# Sample Unit – Forces – Science Life Skills – Stages 4, 5, 6

***Sample for implementation for Year 11 from 2018***

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| **Unit title** | Working with forces | **Duration** | 10 weeks |
| **Unit description** | In this unit, through practical investigations, students explore the effect of contact and non-contact forces and observe how these forces affect their daily lives. |
| **Outcomes** |
| **Stage 4/5** A student:* + - recognises the role of science in personal, social and global issues relating to everyday life SCLS-1VA
		- demonstrates a willingness to engage with science-related issues relevant to their lives SCLS-3VA
		- asks questions that can be tested and makes predictions SCLS-4WS
		- participates in an investigation by following a sequence SCLS-6WS
		- collects, records and interprets data and information SCLS-7WS
		- uses a variety of strategies to communicate information about an investigation SCLS-9WS
		- explores a range of forces in everyday situations SCLS-10PW
 | **Stage 6**A student:* poses questions and hypotheses for scientific investigation SCLS6-1
* plans an investigation individually or collaboratively to obtain primary or secondary data and information SCLS6-2
* participates in investigations individually or collaboratively to collect primary or secondary data and information SCLS6-3
* collects and represents qualitative or quantitative data and information using media as appropriate SCLS6-4
* develops conclusions from primary or secondary data and information SCLS6-5
* uses strategies to solve scientific problems SCLS6-6
* identifies how primary or secondary data is used in scientific investigations SCLS6-8
* uses patterns and trends in data to make observations and draw conclusions SCLS6-9
* investigates technologies used in science SCLS6-12
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| **Working Scientifically skills**In this unit, students will have opportunities to develop skills in planning and conducting investigations to test questions, and to collect, represent and draw conclusions from data and information gathered in relation to forces and motion. The conclusions gathered from investigations where possible are applied to practical situations, such as the use of seat belts and vehicle braking distance.*Note: This unit includes practical investigations and possible fieldwork activities. Teachers will need to comply with legislation, guidelines and system and school requirements in relation to student safety.*  |
| **Assessment overview**When undertaking this unit, it is important to take into account the individual communication strategies used by students. Students’ responses may be communicated through gestures and/or facial expressions, use of key word signing, visual aids or symbols such as a communication board, assistive or augmentative technology and varying degrees of verbal or written expression.Assessment strategies could include but are not limited to:* participation in conducting investigations to explore how forces can impact on motion
* identifying forces evident in everyday life
* recording and interpreting data and information gathered through fieldwork and investigation
* presenting data and information gathered through investigations and/or fieldwork
* constructing models showing forces in everyday contexts
* designing community-based safety campaigns, for example wearing a seatbelt

*Note: There is no formal expectation of assessment for students undertaking Life Skills courses.* |

| **Content – Working Scientifically Skills** | **Content – Knowledge and Understanding** | **Teaching, learning and assessment** | **Resources** |
| --- | --- | --- | --- |
| Stage 4/5 *Questioning and Predicting*Students question and predict by:* asking questions about familiar objects and events

Stage 6*Questioning and Predicting*Students:* ask questions about the world around them https://lh5.googleusercontent.com/Rxtd35_bD9NYVAYTpCQ-l7NjzMfiyFajA_6a4YcahraxXOTfH4tnHYhUexf1uMPSXbOwgmNnpyg5qdPeM0mzCxt4kZSRo3k71lpcoUKMsqqj_fEDdSEoLDDRM41ErrQUfCaz07YL
* make observations and pose questions based on these observations
 | Stage 4/5*Physical World: Forces*Students:* identify a force as a push or pull

Stage 6*Forces in Everyday Life*Students:* recognise a force as a push, pull, twist or tear
 | **Introducing investigations and fieldwork activities about forces**Introduce the concept of forces. View *Career Clips: Forces and Motion in Computer Games*. Questions for discussion:* What does it mean when an object is at rest?
* What happened to the rabbit when it was pushed?
* What happened to the person when the arrow pushed on them?
* What are some other words that mean the same as push?
* What happened to the football players when the computer programmers changed the gravity rules?

Other approaches may include:* vocabulary and spelling activities for specific terminology
* creating a sight word chart
* using the Australian Sign Language (Auslan) Signbank, create a key word signing (KWS) chart to display the key terms, eg push, pull, up, down, stop.

With teacher guidance, students review how to be safe when conducting investigations; recognising safety rules, using equipment safely and following teacher instructions. Students contribute to discussions for displaying and communicating investigation findings. This can be adjusted to suit the needs of students and may include creating a visual or written representation of the questions, observations and results through:* photographs
* flipbooks
* stop motion videos
* picture graphs or charts
* mind maps
* tables
* worksheets.
 | Career Clips: Forces and Motions in Computer Games – STEM UK<https://www.stem.org.uk/elibrary/resource/28119> Auslan Signbank<http://www.auslan.org.au/>   |
| Stage 4/5 *Conducting Investigations*Students conduct investigations by:* working individually and/or collaboratively to participate in an investigation Personal and social capability icon Work and enterprise
* recording observations and measurements, using appropriate units and abbreviations Literacy Numeracy

*Processing and Analysing Data and Information*Students collect, record and interpret data and information by:* drawing conclusions from data and information gathered in an investigation critical and creative thinking

Stage 6*Conducting Investigations*Students:* work individually and/or collaboratively to conduct an investigation Work and enterprise icon
* accurately record observations and data when participating in an investigation Literacy icon Numeracy icon

*Analysing Data and Information*Students:* draw conclusions from data and information gathered in an investigation Critical and creative thinking icon
 | Stage 4/5*Physical World: Forces*Students:* identify a force as a push or pull
* recognise the ways people use pushes and pulls in everyday life
* communicate what happens when a force is applied to an object
* observe the change in motion that occurs when a force is applied to an object
* [investigate](https://syllabus.bostes.nsw.edu.au/glossary/sci/investigate/?ajax) how technological developments have reduced the harmful impact of forces in everyday life CCTICT

Stage 6*Forces in Everyday Life*Students:* recognise a force as a push, pull, twist or tear
* observe forces acting on objects in everyday contexts
* explore a range of contact forces in everyday contexts
* explore a range of non-contact forces in everyday contexts
* identify that forces make objects move or remain stationary https://lh5.googleusercontent.com/WVSnRyGnrqlCrqSS5v-anrdJeyEAzrmzIiGCgHA5OJdUeM-cCS7sZ7L1q4KU1DJHGVnzOB3HSZxQawqPOH2MDWicptTdg2Aj316dtBVlxMBzJCmuKPz_ZlS8HaFKfik1Fzg9rcXa
 | **Forces in everyday life****Inquiry question: How are forces evident in everyday contexts?** ***Teacher background:*** *A force is a push or a pull. To make an object move, a force must be applied to it. To stop an object moving an opposing force acts on it. The heavier the object, the more force is required to move or stop the object. Objects at rest have balanced opposing forces acting on them.*Students explore a selection of clips from STEM UK online library demonstrating everyday forces such as:* pushing and pulling on a canoeing trip
* the forces of a demolition ball
* forces involved in making pizza
* making parachutes for eggs.

Students create a word bank to describe the types of movements observed, such as pushes, pulls, sliding, rolling, jumping and swinging. Students engage in activities to explore the effects of pushes and pulls, eg:* kick a football
* pin a sign on a noticeboard
* squeeze water out of wet clothes
* throw a ball
* type on a device
* pulling on a large elastic band.

Students to add more words describing movements to the word bank as they progress through the unit.Place everyday objects or pictures of objects in a bag. Sort the objects using a Venn diagram (or large hoops on the floor) placing the objects/pictures in the appropriate groups according to the type of force applied when you use the object – push, pull or both. For example:

|  |  |  |
| --- | --- | --- |
| Push  | Pull | Both |
| calculator keyboardremote controlwheelbarrow | kitetug-of-war flagpole rope | shopping trolleytoy cardooryoyo |

**Investigation:** Balloon rocketIntroduce the investigation by blowing a balloon and letting it go. Students observe how the air being released from the balloon pushes the balloon. Consider ways in which the path of the balloon can be controlled; how can we use the push of the air from the balloon to control the direction in which something moves?Make a balloon rocket (*see example from ScienceBob*); observe the air coming out of the balloon pushing the rocket. Consider changing a variable, eg the type/size of balloon; the inflation level of the balloon; the environment in which the balloon is released. Students observe, measure and record the distance travelled by the rocket and compare the data recorded as each variable changes.Students mark the forces on a diagram and discuss which forces have increased/decreased in order to change the movement of the rocket.**Investigation:** The importance of wearing a seatbelt in a moving vehicle***Teacher background****: It takes a push or a pull to start something moving, change its speed or direction or to make it stop. This investigation explores what may happen to passengers in a moving vehicle that brakes quickly and the importance of wearing a seatbelt*.Teacher defines the terms ‘force of inertia’ and ‘force of momentum’ for the group with examples. Students match everyday words such as stop, rest, move, go, slow, speed to the terms.Students design and create a simple vehicle model using an egg carton (vehicle body), plastic bottle tops and straws (wheels and axels); alternatively use a small toy car with a tray. Students propel the vehicle into a barrier such as a wall or box using force and describe what happens. Place a small toy or similar in the vehicle and repeat. Questions for discussion:* When travelling in a car how do we feel the force of inertia?
* When travelling in a car how do we feel the force of momentum?
* What type of force made the toy move?
* How can we stop the toy from falling out?

Repeat the experiment with two small toys, this time using an elastic band to secure one of the toys to the vehicle. Questions for discussion:* Was the outcome the same this time?
* How did the elastic band prevent the toy from moving?

Access the Transport for NSW website and design an awareness poster addressing the importance of wearing a seatbelt. Consider what happens if you do not wear a seatbelt; how to wear a seatbelt properly; fines for not wearing a seatbelt. | Forces - Pushes, Pulls and Friction - STEM UK <https://www.stem.org.uk/resources/elibrary/resource/30655/forces-pushes-pulls-and-friction> Make a balloon rocket –ScienceBob<https://sciencebob.com/make-a-balloon-rocket/> Transport for NSW – Centre for Road Safety<http://roadsafety.transport.nsw.gov.au/stayingsafe/vehiclesafety/seatbeltsrestraints/> |
| Stage 4/5 *Questioning and Predicting*Students question and predict by:* identifying questions that can be investigated scientifically
* predicting the outcomes of an investigation using background knowledge, experience and/or scientific understanding Critical and creative thinking

*Conducting Investigations*Students conduct investigations by:* selecting and using appropriate equipment, measuring tools and methods to make accurate observations and measurements Numeracy
* recording observations and measurements, using appropriate units and abbreviations Literacy Numeracy

Stage 6*Questioning and Predicting*Students:* identify questions that can be scientifically tested
* make predictions based on questions that can be scientifically tested

*Conducting Investigations*Students:* follow a plan to participate in an investigation Personal and social capability icon
* use scientific equipment and materials accurately  Information and communication technology capability icon
* accurately record observations and data when participating in an investigation Literacy icon Numeracy icon
 | Stage 4/5*Physical World: Forces*Students:* observe the way the force of gravity pulls objects towards the Earth
* investigate the effects of gravity as a downward-acting force on a variety of objects

Stage 6*Forces that Attract and Repel*Students:* recognise gravitational force as a force of attraction between objects
* recognise that every object has gravitational pull
* investigate how mass affects gravitational force https://lh6.googleusercontent.com/EdvWh_GyIWeWkoGzdGdG9BqJEgLeSCWG-ycm_Ma_NHT-SdquLmMhWNsXEBePNJdnyi80i2boeVBa6HKHOXPlb8dY9U3FQdu17gGxh2NIB93Ce9_NblFf7MPQ2sow38VEV8vn-tit
* recognise that people are kept on the ground as a result of gravity pulling us downwards and the floor pushing us upwards https://lh6.googleusercontent.com/EdvWh_GyIWeWkoGzdGdG9BqJEgLeSCWG-ycm_Ma_NHT-SdquLmMhWNsXEBePNJdnyi80i2boeVBa6HKHOXPlb8dY9U3FQdu17gGxh2NIB93Ce9_NblFf7MPQ2sow38VEV8vn-tit
 | **Forces that attract** **Inquiry question: How is the force of gravity experienced?*****Teacher background****: Gravity is a force that attracts objects to each other. The size of the force of attraction depends on the mass of the object.* Questions for discussion:* What happens to a stone when you drop it?
* What makes it go in this direction?
* What happens when you jump?
* Why don’t people and things fall into space?

Explain that gravity is a force that cannot be seen and visually represent the direction of gravity. View the video *Crash Course Kids #4.1*. Independently or with assistance, students take turns to throw objects up, down and sideways. Students observe, record and describe what happens to the objects.Pose the question, ‘How can we measure forces that we cannot see?’ Demonstrate the use of a force meter with a weighted bag. Introduce the concept of the Newton measurement scale. Demonstrate the safe and correct use of the meter, eg it must be vertical, the pointer must be on zero, held by the hanging ring, held the right way up.Students to view *Splash ABC’s Look out! Falling Balls!* Encourage students to consider the weight, size and shape of the items and make predictions about what will occur. Which do you think will land first? Will the size of the items change the outcome? Students compare their prediction and observations with the results.**Investigation**: Ball drop***Teacher background:*** *the aim of this investigation is for students to observe the impact weight has on gravitational force by dropping different balls onto a sand tray. Students measure the size of the impact ‘crater’ in the sand and compare their results*. Prepare a sand-filled tray and lightly cover with flour (this allows for a clearer view and measurement of the crater). Collect different-sized balls such as marbles, ping-pong balls or gumballs. Explain that for this investigation to be valid all other variables, except for the weight of the balls, need to remain the same.  Students make predictions about what will happen when the balls hit the sand. Teacher-led questioning could include:* What will happen to the sand when we drop a ball into it?
* What shape(s) might we see?
* Which balls will make the biggest shapes?

Students drop the balls into the pit and observe the size and shape of the crater. Using a ruler, students measure and in a table record the size of the crater left by the different balls. Students compare their predictions with their results. Link this experiment to methods scientists use for measuring the size of meteorites that have hit the Earth.  **Additional activities** Explore Dave Scott’s Apollo 15 experiment on the moon. Discuss how this is a recreation of Galileo’s experiment from the Leaning Tower of Pisa. Students to consider why in Space the objects fall at the same rate.  | Defining Gravity- Crash Course Kids #4.1<https://www.youtube.com/watch?v=ljRlB6TuMOU>Force MeterLook out! Falling balls! Which will land first? - Splash ABC<http://abcspla.sh/m/155520>Apollo 15 Hammer and Feather Drop – NASA <https://youtu.be/QRPLRjk5zkw> |
| Stage 4/5 *Questioning and Predicting*Students question and predict by:* predicting the outcomes of an investigation using background knowledge, experience and/or scientific understanding Critical and creative thinking

*Conducting Investigations*Students conduct investigations by:* selecting and using appropriate equipment, measuring tools and methods to make accurate observations and measurements Numeracy

*Processing and Analysing Data and Information*Students collect, record and interpret data and information by:* relating data and information gathered, to questions and predictions Critical and creative thinking
* drawing conclusions from data and information gathered in an investigation Critical and creative thinking

Stage 6*Questioning and Predicting*Students:* make predictions based on questions that can be scientifically tested

*Conducting Investigations*Students:* accurately record observations and data when participating in an investigation Literacy icon Numeracy icon

*Processing Data and Information:*Students:* relate collected information and data to questions or hypotheses Critical and creative thinking icon

*Analysing Data and Information*Students:* draw conclusions from data and information gathered in an investigation Critical and creative thinking icon
 | Stage 4/5 *Physical World: Forces*Students:* communicate what happens when a force is applied to an object
* observe the change in motion that occurs when a force is applied to an object
* investigate how technological developments have reduced the harmful impact of forces Critical and creative thinking Information and communication technology capability icon

Stage 6*Balanced and Unbalanced Forces*Students:* recognise balanced forces as forces of equal magnitude acting in opposite directions on an object
* observe balanced forces to recognise that objects do not move when balanced forces are applied
* construct models of balanced forces in everyday contexts https://lh6.googleusercontent.com/EdvWh_GyIWeWkoGzdGdG9BqJEgLeSCWG-ycm_Ma_NHT-SdquLmMhWNsXEBePNJdnyi80i2boeVBa6HKHOXPlb8dY9U3FQdu17gGxh2NIB93Ce9_NblFf7MPQ2sow38VEV8vn-tit https://lh6.googleusercontent.com/WSefKq_SVlkCAk8JjIg-pKyEHoJ9mbq8vmhjNlaSXq0PM2NXsYXw6HhprbvvU0SC_O7S7pZxOTygyLn98r1oPNm-O5E79mQsI6M1JEU8xlv8c6iKp1oIe6_2wgLfuojrK4cfjYe5
* recognise unbalanced forces as forces of unequal size acting on an object
* observe unbalanced forces to recognise that objects move when unbalanced forces are applied
* recognise weight as a force
* investigate everyday problems involving unbalanced forces https://lh6.googleusercontent.com/EdvWh_GyIWeWkoGzdGdG9BqJEgLeSCWG-ycm_Ma_NHT-SdquLmMhWNsXEBePNJdnyi80i2boeVBa6HKHOXPlb8dY9U3FQdu17gGxh2NIB93Ce9_NblFf7MPQ2sow38VEV8vn-tit
 | **Balanced and unbalanced forces****Inquiry question: What is the difference between equal (balanced) and unequal (unbalanced) forces?*****Teacher background:*** *When two forces acting on an object are equal in size but act in opposite directions, we say that they are balanced forces. When two forces acting on an object are not equal in size, we say that they are unbalanced forces.*Define the terms ‘equal’ and ‘unequal’. Students observe and describe examples of equal forces, visually representing the direction of the forces with arrows eg* a boat floating on water
* a box hanging from a rope.

Introduce the concept of unequal forces through the game ‘tug-of-war’. Explain that when one team pulls with force greater than the other it results in unequal forces, causing the rope to move. Students to observe and describe examples of unequal forces, eg* a lift going up
* pulling a book across a table
* a vehicle moving.

**Investigation:** SkyscraperDisplay images of various car parks and multi-storey buildings, focusing on the structural framework. Explain that the upper floors of the building apply a downward force while the columns apply an upward force to balance the downward force. If possible, plan a site visit to a car park or multi-storey building and have students observe, record and describe the structural features of the building. Questions for consideration:* What shapes are being used?
* What shapes would be the strongest?
* Would changing the shape impact on the downward and upward forces?

Students create two paper structures (with a flat top surface) using both square and cylindrical columns, using straws and/or paper. Students to measure how many books are placed on the top before the structures collapse. Questions for discussion:* What happened to the columns as more books were added?
* How many books did it take for the square columns to collapse?
* How many books did it take for the round columns to collapse?
* Which shape was the strongest?
* How was the test fair?
* What shape would you recommend to a builder? Why?

**Investigation:** Float a boat***Teacher background****: Students explore the concept of buoyancy as an upward force and investigate the impact surface area has on forces. Students design and make a clay boat to take the most weight.*Using a rolled ball of modelling clay, students predict what will happen to the ball when dropped into a container of water. Ask the students to change the ball into a shape that will float when placed into the water, linking this to the concept of buoyancy. Students experiment floating different shapes and identify that the clay sinks when the surface area is the smallest.Students predict what will happen to the boat as weight or ‘passengers’ are added (coins, washers or dried beans can be used). Students design and build a clay boat to hold the most amount of passengers. Students test their design in the container of water, measuring the amount of passengers added before the boat sinks. Explain that in order to qualify the design, the boat should be tested twice. As a group, students compare their results, considering which design choices were able to carry the most weight. **Additional activities**Play ABC’s online game *Steady Ships* to explore the effect of weight distribution on gravity.  | Steady Ships - Splash ABC<http://abcspla.sh/m/1498087>  |
| Stage 4/5 *Processing and Analysing Data and Information*Students collect, record and interpret data and information by:* interpreting data and information gathered Numeracy
* relating data and information gathered to questions and predictions Critical and creative thinking
* drawing conclusions from data and information gathered in an investigation Critical and creative thinking

*Communicating*Students use a variety of strategies to communicate information about an investigation:* using a variety of strategies including tables, graphs and diagrams to present data and information, using digital technologies as appropriate Information and communication technology capability Numeracy

Stage 6*Processing Data and Information:*Students:* relate collected information and data to questions or hypotheses Critical and creative thinking icon

*Analysing Data and Information*Students:* describe data and information collected Literacy icon Numeracy icon
* draw conclusions from data and information gathered in an investigation Critical and creative thinking icon

*Communicating*Students:* communicate ideas related to an investigation Literacy icon
 | Stage 4/5*Physical World: Forces*Students:* recognise that heat is generated when surfaces rub together
* identify some of the effects of friction
* participate in an [investigation](https://syllabus.bostes.nsw.edu.au/glossary/sci/investigation/?ajax) of the friction caused by a variety of surfaces

Stage 6*Oppositional Force*Students:* observe what happens when two objects or surfaces rub against each other
* recognise that the resistance created by objects moving against each other is known as friction
* recognise friction as an oppositional force
* observe a range of examples of friction in everyday contexts
* participate in a practical investigation into factors that impact on friction https://lh6.googleusercontent.com/EdvWh_GyIWeWkoGzdGdG9BqJEgLeSCWG-ycm_Ma_NHT-SdquLmMhWNsXEBePNJdnyi80i2boeVBa6HKHOXPlb8dY9U3FQdu17gGxh2NIB93Ce9_NblFf7MPQ2sow38VEV8vn-tit
* identify risks and respond appropriately when investigating factors that impact on friction https://lh5.googleusercontent.com/WVSnRyGnrqlCrqSS5v-anrdJeyEAzrmzIiGCgHA5OJdUeM-cCS7sZ7L1q4KU1DJHGVnzOB3HSZxQawqPOH2MDWicptTdg2Aj316dtBVlxMBzJCmuKPz_ZlS8HaFKfik1Fzg9rcXa
 | **Oppositional forces****Inquiry question: How is friction created in a range of environments?** ***Teacher background****: Whenever an object moves against another object, there are frictional forces present. These forces act in the opposite direction to the movement. Friction, including air and water resistance, is a force that can slow moving objects.* Explore everyday examples where friction might occur such as:* opening and closing a door
* pushing an object along the ground
* combing hair
* brakes and tyres on vehicles
* rubbing hands together

Using pictures or photographs, students to label the oppositional forces present in examples listed above. Students explore how rubbing hands together creates friction and heat. Teacher to discuss how this friction could be both helpful (eg when cold) or unhelpful (eg when using tools and machinery). Students sort friction examples listed above into helpful and unhelpful friction.**Investigation**: Friction speed and movement ***Teacher background:*** *The aim of this investigation is for students to explore how friction can be used to slow moving objects and link this to everyday concepts such as safety ramps for vehicles.* Introduce students to the investigation with images and stimulus materials of slopes and angles. Explore the role of friction when creating safety ramps and escalators. Pose the question ‘why is it important for people and objects to move slowly on ramps and escalators?’Explain and visually represent that when an object travels along a slope and reaches a flat surface the distance it travels depends on the angle of the slope, the surface of the slope, and the type of surface onto which it runs. Have students create a simple ramp for a toy car or marble using a cardboard tube, cut in half. Locate a variety of different materials to position at the bottom of the ramp (eg carpet, wood, grass, sand, smooth tiles). Encourage students to feel and describe the different materials, making predictions about which types of material will allow the car to travel the farthest. Explain that in order for the investigation to be valid, other variables, including the angle of the ramp and the size/weight of the car, need to remain the same.Using the different materials, students record the distance travelled and present results in graphical formats. Questions for discussion:* Which material caused the most friction?
* What happened to the car when travelling on this material?
* Why do you think sand is often used on vehicle safety ramps?
* What types of materials should be used to make brake pads?

**Additional activities** Teacher to lead discussion around grip as a source of friction. Students compare the surface grip of the soles of various shoes. Using *Scootle’s Sports Shoes* online activity, students identify which shoe design has the most grip. Students create a display of one selected force studied throughout the unit, describing the scientific concept and an everyday example of the force at work.  | Sports Shoes: shoe4u – Scootle <http://www.scootle.edu.au/ec/viewing/L781/sc_002_clt_313/index.html>  |

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| Reflection and Evaluation |