken throughout the unit. It is a way of keeping track of student understanding and to see the development of their thinking around the key science understandings being covered. It can either be completed by individual students or one can be completed by the class after discussions at the end of each session.

- Organise one bucket / container of water per team

- Decide on an appropriate course for students to take ensuring a variety of challenges along the way – up a slippery dip and down the other side, a section for fast movement and a quick stop, a slow walk area, a place to stop and stand still, weaving through cones, an obstacle to jump over etc.

- Organise a display copy of the question: **How do unbalanced forces change the motion of objects?**

Lesson outline

Key words: movement, force, push, pull, balanced, unbalanced, inertia, motion

1. Introduce the question: **How do unbalanced forces change the motion of objects?** Explain that this is the question students will be focussing on throughout the unit. Generate some initial discussion around the question by breaking it into smaller parts.
    - What is meant by the word force?
    - What is meant by the word unbalanced?
    - What is motion?

    Put this question on display and continually refer back to it whilst working through the other activities within this unit. At this stage it is not about defining each of these words it is about engaging in a discussion around the students' current understandings.

2. Organise each team with a bucket / container of water – the size and shape of the container is not critical but for the activity to be most effective the container needs to be open so the students can see / feel the water splashing around when they move.

3. Explain to the students that they are about to move through a pre determined course whilst carrying a container of water. Explain the course to the students (see preparation notes for greater details) and get students to predict what they think will happen to the water as they move through the different parts of the course.

4. Students then take it in turns to move through the course carrying the bucket of water and engaging with the obstacles and challenges provided. Have them observe what happens to the water as they move through the course.

5. Return to the classroom and organise the students into cooperative learning teams and assign appropriate roles. Ask each team to discuss their current understanding of the term unbalanced forces and have them record at least one example of a situation where they believe unbalanced forces are at work.

6. Then have students record what happened to the water throughout the course in their journals. Engage in a class discussion after the event to determine common understandings around what happened and why? Revisit the key question – **How do unbalanced forces change the motion of objects?**

    1. What happened at different parts of the course?
    2. How does the activity you just did relate to the key question?
    3. What forces do you think were in action?
    4. What evidence do you have that forces were in action?
    5. When do you think they were balanced? Why?
    6. When do you think they were unbalanced? Why?

    After the discussion allow students the opportunity to record responses to some of these questions in their journals.

7. Begin a word wall and glossary of key words. Maintain these throughout the unit. Complete details on unit record sheet.

> **Teacher Tip**
> There is the potential for students to get wet during this activity so it is definitely an outside activity – large garbage bags worn over the clothes works well as a form of temporary protection

Opportunities for Extension

- If time permits repeat the course holding the bucket of water in another way. Is there another position to hold the bucket so that less water is lost? Is there another position to hold it so the person holding it does not get as wet? What is different? Why does it help?

- Design a course that would result in the least amount of spillage. Sketch the outline of the course for others to follow

- Challenge the students to get from x to y in the quickest amount of time, losing the least amount of water. What did they have to do to ensure this happened?

Possible Curriculum Links

Mathematics: students could measure the amount of water lost during the course and make comparisons to the time taken to complete the course

UNIT RECORD SHEET

Moving Things Around

Activity	What forces were in action? (you could draw a force diagram to help you)	What was their impact? Were they balanced or unbalanced? How do you know?

Lesson 2: Thinking about movement

ENGAGE

At a Glance:
To capture students' interest and find out what they think they know about forces in action

Assessment Focus:
Diagnostic Assessment is an important aspect of the Engage phase. This lesson will elicit what students already know and understand about forces in action. This allows teachers to take into account students' existing ideas when planning future learning experiences.

Assessment Opportunities: Diagnostic Assessment
- Participation in discussions
- Movement stories – visual representations with explanations
- Journal entries

Science Outcomes:
Students will be able to:
- Discuss the science behind their movement stories
- Use the key science words in discussions

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind their movement experiences
- Use written text to record their experiences and current understandings
- Engage in a role play and create an annotated diagram to visually represent their movement story
- Use appropriate language to help demonstrate an understanding of the events – cause, effect, because, as a result of, consequently etc

Lesson 2: Thinking about movement

Equipment for the class:
- Class science journal (optional)
- Word Wall and Glossary

Equipment for each student:
- Unit Record Sheet
- Science journals

Preparation
- Ask students to bring in photos of their favourite show rides to share with others and / or

- Identify some possible you tube links that demonstrate show rides in action (optional) to initiate discussion. There are many to choose from.
  http://www.youtube.com/watch?v=-fXL7dW__sE Roller coasters

Lesson Outline

Key words: movement, force, push, pull, balanced, unbalanced, inertia, motion,

ENGAGE

1. Revisit the key question - **How do unbalanced forces change the motion of objects?** Briefly remind students about what happened in the water carrying activity. What forces were in action and were they balanced or unbalanced? How do they know?

2. Ask students to get into cooperative learning teams and share stories around their experiences with movement. (Optional - View YouTube videos of different show rides. View students' photos of their favourite rides and relate their experiences to others.) It may be useful if the teacher shares a personal story first to give students an idea of the expectations. Eg the feelings and effects that you get when you swing on a swing as high as you can. How do you feel? What happens to your body, your hair etc

   Students' discussion could be guided by the following questions:

   - What happens to your body when you are a passenger in a car and it goes around the corner?
   - What happens when you stop quickly on your bike?
   - What would happen if you were at speed on a skateboard and you jumped / fell off?
   - What happens to your body when you swing up high on a swing?
   - What happens to your body at different stages on a roller coaster?
   - How can you lessen the impact of the forces on your body in these situations?
   - What might designers of show rides do to encourage people to ride their rides?
   - What are the forces at work?

3. Meet back as a whole class and share some of the experiences. When students are sharing their experiences encourage them to use the key words. Key words: movement, force, push, pull, balanced, unbalanced, inertia, motion,

4. After these discussions have students create a movement story. Students choose one experience and role play it, clearly telling the story of the movement involved. They then create a visual representation (annotated diagram) of the experience that clearly tells the story of the movement involved and the effect it had on them and their body.

   Literacy Focus

   An **annotated diagram** is a representation used to illustrate particular functions of parts of an object. The diagram includes an accurate drawing, a title, a date and notes to help explain each part. A line or arrow connects the annotation to the part it describes. In this case students draw diagrams showing what happens to their bodies at various stages throughout a particular event. E.g. what happens when you are riding a bike and you stop suddenly? They include annotations (notes) to help explain what is happening.

5. Complete details on Unit Record Sheet

Lesson 3: Move that Ball

EXPLORE

At a Glance:
To provide opportunities for students to explore different ways to get a ball to move

Assessment Focus:
Formative assessment is an ongoing component of the E*xplore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries
- Completed construction

Science Outcomes:
Students will be able to:
- Explore different forces needed to move a ping pong ball

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind their constructions
- Use written text and appropriate key words to record their experiences and current understandings

Lesson 3: Move that Ball

Equipment for the class:
- Class science journal (optional)
- Word Wall and Glossary
- A variety of construction materials – junk, k'nex, cardboard, tape, string etc

Equipment for each team:
- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Ping pong ball / an object to move

Equipment for each student:
- Unit Record Sheet (Resource Sheet 1)
- Science journals

Preparation
- Students will need access to materials for construction so teachers will need to gather a collection of materials for students to use. E.g. K'Nex, meccano, pop sticks, straws, string, boxes etc

Teacher Background Information
A force can simply be described as either a push or a pull. There are different types of forces such as gravitational, friction, air resistance (drag), magnetic and pushing and pulling. When forces are unbalanced they cause objects to speed up, to slow down or to change direction. When forces are balanced the motion and direction of an object does not change.

Lesson Outline

Key words: movement, force, force, push, pull, balanced, unbalanced, gravity, motion

EXPLORE

1. Engage in a class discussion around the question 'What is a force and what can it do?'
2. Divide the class into cooperative learning teams and present them with the following challenge:

   - Construct a device that moves a ping pong ball 1 m in any direction -

3. Give students an appropriate amount of time to construct their device. Along the way stop students to check in with their progress – what problems are there? Does anyone have another way to solve it? etc For those teams that finish quickly have them try to increase the complexity of their construction. Can they build a device that requires a sequence / series of at least 4 events that are needed to happen before the ping pong ball is actually made to move?
4. Ask students to draw a labelled diagram of their completed construction in their science journals. Have them record an explanation of how their construction works. What forces do they think were involved in getting the ping pong ball to move?
5. Have students share their constructions and diagrams with the rest of the class and then complete reflection questions such as:

   a. How close to achieving the 1m movement was your construction?
   b. What did you have to do to increase or decrease the distance the ping pong ball travelled?
   c. How successful was your construction at repeated events? Did you manage to get the ball to travel the same distance each time you tried it?
   d. What problems did you encounter and how did you solve them?
   e. What changes would you make if you could repeat this task to make your construction more successful?

Optional: Have a look at some examples / diagrams of Rube Goldberg creations and discuss the different ways that he planned for things to happen. There are also a lot of other video examples of Rube Goldberg creations on You Tube.

http://www.rubegoldberg.com/ - Official Rube Goldberg website.

http://video.google.com/videoplay?docid=-2367646121273499414# - Making a cup of tea

http://video.google.com/videoplay?docid=-2367646121273499414#docid=-5658676332346880954 – Egg break

Teacher Tip

You may want different groups concentrating on a specific direction e.g. moving it up, moving it down or moving it sideways.

Let the students develop their own ideas first before showing them lots of different examples from other people. Once they have their own ideas and you have shown them other examples you could give them time to make changes / adjustments if they want to.

Possible Curriculum Links

- The Arts: Draw a diagram showing the layout of the construction
- ICT: Video the constructions in action and show to other students

Lesson 4: Session 1 (Best completed outside)
Gravity in Action – Falling cup of water

EXPLORE

At a Glance:
To provide opportunities for students to explore gravity in action

Assessment Focus:
Formative assessment is an ongoing component of the E*xplore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries

Science Outcomes:
Students will be able to:
- Explore gravity in action

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind their explorations
- Use written text to record their experiences and current understandings

Lesson 4: Session 1
Gravity in Action - Falling cup of water

Equipment for the class:
- Class science journal (optional)
- Word Wall and Glossary

Equipment for each team:
- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Copy of Resource Sheet 2 – Gravity in Action
- 1 foam cup
- Access to water
- Pencil for making a hole in cup

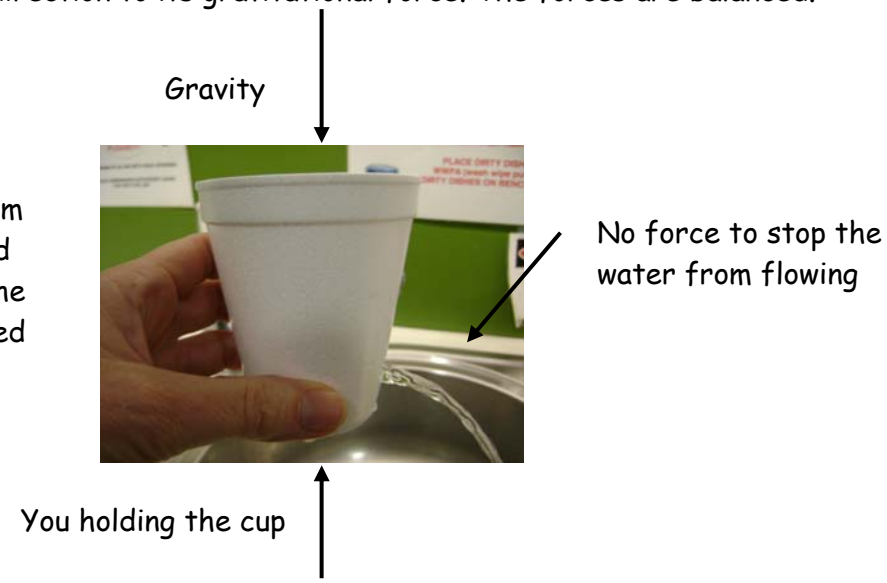
Equipment for each student:
- Unit Record Sheet (Resource Sheet 1)
- Science journals

Preparation

- Prepare a copy of the student Resource Sheet 2 for each team and ensure students have access to water. This activity is best performed outside as water will spill from the cups.

Teacher Background Information

When you are holding the cup and it is at rest the force of gravity pulls down on the water and the cup. The cup stays in place because you are holding it up: You are placing an upwards force on the cup that is equal in size and opposite in direction to its gravitational force. The forces are balanced.



The water flows to the ground due to gravity. Gravity forces the water against the bottom of the cup. As there is a hole in the bottom of the cup there is nothing at this spot to offset the force of gravity so the water flows, under the force of gravity, through the hole towards the ground.

When you let go of the cup and it is falling the water will not fall out because when you release the cup both the cup and the water are under the influence of gravity and both accelerate towards the Earth at the same rate. They are accelerating because they are being acted upon by an unbalanced force – Gravity. Unbalanced forces cause objects to speed up, slow down or change direction.

Lesson Outline

Key Words: forces, gravity, balanced, unbalanced

1. Revisit the key question: **How do unbalanced forces change the motion of objects?** What experiences can the students recall from previous lessons?

2. Organise students into pairs and give each pair a copy of Resource Sheet 3 "Gravity in Action". Allow them time to read through the instructions and ensure they have a clear understanding of the procedure.

3. Ask students to make a prediction around what they think will happen when they release the cup with the water in it. Give students sufficient time to work through the procedure and complete the activity. Have them record their observations and thoughts in their journals.

4. Meet as a class to share experiences and thoughts around the predictions the students made and what actually happened.

Gravity in Action

(This activity is best performed outside!)

WHAT YOU NEED:

- A styrofoam or plastic cup
- Something to make a hole in the cup
- A container of water

WHAT TO DO:

1. Poke a hole in the side of the cup close to the base. Be careful if you use a plastic cup because it will be harder to pierce a hole through it.

2. Cover the hole with your thumb and fill the cup with water.

3. Hold the cup up high and remove your thumb from the hole. Observe what happens. What do you think will happen if you let go of the cup? Would the water flow faster or slower?

4. Hold the cup up high and then let it drop. Observe what happens to the water this time.

Gravity in Action

(This activity is best performed outside!)

WHAT YOU NEED:

- A styrofoam or plastic cup
- Something to make a hole in the cup
- A container of water

WHAT TO DO:

1. Poke a hole in the side of the cup close to the base. Be careful if you use a plastic cup because it will be harder to pierce a hole through it.

2. Cover the hole with your thumb and fill the cup with water.

3. Hold the cup up high and remove your thumb from the hole. Observe what happens. What do you think will happen if you let go of the cup? Would the water flow faster or slower?

4. Hold the cup up high and then let it drop. Observe what happens to the water this time.

Lesson 4: Session 2 (Best completed outside)
Gravity in Action – Catching coins

EXPLORE

At a Glance:
To provide opportunities for students to explore gravity in action

Assessment Focus:
Formative assessment is an ongoing component of the E*xplore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries

Science Outcomes:
Students will be able to:
- Explore gravity in action

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind their explorations
- Use written text to record their experiences and current understandings

Lesson 4: Session 2
Gravity in Action – Catching coins

Equipment for the class:
- Class science journal (optional)
- Word Wall and Glossary

Equipment for each team:
- Role badges for Director, Manager and Speaker
- Each team member's science journal

Equipment for each student:
- Unit Record Sheet
- Science journals
- 6 x 20 or 10 cent coins (some students may be confident to try more)

Preparation

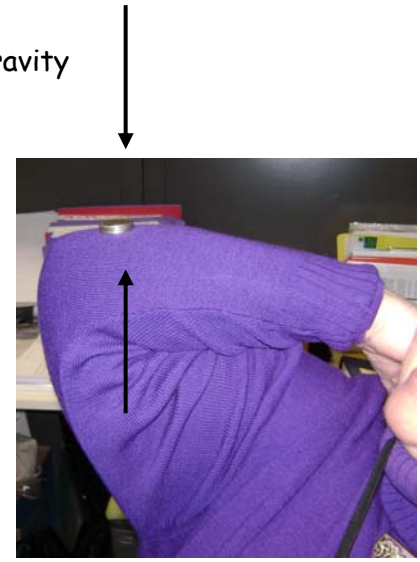
EXPLORE

Safety Note This activity is best performed outside as it is not always successful and coins can get scattered in any direction. Ensure all students have adequate space around them before attempting the task.

You may want to ask students to bring in their coins for this activity.

Teacher Background Information

When the coins are at rest on the elbow the forces are balanced. Gravity is forcing the coins down but your elbow is applying an equal amount of upward force and the coins do not go anywhere. The coins do not fall because of the principle of inertia. This states that an object at rest stays at rest unless acted upon by an unbalanced force. Gravity is the force which causes the coins to move. When you swing your arm downwards, your elbow moves downward too. This means your elbow is no longer placing an upwards force on the coin. The downwards gravitational force is now unbalanced and the coins accelerate towards the Earth.



Upward force from elbow is balanced with downward force of gravity therefore the coins do not move.

As they first start to fall the coins move fairly slowly and your arm is moving much faster than the coins are falling. This means it does not take your hand long to catch up with them. As they are falling at just the right distance from your body when you swing your arm down and around with your hand open the coins fall into the open hand. Your hand then applies an upwards force to stop the coins' movement and then continues to apply a force equal but opposite to the force of gravity and therefore the coins remain stationary in your hand.

Lesson Outline

Key Words: forces, gravity, balanced, unbalanced, inertia

1. Demonstrate to the class the procedure that they will follow to complete the task. You may want to practice first!
    a. First find a place where it is safe for you to release the coins. A place where you won't break anything or hurt anyone if you miss and the coins go everywhere.
    b. Open your right hand and bring it up so it is on your right shoulder, with the palm facing upwards. Extend your arm up so that your elbow is facing the ceiling.
    c. Place a pile of coins into a stack and carefully balance them on your elbow. Start with a smaller number of coins until you have practiced sufficiently.

d. Keeping your hand open swing it down as fast as you can. As your hand comes down you will feel the coins fall into your hand. Close your hand to catch the coins.

EXPLORE

e. Practice using more or less coins and your left and right hands.

2. Provide the students with time to practice catching the coins and trying different amounts.

3. View video clips of coin catching

   http://www.videojug.com/film/how-to-catch-coins-falling-from-your-elbow - the science behind the activity

   http://www.youtube.com/watch?v=b9iZpORconI – slow motion vision of coin catching

4. Meet together as a class and share some of the students' experiences. Encourage them to use the key words in their sharing. Complete Unit Record Sheet / link the activity to the key question – **"How do unbalanced forces change the motion of an object?"** Ask the students to record in their journals a diagram showing the different forces in action during this task. Introduce the idea of recording scientific information using a force-arrow diagram. Ask students to complete a force arrow diagram for this task.

   Literacy Focus:
   A **force-arrow diagram** uses arrows to represent push and pull forces. Arrows can be used to indicate the direction of the force. The length of the arrow can also be used to demonstrate the relative size of the forces.

Opportunities for Extension

- Try catching other objects of various shapes, mass e.g. marshmallows, lego bricks, plasticine (flattened and lumps) Does the change in shape / mass make a difference?

Lesson 5: Newton's Laws of Motion

EXPLAIN

At a Glance:
To support students' understanding of the science behind moving objects

Assessment Focus:
Formative assessment is an ongoing component of the E*xplain* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries
- Written explanations including labelled diagrams

Science Outcomes:
Students will be able to:
- Explain the forces in action in different situations
- Explain how unbalanced forces change the motion of objects
- Describe the links to Newton's Laws of Motion
- Describe the forces in action using force-arrow diagrams

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind their explorations
- Record experiences and current understandings
- Use science terminology in their discussions

Lesson 5: Session 1- Inertia
Newton's First Law of Motion

Equipment for the class:
- Class science journal (optional)
- Word Wall and Glossary
- Laminated copies of Newton's First Law of Motion for display purposes (Resource sheet 3a)

Equipment for each team:
- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Different types of balls e.g. marbles, tennis balls, ping pong balls etc

Equipment for each student:
- Unit Record Sheet (Resource Sheet 1)
- Journal

EXPLAIN

Preparation
Organise for some laminated copies of Newton's First Law of Motion (Resource Sheet 3a) to be displayed.

Possible Curriculum Links
Literacy: Before starting this lesson read and discuss some biographies based on Sir Isaac Newton
Numeracy: Create timelines about the important events in the life of Sir Isaac Newton

Teacher Tip
This is an ideal opportunity to involve the students in a literacy lesson around biographies and their features. It also enables you to investigate the life of a famous scientist in the context of the current unit of learning. It provides a link between the scientist and the science concepts being covered. See Teacher Background Information for links to websites around Sir Isaac Newton.

Teacher Background Information

There are numerous biographies about Newton on the internet. Try these links if you would like more information about his life.

http://www.bbc.co.uk/history/historic_figures/newton_isaac.shtml

http://www.lucidcafe.com/library/95dec/newton.html

http://www.biography.com/bio4kids/bio4kids-meet-newton.jsp

Newton developed three laws in relation to force and motion. Each of the following sessions will focus on one of the three laws with the concluding session involving the students in a task that should help them bring their ideas and understandings together.

Inertia

Newton's first law
An object at rest will stay at rest and an object in motion will stay in motion unless acted upon by an unbalanced force. This means that objects will keep doing whatever it is that they have been doing until they are acted upon by a force which causes an imbalance. For example an object that is moving will continue to move in a straight line at the same speed unless acted upon by unbalanced forces. If we roll a ball along the ground we know it will slow down eventually due to the forces of friction and air resistance which cause an imbalance and therefore cause the ball to slow and eventually stop unless more force is applied.

Lesson Outline
Key Words: forces, gravity, balanced, unbalanced, Newton's Laws, inertia

1. Provide students with some information about Sir Isaac Newton. Give them the opportunity to read through this information and engage in a brief discussion around who he was and what he is well known for.

EXPLAIN

2. Introduce Newton's First Law of Motion to the class (Resource Sheet 3a) Provide the students with some time to complete a 'Think, Pair, Share' exercise around the first law.
   a. **Think:** Time for the students to read the statement and reflect upon its meaning. What do you think it might mean? Can you think of any examples you have experienced that might link to the statement?
   b. **Pair:** Pair up with another class member
   c. **Share:** Share the ideas you have around the statement with a person from another pair.

3. Engage in a class discussion around the first law. What do the students think it means? Can they think of any examples that might fit?

4. Provide students with the equipment needed to complete the following:

   Law of Inertia: Newton's First Law of Motion – **An object at rest will stay at rest and an object in motion will stay in motion unless acted upon by an unbalanced force.**

   - Give pairs of students a ball / marble and ask them to place the ball on the floor in front of them and not touch it. Ask them to talk about what forces they think are currently acting on the ball and do they think they are balanced or unbalanced and their reasons why. *(The forces are balanced – the force of gravity pulling down is equal to the force of the ground pushing up.)*

   - What would need to happen to get the ball moving? *(You would need to create a situation where the forces are unbalanced. Eg push / blow on one side of the ball, create an imbalance between gravity and the force of the table pushing up by lifting the table slightly)*

   - Ask the students to now roll the ball along the floor and observe what happens. What are the outside forces that stop the ball from rolling? *(friction from the ground and the air (air resistance or drag) stop the ball from rolling)*

   - Try rolling the ball across different surfaces. Which surface creates the most friction? How can you tell? What is friction? What impact does it have on objects when they are moving? *(Friction is a force which reduces the motion between objects. The force of friction acts by direct contact between two surfaces. To make something move we need to apply enough force to overcome friction. There are times when we need to reduce friction to keep things moving smoothly e.g. ice skating, parts of an engine. There are also times when increased friction is useful e.g. increased tread on different types of shoes to stop us slipping, the brakes on a bicycle)*

5. Meet as a class to share experiences and understandings around what happened and the science behind it. Ask students to record observations around what they experienced in their journals using force arrow diagrams.

6. Have students consider the following question: **How does the wearing of seatbelts in cars link to the First Law of Motion?** Engage in a discussion around this and then have them write an explanation about why it is important to wear a seatbelt when travelling in a moving vehicle.

   - Use the following you tube link to help demonstrate the importance of seatbelts to students. http://www.youtube.com/watch?v=KvxGXSGuHbA&feature=related wearing seatbelts – inertia

7. Complete Unit Record Sheet

Optional: *View the Myth busters' video clip which clearly demonstrates the strength of friction by trying to separate the pages of a phone book http://www.youtube.com/watch?v=AX_lCOjLCTo or view this clip which provides a visual link to Newton's First Law*
http://www.youtube.com/watch?v=8zsE3mpZ6Hw&feature=related

Lesson 5: Session 2 - Acceleration
Newton's Second Law of Motion

EXPLAIN

Equipment for the class:

- Class science journal (optional)
- Word Wall and Glossary
- Laminated copies of Newton's Second Law for display purposes (Resource sheet 3b)

Equipment for each team:

- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Various size rubber bands,
- Ruler
- Small foam ball / ping pong ball / matchbox

Equipment for each student:

- Unit Record Sheet (Resource Sheet 1)
- Journal

Preparation

Safety Note: Emphasise the need for safety when dealing with rubber bands and projectiles of any sort.

Organise for some laminated copies of Newton's Second Law (Resource Sheet 3b) to be displayed.

Teacher Background Information

Acceleration

Newton's second law

The acceleration of an object depends upon its mass and the size of the force being applied to it. An object's mass is what determines how much force is needed to move, speed up, or slow down the object. The greater the object's mass, the more force it takes to change its motion and the greater the force applied to an object the greater the acceleration. For example if you push two objects – a soccer ball and a car with the same amount of force the soccer ball will move with greater acceleration because it has less mass. To move both these objects the same distance in the same amount of time greater force needs to be applied to the car because it has a greater mass.

Mass is different to weight. Mass is the amount of matter an object has. Weight is the measure of the pull of gravity on an object's mass. Your weight would change on the moon (due to the gravitational acceleration being different to what it is on Earth) but not your mass.

Force = mass x acceleration

Lesson Outline

Key Words: forces, gravity, balanced, unbalanced, Newton's Laws, acceleration, mass

1. Organise students into cooperative learning teams and assign roles. Introduce Newton's Second Law of Motion to the class (Resource Sheet 3b). **The acceleration of an object depends upon its mass and the size of the force being applied to it.** Provide the students with some time to discuss their understanding of this law with their team.

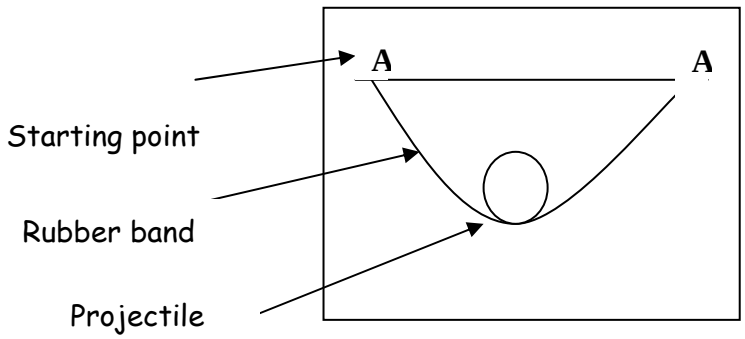
EXPLAIN

2. Meet together as a class to share understandings of the second law. What do you think it might mean? Can you think of any examples you have experienced or know about that might link to the statement?

3. Allow cooperative learning teams time to investigate what happens when you increase the force applied to a marble / ping pong ball. Teams could

    a. Construct a simple launching device using a rubber band (see diagram below) and use the device to determine what happens to the distance the projectile travels if you increase the force applied.
    b. Use flexible plastic rulers to determine what happens to the distance the projectile travels if you increase the force applied.
    c. Create another means for propelling an object that enables accurate measurement of the force applied.

    Ask students to record their investigation in their science journals clearly explaining what they did, how they did it and what they discovered.



Hold the rubber band securely at A

4. Meet together as a class to discuss findings. *(Greater force is applied by extending the rubber bands / rulers further back. The greater the force used the further the projectile should travel)*

5. Complete Unit Record Sheet and discuss how Newton's Second Law helps to explain how the stopping distance of vehicles is affected by the vehicles mass. E.g. the larger the mass the longer the vehicle takes to stop. The faster a vehicle is travelling the greater the stopping distance. How does this understanding relate to driving?

Optional

View this link to show the students a video on Newton's Second Law
http://www.youtube.com/watch?v=iwP4heWDhvw&feature=related

EXPLAIN

Lesson 5: Session 3
Newton's Third Law of Motion

Equipment for the class:

- Class science journal (optional)
- Word Wall and Glossary
- Laminated copies of Newton's Third Law for display purposes (Resource sheet 3c)

Equipment for each team:

- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Balloons
- Tennis balls / marbles / ping pong balls /basketballs

Equipment for each student:

- Unit Record Sheet (Resource Sheet 1)
- Journal

Preparation

Organise for some laminated copies of Newton's Third Law (Resource Sheet 3c) to be displayed.

Teacher Background Information

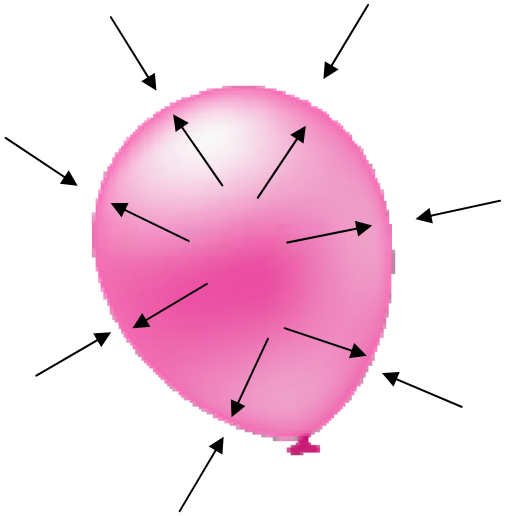
Action and Reaction

Newton's third law

For every action there is an equal and opposite reaction. This means that for every force there is a force equal in size and opposite in direction – this is the reaction. Whenever an object is pushed by another object it is pushed back with equal force in the opposite direction. For example when a balloon is blown up the balloon expands and the air is trapped under pressure from the sides of the balloon. The forces being exerted on the outside and inside of the balloon are balanced.

Before the balloon is released

The forces are balanced.
The balloon remains inflated.

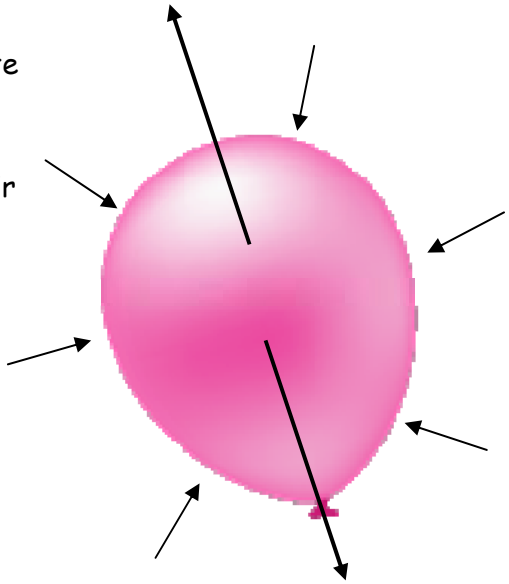


When the neck of the balloon is released the air rushes out due to the pressure from the sides of the balloon. This upsets the balance and as the air exits the balloon it moves in one direction away from the balloon which forces the balloon to move in the opposite direction. The balloon continues moving until all the air is expelled. A rocket is propelled by similar forces.

Force of expelled air on balloon

When the balloon is released

Causes an equal and opposite reaction which shoots the balloon in the opposite direction to the escaping air



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Air is forced from the balloon. (Force of expelled air from the balloon)

Lesson Outline

Key Words: forces, gravity, balanced, unbalanced, Newton's Laws, action, reaction

1. Organise students into pairs and introduce Newton's Third Law of Motion to them: **For every action there is an equal and opposite reaction.** Ask them to briefly discuss what they think this means and then to develop a visual representation of this statement. What could they draw that shows this statement in action?

2. Give pairs of students two balls / marbles and have them roll them towards each other so that they hit. Ask them to observe what happens. *(As the two balls collide they push on each other which causes both balls to move away from each other. The forces are equal in size and opposite in direction)*

3. Give each student a balloon and ask them to blow the balloon up and then release it. What did they observe happening? What happens if you repeat this but release the balloon in different directions? Eg if you release the air from the balloon towards the floor, then towards the ceiling, then towards the left or the right what happens? Ask students to record an explanation of what happens in their journals – remind them of force arrow diagrams.

4. Engage in a class discussion around how these two activities link back to Newton's third law and complete the Unit Record Sheet.

Optional

View this link to show the students a video on Newton's Third Law:
http://www.youtube.com/watch?v=BxomJafd3Rs&feature=related Newton's Third Law

Lesson 6: Laws in Action

EXPLAIN

Equipment for the class:

- Word Wall and Glossary
- A blank A3 page for each of the activities undertaken so far: Water Carrying, Move that Ball, Catching Coins and Falling Cup of Water

Equipment for each pair:

- A copy of Newton's Three Laws of Motion

Preparation

Students will be undertaking a Hot Potato task so you will need to organise enough A3 sheets so that each pair has access to a sheet and the sheets are evenly distributed throughout the tasks. E.g For a class of 30 students you will need 4 copies of each of the 4 activities.

Teacher Background Information

Possible links

a. **Water Carrying**: Before the students began moving through the course the water in the bucket was at rest – all forces were balanced and the water was not moving. When students ran with the water and then stopped suddenly the law of inertia came into effect. Although the person stopped moving the water continued moving forward as there was insufficient unbalanced forces applied to stop its forward motion. This caused water to spill over the top of the container. It is not the speed that they were moving at that affects how much water spills out, but the rate of 'change in speed'. One student could have been running faster than another but stopped at a much slower rate, so that the deceleration was less and therefore less water spilled out.

b. **Move that Ball**: Answers will vary according to individual constructions but generally the forces would have been balanced at the start of the chain of events. E.g. when the ball was not moving. It was not moving because all forces were balanced. Forces may also have been balanced when the ball was moving through the construction. This would have been at a point when the ball was moving at a constant speed and not changing direction. However in this instance constant speed would not be achieved due to friction and air resistance always acting on the ball. The forces were unbalanced when the ball was slowing down. This unbalance is due to friction and air resistance acting upon the ball.

c. **Catching Coins:** When the coins are at rest on the elbow the forces are balanced. Gravity is forcing the coins down but your elbow is applying an equal amount of upward force and the coins do not go anywhere. The coins do not fall because of the principle of inertia. – This states that an object at rest stays at rest unless acted upon by an unbalanced force. Gravity is the force which causes the coins to move. When you swing your arm downwards, your elbow moves downward too. This means your elbow is no longer placing an upwards force on the coin. The downwards gravitational force is now unbalanced and the coins accelerate towards the Earth. As they first start to fall the coins move fairly slowly and your arm is moving much faster than the coins are falling. This means it does not take your hand long to catch up with them. As they are falling at just the right distance from your body when you swing your arm down and around with your hand open the coins fall into the open hand. Your hand then applies an upwards force to stop the coin's movement and then continues to apply a force equal but opposite to the force of gravity and therefore the coins remain stationary in your hand.

d. **Falling Cup of Water** When the cup is at rest the force of gravity pulls down on the water and the cup. The cup stays in place because you are holding it up: You are placing an upwards force on the cup that is equal in size and opposite in direction to its gravitational force.

   The water flows to the ground due to gravity. Gravity forces the water against the bottom of the cup. As there is a hole in the bottom of the cup there is nothing at this spot to offset the force of gravity so the water flows, under the force of gravity, through the hole towards the ground.

   When the cup is falling the water will not fall out because when you release the cup both the cup and the water are under the influence of gravity and both accelerate towards the Earth at the same rate. As they are accelerating they are being acted upon by an unbalanced force. Unbalanced forces cause objects to speed up, slow down or change direction.

Lesson Outline

Key Words: forces, gravity, balanced, unbalanced, Newton's Laws, action, reaction, inertia

1. Ask the students to find a partner. Once the students are in pairs explain that they are about to engage in a hot potato exercise as a way of linking their previous learning to Newton's 3 laws.

   - Hot potato involves students starting with a particular question and then giving them a short period of time to record their responses to the question on the piece of paper. At the end of the time period the pieces of paper are passed on to the next group and students receive a new question to consider. Prior to doing any recording they spend time reading the comments that are already on the sheet from the previous group or individual. Students then add any new information which will support or deepen the understanding around the concept or question.

2. Give each pair a copy of one of the A3 pages. They are then given to time to think about the activity presented on the page, look through their journals, read their Unit Record Sheets etc. Once they have had time to revise the activity they then have some time to talk through the activity with their partner and look for ways that that particular activity links with some or all of Newton's Laws of Motion. (see teacher background information for details)

3. After 5 minutes have the students complete the idea they are currently recording and then the sheets are passed on to another pair. Each pair should now have a new activity in front of them. They are given time to read what the other students have recorded about that activity and then to add more information or details based on their own knowledge and understanding.

4. Repeat this procedure until all pairs have had the opportunity to look at and record their thinking around all 4 activities.

5. Meet together as a class to discuss the information that has been recorded on the different sheets. Display the finished pages for future reference.

Optional – other video links to help demonstrate the laws.

http://www.youtube.com/watch?v=BxomJafd3Rs&feature=related Newton's third law

http://www.stevespanglerscience.com/content/experiment/00000131 - tablecloth pull - inertia and friction

http://www.stevespanglerscience.com/content/experiment/00000084 - egg drop - inertia and gravity

INERTIA

NEWTON'S FIRST LAW OF MOTION

An object at rest will remain at rest and an object in motion will remain in motion unless acted on by an unbalanced force.

This law is often called "the law of inertia".

With no outside forces this object will never move

With no outside forces this object will never stop moving

Resource Sheet 3a

ACCELERATION

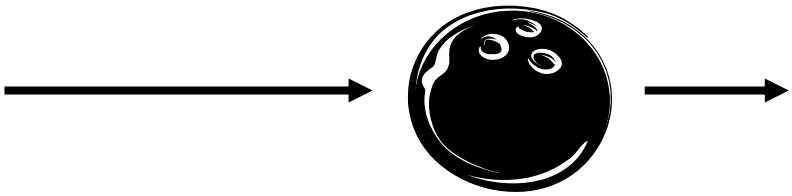
NEWTON'S SECOND LAW OF MOTION

The acceleration of an object depends upon its mass and the size of the force being applied to it.

Force = mass x acceleration (F=ma)

The greater the force applied to an object the greater the acceleration

More force is needed to accelerate an object that has a greater mass



Resource Sheet 3b

ACTION AND REACTION

NEWTON'S THIRD LAW OF MOTION

For every action there is an equal and opposite reaction

The two balls are rolling toward each other

When they collide the balls push on each other. These two forces are equal in size and opposite in direction.

Resource Sheet 3c

Lesson 7: Understanding Movement

EXPLAIN

At a Glance:

To provide opportunities for students to develop an understanding of forces in action

Assessment Focus:

Formative assessment is an ongoing component of the E*xplain* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment

- Participation in discussions
- Journal entries

Science Outcomes:

Students will be able to:

- Develop an understanding of forces in action
- Explain what forces are in action using scientific terminology
- Develop an understanding of how scientific knowledge has changed over time and how this has helped change people's understanding of the world

Literacy Outcomes:

Students will be able to:

- Contribute to discussions about their science understandings
- Use written text to record their experiences and current understandings

Lesson 7: Understanding Movement

Equipment for the class:

- Class science journal (optional)
- Word Wall and Glossary

Equipment for each student:

- Unit Record Sheet
- Science journals
- A4 pieces of paper
- A copy of Resource Sheet 4

Teacher Background Information

EXPLAIN

The weight of an object does not affect the rate at which it falls. (if you ignore the effect of friction (air resistance))

Why do the two pieces of paper fall at different rates? The rate at which objects fall is greatly affected by their shape and the surface area. When you compare the different pieces of paper, it is the shape of the paper that affects the speed at which it falls - the bigger and flatter pieces of paper will have larger surface areas. This means there is greater air resistance (upwards force resisting the paper's downwards movement), and the paper should fall more slowly as it 'floats' to the ground. The scrunched up piece of paper has a smaller surface area. There is less air resistance. It should fall more quickly to the ground.

The two quotes being used in this activity demonstrate how scientific thinking changed over time. Aristotle initially believed that heavy objects fell faster than light ones and it wasn't until the work of Galileo hundreds of years later that this thinking changed.

There are numerous biographies about Aristotle and Galileo on the internet. Try these links if you would like more information about their lives.

http://space.about.com/od/astronomerbiographies/a/aristotlebio.htm - biography on Aristotle

http://www.online-literature.com/aristotle/ - biography on Aristotle

http://inventors.about.com/od/gstartinventors/a/Galileo_Galilei.htm - biography on Galileo

http://www.biography.com/articles/Galileo-9305220 - biography on Galileo

Lesson Outline

Key Words: forces, gravity, balanced, unbalanced,

1. Introduce the class to the scientific ideas of Aristotle and Galileo giving a bit of background information on them both. (Resource Sheet 4 and Teacher Background Information) Read the two statements and give the students time to discuss both of them and then decide which one they think is most accurate and their reasons why. Have students share their thinking with the rest of the class. (You may wish to cover up the dates on the quotes so that students initially base their thoughts on what they think and not on the fact that one idea is much later than the other)

2. Give students the opportunity to drop two different objects from arms length and observe what happens. Record their findings and then engage in discussions and share their experiences. What did they see happen and why do they think it happened? Was it what they expected? Did anything surprise them?

3. Stand in front of the class and hold two pieces of paper at arm's length. Make sure one piece is a whole flat sheet and the other can be changed in some way. Eg scrunched up into a ball, folded into a much smaller size, cut up into lots of smaller pieces etc. Ask the class to predict what they think will happen when you let the papers go. Ask them to share their predictions and the thinking behind it with another person in the class.

4. Give the students the opportunity to discover if their predictions were correct by allowing them to drop two different pieces of paper from the same height. Can they find a way to get both pieces of paper to land on the ground at the same time? What are the variables that need to be considered? Allow them time to investigate and record their findings.

EXPLAIN

5. Meet back as a class and share their experiences. When students are sharing encourage them to use the key words if relevant. Discuss the science behind what is happening:
    - Why does the flat sheet of paper take longer to hit the ground?
    - What forces are in action and what are they doing?
    - Why does the scrunched up piece of paper hit the ground first?
    - Does crumpling the piece of paper make it any heavier?

    After engaging in class discussions ask the students to record their responses to some or all of the above questions in their science journals.

6. Engage in a class discussion around the development of scientific concepts over time. Why do things change?

Teacher Tip
It is important for students to recognise that the two pieces of paper both weigh exactly the same. Weight is not a factor in the speed with which things fall. The rate at which objects fall is greatly affected by their shape and the surface area.

Optional

- View the following video http://www.youtube.com/watch?v=WyBYVQzvGdI (Mythbusters - Galileo's Hammer and Feather Drop) and give students the opportunity to see the results of dropping a hammer and a feather in a vacuum.

"Heavier objects fall faster than lighter ones"

Aristotle (384BC - 322BC)

"Objects of different weights fall at the same speed"

Galileo (1564 – 1642)

Resource sheet 4

Lesson 8a: Understanding Movement - Parachutes

EXPLAIN

Teacher Tip:
Teachers can decide whether to use parachutes or marble tracks or both as the means to help develop the conceptual understanding around the forces involved in movement.

At a Glance:
To support students understanding of the science behind moving objects

Assessment Focus:
Formative assessment is an ongoing component of the E*xplain* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries
- Written explanations including labelled diagrams

Science Outcomes:
Students will be able to:
- Explain the forces in action in skydiving
- Explain how unbalanced forces change the motion of objects
- Describe the links to Newton's Laws of Motion

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind their explorations
- Use written text and labelled diagrams to record experiences and current understandings
- Use science terminology in their discussions

Lesson 8a: Understanding Movement - Parachutes

Equipment for the class:
- Class science journal (optional)
- Word Wall and Glossary
- Copies of Newton's Laws of Motion on display in the room

Equipment for each team:
- Role badges for Director, Manager and Speaker
- Materials to make parachutes – string, fishing line, different types of paper, plastic and cloth materials

Equipment for each student:
- Unit Record Sheet
- Journal

Preparation
Organise a variety of materials for the students to use as parachutes. This could include things such as string, fishing line, different thicknesses and types of paper, plastic and other cloth materials, plasticine for weights.

Teacher Background Information

EXPLAIN

Why do parachutes fall slowly to the ground? As the sky diver leaves the plane and is falling towards the ground, the force of gravity is pulling them towards the Earth. As they are falling they also experience air resistance or drag which is an upward force. The downwards gravitational force remains constant regardless of speed, but the faster you fall the greater the air resistance (the greater the upwards force). Eventually however the two forces (gravity and air resistance) become balanced and the sky diver ceases to accelerate and continues to fall at a constant speed.

To slow down their speed the skydiver needs to create a situation where the upward force is greater than the downward force. To do this they open their parachute. This immediately slows them down because the open parachute greatly increases the amount of air resistance or drag causing an imbalance in the forces acting on the parachute. The air trapped under the canopy of the parachute pushes upwards on the parachute and creates a larger upwards force than the force of gravity which is pulling the skydiver down. As the forces are now unbalanced the sky diver slows down. The sky diver continues to slow down and therefore the air resistance force decreases once more. The gravitational force remains constant.

The skydiver will continue to slow down until the forces of drag and gravity are balanced once again and at this point the skydiver maintains a constant speed as they drift towards the ground. As stated by Newton's first law an object in motion will stay in motion unless acted upon by an unbalanced force. This means the parachutist will continue to fall towards the ground at a constant speed until the forces once again become unbalanced. This occurs when the skydiver reaches the ground. As they hit the ground, they stop because of the force exerted by the ground. Once the skydiver has stopped the forces are once again balanced.

Lesson Outline

Key Words: forces, gravity, balanced, unbalanced, Newton's Laws, inertia

1. Give each student a small lump of plasticine and ask them to use the materials available to make at least two different parachutes that can be used to bring the plasticine gently to the ground. Record the two different parachutes in journals by using appropriate labelled diagrams. Remind students to record not only the materials they used but also the measurements of things such as size of canopy, length of string etc. Get students to test their two parachutes and explain the difference between them and which one they think works best and why.

2. Once students have had time to successfully complete the task ask them to meet back together and share information around the success of their parachutes.

3. Ask students to find a partner and together begin creating a visual representation of the forces in action during a sky dive, e.g. what forces are in action when the skydiver is sitting in the plane? Are they balanced or unbalanced forces at this stage? How do you know? This could be a visual representation such as a flow diagram, which contains information about the forces during the main stages of the sky dive. Stages could be things such as – in the plane, standing on the edge, the first step, release the ripcord, drifting downwards, reaching the ground. Students could use force arrow diagrams to help them with their explanations.

4. View the video http://www.youtube.com/watch?v=ur40O6nQHsw&feature=related to get an understanding of the science behind sky diving. What forces are in action? Give students the opportunity to watch and discuss the video and then to make modifications to their visual representation of what happens during a sky dive.

Lesson 8b – Understanding Movement - Marble Tracks and Inclined Planes

EXPLAIN

At a Glance:
To support students' understanding of the science behind moving objects

Assessment Focus:
Formative assessment is an ongoing component of the E*xplain* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities: Formative Assessment
- Participation in discussions
- Journal entries
- Written explanations including labelled diagrams

Science Outcomes:
Students will be able to:
- Explain forces in action in different situations
- Explain how unbalanced forces change the motion of objects
- Engage in science discussions around Newton's Laws of Motion
- Draw an annotated diagram

Literacy Outcomes:
Students will be able to:
- Contribute to discussions about the science behind their explorations
- Use written text and labelled diagrams to record experiences and current understandings
- Use science terminology in their discussions

Lesson 8b – Understanding Movement - Marble Tracks and Inclined Planes

Equipment for the class:
- Class Science journal (optional)
- Word Wall and Glossary
- Copies of the resource pages on Newton's Laws of Motion for display

Equipment for each team:
- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Marbles and marble track (can be bought from hardware store – sold as moulded angle – see photos for more information)
- Toy cars, balls
- Material for ramps

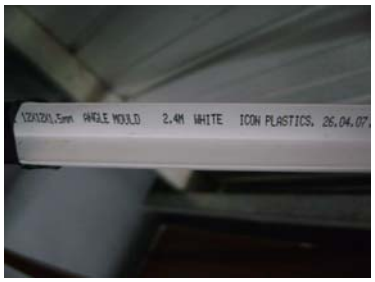
Equipment for each student:

- Unit Record Sheet
- Journal

EXPLAIN

Preparation

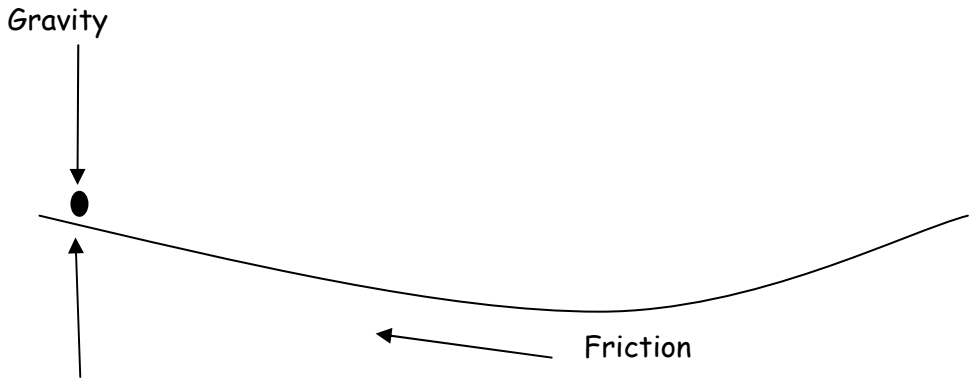
- Organise marbles and tracks. Buy strips of angle moulding from a local hardware store or find other alternatives to use. (See photos for details). You could use anything else that enables marbles to easily roll down an inclined plane. The advantage of the moulding angle is it is flexible and can be used with the marbles rolling up and down continuously until the energy dissipates.
- If you can't obtain angle moulding organise other materials to be used as ramps. E.g. strips of strong card, pieces of wood etc



Teacher Background Information

When the track is held at either end in a curved shape (see diagram below) and a marble is released from one end the marble immediately starts rolling down the track. The force of gravity is larger than the force of friction which occurs between the marble and the track.

The marble will roll along the track and the downwards gravity force will increase its speed until it reaches the bottom of the track. The frictional force will act to slow the marble down, but because the frictional force is smaller than the gravitational force the overall effect is an increase in speed. Once the marble reaches the lowest point it has a large speed and therefore will roll up the other side of the track, during which time the forces of gravity and friction will both constantly decrease its speed. The marble will continue to slow until it is momentarily stationary once more. The marble will then start to move down the track once more (under the influence of gravity) and it continues this backwards and forwards motion until friction brings it to a stop and gravity holds it in place at the base of the track. Because the frictional force always resists the marble's motion, the height the marble reaches each time it moves up and down the track will be less than the previous height. When it has stopped moving the forces acting upon the marble are once again balanced. The force of gravity pulling down on the marble is equal to the force of the track pushing up.



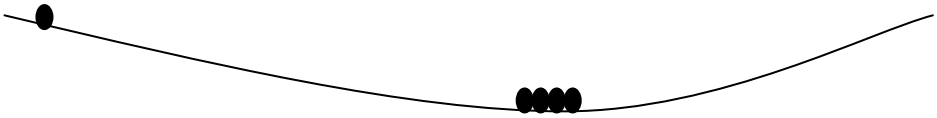
Track pushing up

As the marble rolls friction acts as a force in the opposite direction

EXPLAIN

When you place four marbles on the track and allow them to come to rest in the middle and then release a marble from one end it will roll down the track towards the other marbles in the centre due to the force of gravity. When it hits the central marbles the marble on the end of the line shoots forward. This is because when the rolling marble reaches the other marbles it pushes into the first marble in the line and forces this marble forward. The marble tries to move away but it can't because there is another marble in the way. This is evidence of an action – first marble pushing – and a reaction – second marble moving forward. So the force of the impact passes through the next marble and this marble is pushed forward. This continues on to the end of the line until there is nothing stopping the last marble and it shoots forward. The inertia of the first marble is passed on to the last marble.

When the marbles are not moving the forces acting upon them are balanced. When the forces are unbalanced then the marbles will start to speed up or slow down.



Lesson Outline

Key Words: forces, gravity, balanced, unbalanced, inertia, inclined plane

1. Place students in cooperative learning teams. Introduce students to the marble tracks and after discussing safety issues with regards to moving around with the long pieces of track give them access to marbles and the track and allow them time to explore the track and its possibilities. If track is not available students should have time to explore using marbles and inclined planes. Ask students to record in their journals any questions that come to mind while they are exploring the marbles and track.

2. After allowing the students time to initially "play" with the track and the marbles gather them together as a group and engage in a discussion to direct their thinking. What questions did they think of as they were exploring? Record a list of these generated questions and then ask students to spend more time (10/15 minutes) investigating one or two specific questions.

    a. How long can you keep the marble moving up and down the track once you have got it started? (no extra force applied)
    b. What happens when you put stationary marbles in the centre of the track and then release marbles from one end?
    c. What forces are in action at different points along the marble track?
    d. What happens when you raise the height of the ramp? How does this impact on the amount of time the marble spends moving?
    e. What happens when you release a marble from either end at the same time?
    f. What happens when you release two marbles from one end?

3. Ask students to choose one idea explored in the previous part of the lesson and to look more closely at the science behind what is happening. Can they use their current knowledge of forces in action to help explain a particular event involving the marbles and marble track? **"How do unbalanced forces change the motion of an object?"** Ask the students to share their thinking with their team before meeting back as a class group.

4. Meet together as a class to share current thinking and understandings. View the following video http://www.youtube.com/watch?v=cP0Bb3WXJ_k which helps explain some of the results from the marble track (from 2:22 – 3:33 on the video clip). Then ask students to draw an annotated diagram that shows their understanding of the science that is happening.

5. Discuss how the understanding of action and reaction links to rear end collisions. Why, in heavy traffic, do we often have rear end collisions involving two or three cars? Why might the weather conditions play a critical role in the cause of accidents?

Teacher tip:
Students can also use coins to demonstrate this concept. Line 3 or 4 coins up in a row and then slide another coin into the end of the line. Observe what happens to each of the coins. The same can be done with pool balls or a Newton's Cradle.

Lesson 9 – Investigating Forces in Action

ELABORATE

At a Glance:
To provide students with the opportunity to develop an investigation on forces in action

Assessment Focus:
Summative assessment of the investigating outcomes is an important aspect of the E*laborate* phase. It involves monitoring students' developing skills and understanding of the Science Inquiry Skills and the investigative process.

Assessment Opportunities: Summative Assessment
- Participation in discussions
- Journal entries
- Investigation planner
- Investigation results and conclusions

Science Outcomes:
Students will be able to:
Develop an investigation into forces in action by…
- Identifying questions appropriate for investigation
- Make predictions based on their current understandings
- Plan and conduct an investigation
- Summarise their data and represent their findings
- Evaluate their investigation
- Communicate their findings using scientific language

Literacy Outcomes:
Students will be able to:
- Communicate their findings in an appropriate form
- Use science terminology in their writing and discussions

Lesson 9 – Investigating Forces in Action

Equipment for the class:
- Class science journal (optional)
- Word Wall and Glossary
- Access to materials is dependent on the investigations being undertaken

Equipment for each team:
- Role badges for Director, Manager and Speaker
- Each team member's science journal
- Access to materials is dependent on the investigations being undertaken – each investigation will separately list the basic equipment required

Equipment for each student:
- Journal
- Investigation planning sheet (Resource Sheets 5)

Teacher Background Information

ELABORATE

One way for students to identify an investigable question is for them to first identify the possible variables within their investigation. E.g. if they are developing an investigation around marble tracks the possible variables are height of the track, number of marbles on track, number of marbles released, starting position of marbles, mass of object rolled down track.

Students then determine which variable it is they are going to change. (Independent variable). They then need to decide what it is they are going to observe or measure. (Dependent variable) In this example the students may decide to change the mass of the object they release and measure the distance the final marble moves forward.

Once they are clear on these two variables the investigable question can be developed using the following guide:

What happens to___ (dependent variable) ___ when we change ___ (independent variable) _____?

What happens to the distance an object travels forward when we change the mass of the object being released?

Lesson Outline

Key Words: questioning, predicting, planning, fair testing, variables,

1. Review students' current understanding with regards to the question **"How do unbalanced forces change the motion of an object?"** Ask them to share the responses they have recorded on the unit evaluation sheet and spend time discussing the different activities they have done so far and how these relate to the question.

2. Explain that the students will be working in cooperative learning teams to conduct an investigation into forces, how they interact and how this could relate to our lives. Possible Student Investigations include…..
   (Possible variables and /or things to consider have been included in red. Possible investigable questions have been included in blue.)

   - **Design an investigation to support the necessity for wearing seatbelts in vehicles.**
     Use toy cars and ramps – create plasticine people or use small toy figurines to represent passengers – Develop an investigation that looks into what happens when vehicles with passengers are released down slopes of varying heights (increase and decrease the speed of the vehicle) and come to a sudden stop. What happens to the passengers? Why does this happen? What difference does it make if they are secured? How does this relate to vehicles on our roads?
     Possible Variables: weight of object, weight of vehicle, height of slope, surface of ramp, surface of runoff. In this instance if students are developing an investigation into seatbelts and their necessity for safety the students will be comparing the effect of wearing seatbelts to not wearing seatbelts in a variety of different situations.

     Possible Investigable Questions: Why is the wearing of seatbelts a critical part of passenger safety?

ELABORATE

- **Conduct an investigation into pendulums**
  Which variable has the greatest impact on the time taken for a pendulum to complete a swing? Students choose a variable and develop an investigation into what happens when this variable is changed. Test the other variables to see what difference they make.
  Possible Variables: length of string, starting position of swing, weight of bob, shape of bob

  Possible Investigable Questions: What effect does lengthening the string have on the time taken for a pendulum to swing? What effect does increasing the weight of the bob have on the time taken for a pendulum to swing? What variables impact on the time taken for a pendulum to complete a swing?

- **Marble track investigation**
  Develop an appropriate question to investigate involving marbles and inclined planes / tracks. Students choose a variable and develop an investigation
  Possible Variables: height of the track, number of marbles on track, number of marbles released, starting position of marbles, size of marbles

  Possible Investigable Questions: What effect does increasing the numbers of marbles released have on the distance a single marble will travel? How does changing the starting height of a release marble impact on the distance another marble will travel?

- **Investigate forces at work in a sport of your choice – golf, basketball, cricket, baseball etc.**
  Choose a sport of interest and identify the places where different forces are in action e.g. throwing, hitting, running, etc. design an investigation into one of these areas
  Possible Variables: type of ball, amount of air in ball, size of swing, type of hitting device

  Possible Investigable Questions: How does changing the type of ball effect how far it can be thrown or kicked? How does changing the type of bat impact on how far a tennis ball can be hit? What effect does having more or less air in a basketball or football have on its ability to be bounced, thrown or kicked? Does having a larger bat mean the ball will travel further when hit?

- **Investigate forces in action in a playground**
  Identify the different forces in action in a playground. Choose one piece of equipment to investigate further or compare the forces involved in a variety of playground equipment.
  Possible Variables: surface of slippery dip, weight of object going down, amount of friction

  Possible Investigable Questions: What happens if you change the surface of the slippery dip? What happens if you change the weight of the object going down the slippery dip? Is friction a necessary part of the playground for kids to have fun? What part does friction play in the different pieces of playground equipment?

  - **NOTE:** Students could be presented with a variety of investigations and then allowed to make a choice about which one they will develop further **OR** the teacher could choose two or three for them to choose from **OR** the teacher could choose one investigation that the whole class will investigate.

3. Once the investigation has been determined by either the teacher or the students the planning process can begin. Direct students' attention to the statement '**How do unbalanced forces change the motion of objects?**' before they begin their investigation. How does this statement impact on the investigation they are planning?

ELABORATE

Teacher Tip:
Although there are 4 elements in the planning, recording and evaluating process students do not necessarily need to focus in depth on all four components. You may have a specific focus that you are trying to develop with your students e.g. improving their ability to process and analyse data so this is the particular sheet you really focus the student's attention towards. The other resource sheets can then simply be used as a guide for students to consider when planning and implementing their investigation.

4. Form cooperative learning teams and allocate roles. Work with the students through the process of developing an investigable question. Model the development of such a question (see Teacher Background Knowledge for more details.) you could get the students to use a variables grid (available from the Moodle http://dlb.sa.edu.au/pmssmoodle/) Have students think about what it is they want to know and how they think they could find this out.

5. Introduce students to the Investigation Planning Sheets (Resource Sheets 5) and have them complete the relevant sections. What is their question? What are their predictions?

6. Give teams time to plan their investigation. What steps are involved? What are they going to do in order to find an answer to their investigable question? Is the process easily replicated? Have them complete the relevant section of the planner.

7. Allow teams the time needed to complete their investigations. Depending on the investigation this could take several sessions.

8. Ask students to present their findings in a way that is appropriate to share with the rest of the class. Remind students that their final responsibility is to present their findings from their investigation to a selected audience. Explain to students that they need to include evidence from their investigation to support their conclusions. Ask them to complete the results sheet and to evaluate the success of their investigation by completing the remaining relevant sections of Resource Sheet 5.

9. As a way of sharing the completed investigations with the class complete a gallery walk. This allows students the opportunity to view the investigation results from all groups, engage in discussions around what they see and provide feedback to groups. Students could be given a specific focus for the gallery walk. This enables them to focus their attention and engage in meaningful discussion. Eg Focus: providing feedback, identifying different ways of presenting information, conclusions reached – do you agree or disagree? How clearly have people supported their conclusions?

    - In a **Gallery Walk** students move from one exhibit to another, using the agreed focus to discuss / respond to the exhibits. It provides an opportunity for all work to be on show and students to see the variety of responses provided for the task.

Questioning and Predicting

FORCED TO INVESTIGATION PLANNER

Name:_____ **Date:**_____

Other members of your team:_____

What are you going to investigate?

Can you write it as a question?

What do you think you will find out? Explain why.

Give scientific explanations for your prediction(s)

Planning and Conducting

How are you going to investigate this? What processes will you use?
What procedure will you follow?

What things do you need to keep fair? Why? How will you do this?
What variables will you keep the same? Which variable will you change?

What equipment / resources will you need?
Use dot points

Processing and Analysing Data and Information

FORCED TO INVESTIGATION RESULTS

Name:_____ **Date:**_____

RESULTS

What was your investigable question? What were the results of your investigation? How can you represent your results in a way that others can easily understand? What is the data you collected to support your claim?

What do your results show? What conclusions can be drawn?

Evaluating and Communicating

What claims (if any) can you make based on the results of your investigation? What evidence do you have to support your claims?
How successful was your investigation? What could you do to improve the investigation and the quality of the data you collected?

Lesson 10 – Showing the Learning – Session 1

EVALUATE

At a Glance:
To provide opportunities for students to represent what they know about how unbalanced forces change the motion of an object?

Assessment Focus:
Summative assessment of the conceptual learning outcomes is an important aspect of the E*laborate* phase. It involves monitoring students' developing skills and understanding of the scientific concepts.

Assessment Opportunities: Summative Assessment
- Participation in discussions
- Journal entries
- Words and definitions
- Interview and script

Science Outcomes:
Students will be able to:
- Explain how unbalanced forces change the motion of an object
- Identify forces in action in a variety of situations
- Explain what is meant by key words such as force, inertia, friction, balanced and unbalanced

Literacy Outcomes:
Students will be able to:
- Use diagrams to support their explanations
- Use science terminology in their writing and interview

Lesson 10 – Showing the Learning - Session 1

Equipment for each student:
- Journal
- Access to completed Unit Record Sheet
- Copy of Resource Sheet 6 – one per student

Teacher Background Information

EVALUATE

Push: To apply force to something so that it moves away from the origin of the force. A push is a force that acts in the opposite direction of the origin of the force. Opposite to a pull.

Pull: To apply force to something so that it moves towards the origin of the force. A pull is a force that acts in the direction of the origin of the force. Opposite to a push.

Balanced: Forces that do not cause a change in speed or direction. They are equal in size and opposite in direction

Unbalanced: Forces that always cause a change in speed or direction. They are not equal and opposite in direction

Force: A push or pull acting on another object. Forces can make objects start or stop moving

Friction: A force which works against the motion of objects that are in contact with each other as they move past one another. The rubbing or contact of one object or surface against another.

Inertia: When an object is at rest it will remain at rest and an object in motion remains in motion unless acted upon by a force. The tendency to remain at rest, or to keep moving at a constant speed in a straight line.

Gravity: A force that pulls objects towards the centre of the Earth. The force of attraction between two masses (objects).

Mass: The amount of matter an object contains

Weight: The measure of the pull of gravity on the object's mass

Acceleration: Rate of change of speed

Distance: How far something travels / how far apart two points are

Speed: Rate of change of distance - speed = $\frac{\text{distance}}{\text{time}}$

Rate: How fast something changes

Air resistance: It is the force that the air exerts on an object moving through it, resisting the object's motion. It is a form of friction and can also be known as drag.

Lesson Outline

Key Words: balanced, unbalanced, force, friction, inertia, gravity, air resistance, push, pull

EVALUATE

1. Present students with a copy of resource sheet 6 and ask them to complete the sheet by recording their current understandings on each of the key words. These recordings may include diagrams to help the students demonstrate their understandings.

2. Once students have completed the sections meet together as a class to discuss and share understandings. You may want to allow students the opportunity after the discussions to update their understandings by adding or changing their responses. This could be done in another colour so you get a sense of what was recorded prior to the discussion and what other information was included after the discussion. How did the discussion help the students clarify their understanding?

MY UNDERSTANDINGS	
Inertia	**Force**
Unbalanced force	**Gravity**
Friction	**Air resistance**
Pull	**Balanced force**
Push	

Lesson 10 – Showing the Learning - Session 2

EVALUATE

Lesson Outline

Key words: balanced, unbalanced, force, friction, inertia, gravity, air resistance, push, pull

1. Organise the students into pairs and then present the listed scenarios to the class. (Resource Sheet 7) Give the students time to talk about the scenarios and ask any questions they may have in regards to them.

2. Explain to the students that they are going to choose one of the scenarios and then present an interview situation which explains the science behind the scenario. One student will be the interviewer and the other will be the 'expert'. Both students should work together to develop the appropriate questions and answers. Students need to ensure that the presentation they give clearly explains what is happening with regards to forces in action. They need to demonstrate the scientific principle in some way and link back to the key question. **"How do unbalanced forces change the motion of an object?"**

3. Go through the rubric with the students so that they get a sense of just what is expected. You could create your rubric with the students to further personalise the learning.

4. Provide students with time to choose one of the scenarios to explain further. Students then have time to plan, prepare and develop a script with questions and answers that helps explain the scientific principles involved. Students may like to use diagrams, props etc to help them with their explanation.

Teacher Tip
Remind students about
- The use of force arrow diagrams to help explain what is happening in different situations.
- Linking science concepts to real life situations
- Newton's Laws of Motion
- Giving clear explanations about what is happening and why?
- The use of scientific vocabulary

5. *Optional:* Invite an audience to view the presentations. Video student presentations to enable you to have a record of student understanding.

6. After completing the presentations ask students to conduct a self assessment of the whole unit in their journals by completing sentences such as:
   - Something I understand now that I didn't understand before is…..
   - I'm still wondering about….
   - One thing that challenged me is ….
   - Something I really enjoyed is ….
   - A suggestion for the future is……

FORCES IN ACTION SCENARIOS

Choose one of the following scenarios for you and your partner to work on. You will need to write questions and answers to develop an interview that clearly explains the science involved in this scenario. Relate your thinking back to all that you have covered in this unit and remember the key question:

"How do unbalanced forces change the motion of an object?"

Remember that the use of diagrams, props and key scientific words will assist you with your explanation. When you are presenting it is also important to relate your understandings to other situations. E.g. Why is it important for us to understand these science concepts? What developments may have occurred as a result of these understandings?

What happens when……

- A balloon is blown up and then released?
- You stand on a skateboard and then push against the ground?
- You are riding your bike and pull hard on the front brakes?
- You throw a tennis ball into the air?
- A car stops suddenly and there are objects loose on the back ledge?
- A truck loses it brakes coming down a steep hill and drives into the arrestor bed?
- You pull a tablecloth rapidly off a table full of plates?
- A bowling ball rolls down the alley towards the pins?
- You are on a scooter and your front wheel hits a rock or crack?
- Other

	Beginning	Achieving	Advanced
<u>Science understandings</u> • Explains how unbalanced forces change the motion of an object	Students can identify situations that involve unbalanced forces	Students can describe situations where balanced and unbalanced forces are in action	Students can describe situations where balanced and unbalanced forces are in action and explain the difference between them
• Identify and describe forces acting on an object in familiar situations	Students can identify different forces	Students can identify different forces and describe them	Students can identify different forces and explain how they impact on objects in familiar situations
• Explains that Earth's gravity pulls objects towards the centre of the Earth	Students can identify that gravity is a force that acts upon all objects on Earth	Students can describe situations where gravity is in action	Make predictions about new situations
<u>Communication – Science Inquiry Skills</u> • Uses appropriate scientific terminology	Students use appropriate scientific terminology in their presentation	Students use appropriate scientific terminology and explain its meaning	Students use appropriate scientific terminology, explain its meaning and use it in context
• Uses appropriate props and labelled diagrams to support explanation	Students attempt to use props and diagrams to support their explanations	Students use props and diagrams to support their explanations	Students use props and diagrams that clearly support their explanations
<u>Application – Science as a Human Endeavour</u> • Able to apply science understandings	Students attempt to apply their understandings to a variety of situations	Students are able to successfully apply their understandings of forces to a variety of situations	Students are able to successfully apply their understandings of forces to a variety of situations and explain how these understandings have influenced development of practice in areas of human activity

Other possible video links to support learning

http://www.youtube.com/watch?v=bkHd6cSz104&feature=related – friction and gravity

http://www.youtube.com/watch?v=lFLpwRMS00g Frank Spencer roller skating

http://www.youtube.com/watch?v=ax9_NLBtCwo&feature=fvsr equal and opposite reaction – balloon cars

http://www.stevespanglerscience.com/content/science-video/floating-rice-bottles-trick - friction at work

http://www.exploratorium.edu/snacks/center_of_gravity/ finding the centre of gravity of a ruler

Scootle

Wild ride – get a grip - TLF-ID L477: Investigate the role of friction in performance of bicycle tyres. Test how the type of tread affects grip and speed. Choose tyres best suited to track and weather conditions in a time trial. This learning object is one in a series of four objects.

Wild ride – on a roll – TLF-ID L479: Investigate the role of physical forces in how bicycle wheels work. Test how wheel size, tyre pressure, tread and load affect rolling resistance. Then choose wheels best suited to track conditions in a time trial. This learning object is one in a series of four objects.

It's a drag – TLF-ID L51: Investigate the braking efficiency of cars and trucks. Test stopping distances under controlled conditions. Compare effects of vehicle type, tyres, road surface and weather conditions. Choose driving speed, then apply brakes and compare stopping distances. Answer questions about friction, tyres and driver fatigue. This learning object is one in a series of two learning objects.

Give me a brake - TLF-ID L52: Investigate braking efficiency of cars and trucks by testing stopping distances under controlled conditions. Test effects of vehicle type, tyres, road surface and weather conditions. Choose driving speed, then apply brakes and compare stopping distances. Estimate distances from target markers. Answer questions about antilock braking systems and speed limits. This learning object is one in a series of two learning objects.

Primary Connections Website

http://www.science.org.au/primaryconnections/

Physical Science

Equipment List

- Buckets
- Ping pong balls
- Tennis balls
- Basketballs
- Marbles
- Construction material – junk materials, cardboard
- Tape
- String
- Foam cups
- Coins – 5, 10 and 20 cent coins
- Rubber bands
- Balloons
- Fishing line
- Materials suitable for parachutes – plastic bags, bin liners, paper, light fabrics
- Marble track or cardboard - Buy strips of angle moulding from a local hardware store or find other alternatives to use. (See photos for details). You could use anything else that enables marbles to easily roll down an inclined plane. The advantage of the moulding angle is it is flexible and can be used with the marbles rolling up and down continuously until the energy dissipates.

- Plasticine