School Name

Year 4 STEM Task Sheet

Why do schools have 40 zones?

Assessment Task: Purpose: To design a safety device that will help keep students safe around schools.

Name

Task: Guided Inquiry

Students will conduct an investigation into contact and non contact forces using Lego models. They will follow instructions, make predictions and record observations in tables and column graphs. Studetents will use their findings to design a Smart Car to be used around the school. Students will then extend their learning using the design thinking model to create a prototype of a Smart Device that will help keep students safe around schools.

Instructions

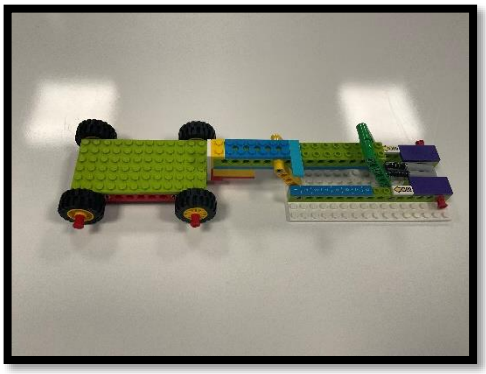
This term you will explore contact and non contact forces. You will conduct investigations, make observations and record predictions about how objects move. You will then design your own **Smart Car** that can solve a problem.

Assessment Part A – Digital Journal

During your inquiry you will create a digital portfolio to show your scientific understanding from activities performed in class. You will pose questions, make predictions and record your results during the investigations.

Using your findings you will individually design your own smart car.

1. Create an annotated diagram of your smart car using your findings eg. wheel size, weight etc
2. Draw a force diagram to show the forces involved in your car



Assessment Part B – Group Task: Smart Device

Collaboratively design a Smart Device that can be used in the school community to solve a problem and keep our students safe. Include motors, sensors and simple machines within your design.

- Interview somebody in your community that would have an interest in your design e.g. school students, teachers, parents, community. Create an empathy map of your findings.
- Collaboratively draw and annotate an idea for your groups smart car/device. Justify its features from your investigation findings and your empathy map. Includes motors and/or colour and light sensor

Build and program your Smart Device

- Collaboratively build your Smart Car/ Device using the BricQ and Spike Essential Kit
- Test and modify your design if required
- Program your device using the LEGO® Education SPIKE™ App
- Document the changes you made to your Smart Device during your testing
- Program your device using the LEGO® Education SPIKE™ App
- Present your Smart Device to the class explaining its features

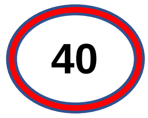
Year 3_4 STEM: Technologies: Smart Device

Name:

Purpose of assessment: To design and program a Smart Device for the local community that solves a safety problem.

Digital Technologies: Process and Production Skills	Design Technologies: Process and Production Skills		
Design and implement digital solution using algorithms that involve decision making and user input. Explains how the solutions meet their purpose.	**Create a design solution using models and drawings including annotations.**	**Plans and sequences steps in design and production. Evaluates ideas against identified criteria.**	
Designs clear and logical algorithms that involve decision making and user input. Explains how the algorithms met the digital challenge. Justifies how the digital solution meets their purpose and how it could be improved.	Clearly creates a detailed design solution using models and annotated drawings that show how forces are used within the design using appropriate technical terms and graphical representation techniques.	Collaboratively plan and sequence detailed steps to produce a design solution that meets the challenge. Evaluates and justifies ideas using evidence from their findings.	**A**
Designs a logical algorithm that involves decision making and user input. Explains how the digital solution meets their purpose and how it could be improved.	Creates a detailed design solution using models annotated drawings that show how forces are used within the design.	Collaboratively plan and sequence steps to produce a design solution that meets the challenge. Evaluates ideas using evidence from their findings.	**B**
Design and implement digital solution using algorithms that involve decision making and user input. Explain how the digital solution meets their purpose.	Create a design solution using models and drawings including annotations.	Plans and sequences steps in design and production. Evaluates ideas against identified criteria.	**C**
Designs a digital solution. Collects data.	Draws a design idea. Builds a solution.	Makes a simple car/ device with guidance. Comments on design idea.	**D**
Programs an action.	Selects a design idea.	Follows directions to create a simple car.	**E**

Why do schools have 40 zones?



Context: Physical Science/ Technologies	**Duration:** 10 Sessions
Australian Curriculum Achievement Standard	
Science	By the end of Year 4, students apply the observable properties of materials to explain how objects and materials can be used. They describe how contact and non-contact forces affect interactions between objects. They discuss how natural processes and human activity cause changes to Earth's surface. They describe relationships that assist the survival of living things and sequence key stages in the life cycle of a plant or animal. They identify when science is used to understand the effect of their actions. Students follow instructions to identify investigable questions about familiar contexts and make predictions based on prior knowledge. They describe ways to conduct investigations and safely use equipment to make and record observations with accuracy. They use provided tables and column graphs to organise data and identify patterns. Students suggest explanations for observations and compare their findings with their predictions. They suggest reasons why a test was fair or not. They use formal and informal ways to communicate their observations and findings.
Technologies	By the end of Year 4, students describe how social, technical and sustainability factors influence the design of solutions to meet present and future needs. They describe features of technologies that influence design decisions and how a range of digital systems can be used. Students outline and define needs, opportunities or problems. They collect, manipulate and interpret data from a range of sources to support decisions. Students generate and record design ideas for an audience using technical terms and graphical and non-graphical representation techniques including algorithms. They plan a sequence of steps (algorithms) to create solutions, including visual programs. Students plan and safely produce designed solutions for each of the prescribed technologies contexts. They use identified criteria for success, including sustainability considerations, to judge the suitability of their ideas, solutions and processes. Students use agreed protocols when collaborating, and creating and communicating ideas, information and solutions face-to-face and online.
Learning Areas: Science, Technologies, Maths	
Science Science Understandings	Forces can be exerted by one object on another through direct contact or from a distance (ACSSU076)
Science Science as a Human Endeavour	Science involves making predictions and describing patterns and relationships (ACSHE061)
Science Inquiry Skills	With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment (ACSIS065) Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS068) Compare results with predictions, suggesting possible reasons for findings (ACSIS216) Reflect on investigations, including whether a rest was fair or not (ACSIS069) Present and communicate observations, ideas and findings using formal and informal representations (ACSIS071)
Digital Technologies Knowledge and Understanding	Recognise different types of data and explore how the same data can be represented in different ways (ATDIK008)
Process and Production Skills	Collect, access and present different types of data using simple software to create information and solve problems (ACTDIP009) Define simple problems, and describe and follow a sequence of steps and decisions (algorithms) needed to solve them (ACTDIP010) Implement simple digital solutions as visual programs with algorithms involving branching (decisions) and user input (ACTDIP011) Plan, create and communicate ideas and information independently and with others, applying agreed ethical and social protocols (ACTDIP013)
Design Technologies Knowledge and Understanding	Investigate how forces and the properties of materials affect the behaviour of a product or system (ACTDEK011)

Design Technologies Process and Production skills	Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to produce designed solutions (ACTDEP014) Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques (ACTDEP015) Evaluate design ideas, processes and solutions based on criteria for success developed with guidance (ACTDEP017) Plan a sequence of production steps when making designed solutions individually and collaboratively (ACTDEP018)
Maths Data Representation and Interpretation	Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data value (ACMSP096) Evaluate the effectiveness of different displays in illustrating data features including variability (ACMSP097)
Maths Using units of Measure	Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084)

Assessment and Data

Part1: Digital Journal and Smart Car
Part 2: Smart Device

Resources

Each group requires the following:

- A BricQ Set
- A Spike Essential Kit
- Device to record findings and program the Spike Essential Kit (Tablet, Laptop, iPad)
- LEGO® Education SPIKE™ App

Lesson Sequence/ Overview

Engage

Introduce scenario – Drop off and pick up zones around schools can often be a hectic place, however, schools have things in place to help keep us safe. Why do you think we have 40 zones around schools? What other safety measures do we have around schools to keep us safe? What are some of the concerns around our school? Create a wonderings chart.

Explore

Challenge 1: *To keep students safe around the school we are going to design and create a Smart Car that stops at the crossing. Before we start our challenge we need to investigate how different forces affect the stopping distance of cars.*

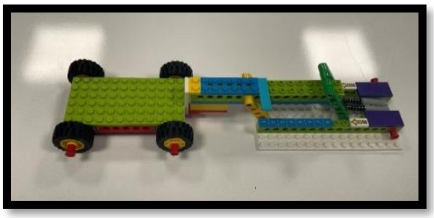
Lesson 1: Build the 'race car' and 'launcher' module (4) in the book B of BricQ.

Question: How does contact force affect the distance a car travels?

Predict what will happen to the car when more or less force is exerted. Using the launcher, measure the distance travelled by the car when changing the amount of contact force applied

Step 1: Pull the launcher back to 1 on the blue ruler and let go. Measure how far the car has travelled. Record your results in a graph.

Step 2: Pull the launcher back to 2 on the blue ruler and let go. Measure how far the car has travelled. Record your results in a graph.



Step 3: Repeat Step 2 for 3, 4, 5, 6, 7 and 8. Record your result for each.

What did you results show? How accurate was your prediction? Draw a diagram to show how force was applied on your car.

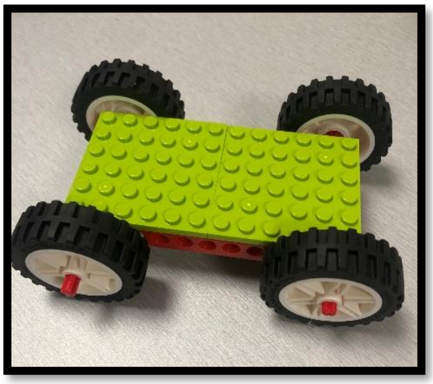
__Lesson 2: Making Changes__

Question: How does friction affect the distance a car travels?

In this activity you will investigate friction to see what happens to your car when you make a change. You will conduct three experiments changing only one element at a time:

1. Wheel Size
2. Weight of car
3. Surface

Using the launcher measure the distance travelled by the car when a contact force is applied in each of your fair tests.



What did you results show? How accurate was your prediction? Draw a diagram to show how force was applied on your car.

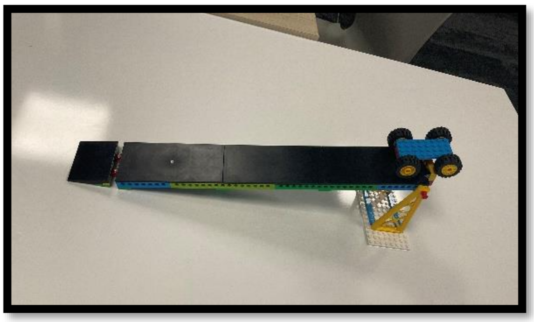
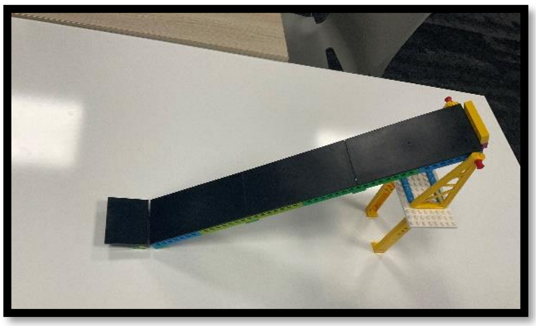
Lesson 3: Build the 'ramp' p88 book B of BricQ

Question: How does gravity and an inclined plane affect the distance a car travels?

Predict what will happen to the distance travelled when a force is exerted down a ramp.

Step 1: Build the 'ramp' on p88 of book B from BricQ
Step 2: Build a smaller car with the small wheels.
Step 3: Push the car down the ramp. Measure how far the car travelled when a force is applied.
Step 4: Increase the height of the ramp. Measure how far the car travelled when a force is applied.

Optional extension: change the surface of the ramp eg. cutting carpet to fit or wrapping with sandpaper.

What did you results show? How accurate was your prediction? Draw a diagram to show how force was applied on your car.

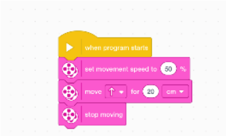
Lesson 4: Spike Prime Essential – Smart Car

How is force affected by speed?

Build a car with two motors using the Spike Essential Kit.

Predict how the speed of your car will impact on the force applied to a row of dominoes.
Program your car to drive forward using the LEGO® Education SPIKE™ App.

Step 1: Set up a row of dominoes 20 cm away from your car.
Step 2: Program your car to drive forward for 21 cm at a speed of 20% and then stop.



Step 3: Record how many dominoes were knocked over.
Step 4: Repeat steps 1 to 2 changing the speed to 50%. Record how many dominoes were knocked over.
Step 5: Repeat steps 1 to 2 changing the speed to 100%. Record how many dominoes were knocked over.

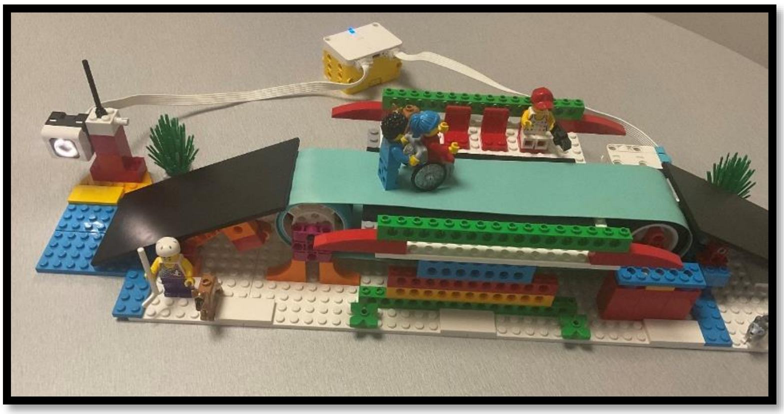
Teacher Note: When placing the dominoes ensure the first domino is placed 1cm before the stopping point of the robot.

Building a Smart Car: Modify your car to include one 1 motor and a colour sensor. Can you reprogram your car to stop at a school crossing? Use your findings from the previous investigations to decide how heavy to make your car and what type of wheels to include on your car.

Explain

Lesson 5: The – Safe – Travellator

Discuss simple machines and the forces used in Travelators. Using the BricQ and Spike Essential kit design a travellator to help students get across the school carpark safely. Program the Travellator to activate when approached using the colour sensor. Draw a diagram showing the forces used within your travellator.

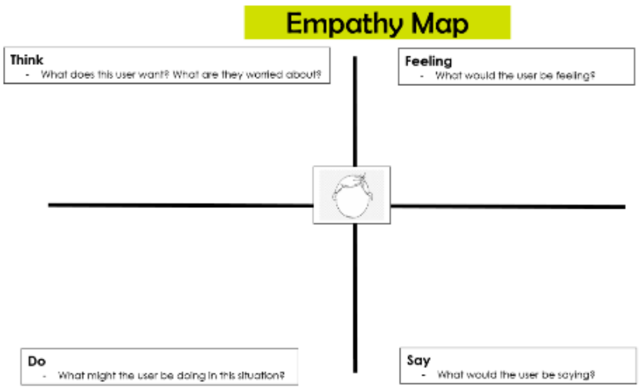


Elaborate

Lesson 6 - 9: Designing your solution using the Design Thinking Model

Empathise

Interview members of your community about safety issues and what they would like solved. Create an empathy map for your chosen person eg. parent, teacher, student



Define
In groups, collaboratively brainstorm what problems you could solve using your Empathy map.

Teacher Note – Possible Design Solutions: a set of traffic lights that go red when a car approaches, a motor that activates a simple drawbridge that protects students walking the crossing, a pulley system that lifts a student up out of the car and transports them across the road, a smart car that stops at a designated point with a slide that students can use to enter the school without walking on the road.

Ideate
Collaboratively design a Smart Device that could be used in your school community to keep students safe. Create an annotated diagram of your 'Smart Device.'

Prototype: Build a prototype using the BricQ and Spike Essential
Build a solution using the BricQ and Spike Essential kits. Record your design steps in your digital journal. Record any design changes you have made from your original design.

Test and Modify
Using the Spike App program your Smart Device. Test and refine your design if required. Upload a video of your Device working. Include a Screenshot of your finished algorithm. Explain how your algorithm works.

Evaluate

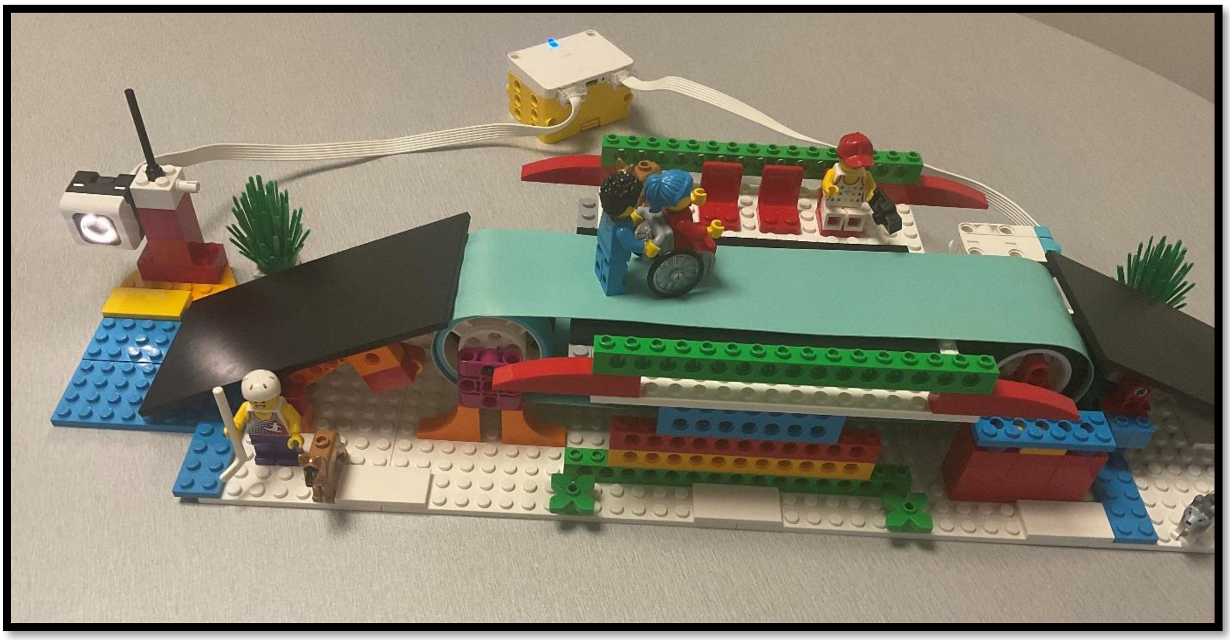
Lesson 10: Evaluation
Draw a force diagram to show the forces are used in your smart device.

Answer the following questions:

1. What special features did your smart device have?
2. How does your smart device solve the problem by keeping students safe?
3. Did your smart device meet the target audience? How?
4. Did you make any changes on your smart car/ device from your original design?
5. What would you do differently next time?

The - Safe – Travellator

Create a safe way to get students across the school carpark using The – Safe – Travelator!



70 - 90 min.
Intermediate.
Grades 3 – 6

Equipment Required

- BricQ Kit
- Spike Essential Kit
- Band or material

Prepare

- If necessary, pre-teach these related vocabulary words: *travelator, conveyor belt, pulleys*
- Consider the abilities and backgrounds of all your students. Differentiate the lesson to make it accessible to everyone

Engage

- Facilitate a discussion about the components in a simple machine.
- Discuss how a conveyor belt is a simple machine that moves objects from Point A to Point B. Explore the three main compartments – the driving unit

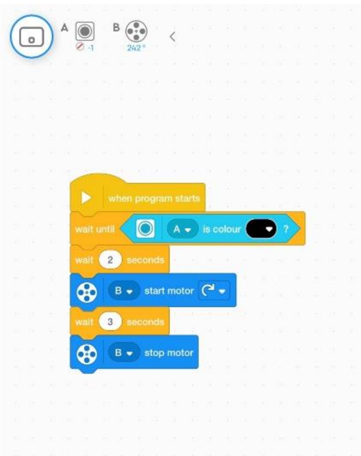
- (motor), the frame (frame, belt, supports) and the pulley system. Show students pictures of different types of conveyor belts.
- Discuss the forces used within a conveyor belt and how a pulley system can change the direction of a force.
- Distribute kits to students and discuss task – to create a conveyor belt to transport students form one side of the carpark to the other safely.

Explore

(Small Groups, 30 Minutes)

- Have students use the BricQ and the Spike Essential kit to create a model conveyor belt.
- Have your students use the LEGO® Education SPIKE™ App to guide them through their first challenge:
  - Create and test the program that uses the colour sensor to activate the motor on the conveyor belt.
  - Extension: Can you create a program that makes the conveyor belt go in the opposite direction

Example program:



Explain

(Whole Class, 5 Minutes)

- Gather your students together to reflect on their completed challenges.
- Ask questions, like: *What forces were used in the travelator? Draw a force diagram of the travelator.*

Elaborate

(Whole Class, 5 Minutes)

- Brainstorm: What other safety problems could you fix using a simple machine? e.g. a drawbridge on the pedestrian crossing, lights that flash red when a car approaches, a pulley system that lifts a student up out of the car and transports them across the road
- Discuss the components of other simple machines. How could we use our knowledge of simple machines to design a solution using Lego that will keep our students safe are schools?

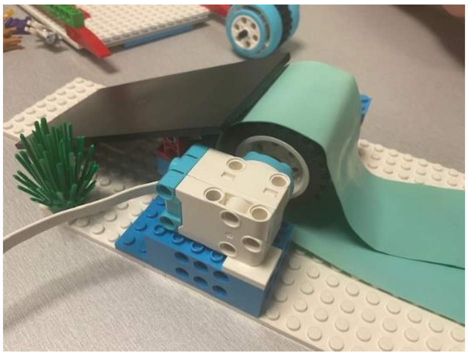
Evaluate

(Ongoing Throughout the Lesson)

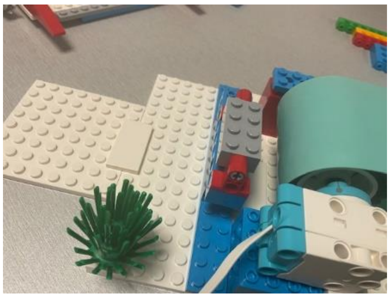
- How effective was your travelator? Would this be an effective solution at our school? Why or why not?

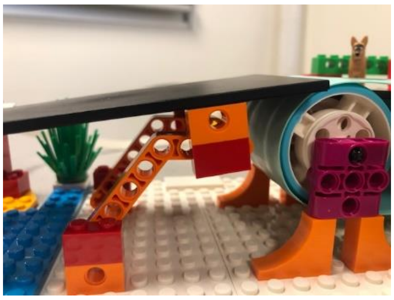
Building Tips

Tip 1: Wheels for the conveyor belt



Tip 2: Connecting to a motor





Tip 2: Building the ramps