MUSEUM
IN A BOX
STEM

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NAVY MUSEUM

MEET THE FLEET

What do you think the Royal New Zealand Navy does?

Find out here.

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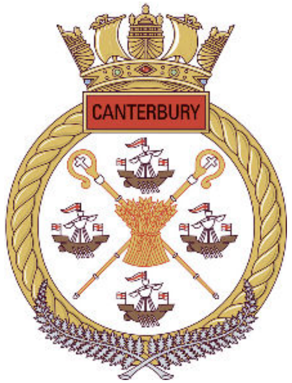
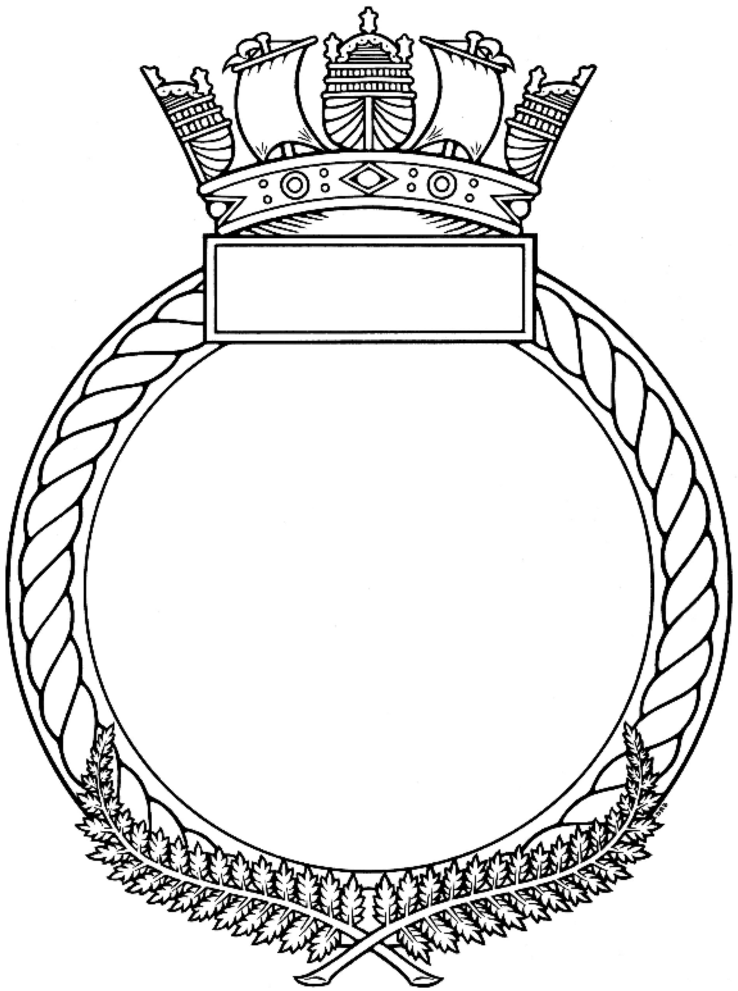
MEET THE FLEET

Every Navy ship has its own badge. The surround for every badge is the same and has a crown and fern leaf. The main design is unique and is usually linked to either the ship's name or its role in the fleet.



MEET THE FLEET



Design your own badge

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VIDEOS

Seasprite Helicopter Cockpit

HMNZS Aotearoa Tour

Southern Ocean Science

Fishery Patrol

HMNZS Te Mana and Helos

RAS International

Refuelling at Sea

Life in HMNZS Canterbury

HMNZS Wellington in Rough Seas

6 Squadron

Drone in Action

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The Science of Forces

A **force** is a push or a pull on an object that causes it to speed up, slow down, or stay in one place.

Forces are measured in **Newtons** (N).

Force diagrams show the forces acting on an object. The length of the arrows represent the strength of the force. If the forces are balanced, then the arrows are the same size.

The Science of Forces

If an object is stationary (standing still) then the forces acting on it are said to be **balanced**.

This means that the forces are of equal strength but in opposite directions so they balance each other out. The **weight force** is equal to the **support force** (if the object is on something solid) or **buoyancy force** (if the object is in the water).

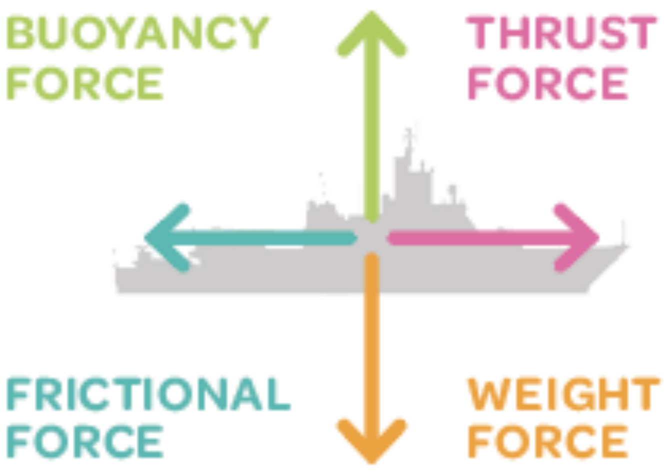
A stationary ship

The weight force is due to gravity!

The Science of Forces

If an object is moving at a constant **speed** in one direction, say 10km/h, then the forces acting on it are **balanced**. The **frictional force** that is trying to slow the object down is equal to the **thrust force** driving the object forward.

A ship going at a constant speed



The thrust force comes from the engine of the ship

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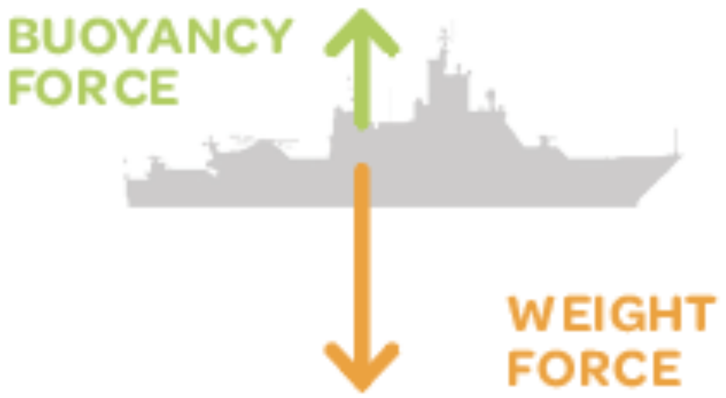
The Science of Forces

If the forces are **unbalanced** then the object's speed or direction will change. If the **buoyancy force** is less than the object's **weight force**, then the object will sink.

A sinking ship



Buoyancy force is an upwards force caused by water.

Operation Big Lift

The Navy uses cranes to help lift and move heavy things such as supplies, equipment, and small boats.

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Operation Big Lift Video

[HMNZS Aotearoa Tour]

Operation Big Lift Challenge

Make a crane that sits on a table and will lift an object.

To operate the crane you can only push one end of the syringe.

HMNZS CANTERBURY'S MASSIVE 60 TONNE CRANE HARD AT WORK!

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Operation Big Lift – The Science of Cranes

Cranes use a combination of simple machines to make a compound machine to lift heavy objects.

The long arm of a crane acts as a **lever**. Cranes also use **pulley** systems. These are simple machines.

Cranes use hydraulics to move the lever.

If you fill the syringe with air and put your finger over the end you will be able to compress the air.

When you apply a push force to the plunger of the syringe filled with water, the pressure moves through the water and causes the plunger of the other syringe to move.

Hydraulic systems use pressurised liquid to make a machine move.

Operation Helo

The Navy has five Seasprite maritime helicopters that are kept in shape by the Royal New Zealand Air Force but flown by Navy aircrew.

The Air Force also have eight NH90 helicopters that can operate from HMNZS Canterbury.

DID YOU KNOW:
Sometimes they take conservation dogs in the helicopters!

Operation Helo Videos

Seasprite Helicopter Cockpit

HMNZS Te Mana and Helos

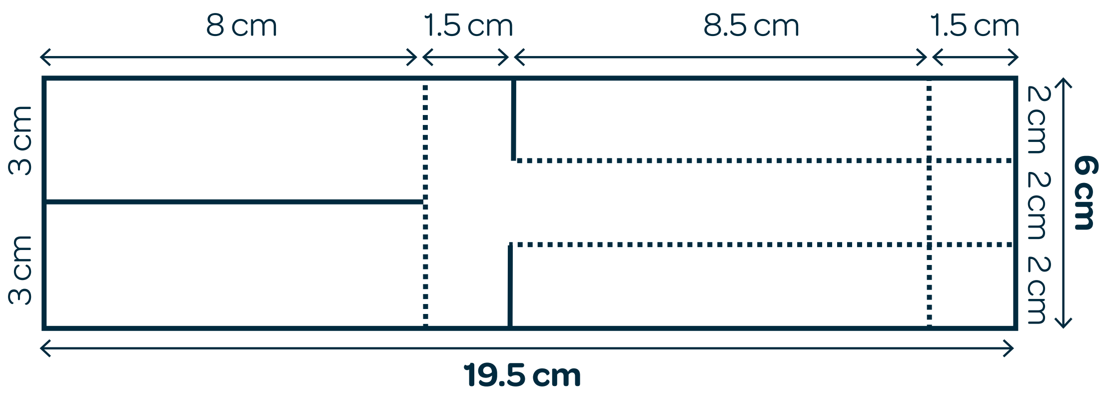
6 Squadron

Operation Helo Challenge

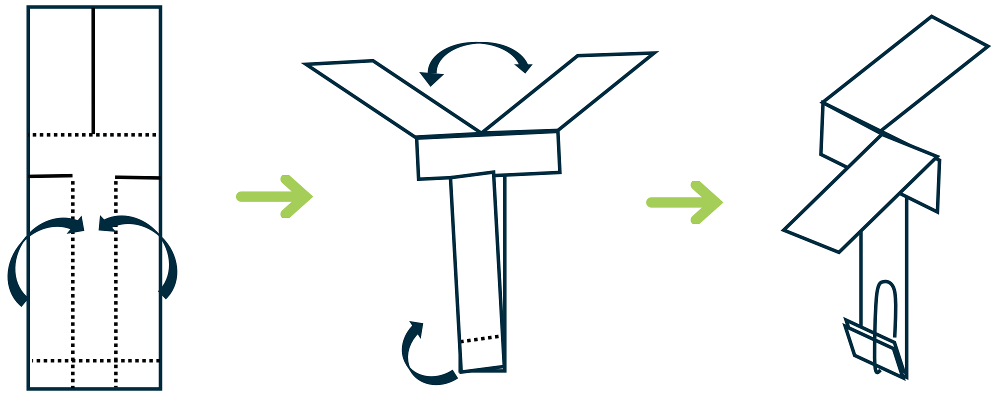
Make a helicopter that will stay in the air for as long as possible.

The basic instructions are given below, how can you change these to make the helicopter take longer to reach the ground?

Cut out the template and cut along the solid lines:



Fold along the dotted lines and add the paperclip to the bottom:



Operation Helo – The Science of Helicopters

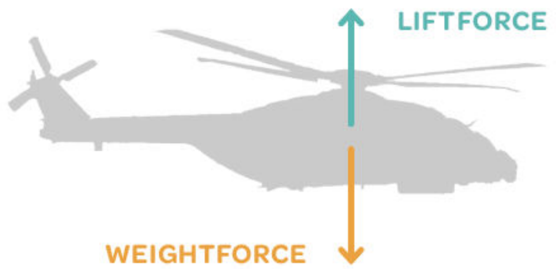
Helicopters use rotating wings called rotor blades to fly.

When a helicopter is hovering in mid-air, the **weight force** of the helicopter, caused by **gravity**, is pulling the helicopter down. The engine powers the rotor blades which makes them move.

The blades are curved on top so the air rushing over the top of them creates something called **lift force**. The upwards force caused by the lift must be the same as the downwards weight force for the helicopter to remain hovering.

Balanced forces lead to an object remaining stationary (staying still).

A hovering helicopter



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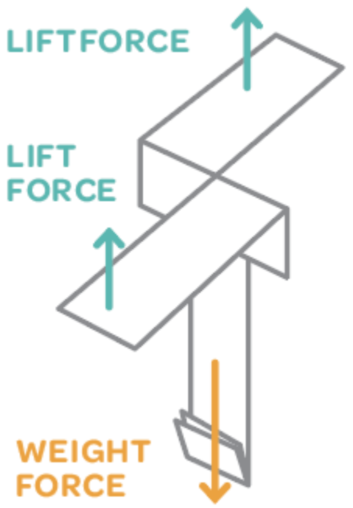
Operation Helo – The Science of Paper Helicopters

The paper helicopter has a downward **weight force** acting on it pulling it down to the ground. As it falls the air pushes the blades upwards so that they are not horizontal. The **lift force** of the air pushes on each of the blades equally, but in opposite directions. This results in them spinning.

The helicopter falls downwards due to **unbalanced forces**. The weight force of the helicopters is greater than the **lift force** of air.

A falling paper helicopter



Operation Jackstay

Replenishment at Sea (RAS) is how a ship takes on more supplies when they are at sea and not near a port. Another ship comes alongside and transfers equipment, food or fuel down the **jackstay** line.

The **jackstay** is a strong wire cable that connects the ship needing the supplies to the ship bringing the supplies. HMNZS Aotearoa can transfer fuel to other ships so that they don't have to go into a port to refuel. It can even fill two ships at the same time, like in the photo below.

One ship uses a line thrower to fire a line over to the other ship.

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Operation Jackstay Videos

[Refuelling at Sea]

[RAS International]

[HMNZS Aotearoa Tour]

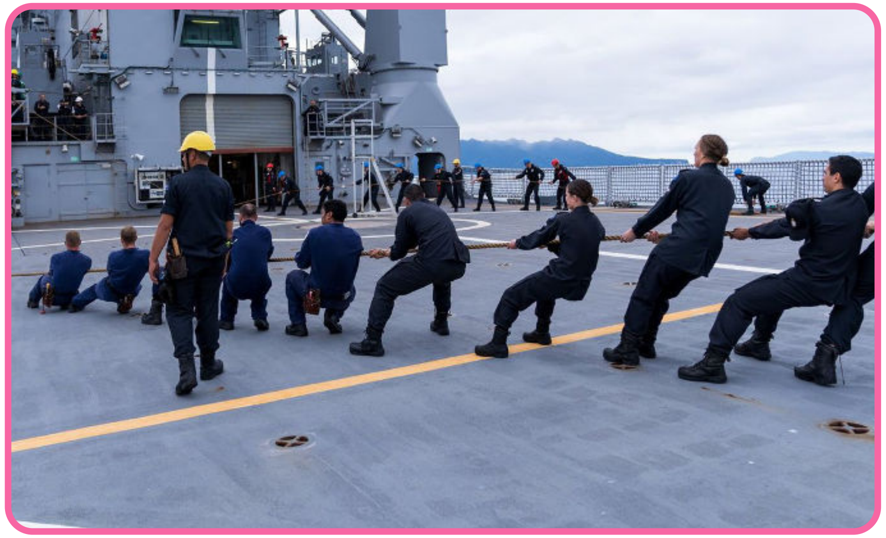
Operation Jackstay Challenge

For this challenge you are not allowed to touch the object being transferred or the container you use to carry the object.

Transfer the object from point A to point B and back to point A using the materials supplied. The jackstay line must remain fixed at both ends so that it cannot move.

One group member is allowed to touch the string, but not the line.

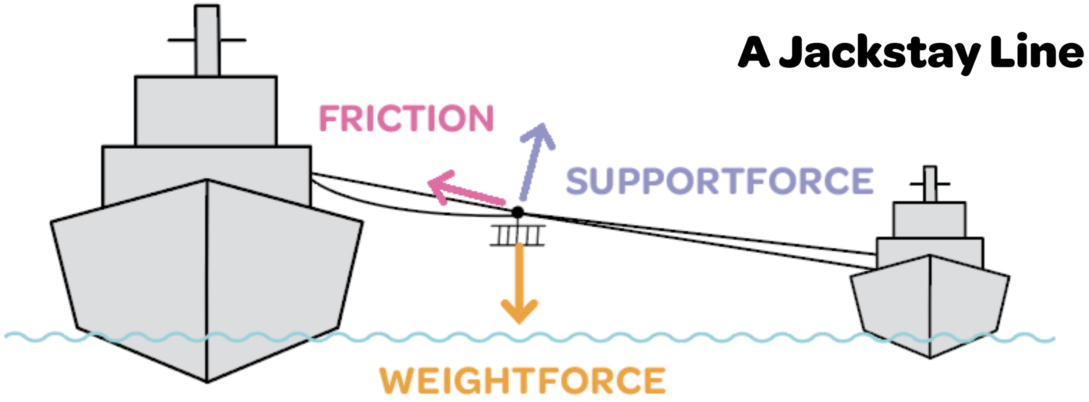
A jackstay passing a ladder between two ships. The Navy personnel have to keep the line tight by hand!



Operation Jackstay – The Science of Jackstay

When a jackstay line is on an **incline**, angling downwards, the weight force due to **gravity** will pull the load down. As the paper clips are sliding along the line the two surfaces rubbing together create **frictional force**.

The force of friction acts against the **weight force** and will slow down the moving object. The particles of air that the object moves through will also hit the object causing **air resistance**, which is a form of **frictional force.** This will also slow down the object by acting against the **weight force**.



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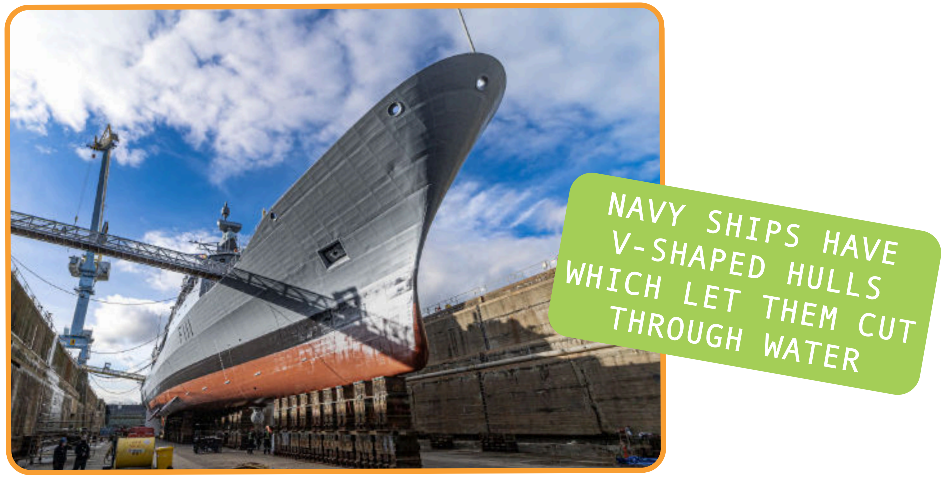
Operation Float



The hull is the bottom of the ship. Navy ships are made of iron metal, called steel.

There are three basic shapes of hull.

Round bottom hull

Flat bottom hull

V-shaped hull

Which one do you think would be the most stable and help the ship carry the greatest load?

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Operation Float Videos

HMNZS Aotearoa Tour

Southern Ocean Science

Fishery Patrol

HMNZS Wellington in Rough Seas

MUSEUM IN A BOX STEM

Operation Float Challenge

There are two parts to this challenge:

1. Shape your foil rectangle into a ship that will take the most weight.

2. Make a foil ship that will take the most weight and can stand a large wave made by dropping a heavy object into the water next to the ship.

The ship that holds the most weights and stays afloat wins!

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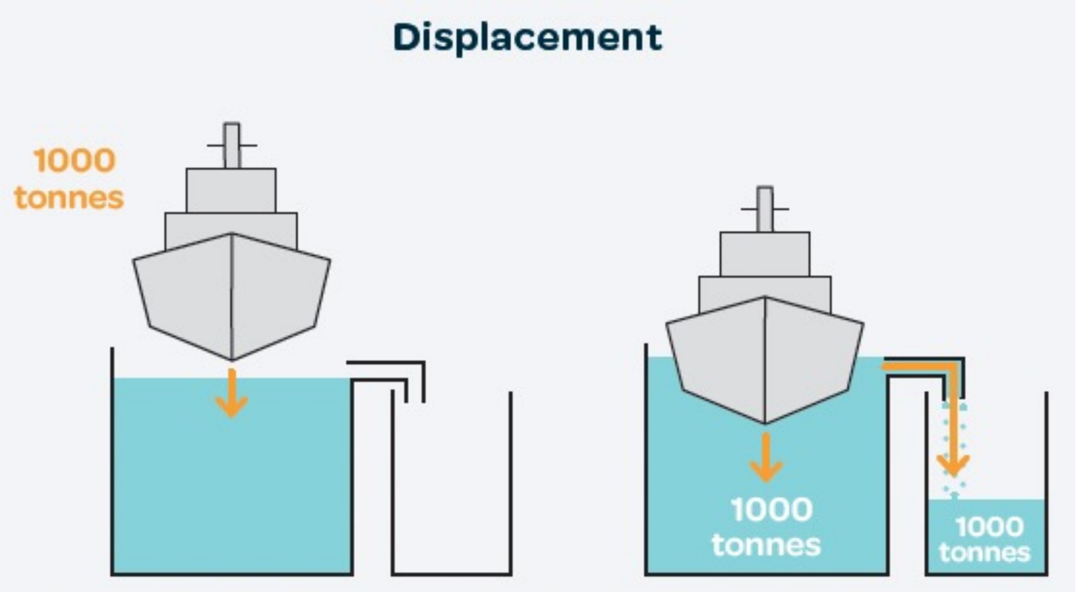
Operation Float – The Science of Buoyancy

Buoyancy is all about whether a ship can or can't float in water. Things that float are buoyant.

Whether a ship floats depends on two things; the **weight** of the ship, also called its **displacement**, and the **density** of the ship.



The weight of the ship is due to its **mass** and the **force** pushing down on it due to **gravity**.

As the force due to gravity pushes the ship down it pushes aside the water to make room for the ship, this is called its **displacement** or **weight**.

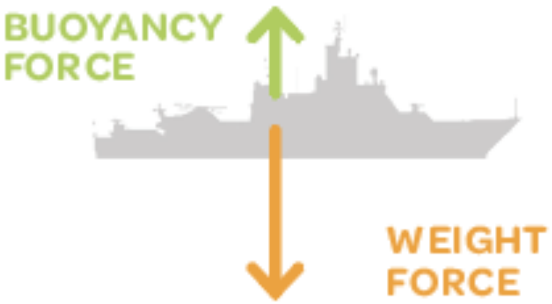
Operation Float – The Science Buoyancy

The **density** of the ship is how much matter (stuff) is packed into its volume (size).

If the ship is less dense than the water it is in then it will float. This is because even though it is made from heavy metal, it is shaped so that it is mostly full of air.

The two forces interacting when a ship is afloat are the **weight force** due to **gravity** and the **buoyancy force**.

A floating ship



A sinking ship

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Operation Claw

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The Royal New Zealand Navy uses many different types of uncrewed systems. These are drones that operate on the water, underwater and in the air without people on board.

THE REMUS IS USED TO SURVEY THE SEAFLOOR

THE BLUEBOTTLE IS AN UNCREWEWED VEHICLE POWERED BY RENEWABLE ENERGY

NAVY HYDROGRAPHERS AT WORK

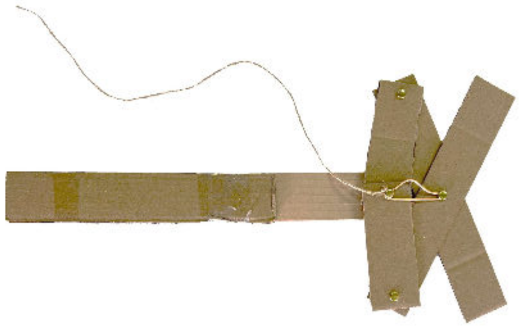
Operation Claw Videos

[Drone in Action]

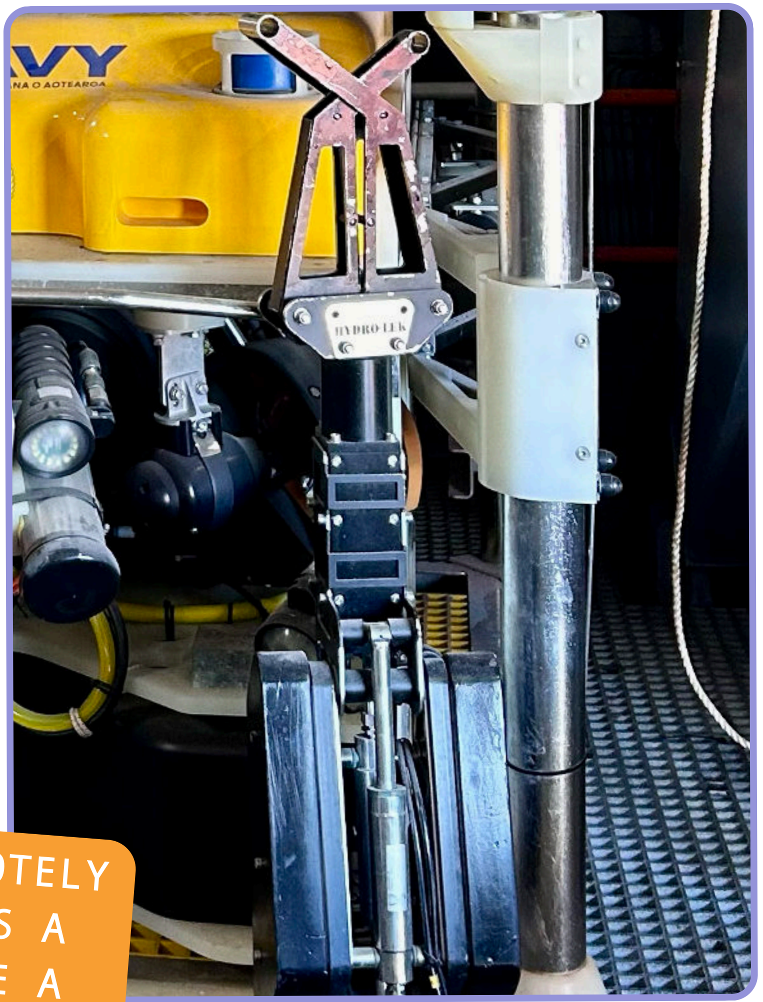
Operation Claw Challenge

Make a basic robot arm using the supplied instructions.

Use your own materials and design to make a claw for the end of the arm so it can pick up the objects.



ONE OF THE NAVY'S REMOTELY OPERATED VEHICLES HAS A MANIPULATOR ARM, LIKE A ROBOT CLAW.



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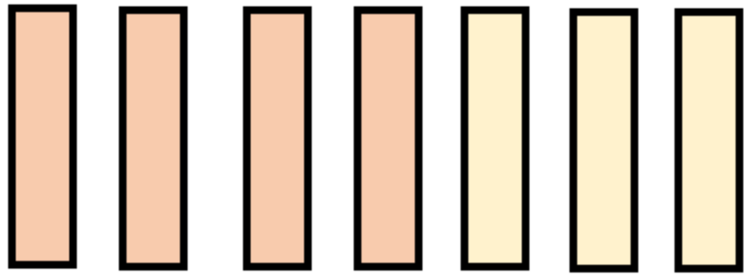
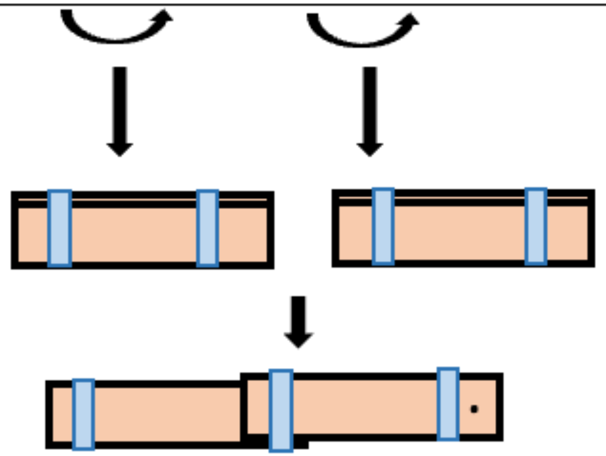
Basic Robot Arm Instructions

1. Cut out seven strips of cardboard, 4 cm x 22 cm. You can use scissors and a ruler to scour the lines before you use the scissors to cut the strips out. Be sure to cut down the corrugation of the cardboard, not across it.	
2. Take 2 strips and tightly tape them together to make a double layered strip. Repeat this step with another two strips and then join the end of each double layered strips together with tape to make a long strong handle. Use a pencil to poke put a hole through the cardboard 1 cm from one end.	

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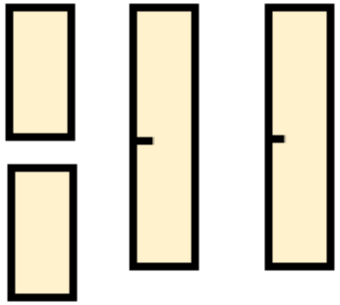
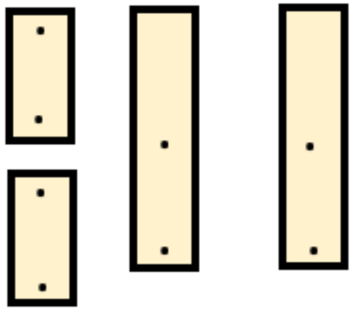
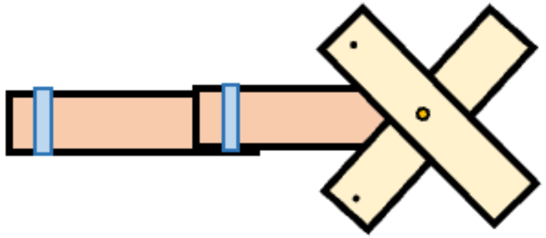
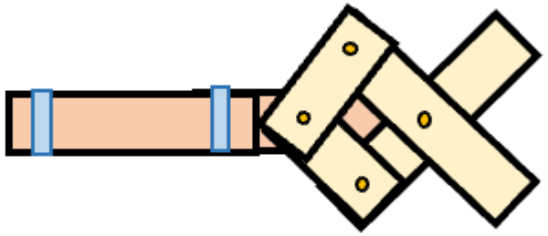
Basic Robot Arm Instructions

3. Use a ruler to find and mark the half way mark on the remaining 3 strips. Cut one strip in half.	
4. Use a pencil to poke a hole in the top and bottom of the half strips, about 1 cm from the end. Put a hole in one end of the other two strips, about 1 cm from the end and a hole in the middle.	

Basic Robot Arm Instructions

5. Take a split pin, push it through the holes in the middle of the two strips and into the hole in the handle. Fold the ends of the split pin back and put some tape over it.	
6. Use split pins to join the ends of the short strips to the long strips and then join the short strips together with a split pin. On the reverse side, fold all the split pins back and place tape over them.	

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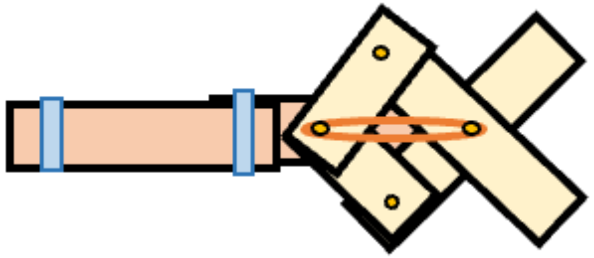
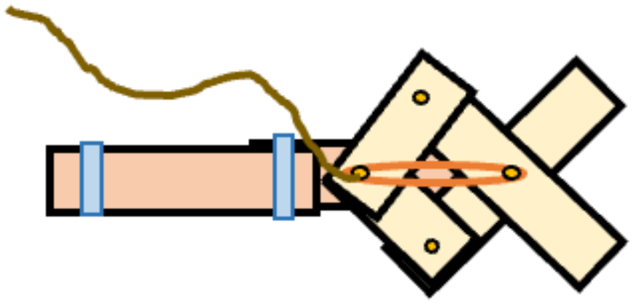
Basic Robot Arm Instructions

7. Use a rubber band to join the two heads of the middle split pins together.	
8. Tie the string to the bottom split pin. This is your basic robot arm ready for you to add a claw of your own design.	

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Operation Claw – The Science of Robot Claws

The robot claw is used to hold or lift things up. It is a simple machine as it has levers.

A lever is a simple machine made from a length of hard material that can **pivot** (move) on a fixed hinge, or **fulcrum**. Everyday examples are a seesaw or a pair of scissors.

The robot claw is made of cardboard strips that are joined by split pins. These are the **levers**. The split pins mean the cardboard strips can **pivot** around a point, that's the fulcrum. When you pull the string attached to the **levers** you make a **pull force**.

The force is equally distributed, or even, between the two claws allowing you to make the robot claw reach for things and pick them up.