Content	Teaching and Learning Experience	Resources

Stage 2	Term	1	2	3	4	Week	1	2	3	4	5	6	7	8	9	10	11

Unit Name:	Stage 2 Science – Physical World (Forces)
Key Concepts **Knowledge and Understanding Outcomes**	**ST2-7PW** *describes everyday interactions between objects that result from contact and non-contact forces* Forces can be exerted by one object on another through direct contact or from a distance. Students: - investigate the effect of forces on the behaviour of objects, eg dropping, bouncing or rolling objects - observe the way the force of gravity pulls objects towards the Earth, eg dropping objects from different heights - observe everyday situations where the direct contact force (friction) affects the movement of objects on different surfaces, eg a bike or skateboard - carry out tests to investigate the forces of attraction and repulsion between magnets
Assessment:	

Learning Sequence 1:		
Engage Provoke thought on the concept of what FORCES are, and investigate various distinctive properties of these. Discuss the different actions and reactions of applied forces and make predictions on the behaviour of specific objects with regard to this. Identify forces in action in everyday life and the sources of these.	**<u>Forces - What are they?</u>** **Introduction** ● Use a tennis ball to demonstrate forces acting in a variety of situations. Use verbal questioning to explore what is happening and why. E.g.: - Throw ball in air: *What happened? What forces are acting on the ball?* - Bounce ball gently, then bounce ball hard: *What made the ball move upwards when the ground doesn't move?* - Roll ball along the ground: *What forces are acting on the ball?* *Why did it not fly like when it was bounced?* *Is it moving the same as when it was in the air? What forces are slowing it down?* - Roll a ball so it collides with another stationary ball: *What did you observe happen to the first ball?* *What did you observe happen to the second ball?* **Definition** ● Define the term 'force' as a class. Write individual definitions on board and share ideas and discussion. ● Students write their own definitions based on class discussion. **Examples of Forces** ● In pairs or small groups, students are to go around the room identifying examples of forces in action around the room. E.g. - Doors: Opening and closing - Ceiling fan: spinning - Chairs: pushing and pulling - Pencils and glue sticks: rolling - Scissors: Cutting - Other examples of objects swinging, falling, throwing, bouncing, etc. ● Have students record the objects and actions in their sciences books. **Brainstorm/Word Wall** ● As a class, brainstorm words related to forces. Use experiences from experiment to contribute to ideas. Have students write ideas in their science books.	● Tennis Balls ● Science book ● Whiteboard

Learning Sequence 2:	Teaching and Learning Experience	Resources
Assessment Focus: Students' understanding of forces and counteracting forces to create states of equilibrium. Student's ability to articulate the processes of forces acting on one another using scientific vocabulary. Students' ability to collaborate and engage in scientific experimentation and observation. Students' ability to record observations in an information table and analyse and evaluate results to reach conclusions.	**<u>Contact Forces - Elasticity</u>** **Revision** ● What is force? ● Ask students where forces can be found and how it affects our everyday lives? - E.g. opening a door, up and down motion using scissors, changing direction when walking, etc. ● What are words associated with force? **Newton's Laws** - Newton's 3rd Law - Every action has an equal and opposite reaction **Discussion – Tug of war Demonstration** ● Have two students volunteer. They are each to hold onto a different end of the rope. Initially have them not apply any pulling force. Then, gradually students are to increase the force but at an equal rate so that neither are pulling harder than the other. ● Have the rest of the class observe the volunteers. Question students on why - despite the larger amount of force being applied by both students, no movement displacement is occurring. Direct conversation to comment on how and why it is the same as no force being applied at all, and invite students to try and represent via drawing a diagram. ***NOTE: remind students to be sensible, and that if they wish to participate, they won't pull their partner in a dangerous manner.*** ● Present students with a mass. Allow the mass to drop to the floor to establish that there is a force acting on it i.e. gravity. ● Dangle the same mass from a string and display for students. Ask students more probing questions: - If the object is stationary, does this mean there are no forces acting on it? - Does it mean that there are multiple forces acting on it?	● Pencils ● Elastic bands ● Mass weights ● Rulers ● Science Books

	- If there was only one force acting on it, what might it look like? - What forces are acting on it right now? (gravity and the string) - Which force is stronger? How can you tell? - Discuss that if one was stronger, the mass would be observed to be moving in one of the directions. **Experiment** Part 1 - Loop elastic band around a pencil and rest on the side of a table. - Apply a small mass and then measure the length of the elastic band using a rule. Record this onto table. - Gradually apply larger masses and repeat the process. Part 2 - Along the ground in an open space, students are to hook the elastic band over the top of the ruler. Students must then pull elastic band bag until it extends to the length of the first recorded measurement in part one. Record the distance it travels from starting point using ruler and document into another table. - Repeat the above process, gradually increasing the length the elastic band is stretched according to the initial measurements taken. Part 3 - In groups students are to review and evaluate results to answer questions. Remind them to use appropriate scientific terminology in their answers. Example questions are: - **Q1:** What was the elastic band doing as it was being stretched? - **Q2**: What when the elastic band was stretched back further then released in experiment two? Was it using more or less force? - **Q3:** What was happening as the elastic band was being stretched in experiment one? Why was it doing this?	

Learning Sequence 3:	Teaching and Learning Experience	Resources
Assessment Focus Students' ability to recognise the presence and function of friction in everyday life on earth. Student's ability to articulate the processes of forces acting on one another using scientific vocabulary. Students' ability to collaborate and engage in scientific experimentation and observation. Students' ability to record observations in an information table and analyse and evaluate results to reach conclusions.	**<u>Contact Forces - Friction</u>** **Newton's First Law of Motion** ● *An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force.* ● Summarise what this definition means as a class and write in books. **Experiment** ● Students discuss the materials and hypothesise with material the ball will roll furthest on. ● Students are to be grouped in teams of 3 or 4. ● Referring to table, students are to hold a ruler at a 45 degree angle and let it role down along different surfaces. Students are then to measure the distance the ball travels and record this on their table. **Analysis** ● Discuss results with students and possible reasons for these. ● Students answer the following questions: o On which surface did the ball role the furthest distance? Why? o On which surface did the ball role the least distance? Why? o What would happen if the ball rolled on a surface with no friction? **Video** ● Watch video as a class. Use information to analyse whether students written answers were correct.	● http://teachertech.rice.edu/Participants/louviere/Newton/law1.html ● Rulers ● Balls ● Science Books ● Information Table ● https://www.youtube.com/watch?v=C7NPD9W0kro

Learning Sequence 4:	Teaching and Learning Experience	Resources
Assessment Focus: Students' abilities to hypothesise results and explain these predictions based on prior knowledge. Students' abilities to make and record observations, and articulate these using appropriate and meaningful language. Students' abilities to clearly represent physical phenomenon in their writing and diagrams Students' understanding of the properties of non-contact forces.	**<u>Non-Contact Forces - Magnetism</u>** **Introduction** ● Revise with students what 'forces' are. ● Give students a simple object e.g. a pencil. instruct students that they are to move this object but are not able to come into contact with it. ● Inform students that they are to place something between themselves and the object such as a piece of cardboard. Have students attempt to blow the object (while the cardboard blocks it). Discuss why the object was unable to move when blocked **Demonstration** ● Go through worksheet with students. Have them answer the first two questions and then discuss as a class. ● Introduce students to magnets and demonstrate the various movements of attraction and repulsion. ● Use the cardboard as a barrier between the magnets, same as before, and demonstrate how unlike other ordinary object, magnets are still able to project force onto one another when physically blocked. **Experiment** ● Break students into groups. ● Groups are to tape one side of a length of string to the carpet, and the other side to a magnet. Using another magnet, students are then to attempt to create a state of levitation where the magnet on the string appears to be floating. ● **Worksheet** ● Discuss observations as a class and record these on worksheet along with a diagram.	● SImple everyday objects ● Worksheets ● Magnets ● Cardboard ● Magnets ● String ● Sticky tape

Learning Sequence 5:	Teaching and Learning Experience	Resources
Assessment Focus: Students' abilities to explain observations using science vocabulary related to forces. Students' abilities to use prior understandings to rationalise and explain observations of physical phenomena and what factors lead to changes in behaviour. Students' abilities to contemplate the concept of relative motion what this would look like, and where it can be observed in everyday life. Students' abilities to accurately illustrate the concept and process of relative motion through diagrams and annotations.	**<u>Relative Force</u>** **Introduction** ● Revision of last lesson on non-contact forces i.e. What are they? How do they work? What are some examples? **Experiment** ● In groups, students are to assemble outside with basketballs. One member is to drop the ball from the balcony and the other is to catch it. Students are to record observations as they work. ○ 1st attempt: hands are to remain completely still ○ 2nd attempt: hands are to make a downward motion to intercept the ball ○ 3rd attempt: hands are to move upward to hit the ball ● Discuss observations i.e. what difference did you feel each time you touched the ball? Did the force the force of the ball change? Or was it constant? Why did it feel different each time? **Video** ● Show students video of docking scene from the movie 'Interstellar' ● Ask students what they observed e.g. why did the spaceship suddenly look as though it stopped spinning? Why did this happen? **Relative Motion** ● Share with students the definition of relative motion. Students are to copy into their books ● Students are to draw a diagram of their experiment and annotate. They must then explain what different effects were experienced each time using their knowledge of relative motion.	● Basketballs ● Worksheets ● Science Books Interstellar: https://www.youtube.com/watch?v=c4tPQYNpW9k

Learning Sequence 5:	Teaching and Learning Experience	Resources
Assessment Focus: Students' abilities to explain observations using science vocabulary related to forces. Students' abilities to use prior understandings to rationalise and explain observations of physical phenomena and what factors lead to changes in behaviour. Students' abilities to contemplate the concept of relative motion what this would look like, and where it can be observed in everyday life. Students' abilities to accurately illustrate the concept and process of relative motion through diagrams and annotations.	**<u>Designing a 21st Century Vehicle</u>** Rich Task activity- Duration Week 6-9. Testing Week 10. Students form groups of three and follow the design process to build a light and fast 21st century vehicle that can travel a minimum 3 metres. The students will follow the below design path. Teachers will determine the duration of each design process in order for vehicles to be tested in Week 10. 1. Design brief - Provides context, states the task, sets design criteria. 2. Problem - State the problem in your own words. 3. Solution - Brainstorm and discuss ideas for design solutions using available materials. 4. Plan - Sketch design ideas for your vehicle. Show plan, side and rear views. 5. Prototype - Choose one design plan, work together to construct a prototype vehicle. 6. Testing - Plan and conduct a fair test. How effective is your vehicle? 7. Compare - Collect data from other groups. Analyse the overall success of the designs. 8. Conclude - What generalisations or conclusions can you make from this data? 9. Evaluate - Was your vehicle prototype successful? 10. Problems – Outline any problems with your design. 11. Redesign - What modifications would improve the design? 12. Explain – Draw a multimodal representation of the final design and: a) label and justify the design features and the materials used; b)show the effects of the forces on the car when it is moving. 13. Apply – Based on the data collected in your investigation, discuss and record the factors that would need to be considered by the engineering company in the design of wind powered cars for use as passenger vehicles.	**Design Process Powerpoint** https://drive.google.com/open?id=1gqTrKWsaSFuKi6nP3_PGpkFerK89Q5kgmqyDbr1G97U **21st Century Vehicle resource folder** https://drive.google.com/open?id=1EEG2eHh9LlW7WwkrSkoUXmXAPZIA9Djp