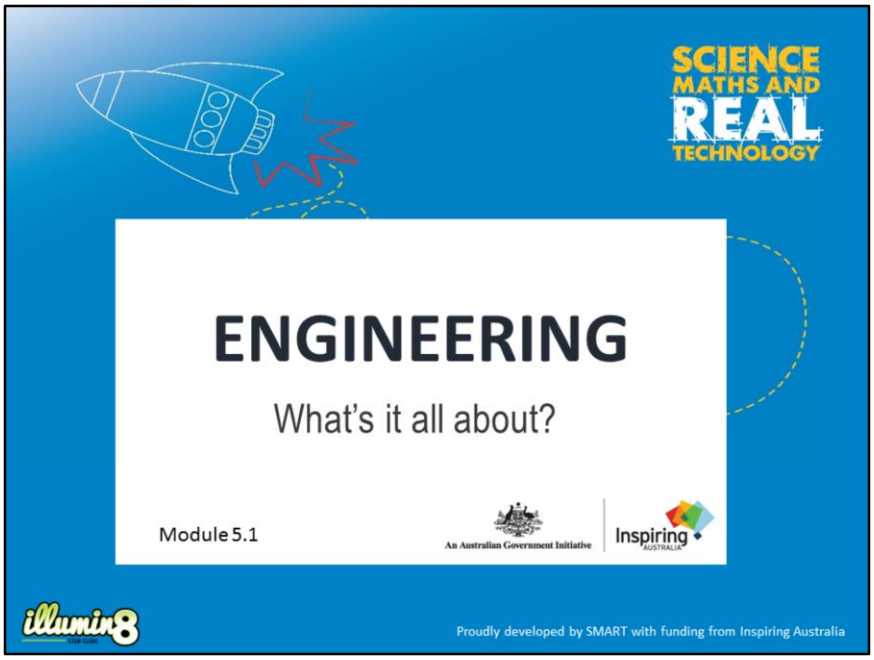
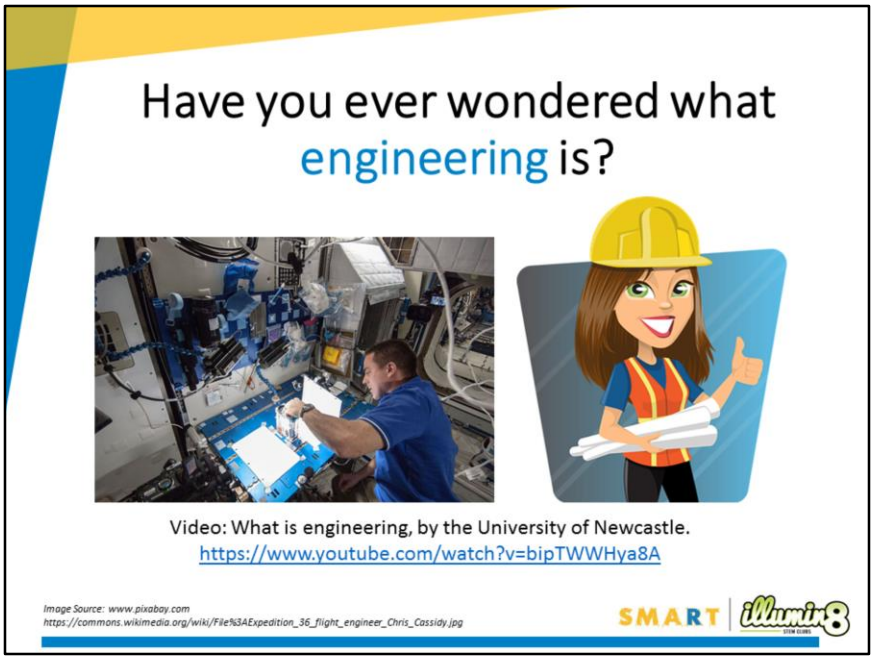


You have been engineering from the first day you came to an Illumin8 Club session! From designing and constructing your paper planes, to building your submarines. Each challenge has required you to be creative and solve problems using science, maths and technology just like an engineer does. Just like engineers have to work with budgets and available resources, you were given a set list of materials in which you were able to use to complete your challenges.



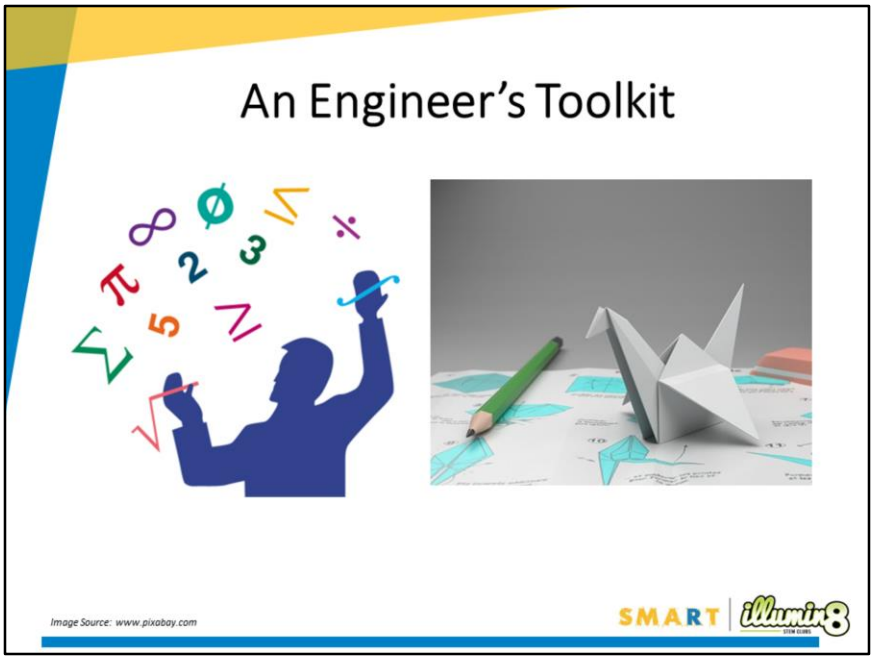
Engineering is the use of tools like science and maths to solve problems! Some engineers use mechanical tools and machines, some use computer programs, and some even work with chemicals.

Engineers design solutions for solving problems we have in our day to day lives, such as safe water supply, electricity, transport and communication!

Engineers have to consider social, political and financial aspects when solving problems. These include international standards that designs must conform to; building codes; software standards; budgetary considerations and government or company policies.

They also need to think about and solve for environmental constraints – protecting water ways, wild life and landscapes for future generations.

Video: What is engineering, by the University of Newcastle.
https://www.youtube.com/watch?v=bipTWWHya8A

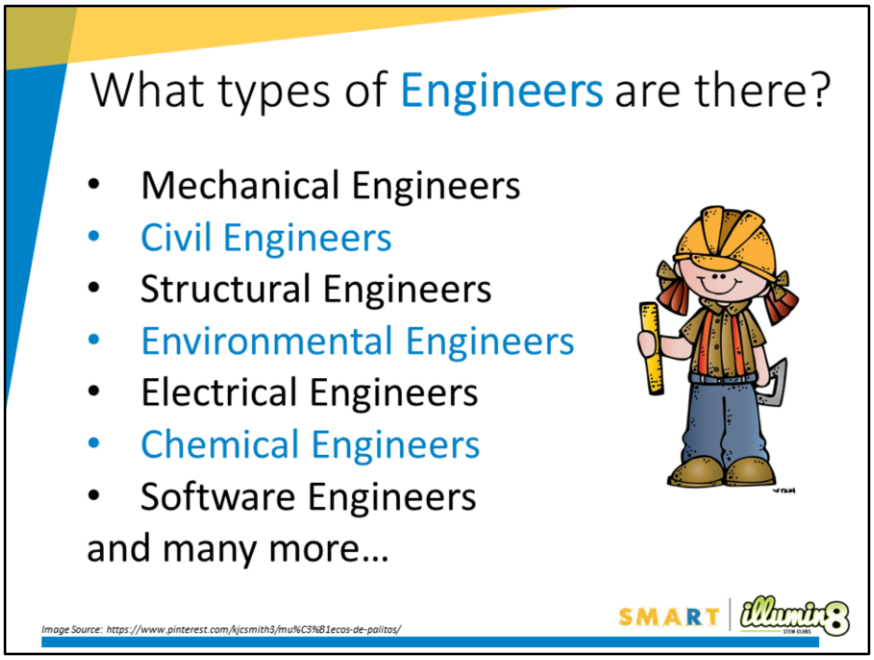


Engineers plan, design and constructing amazing things! The toolkit of an engineer is not just the physical tools they carry with them, or the computers they design their projects with.

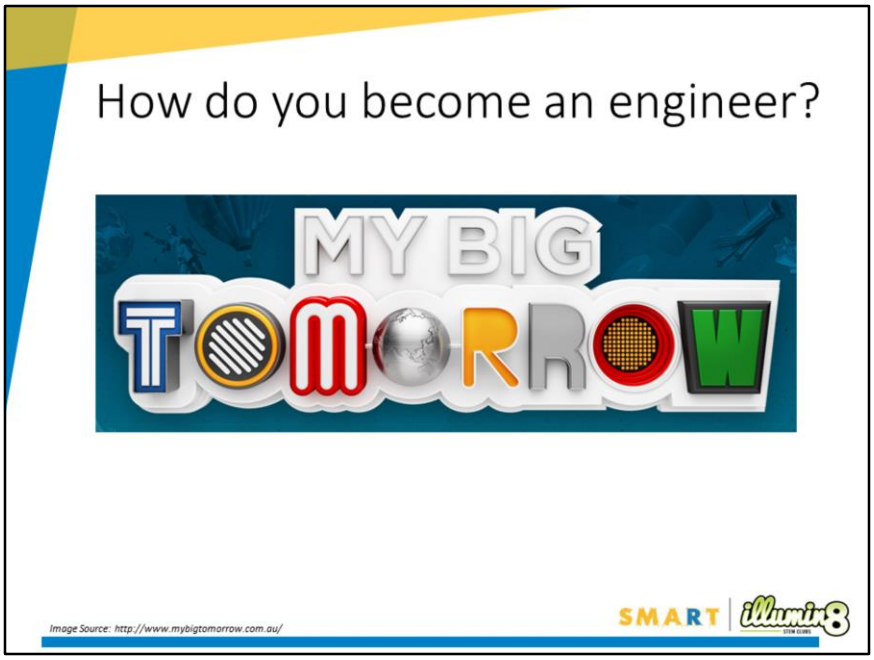
It is also the science, mathematics and other skills they learnt in school and at university!

To be an engineer you also need to have:

- Creative thinking
- Team work skills
- Computer skills
- Time management skills
- Communication skills
- Problem solving skills



There are loads of different types of engineers! Each type of engineer works on different problems to help find solutions to some of the challenges society faces. Some of the different types of engineering are:
-Mechanical Engineering
-Civil Engineering
-Environmental Engineering
-Mechatronics Engineering
-Aeronautical Engineering
and many more…

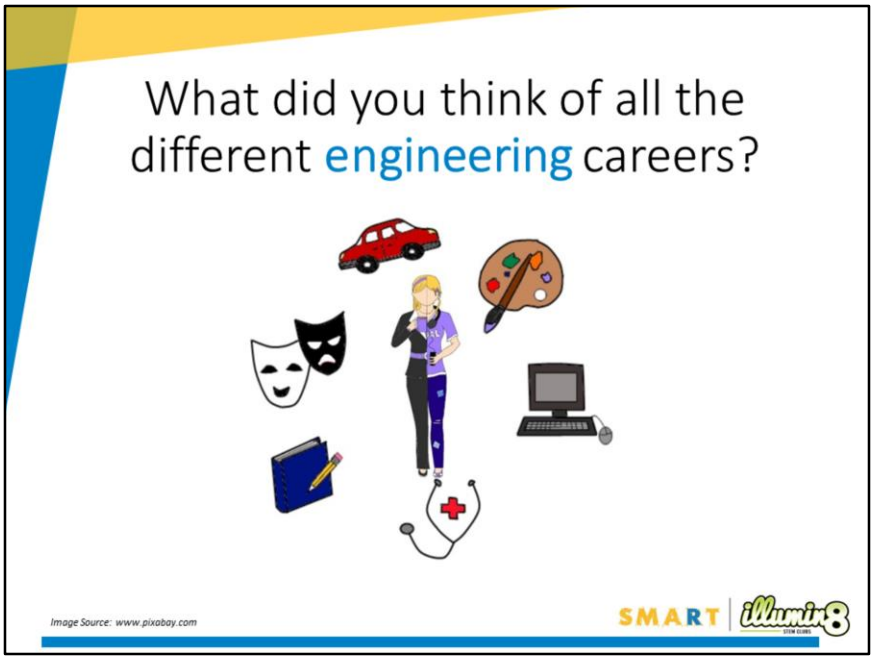


My Big Tomorrow is a fantastic website which helps you explore different future careers. There are profiles on different careers as well as a search tool that helps find careers that suit your interests. Maybe you'd enjoy being an engineer!

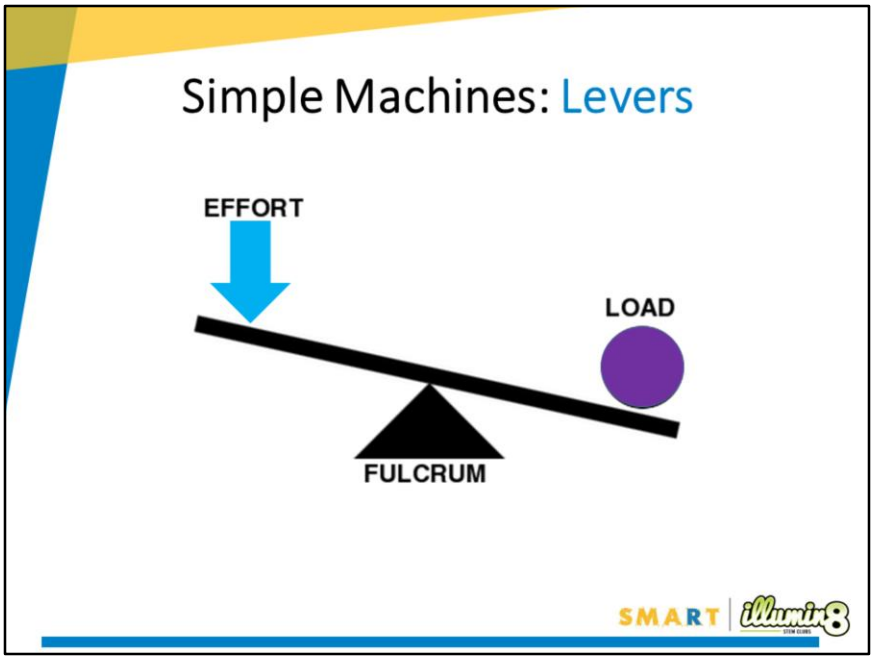
Technology Option: Today we are going to use the My Big Tomorrow website to discover more about different types of engineering jobs. There are more than you think!

Low Tech Option: Today we are going to explore the different types of engineering careers (there are more than you think!), you can find out more about these (and many other different types of careers) on the My Big Tomorrow website at home.

Refer to coordinator notes for Activity 5.1.1.



Discussion: Does anybody think they might want to become an engineer one day? Which type? Why? Which career seemed most interesting to you? Etc.

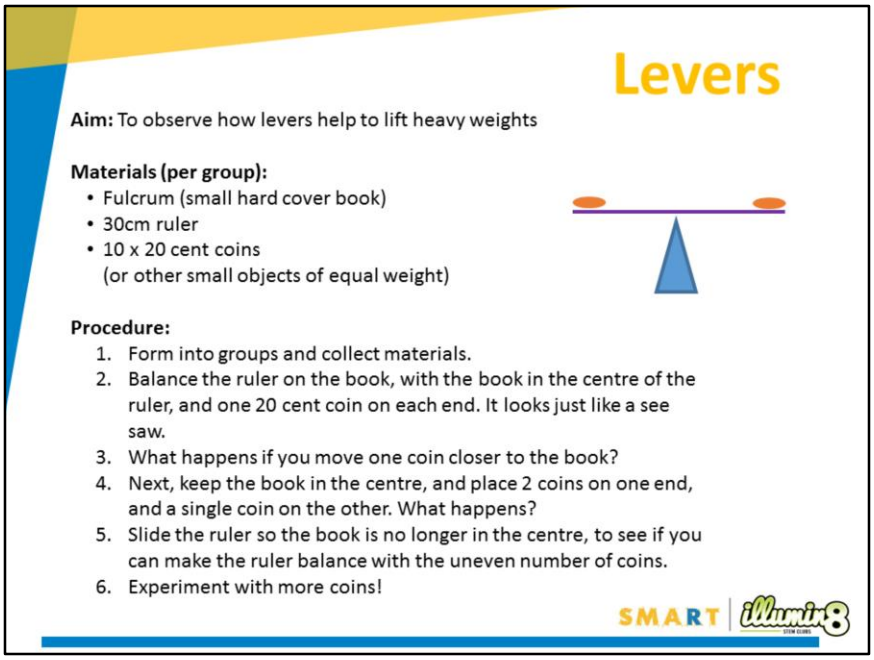


Mechanical engineers work with machines. A machine is a device that makes work easier. It does this by increasing the effect of our efforts. One of the simplest machines is the lever. By using a lever, you can lift heavy weights with less effort! Levers are some of the oldest machines in the world.

A see-saw is a type of lever. We use levers in lots of places, including some that aren't obvious – like scissors!

Levers need something called a "fulcrum" to balance on. By changing the position of heavy and light things along a lever, heavy things can be lifted more easily. Something light can help lift something heavy, if the heavy thing is close to the fulcrum and the light thing is far from it.

Let's explore a simple lever.

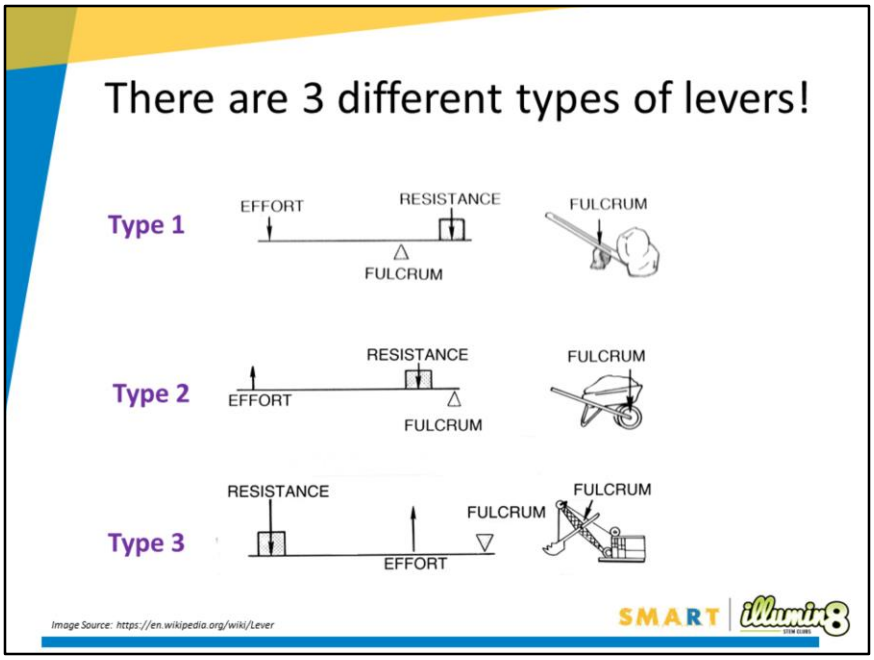


See if you can balance a ruler on top of a fulcrum. A hard cover book may do the trick!

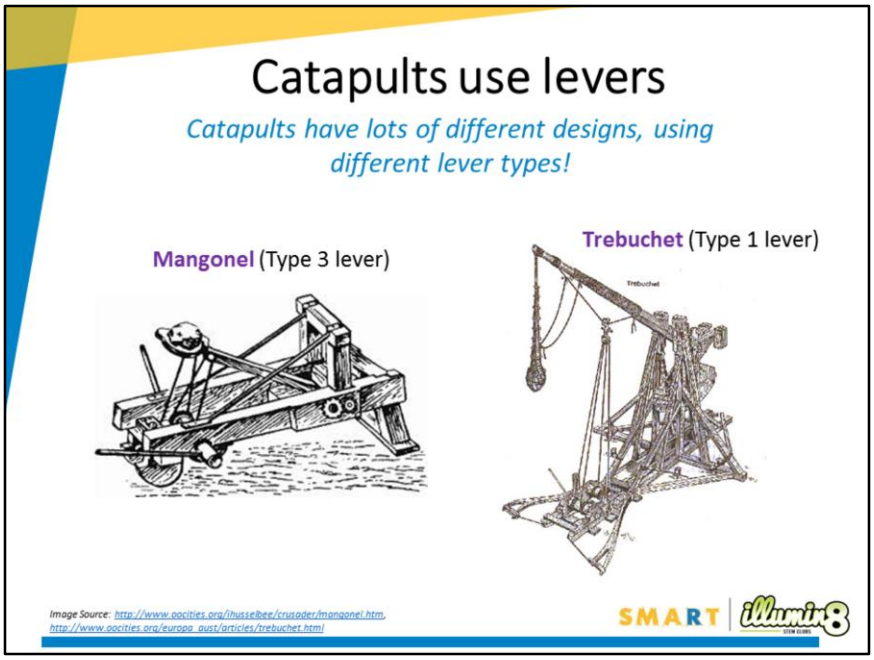
Refer to coordinator notes for Activity 5.1.2 and risk assessment for Module 5.

Discuss hypotheses with students before you begin. What do they think will happen?

Discuss what happened after the activity. Were hypotheses correct, or were they surprised?



A lever is made up of three parts:
The fulcrum (or hinge), the load and the effort.
Think of the "load" as the heavy object we want to lift with the lever, and the "effort" as the pushing (or lifting) effort we are putting in ourselves.
There are three types of levers.
The most common lever is the top one shown, which is a **type 1 lever** (this is just like a see-saw). It has the fulcrum in the middle of the lever, with the load and effort at opposite ends.
A **type 2 lever** has the load (or resistance) in the middle, between the fulcrum and the effort. The fulcrum is at one end, and the effort is made at the other end. This type of lever is used in wheelbarrows.
A **type 3 lever** has the effort in between the load (or resistance) and fulcrum. These levers involve using a large effort to move a small load a long distance. A fishing rod is a type 3 lever (using the rod to cast out a line), so is a golf club (the club plus the golfer's arm are the lever, the golfer's shoulder is the fulcrum, the force applied by the golfer's hand is the effort, and the load is the weight of the golf ball)!

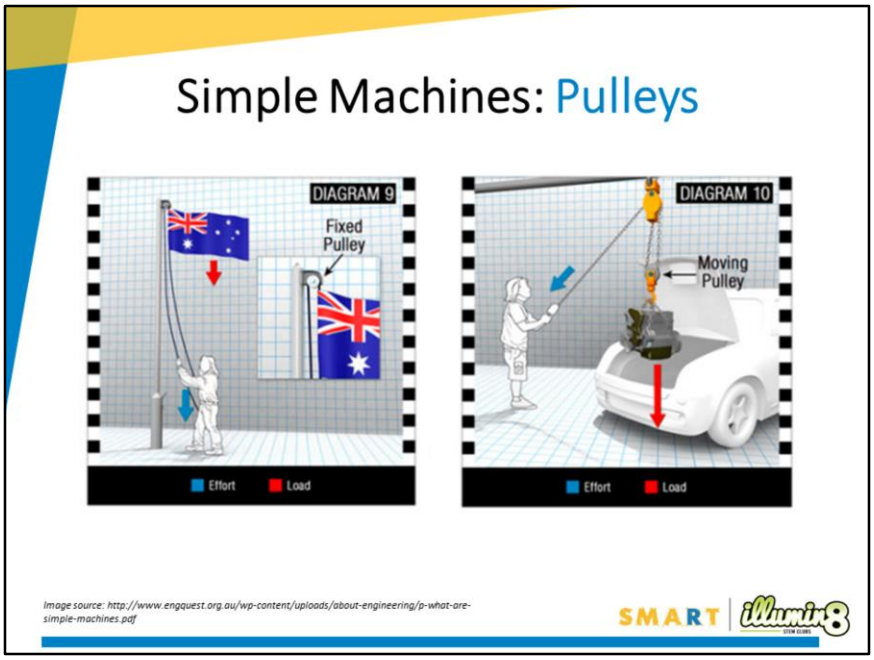


The first catapult was invented in around 400 BC in Greece. Early catapults were used in war fare, to launch large missiles (usually rocks) at castle and city walls to knock them down, or, over the walls to cause damage inside.

The catapult has many forms but the classic sprung arm style is known as the **Mangonel.** The name Mangonel comes from the Latin word "manganon", meaning engine of war. It was invented by the romans in 400 BC. The Mangonel consists of a long wooden arm with a bucket (early models used a sling) with a rope attached to the end. The arm is then pulled back from a vertical (90 degree) angle, the bucket loaded, and the arm released, launching the missile object forwards.

The **"mangonel"** uses a type 3 lever. The fulcrum is at the end of the arm, the effort is in the middle and the load is at the opposite end.

The **"Trebuchet"** uses a type 1 lever. It has a load at one end, the fulcrum in the middle and the effort (a counter-weight) at the other end. A sling was attached to the end of the arm, and loaded with missiles (stones). The trebuchet is thought to have been invented in China around 300 BC, and arrived in Europe around 500 BC.



A pulley is a machine that uses rope and wheels to make weights easier to lift.
A simple pulley works like this: a rope runs through a grove in a wheel, it has a load on one end and someone pulling down on the other end. As the person pulls down on the rope, the load goes up. It's easier to pull down on the rope, than to just lift the load up, because pulling down is working with the force of gravity, not against it. Gravity is the force that pulls things downwards.
There are different types of pulleys.
A **fixed pulley** is like a pulley at the top of a flagpole. The wheel of the pulley is at the top of the flag pole, and the person at the bottom can pull on the rope to raise the flag up.
A **moving pulley** is shown in the diagram, the moving pulley is attached to the load, and a fixed pulley is attached to a support above. This type of pulley is called a "block and tackle" system, where the pulley's are the block and the tackle is the rope or chain the person pulls.

Pulleys

Aim: To observe how pulleys help to lift heavy weights

Materials (per group):

- 2 x 1m lengths of strong string
- Scissors (shared between groups)
- Empty cotton reel (or similar)
- Masking tape
- A weight to lift e.g. toy car, or drink bottle filled with water

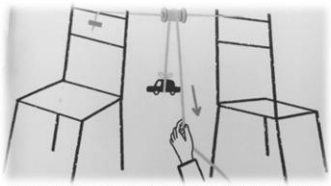


Illustration by Nastia Sleptsova, in "Engineer Academy" by Steve Martin

Procedure:

1. Form into groups and collect materials.
2. Thread one of the lengths of string through the middle of the cotton reel.
3. Tape or tie the ends of the string with the cotton reel at the same height between two chairs or two tables (or have two group members hold either end). Move the chairs, tables, or group members apart until the string is quite taut (straight and tight).
4. Tie the second piece of string to the weight. Place the weight on the floor and lift it up using just the string.
5. Next, return the weight to the floor, loop the string attached to the weight over the cotton reel, and pull down on the string.
6. Is it harder or easier, to lift the weight with the pulley? Document your results!

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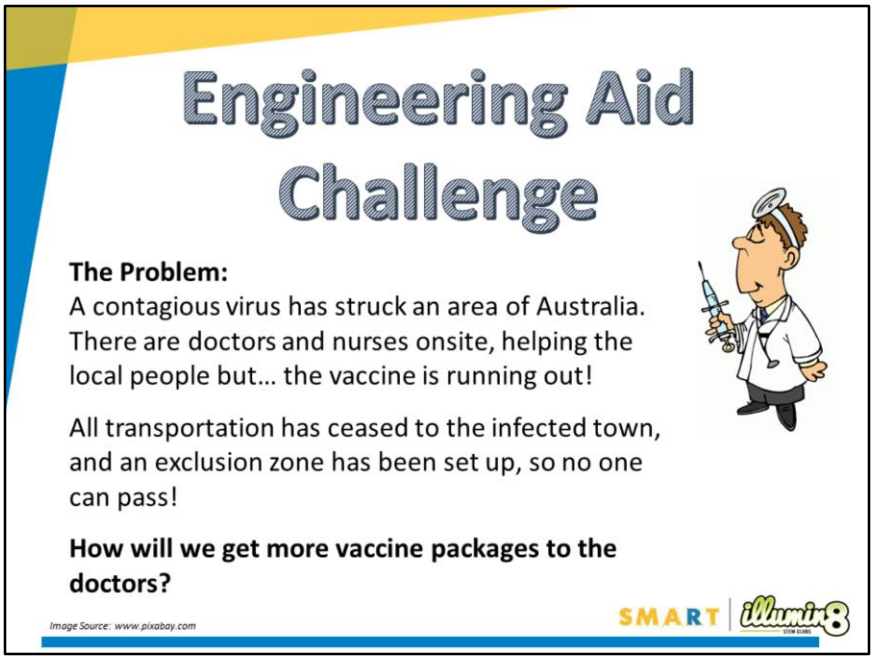
Refer to coordinator notes for Activity 5.1.3 and risk assessment for Module 5. Discuss hypotheses with students before you begin. What do they think will happen? Discuss what happened after the activity. Were hypotheses correct, or were they surprised?



In this session's challenge, we are being put into the shoes of an engineer!
There is an important problem facing the world and we have been given the task of finding a solution.

The Challenge

Your team of engineers must construct a **device** that will deliver the vaccine package to the infected town.

The closer you get to the town the more risk there is of becoming infected. So you need to build a device that can launch the packages from the greatest distance.

Your device also needs to be on target, so the doctors receive the vaccines on time and can treat their patients.

Image Source: www.pixabay.com

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The Rules

- Build a device which can accurately propel the vaccine package into the infected town, over the exclusion fence. The further away you can launch the package from, the more points you will receive.
- You will be given a supply of resources materials. Any extra materials you collect will cost you points.
- During testing, your team will select a distance for your first attempt. You can only increase the distance for your other attempts if you are successful in getting the package to the target. Points for each distance are only achieved if the aid package (ball) lands in the town (hula hoop).

Image Source: www.pixabay.com

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Designs…

There are unlimited ways you and your team can design your device. Don't be afraid to be creative!

One type of device you could build is a catapult…

What other designs could you use?

Image Source: www.pixabay.com

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