MEDICAL MISSION

Engineering Education – Introduction to Materials

Overview
This is an engineering education activity that addresses requirements of the Technology KLA, applying students' prior learning in science and mathematics. The activity includes aspects of Year 4 science and mathematics from the Australian Curriculum (ACARA) and C2C as well as Essential Learnings for technology (QCAR).

Medical mission: Some medicines such as eye drops must be stored in a refrigerator because at higher temperatures they break down or "go off". The student will consider how to transport medicine from a helicopter to an injured person in the rainforest. The medicine must be kept within the temperature range: 2°to 8°C. The student's medical mission is to make a Design and make a strong and safe medical kit (3D shape, insulation container) that can keep medicines at a cool temperature, so it can be transported from the helicopter to the patient 20 minutes away.

Mission/challenge: Design and make a strong and safe medical kit (3D shape, insulation container) that can keep medicines at a cool temperature.

Objectives:
- Introduce children to aspects of materials engineering and the roles of these engineers;
- Develop students' problem-solving skills, including applying engineering design processes;
- Describe, explore and test the properties of a range of common materials;
- Develop an appreciation of the work of materials engineers;
- Design and test a strong and safe medical kit (3D shape, container) to insulate an ice cube.

Materials:

- Medical Mission Activity - Teacher Guide Booklet
- Medical Mission Activity - Student Design Workbook (1 per student)
- Pencil, rubber, ruler, scissors – student supplied
- Template nets of a cube - http://www.mathsisfun.com/cube.html
- Materials for testing (5cm²) - aluminium foil, bubble wrap, paper towel, polyfoam, fabric (5 of each per group + extras in case of damage during testing)
- One plastic cup per group, half-filled with water
- Materials for 3D container – 10 cm pipe cleaners, 5 cm straws (16 per student) + materials (aluminium foil, bubble wrap, paper towel, polyfoam, fabric – 30cm²)
- Sticky tape/masking tape
- One ice cube per student and one ice cube as a control (for placement in sunlight)
- 30mL medicine measures (1 per student)
- 10mL syringes (1 per student)
- Thermometer
- Quarter-filled bucket of water – school supplied
- Weights (approx. 435g per group – 5g, 10g, 20g, 50g, 100g, 250g)
- Firm cardboard (20cm² per group)
- QUT supplied DVD containing:
  - 1. Engineering Model
  - 2. Super Material segment on The Project 8th August 2013 (http://www.youtube.com/watch?v=5SgvKYxMUq8)
  - 3. Three States of Water (http://www.youtube.com/watch?v=FDxugKfTk_A)
  - 4. Three States of Matter 1 (http://www.youtube.com/watch?v=s-KvoVzukHo)
  - 5. Three States of Matter 2 (http://www.harcourtschool.com/activity/states_of_matter/index.html)
  - 6. Template net of a cube (http://www.mathsisfun.com/cube.html)

Additional Teacher Information:

Thermometers

- http://home.howstuffworks.com/therm1.htm
- http://www.youtube.com/watch?v=VlZC4wc-9Cg

Drones

- http://www.youtube.com/watch?v=qDtsTQNGfWQ
- http://www.youtube.com/watch?v=-CYT4PFV_Hs

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Technology, science and mathematics curriculum links are listed here.

Technology (by the end of Year 5):
Ways of Working:
- Identify and analyse the purpose and context for design ideas
- Generate design ideas that match requirements
- Communicate the details of their designs using 2D or 3D visual representations
- Select resources, techniques and tools to make products
- Plan production procedures by identifying and sequencing steps
- Make products to match design ideas by manipulating and processing resources
- Identify and apply safe practices
- Evaluate products and processes to identify strengths, limitations, effectiveness and improvements

Knowledge and Understanding: Technology as a human endeavour
- Aspects of appropriateness influence product design and production decisions

Information, materials and systems (resources)
- Resources have particular characteristics that make them more suitable for a specific purpose and context
- Techniques and tools are selected to appropriately manipulate characteristics of resources to meet design ideas

Chemical Science:
- Natural and processed materials have a range of physical properties; these properties can influence their use (ACSSU074)

Elaborations (C2C):
- Identify the properties of a substance and describe its possible uses
- Name and describe properties of familiar objects and materials
- Understand how familiar materials are suited to a particular purpose
- Understand that materials are selected for products based on their properties and intended use
- Understand that materials can be tested for properties and this may influence their use
- Understand that materials are selected for a purpose because of their particular properties

Measurement and Geometry:
Using units of measurement
- Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084)

Shape
- Make models of three-dimensional objects and describe key features (ACMMG063)

Elaborations (C2C):
- Measure and compare lengths using informal and formal measurement instruments
- Use the graduated scales on simple, formal measurement instruments to measure and compare lengths
- Organise and measure the duration of events
- Explore the creation of three-dimensional objects

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Introduction

There are two parts to this Medical Mission activity which focuses on engineering education. Part 1 involves conceptual development (i.e. properties of 3D shapes, temperature, properties of materials) towards the engineering education activity. Part 2 involves the design, make and test components of the engineering education activity.

NB: There are spaces for teacher notes, questions and/or advice throughout the Teaching Notes. In addition, please feel free to write anywhere in the workbook.

- If you wish, you can extend any of the activities in Part 1 but please indicate what you did so we have a record.
- QUT staff will be on site for Part 2.

The numbers in the teacher's guide (left hand pages) correspond with the numbers in the student's workbook (right hand pages).

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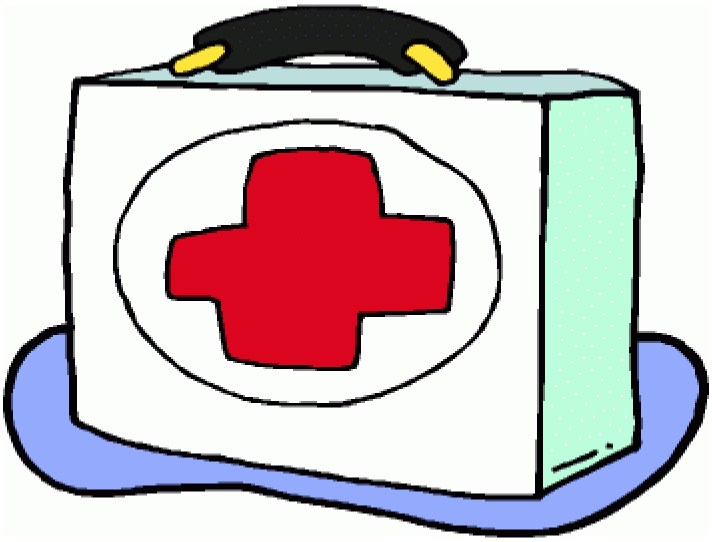
MEDICAL MISSION

Year 4



STUDENT WORKBOOK

Name: ____

Other group members: ____

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Group Number: ____________________ Class: ___________________________

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Part 1 (2 – 2.5 hrs)

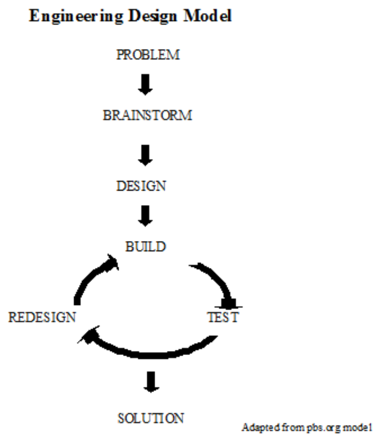
ENGINEERS WORKING WITH MATERIALS (20 – 30 minutes)

1. **Discuss** with students what they think an engineer does.

   Elicit responses from students about the different types of engineers and engineering activities so far (*What is Engineering* with the tumbling tower and *Aerospace Engineering* with designing a plane).

   Ask students to recall what happened in the storybook Engibear's Dream (e.g. there was a problem to solve and there were many different designs before the final robot). Also ask about the introduced word "prototype".

   Remind students about this engineering design model. Have students complete the engineering design model in student workbook.



   Tell students that the **Thinking Spaces** in their workbooks can be used to draw other ideas, make notes, or write about their thinking in this engineering education at any time.

   Explain that nearly all engineers use materials. Make a link to how Engibear's robot was made from different materials. Refer to the 'Dream Up The Future' poster and/or cards and ask students where engineers use materials. Ensure materials engineer is discussed last as it is the focus of the activity. **Elicit responses** from students on what they think a *materials engineer* would do.

   Have students **watch** the materials engineer segment from The Project (8 August 2013) http://www.youtube.com/watch?v=5SgvKYxMUq8

   Ask what they noticed in the video. What was the problem? What was a solution to this problem? What do materials engineers need to think about?

   Tell students that they will be focusing on a real *problem*, which is part of what engineers do.

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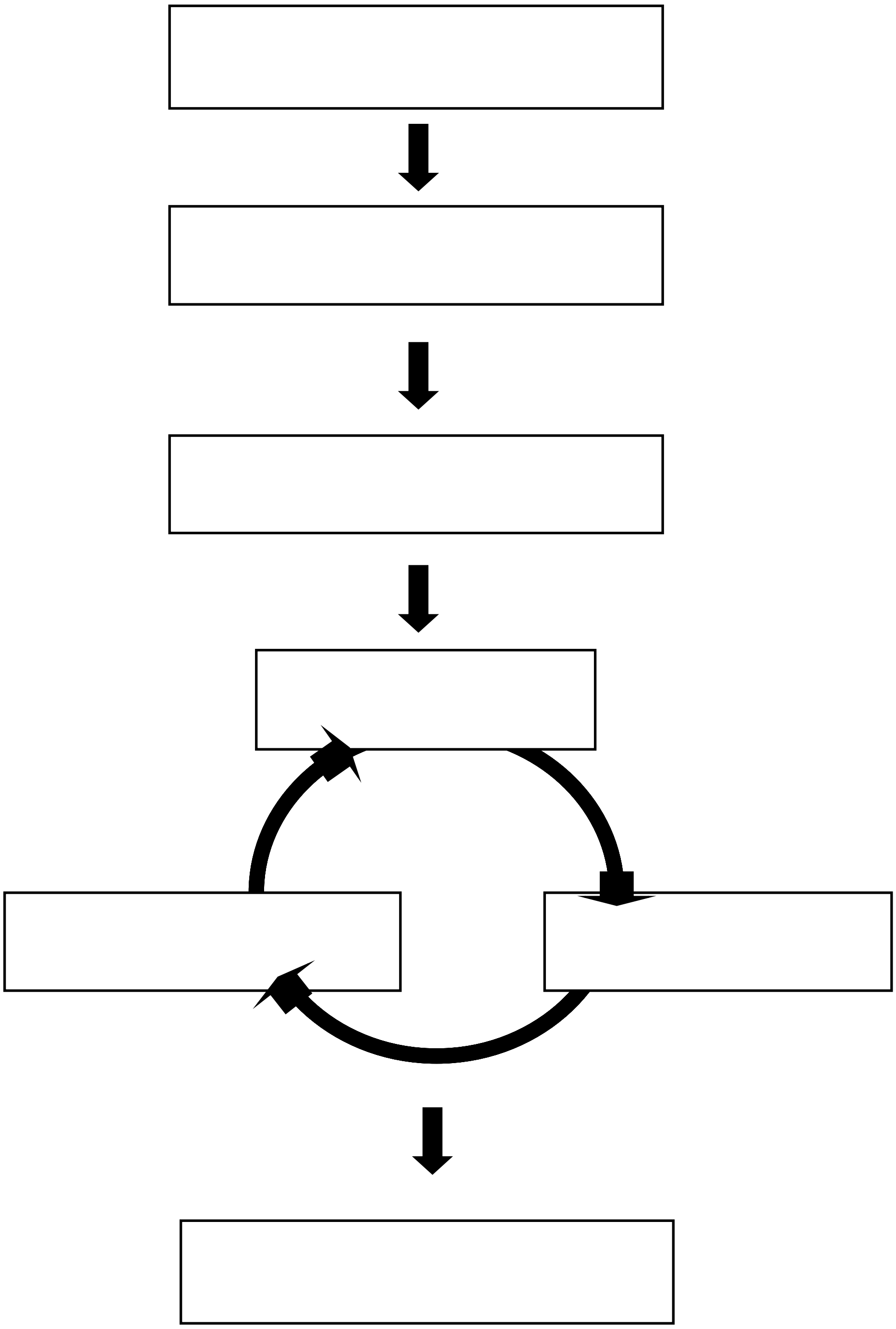
PART 1

ENGINEERS WORKING WITH MATERIALS

1. **Complete** the engineering design model below.

ENGINEERING DESIGN MODEL



Adapted from pbs.org model

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THE PROBLEM (5 minutes)

2. **Problem -** the teacher explains that later on (Part 2) the materials engineering challenge will be to design and test a *strong* and safe medical kit (3D shape, container) to carry medicines (such as eye drops) from a helicopter to an injured person in the rainforest as part of a Medical Mission. This kit will be a prototype.
   However, first they need to **explore** various 3D shapes. Tell them they will make a cube as one example.

*Teacher's notes/questions/advice:

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EXPLORING 3D SHAPES: OPTIONAL (IF DONE PREVIOUSLY) (25 – 30 minutes)

3. Hand out a sheet with the net of a cube.
   Students' task: Cut along the lines of the net of a cube but do NOT cut the dotted lines. Fold the lines to make a cube. Have students "trace" the edge and face and "touch" the vertices on their cubes.

   Ask students to **write** a description of this cube (considering edges, faces and vertices).
   Students use a ruler to measure the sides of the cube and write these measures in cm (or some students may use mm) on the cube.
   Ask "What did you notice when you measured the sides of the cube?" (Possible response: All sides were the same measurement).

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THE PROBLEM

2. **Read** about the problem you will be solving:

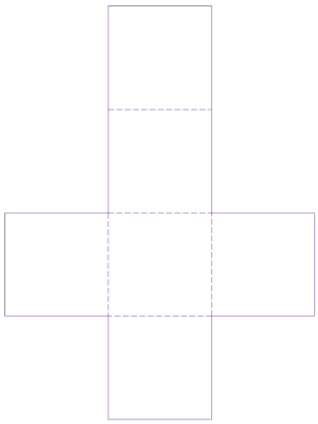
To design and make a strong, covered 3D shape to carry medicines (such as eye drops) at a cool temperature from a helicopter to an injured person in the rainforest.

Before you start on your design, you will learn about some things that will help you with your design.

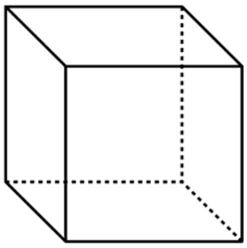
EXPLORING 3D SHAPES

3. Try to **make** a cube. **Cut** along the lines of the net of a cube but do NOT cut the dotted lines. **Fold** the dotted lines to make a cube.

Trace around the edges. **Trace** over the faces. **Point** to the vertices (corners).



Net of a cube



Cube

Describe the cube. Think about the faces, edges and vertices.

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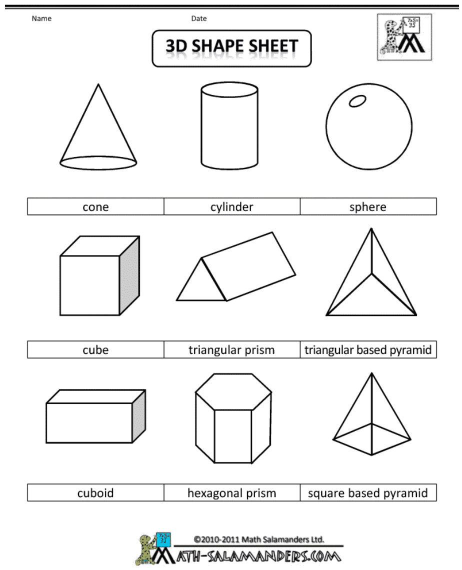
4. Refer to the **3D shapes** in the student workbook. Ask students to identify objects in the classroom that have 3D shapes and explore the edges, faces and, where relevant, vertices (singular – vertex). The teacher can also direct students to objects outside that may be in these shapes (e.g., a roof – triangular prism). Explain the terms regular and irregular.



*Teacher's notes/questions/advice:

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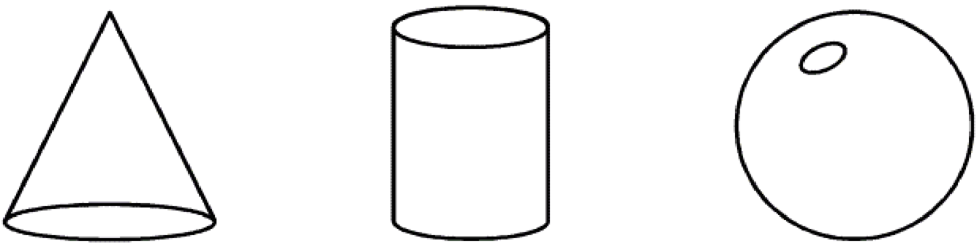
4. **Explore** regular 3D shapes (a cuboid is also known as a rectangular prism).

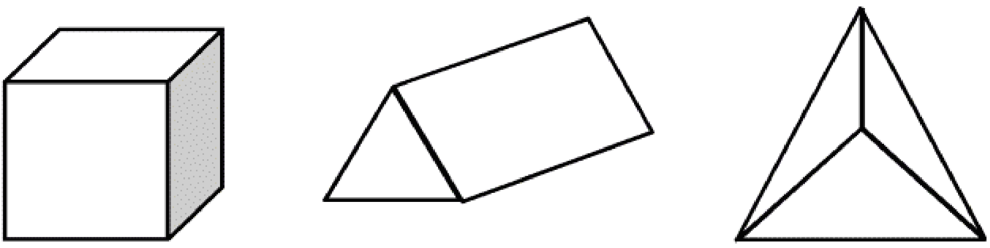
- Can you identify objects with these shapes in your classroom or outside environment?
- Can you tell how many edges, faces and vertices there are for each shape?

Name Date

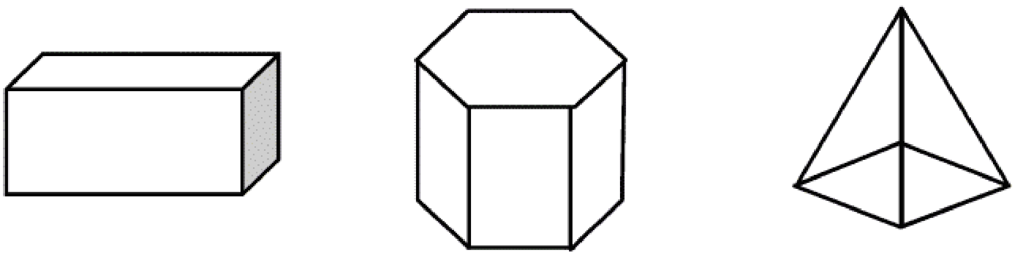
3D SHAPE SHEET



cone	cylinder	sphere



cube	triangular prism	triangular based pyramid



cuboid	hexagonal prism	square based pyramid

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TEMPERATURE: OPTIONAL (IF DONE PREVIOUSLY) (10 – 15 minutes)

5. **Problem** - the teacher explains that later on (in Part 2) the challenge will be to design a strong 3D shape as a medical kit to carry medicines (such as eye drops). However, eye drops must be kept cool (between 2 to 8 degrees Celsius). Write this on the board: 2˚C to 8˚C. Explain the degree symbol (i.e. ˚) and that the C stands for Celsius as a measurement of temperature.

   Question students about different temperatures (e.g. today's temperature) and ask students if 8˚C is hot, warm, cool, or cold. Do the same for other temperatures (e.g. 50˚C, 24˚C). Explain that water freezes at 0˚C and boils at 100˚C.

   Ask students to **draw** pictures to show different temperatures (0˚C, 25˚C, 100˚C). For example, 0˚C may be an iceblock or a snowy land, 100˚C may be a pot boiling on a stove. Discuss the students' pictures.

   Ask students how temperature is measured (thermometer) and whether they have seen a thermometer. *Teacher background only*: http://home.howstuffworks.com/therm1.htm and http://www.youtube.com/watch?v=VlZC4wc-9Cg.

   (If handy, show a temperature gauge and read the temperature). When the air temperature is hotter, the thermometer liquid warms up and expands in the tube. Remind students that C stands for Celsius and discuss what happens to ice when it melts.

   Ask: what happens to ice cream on a hot day? Ask: what happens to ice on a hot day? (Ice is a frozen state of water and starts to melt when temperatures are above 0˚C).
   Ask: How do we keep things cool? (Possible responses: use a fridge/freezer, be in the shade/stay indoors/wear a hat)

*Teacher's notes/questions/advice:

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TEMPERATURE

5. **Draw** a picture to show the different temperatures.

Remember: 0°C is the freezing point for water and 100°C is the boiling point for water.

0°C	25°C	100°C

STATES OF MATTER

6. **Watch** the video explaining how *water* has three different states.

   Watch the videos about the three states of *matter*.

Role play the three states of matter.

TESTING THE PROPERTIES OF MATERIALS

"Properties" means how the material looks, feels, and behaves with different push and pull forces.

7. Look at the **"Testing the Properties of Materials"** table on the next page.
   Your task:
   a. **Predict** what will happen to the material and *underline* YES, UNSURE or NO.
   b. **Observe** what happens to the material and *circle* YES, UNSURE or NO.
   c. **Explain** to your group what happened and why.

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STATES OF MATTER: OPTIONAL (20 minutes)

6. Tell students that they will use an ice cube to keep the medicine (eye drops) cool inside their 3D shape (which will become a medical kit). **Ask**: What is ice?

   Watch an explanation about the three states of *water* (ice, liquid, steam/vapour) http://www.youtube.com/watch?v=FDxugKfTk_A (1 min 24 sec). Select two or three willing students to say what they had seen on the video. Outline to students that *ice* is a *solid* and the *steam or vapour* is a *gas*.

   Explain that if we had a powerful microscope we would see how these three states of matter (solid, liquid and gas) are made up. They are made up of tiny particles called *molecules*. Write the word *molecules* on the whiteboard. Tell them "Everything is made up of molecules – we're made of different molecules".

   Students **watch** the videos on three states of matter (solid, liquid, gas) http://www.youtube.com/watch?v=s-KvoVzukHo (62 sec) then click on: http://www.harcourtschool.com/activity/states_of_matter/index.html and have students tell you what they see. Note that solids have moving particles but they are connected.

   Students **role play** the states of matter: Select nine students and ask them to form three lines of three, touching the shoulders of the person in front and at the side. The rows of three by three act as a "container". Explain that as a solid they are connected and cannot move from their location but they can "vibrate". As a liquid they can move around within the "container". As a gas they can move freely around the room.

   Talk to students about how the *molecules* acted or behaved in the three states of matter. (Note that when the temperature is hotter the molecules move more freely and this is why the liquid in the thermometer gauge rises up the tube).

*Teacher's notes/questions/advice:

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TESTING THE PROPERTIES OF MATERIALS (30 – 45 minutes)

7. **Problem**: Explain that the strong 3D shape will need to be covered, so it will be important to decide on the type of material to cover the 3D shape to make a medical kit.
   Ask: Why do you think engineers have to understand materials? Materials engineers would explore different materials before making a decision on the best material to use for the design.

   At tables, students are instructed that they will receive different materials for making a cover around their 3D shape so as to keep an ice cube cool when it is placed inside.

   Write on the board: <u>Properties</u>
   Looks
   Feels
   Push
   Pull

   Tell students that *properties* means how the material looks, feels, and behaves with different push and pull forces.

   Tell the students that the only materials available for covering the medical kit (3D shape) are: aluminium foil (a metal), paper, plastic (bubble wrap), fabric (calico), and polyfoam.

   Go through each of the materials and ask the class: What does it (the material) look like?
   Have a student feel the material and ask: How does this material feel?

   The medical kit needs to be covered with a suitable material by thinking about the push and pull forces that could affect the material when being carried. Highlight the words *push* and *pull* on the whiteboard.

   Have students explain each of these forces: squash, stretch, twist and scratch. Students **act out** with their hands the following actions under the teacher directions:
   - Squash (*push*, like squashing a small cardboard box);
   - Stretch (*pull*, pretending to stretch a t-shirt);
   - Twist (*push* with one hand and *pull* with the other hand, like wringing out a towel);
   - Scratch using a pulling action and using a pushing action.

   Also the material for covering the medical kit would need to be waterproof in case of rain or if the ice melts and wets the material.

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Now refer students to the ***Testing the Properties of the Materials*** chart in the student workbook.

Use the **P**redict, **O**bserve and **E**xplain (POE) method in testing materials. That is, the students:

a) Predict what will happen first and underline YES, UNSURE or NO
b) Observe when testing the material then circle YES, UNSURE or NO
c) Explain what happened and why it might have happened.

Students can test the waterproofing of each material in a plastic cup, half-filled with water.

Hand out the materials to each group for testing.

Extension: Students can also write a word or two in the YES/NO boxes to describe how it looks or feels or behaves. For instance, students may want to write how "wet" the material became or how much the material could be "squashed".

Ask students to **share** what they learnt with other group members.

Teacher gathers students and asks "why" and "what if" questions. For instance:

- What might happen if plastic were used to cover a hot dish of food from the oven instead of aluminium?
- What happens to some materials when they get wet?
- Why do you think it is important to choose the best material?

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Predict –underline
Observe – circle
Explain to group

Testing the Properties of Materials

Material	Squash			Stretch			Twist			Scratch it			Waterproof		
Aluminium (metal)	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No
Paper	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No
Plastic	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No
Fabric	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No
Polyfoam	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No	Yes	Unsure	No

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Refer students to their workbook and ask them to **write** what material they would like to choose for covering their strong 3D shape and why they chose that material.

*Teacher's notes/questions/advice:

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Teacher Preparation Before Part 2

The day before implementing Part 2 of Medical Mission, prepare the ice cubes for the class. Using a syringe to accurately measure the amount of water, squirt 10mL of water into each compartment of the ice cube tray/s, ensuring you have enough ice cubes for each student in the class, plus one as a control.

You may also like to allow students to practise using a syringe to draw up water and read the water level in mL.

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What material will you choose to cover your 3D shape to stop the ice from melting so quickly?

Why did you choose this material?

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Part 2 (2.5 – 3 hrs)

THE PROBLEM AND DISCUSSING RESOURCES (15 minutes)

8. Ask students about the **problem** for this engineering education activity: Making a strong and safe medical kit (3D shape, container) to carry medicines (eye drops) at a cool temperature. (Eye drops need to be stored at a cool temperature otherwise they can break down or "go off".)

   Contextualise the activity as a *Medical Mission.* That is, the covered 3D shape is supposed to keep the medicine at the right temperature long enough for the paramedic to run from the helicopter to a person injured in the rainforest or show a *drone* as a way to transport the medical kit:
   http://www.youtube.com/watch?v=qDtsTQNGfWQ
   http://www.youtube.com/watch?v=-CYT4PFV_Hs

   Elicit from students what they have explored so far (e.g. 3D shapes, temperature, and different materials that could be used to cover a strong 3D shape).

   Tell students that the **resources** include: 16 pipe cleaners (10cm long) and 16 straws (5cm long) to make any 3D shape (regular or irregular) and that this 3D shape will need to be strong and safe for the medicines to be kept in. It will become a medical kit.

   - Show how the pipe cleaners can be attached by bending or twisting them around each other. Make sure students do not shorten the pipe cleaner too much when attaching as this will impact on the size of the 3D shape (which might make it hard to fit the ice cube in).
   - Explain that they need to think about how to make the 3D shape as strong as possible.
   - Students need to cover their 3D shape with their selected material. They can use sticky tape to attach the material to the 3D shape. They can use scissors to cut the material (explain health and safety in using scissors).
   - Tell students that they need to place an ice cube inside the 3D shape – so the design needs a lid or door or opening flap to place the ice cube inside. (Show the size of the 30mL plastic container where the ice cube will sit so students can see how big the opening needs to be).

*Teacher's notes/questions/advice:

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PART 2

THE PROBLEM AND DISCUSSING RESOURCES

8. **The problem:**

Remember the problem to solve for the **MEDICAL MISSION**… That is, design and make a strong medical kit (covered 3D shape) to carry medicine to an injured person. The aim is to keep the medicine safe and cool.

Materials:

- 16 pipe cleaners (10cm long)
- 16 straws (5cm long)
- Material to cover the container (foil, paper towel, bubble wrap, fabric, polyfoam)
- Scissors
- Sticky tape

Instructions:

➢ Use the straws and pipe cleaners to make any 3D shape – regular or irregular. You can strengthen this shape in any way you want with the resources provided. This shape will become your medical kit and will be used to keep the medicine in.

➢ You can join pipe cleaners by bending and twisting them around each other.

➢ Cover your container with your chosen material.
  - Use scissors to cut your material to fit your container.
  - Use sticky tape to attach the material to your container.

➢ Your container needs to have a lid/door/opening flap so that you can place your ice cube inside.

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DESIGNING AND MAKING THE MEDICAL KIT (45 – 60 minutes)

9. Students **design** and **make** a *strong* medical kit (it can be any 3D shape, including regular and irregular 3D shapes with any additions from supplied resources to make it stronger) as a safe container to carry the medicine. They then carefully cover their medical kit (3D shape) with the material of their previously investigated choice. The amount of material they use will depend on the size and shape of their container.

   All students **draw** and **label** the medical kit. There may be varying levels of sophistication in the students' designs and this will be more obvious if they label the design.

   NB: Encourage students to design their strong 3D shape ***before*** making it. If the kit is modified during the building stage, students can draw a second diagram showing the changes.

   (*Extension*: A handle can be made if they have left over pipe cleaners and straws; left over materials can also be used to strengthen the kit. Some students may have time to measure the various lengths and record these on their drawing).

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DESIGNING AND MAKING THE MEDICAL KIT

9. **Design** a strong medical kit (covered 3D shape) as a container to carry medicine. **Draw** and **label** your design below.

Build your medical kit.

Now, **draw** and **label** your design *after* making it.

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Ensure students have **written responses** to the following questions before having a whole class **discussion** about their designs.

- What do you think is good about your design?
- Will your medical kit be strong enough to carry the medicines? Why? Why not?
- Why do you think the covering will work to keep the medicine cool?

*Teacher's notes/questions/advice:

Record answers to the following questions about your design.

a. What do you think is good about your design?

b. Will your medical kit be strong enough to carry the medicines? **Why** or **why not?**

c. **Why** do you think the covering will work to keep the medicine cool?

Extension: **Describe** your design.

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TESTING THE COVERING OF THE MEDICAL KIT DESIGN – STAGE ONE (5 minutes)

10. **Explain** that the students will be doing two activities to test their medical kit. The *first* test will be to determine the effectiveness of the covering. The *second* test will be to determine the strength of the medical kit. So students will need to take care of their medical kit for the second test.

    Explain to the students that *first* they will test the effectiveness of the medical kit covering. Outline the following instructions for their activity:

    a. Take your covered medical kit, workbook and pencil outside, along with a syringe and 30mL medicine measure. Students may need to put on hats.
    b. The medical kits will be set up in direct sunlight and out of the wind.
    c. There will be one ice cube (for the class) that is placed inside a 30mL medicine measure to capture the water when it melts. Leave this in the direct sunlight. This is the control.
    d. They will each take an ice cube and place it inside a 30mL medicine measure. This is placed carefully inside the medical kit and the lid/door/opening is closed. Have sticky tape handy if some need to tape it closed.
    e. They will need to take a note of the outside temperature (with the thermometer) and time and record this in their workbooks.
    f. A quarter-filled bucket of water can be taken outside so students can use the syringe to practice their measurement reading in mL. Each group could also use a plastic cup, half-filled with water, for individual group members to practise using the syringe.

    Check for understanding and have students repeat the instructions.

    NB: It will take less than 20 minutes to fully melt the ice cube at midday in direct sunlight; if cloudy it may take longer. If it rains, do the activity in an outside shelter, but it may take longer to melt the ice. Nevertheless, do not extend beyond 20 minutes and if the ice in the sunlight melts faster than 20 minutes (e.g. 14 minutes) then stop the timer at that point.

    Teacher and/or student(s) keep a watch on the time and the ice cube in the sunlight – the control. A smart phone can be used to set a timer for 20 minutes.

*Teacher's notes/questions/advice:

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TESTING THE COVERING OF THE MEDICAL KIT DESIGN – STAGE ONE

10. Follow the instructions below to **test** the covering of your design.

a. Carefully take your medical kit (covered 3D shape design) outside along with your booklet and pencil.

b. Set it up in direct sunlight and out of the wind.

c. One for the whole class - Take an ice cube and put it in a small 30mL plastic container. Leave this one in the direct sunlight. This is known as the *control*.

d. Take another ice cube and put it in another small 30mL plastic container. Place it inside your medical kit and close it.

e. **Record** the time and temperature below.

Time: ____________________ Temperature: ____________________

DISCUSSIONS DURING TESTING – STAGE ONE

11. While you are waiting for the class ice cube *(control)* to melt, you can do the following:

Observe other students' 3D designs. **Discuss** these designs.

Learn how to use the syringe to measure in mL.

When the *control* ice cube has melted, **watch** while the remaining water is measured in mL.

Record the amount of water for the *control* in mL.

_____________mL

Work with other group members to **measure** the amount of water left for each of your 3D designs.

- Be careful when removing the 30mL container from your medical kit.
- Use a syringe to draw up the remaining water.

Record the amount of water from your container in mL.

_______________mL

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DISCUSSIONS DURING TESTING - STAGE ONE (20 minutes)

11. While outside, the students **observe** each of the other designs (without touching them).

    Discuss the medical kit and the materials chosen to cover the medical kits.

    Discuss what medical kits appear strong and why.

    Show students how to use the syringe to draw up water and read the water level in mL. Ensure the syringe is pushed down before drawing up. If time, have selected students draw water out of a bucket and read measurement. They then squirt the water back into the bucket.

    Each group could also have a plastic cup, half-filled with water, and individual group members can use this to practise using a syringe.

    Students could also ensure their designs are complete, including labels.

    Explain the following instructions on what the students will need to do when the teacher says "time's up":

    a. Select a pair of students who will use a syringe to measure the water level from the ice left in sunlight. One student holds the container on a slight angle while the other uses the syringe to draw up the water. Ensure the syringe is pushed down before drawing up. Check the water level in the syringe. This will be recorded in their workbooks.
    b. Students will be provided with syringes for measuring in mL.
    c. They need to work in pairs at this point to assist each other.
    d. Open door/flap of one medical kit, carefully take the medicine measure out of the medical kit. Use the syringe to draw up the water. Students read the water level in mL and write this measurement in their workbooks.
    e. Take the covered 3D shape and syringe with water in it back to the classroom.

*Teacher's notes/questions/advice:

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RECORDING RESULTS – STAGE ONE (10 – 15 minutes)

12. Students **discuss** their results with other students at their table.

    The teacher records students' results on the whiteboard (or can ask students to indicate these measures on the board).

Table 1. Material and melted ice cube measurement

Melted ice in sunlight: mL Temp: ˚C

Material	0mL to 2mL (most effective)	>2mL to 5mL	>5mL to 8mL	>8mL (least effective)
Aluminium				
Paper	✓		✓✓✓	✓
Plastic				
Fabric				
Polyfoam				

Question students about the ticks in the chart, such as the same 3D shapes that have used the same materials. For instance, there are three ticks for "paper" in the 6mL to 10mL column. If the 3D shapes are the same (e.g. cubes) then a conclusion can be drawn about the material and the ice melting. If they are different 3D paper shapes then another conclusion may be drawn that different 3D shapes may not make a difference to the melting of the ice.

The teacher (and students) select medical kits that they want to question further.

Select one or two students to talk more about their overall design and what they had learnt.

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RECORDING RESULTS – STAGE ONE

12. **Record** the class results in the table below.

Table 1. Material and melted ice cube measurement

Melted ice in sunlight: mL Temp: ˚C

Material	0mL to 2mL (most effective)	>2mL to 5mL	>5mL to 8mL	>8mL (least effective)
Aluminium				
Paper				
Plastic				
Fabric				
Polyfoam				

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*Teacher's notes/questions/advice:

TESTING THE STRENGTH OF THE MEDICAL KITS – STAGE TWO (20 minutes)

13. Tell students that they will now **test** the strength of their medical kits. Explain that each group of students will have weights and a cardboard sheet to place on top of their prototype medical kit to see when it will start to fold (break). It is important to note that when the kit starts to show signs of folding (failing, collapsing, breaking) or the cardboard begins to move downwards while loading, then that is the extent of the strength of the kit.

    Instructions:

    a. Two students balance a cardboard sheet on one medical kit.
    b. The owner of the kit places weights on top of the cardboard directly over the medical kit.
    c. When the medical kit starts to fold (breaking point) then the owner of the kit adds up the weights, including the weight of the cardboard (15g).
    d. Students record the breaking point for each group member's medical kit in their student booklets.

    Students **discuss** their results in their group, particularly the reasons why it folded or did not fold.

    Class discussion about the strength of the medical kit designs, particularly why some designs could withstand greater weights.

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TESTING THE STRENGTH OF THE MEDICAL KITS – STAGE TWO

13. Follow the instructions below to **test** the strength of your design.

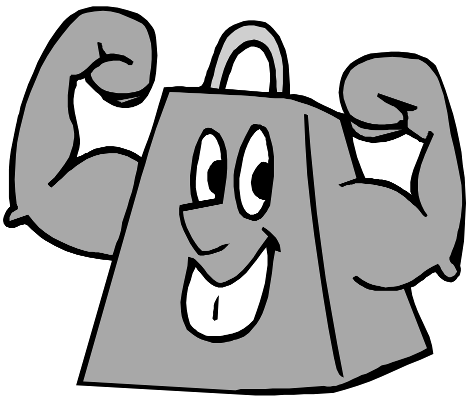
a. In your group, two students hold a piece of cardboard on top of a medical kit.

b. The owner of the medical kit places weights on top of the cardboard directly over the medical kit.

c. When the medical kit starts to fold (collapse) or the cardboard begins to move downwards while loading, the owner of the kit adds up the weights, including the weight of the cardboard (15g).

Record each group member's name and measurement in grams (g) in the table below.

Name:	Name:	Name:	Name:
g	g	g	g



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EVALUATION AND REDESIGN (30 minutes)

14. Students **write** responses to the following questions:
    - What did you learn from designing and testing your medical kit?
    - What would you like to change in your medical kit design?

    Remind students about Engibear and how the robot was redesigned each time and that part of engineering is redesigning after testing the product.

*Teacher's notes/questions/advice:

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EVALUATION AND REDESIGN

14. **Record** answers to the following questions about designing and testing your medical kit.

a. What did you learn from designing and testing your medical kit?

b. What would you like to change in your medical kit design?

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Ask: If you could use any materials at all, how would you redesign your medical kit? Ask them to **draw** and **label** their redesigned medical kit in their workbook. Students then discuss their design with their group and **write** about why this new design would be better.

Students can also reflect on the engineering model.

*Teacher's notes/questions/advice:

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If you could use any materials at all, how would you **redesign** your medical kit?

Draw and **label** a picture below.

Why would this new design be better?

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FEEDBACK (5 minutes)

15. Finally, please have students **complete** the *Engineering Education* feedback by colouring in the face to show how they felt about the different parts of the *Engineering Education*. You may need to read out each question.

*Teacher's notes/questions/advice:

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ENGLISH EXTENSION - OPTIONAL: Medical Mission Story (45+ minutes)

16. Students use their knowledge from designing and making a medical kit to write a creative story about themselves as engineers of a medical kit for a special medical mission. The imaginative story can also involve themselves in the actual mission to save someone. They may want to consider the use of drones or other technologies.

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MEDICAL MISSION FEEDBACK

15. Please **colour in the face** to show how you felt about the different parts of the *Medical Mission*.

Did you like:	**Did not like it**	**Not sure**	**Liked it**
1. ... the activity about a Medical Mission?			
2. ... having a real problem to solve?			
3. ... testing the different materials?			
4. ... designing a 3D shape?			
5. ... making a strong medical kit?			
6. ... testing your medical kit?			
7. ... recording the results of your medical kit?			
8. ... thinking about how to make your medical kit better?			

Next time I would like to:

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