



# KS2 Science Activities: SONAR, Sound and Water



EKO stands for **Engagement, Knowledge, and Opportunities**. All organisations who are part of the Defence Nuclear Enterprise (DNE) are interested in promoting and encouraging STEM to young people in educational establishments and communities.

The DNE help to build and keep submarines at sea. Part of their work also includes protecting the nation and keeping us all safe.

There are a wide range of apprenticeships and graduate opportunities to start your career in the DNE who support the building and maintenance of submarines. These include designers, project managers, software developers and engineers. The DNE also have careers for those who look after the crew whilst on board a submarine - including chefs and medical officers.

In this booklet, we have designed some fun activities that involve science, technology, engineering and maths (or STEM for short). They have all been designed to help you think about STEM and how useful it is for many different careers.

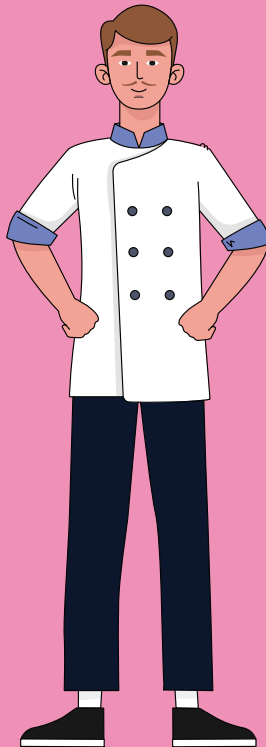


Sarah



Sarah is an Engineer working with SONAR. SONAR stands for SOUND Navigation And Ranging. It is a system that uses sound to detect objects in water.

Will



Will is a Chef working on a submarine. He prepares all of the meals for the crew of the submarine and makes sure their diet is balanced and nutritious.

Kofi

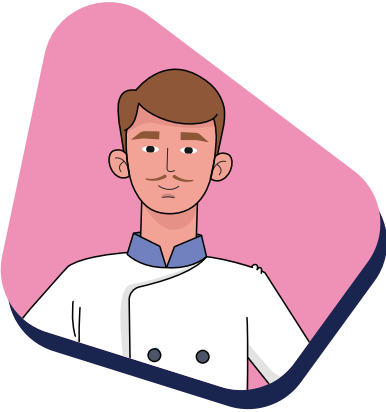


Kofi is an Apprentice Engineer. An Apprentice is someone who is training for a qualification and getting paid to learn their job.

Sarah, Will and Kofi work together on lots of STEM projects. We have brought them together here to guide us through the activities in this booklet.



# Measuring Water



Will needs to measure lots of ingredients as part of his work. Can you help him with this measuring task?

He wants to **half-fill** this jug so that he can prepare a sauce for his cooking. Can you write in the box below which line he needs to fill the jug to?

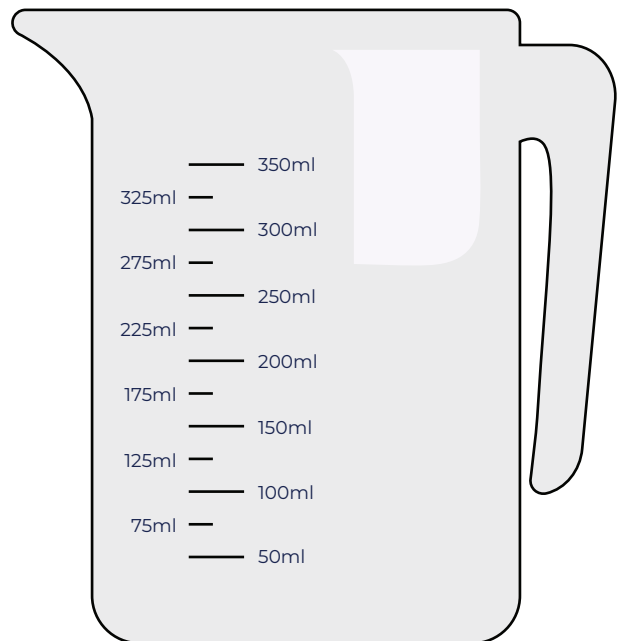
Half full =

ml

If Will had two full jugs of water to make much more sauce, how much water would this be? Can you write the amount in the box here?

Two jugs of water =

ml



Litres and millilitres (ml for short) are units that can measure the volume of a liquid.



# Sound Waves

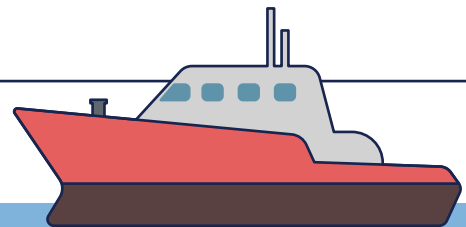
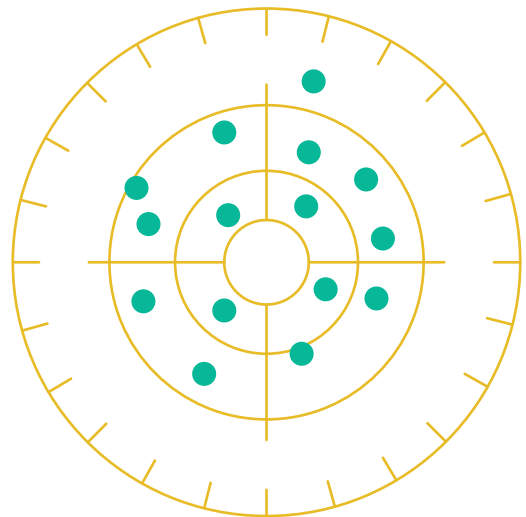


Sarah uses SONAR for her job. This is a special way to detect objects under the sea using sound waves. She uses a special machine to do this, and the objects that are detected are shown on a screen like the one below.

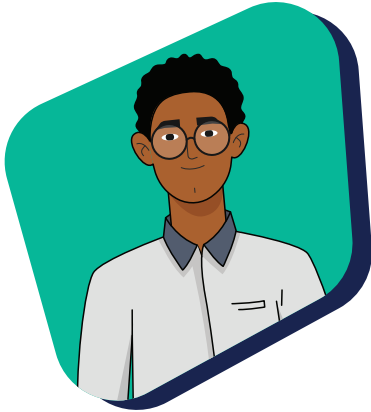
Can you help her by counting all of the objects she can detect?

How many objects are detected? =

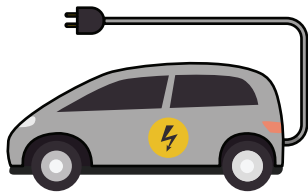
If you look at the screen you can see that it is divided into four quarters. Can you work out which quarter has the most objects in it by drawing a circle around it?



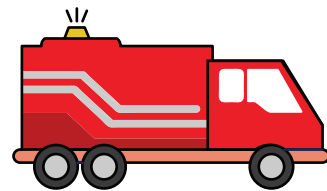
# Loud and Quiet Sounds



Kofi knows lots about sounds as part of his job. This includes being able to tell whether a sound is loud or quiet. Can you help him by labelling each of the items below as either loud or quiet?



Electric Car



Fire engine



Hot air balloon

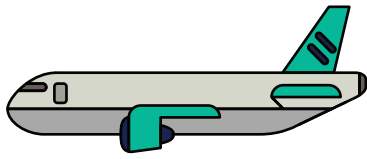


Sailing boat

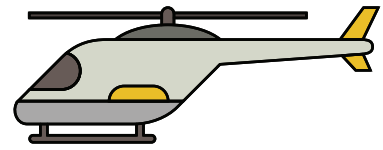


Bicycle

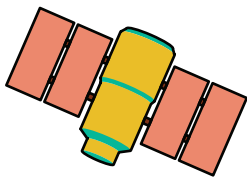




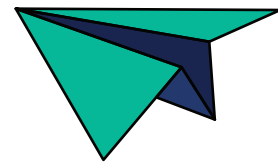
Aircraft



Helicopter

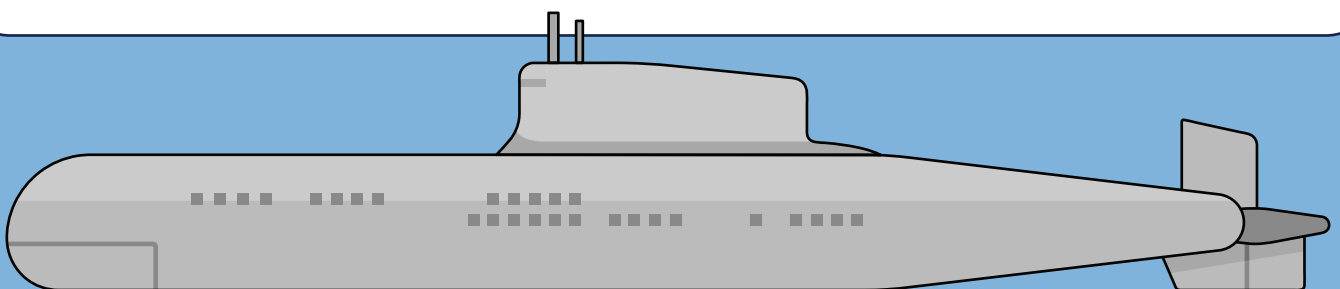


Satellite in space



Paper plane

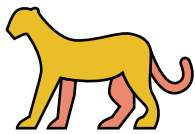
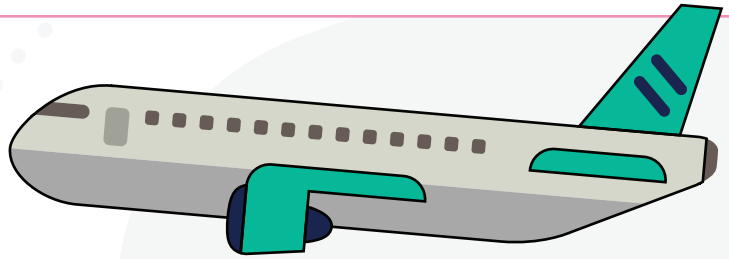
Kofi is listening to the sound that a submarine makes as it travels through the ocean. Do you think that this is loud or quiet? Write your answer in the box and explain why you think its loud or quiet.



# Which is the Fastest?



As an engineer, Sarah knows that sound travels really quickly through the air - even faster than a passenger aircraft! Can you help her arrange these items from the fastest to the slowest? She's put the first one in the list for you.



A cheetah



A rocket



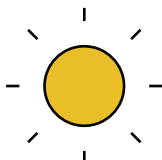
A snail



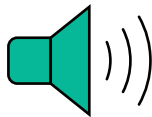
Someone walking



A lightning strike



Visible light



Sound wave (about 750 miles per hour)

SLOWEST

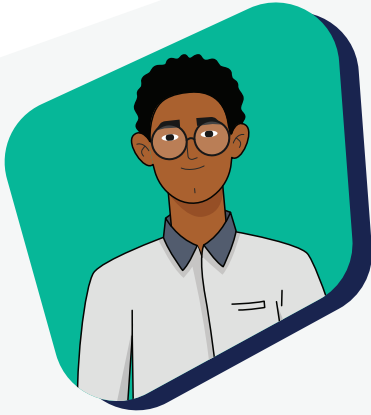
**A snail**

FASTEST





# Lightning Power



Kofi says that lightning contains lots of energy. When we measure energy like lightning, we measure it in 'Joules'. There are 1 billion joules of energy in a lightning strike. Can you count the number of joules that are striking the ground in the box below?

Joules



# Travelling Sound



Sarah calculates that sound travels through air roughly 750 mph (miles per hour), that's about one mile every 5 seconds! This isn't as fast as the speed of light, which is why we can hear thunder after we see lightening in the sky.

Can you help Sarah to work out how far away these lightening strikes are by counting the number of seconds between the strike and hearing the thunder? She's already completed the first one.



10 seconds = 2 miles



35 seconds =  miles



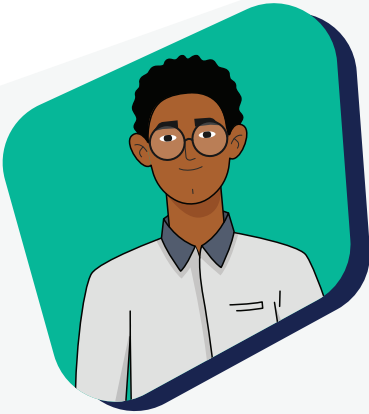
15 seconds =  miles



5 seconds =  miles

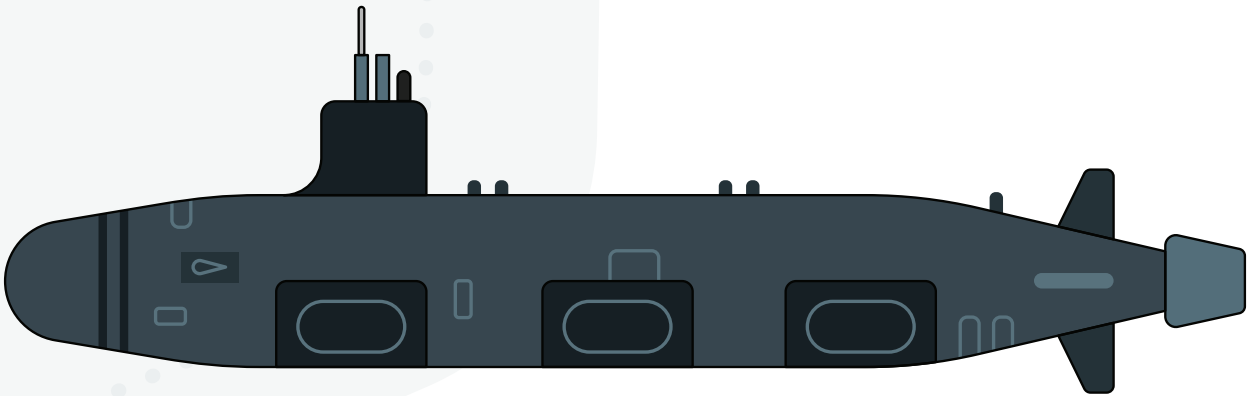


# Spot the Difference



Kofi works on lots of projects that need him to spot when things change or are different. Can you help him with this task he's been given?

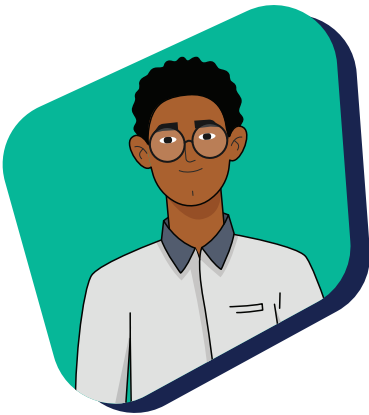
Look at the two submarine images below. Can you circle on the second submarine all of the differences? [hint: there are 8 differences]



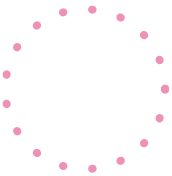
A submarine has large tanks that fill with water to give the submarine the weight it needs to sink. When the submarine is ready to surface, the tanks are emptied (so they fill with air). This lightens the submarine enough for it to float.



# Energy Sources



Kofi knows that submarines can be propelled using a variety of different energy sources. Energy can be generated in many ways. Can you help him to match the source to the correct label below?



Find out more about types of energy.



CLICK OR SCAN ME

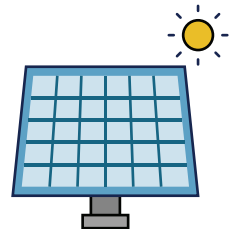
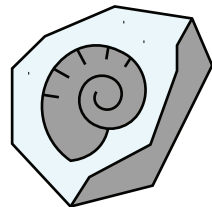
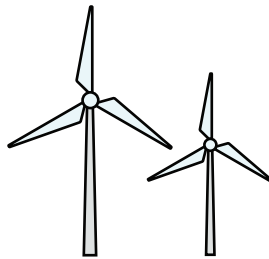
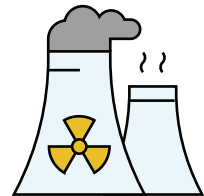
Fossil fuel

Wind power

Nuclear power

Solar energy

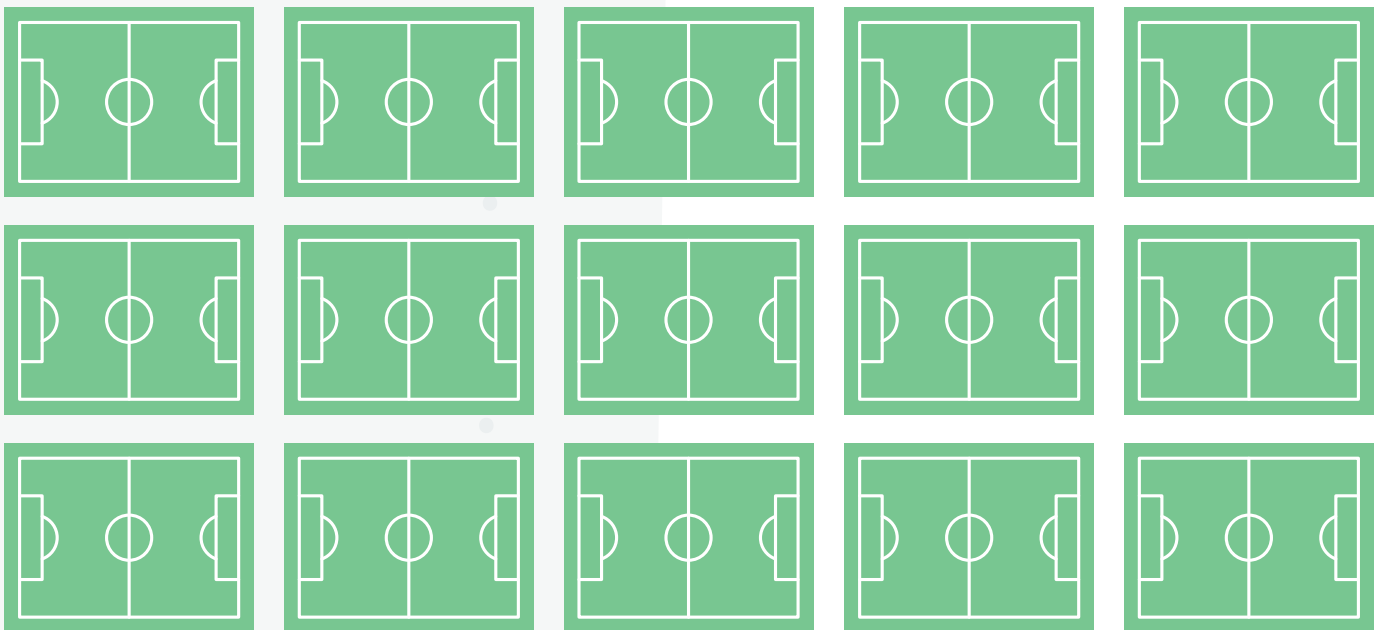
Wave power



# Measuring Distance with SONAR



SONAR works by sound bouncing back from objects in water. Scientists know that sound travels in water at about 1500 meters per second - that's about the same distance as 15 football pitches!

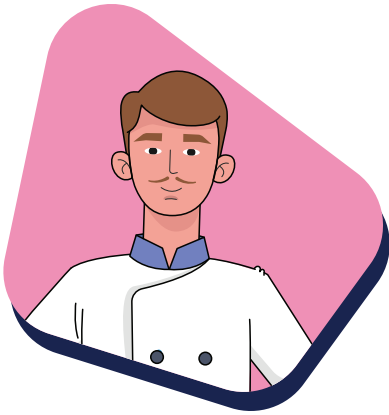


Can you help Sarah to work out how fast sound travels through air if it is only one quarter ( $\frac{1}{4}$ ) as fast as it travels through water (1500 divided by four)?

**SONAR** stands for **SO**und **N**avigation **A**nd **R**anging.



# Changing States




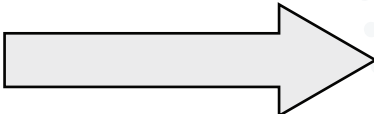
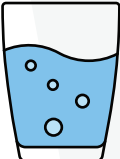
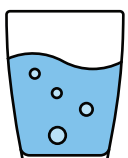
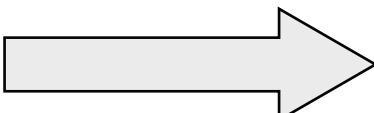
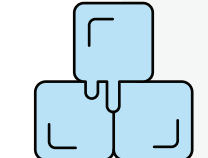
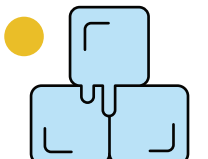
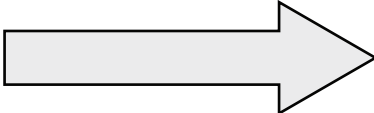
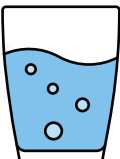
Will knows that solids, liquids and gasses can change state when heated or cooled. Can you use the information below to help Will to work out how these states change? Write if it is heated or cooled in the arrow, and write what the process is called in the box on the right.

When a solid is **heated**, it turns into a liquid. This is called **melting**.

When a liquid is **cooled**, it turns into a solid. This is called **freezing**.

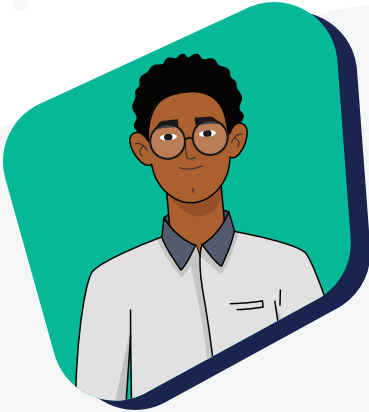
When a liquid is **heated**, it turns into a gas. This is called **evaporating**.

When a gas is **cooled**, it turns into a liquid. This is called **condensing**.

|  | Heated or cooled ?  |   | This is called ?     |
|--|---|---|----------------------|
| <br>Steam |  | <br>Water | <input type="text"/> |
| <br>Water |  | <br>Ice   | <input type="text"/> |
| <br>Ice   |  | <br>Water | <input type="text"/> |

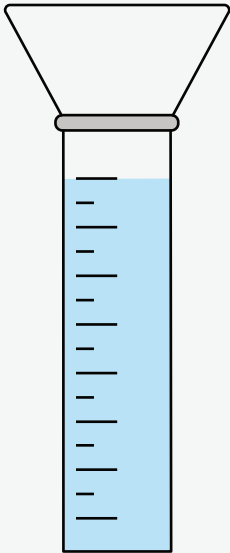


# Measuring Rainfall

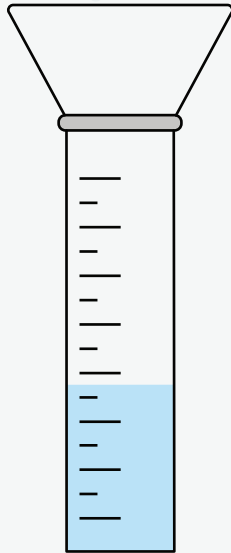


Rainfall is measured using a rain gauge. Kofi needs to know how much rain is falling in different regions of the world for part of his Apprenticeship work. These regions are called 'continents'. Can you help Kofi by filling in the blanks in the statements below?

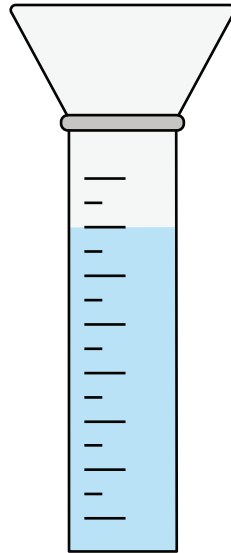
North America



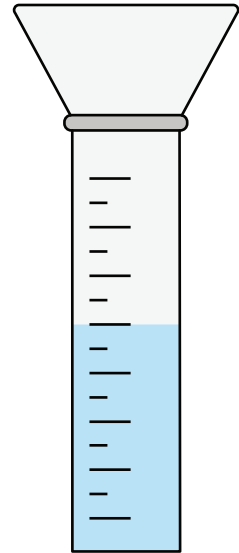
Europe



Asia



Africa



The continent with the most rainfall is

The continent with the least rainfall is



# Water Cycle



Nuclear power stations need a large supply of fresh water to create nuclear energy. The water we have here on earth is always moving and being recycled. This is what we call the water cycle. Can you help Sarah by writing the correct letter in the box to match up the stages in the water cycle with the correct description?

- A** Water droplets cool and condense, turning into clouds.
- B** Water droplets from the sky return to the sea to begin the cycle again.
- C** The sun heats up the water from the sea and it evaporates into the air.
- D** When the clouds get heavier, the water droplets fall as rain.

Stage 1 =

Stage 2 =

Stage 3 =

Stage 4 =



Find out more about the water cycle and how it works.

CLICK OR SCAN ME





Use this space to draw what happens during each of the water cycle stages.

Stage 1

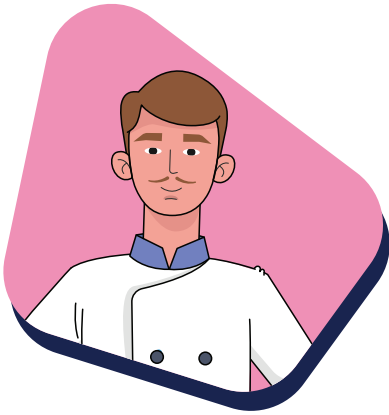
Stage 2

Stage 3

Stage 4



# Solids, Liquids, Gases



Will uses a range of ingredients, and different sources of energy to cook with. He regularly uses lots of water (which is a liquid), when he's cooking. He has asked you to help him with this task to name examples of solids, liquids and gases.

Solids, liquids, and gases are states of matter. They are all different in their own unique ways. Can you name some examples? Use the hints below to help!

SOLID

LIQUID

GAS

**Solids:** have a fixed shape and volume, can be held, and can be cut.

**Liquids:** have a fixed volume, flow easily, and change shape depending on the shape of the container.

**Gases:** do not have a fixed shape, expand to fill their containers, and can be squashed.



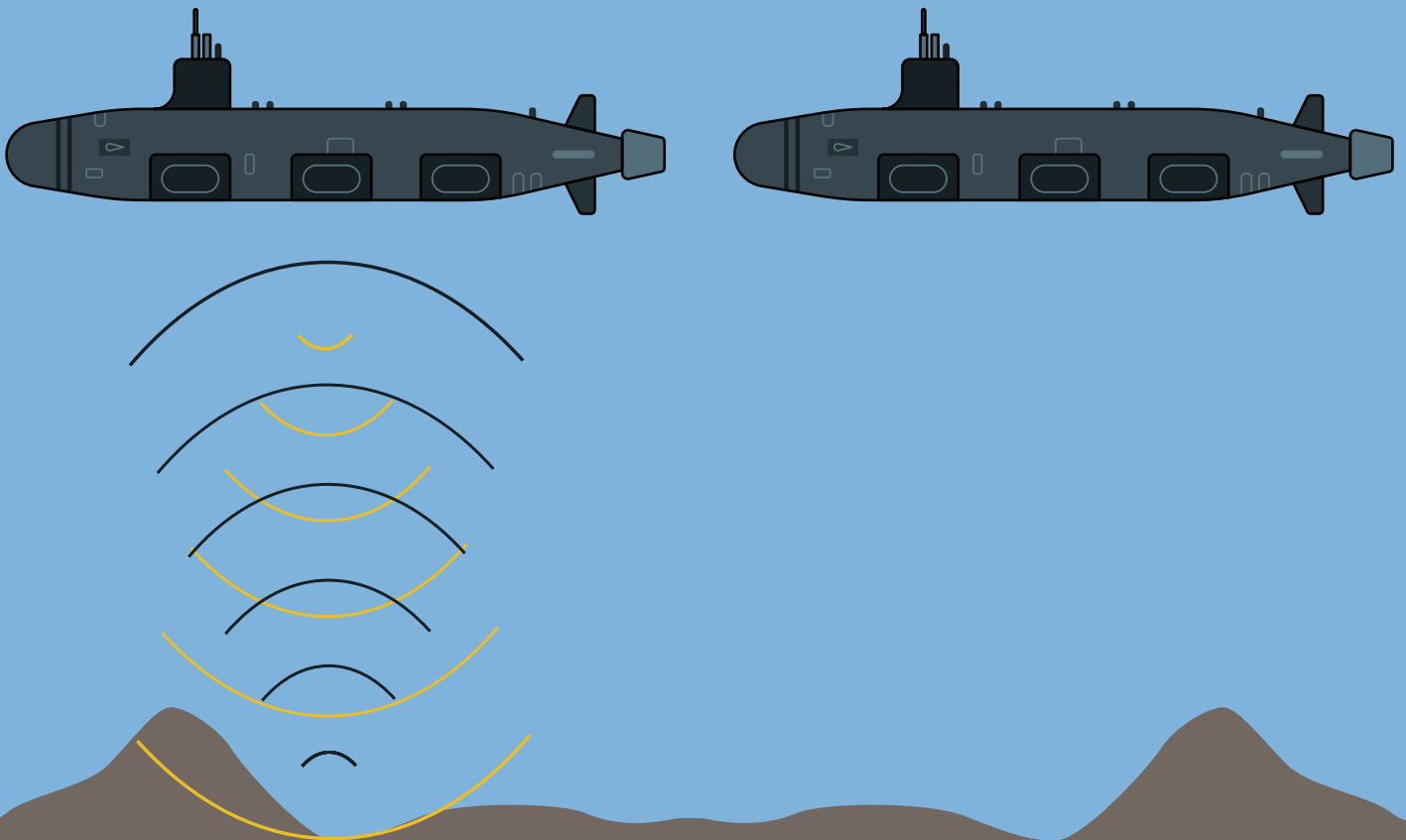
# SONAR Waves



SONAR can be used by submarines to tell how far away the sea floor is. In the picture below, the light coloured waves have been emitted by the submarine and the dark coloured waves are reflected from the sea floor to be picked up by the submarine.

Can you help Sarah to redraw the wave pattern for the second submarine to help it find the sea floor? If each line on the wave pattern equals 100 metres, how far are the submarines from the seabed?

The submarines are:  metres from the seabed.



# SONAR Wordsearch



Sarah is taking a break from her busy job. She is relaxing and working on the wordsearch below. All of the words have some use for SONAR. Can you help her find the words in the list?

K G Q K F U L H V U B X Z X L A  
 W W P P F N N A R W A L S I B S  
 M I L I T A R Y A I R C R A F T  
 U T U Z U Q F R U J J N C E R X  
 S O U Q J Z W Q A C D I D D A Z  
 O K I F I S H I N G B O A T S X  
 R U G U K U C B O Z P N K D G P  
 K F V V M I G K G H K S B A T S  
 D Q O R N S U B M A R I N E S Z  
 P U V L M S P F G A P B D O H U  
 O Z B Z Y Z Q P L L J F H K X C  
 M D O L P H I N S E N G Q P A I  
 W V Z L I N S Z Y Y G Z L A J A  
 G W H A L E S R I F F E H W C I  
 K J L I W H J Y H E Y Q T Z U P  
 P G Z W T C N U F Z Q F P A W K

BATS

DOLPHINS

SUBMARINES

NARWALS

MILITARY AIRCRAFT

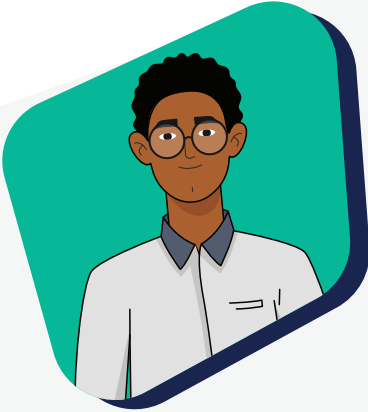
WHALES

FISHING BOATS

Fishing boats use SONAR to help them find where the fish are in the sea. This makes their job much easier.



# Solids, Liquids, Gases



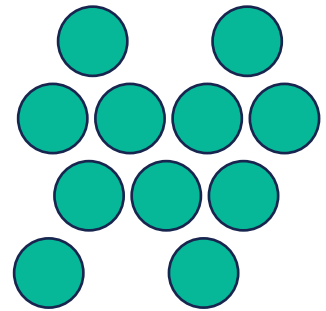
Solids, liquids, and gases all act differently because of the particles within them. The particles within a solid are packed tightly and close together, and are arranged in a regular way. For liquids, particles are close together with some gaps. They are arranged randomly. The particles within a gas are spaced wide apart and randomly arranged.

Can you help Kofi draw the particles for each item in the box using the description above? He's already drawn the particles for liquid.

STEEL - SOLID

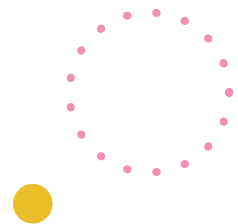
AIR - GAS

OIL - LIQUID



Find out more about solids, liquids and gases.

CLICK OR SCAN ME



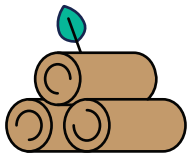
# Echos



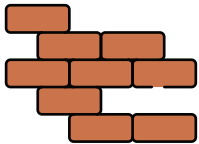
Sarah knows that when sound waves hit surfaces, they can sometimes be reflected back. This is called an echo.

Sound waves will be reflected back as an echo from hard surfaces. They will be absorbed by soft ones. When sound meets a soft surface, you will not be able to hear it repeated.

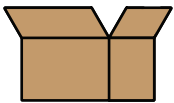
Can you tick the boxes for the materials that have hard surfaces? Put a double tick in the boxes where you would easily be able to hear an echo.



Wood



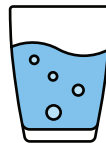
Brick Wall



Cardboard



Pillow



Glass



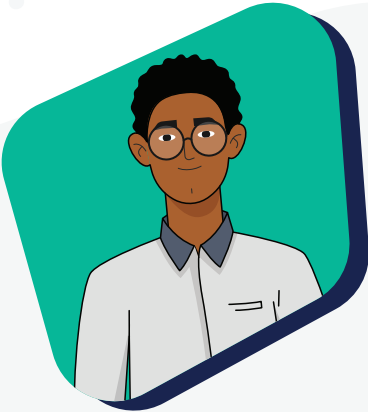
Tunnel



Cave



# Necessary Sounds



Kofi knows that sound can be produced in a number of ways. Sound is usually a kind of energy waste, as it heats up the space around it.

This is because sound waves travel through particle vibrations, which heat up as they move. Can you name any examples of machines that produce necessary or unnecessary sounds?

For example, a whistle used by a lifeguard is necessary because it is used to tell us about danger. Loud and unwanted sounds, like that made by a vacuum cleaner, are unnecessary sounds.

## NECESSARY

*A whistle used by a lifeguard*

## UNNECESSARY

*A vacuum cleaner*



# Sharing Pizza!



Sarah is inviting some friends to have pizza with her as a treat. Will, the chef, is making the pizza for her. Sarah needs you to help her work out how many of her friends to invite given the ingredients that she has.

Can you help her to work through the calculations below?

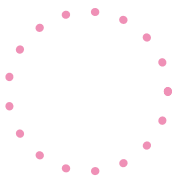
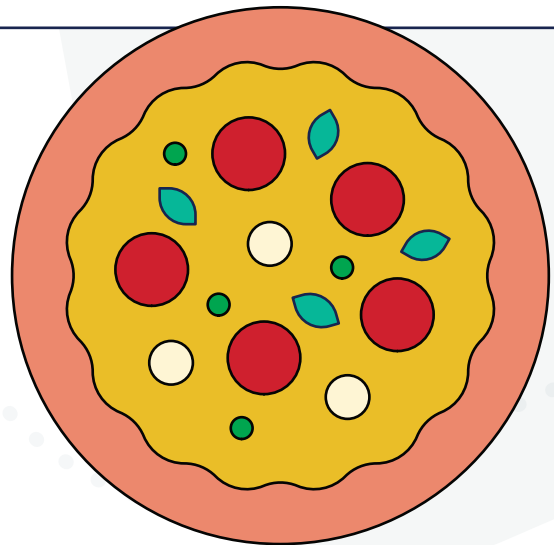
A pizza can serve 8 people and Sarah has the ingredients to make 10 pizzas. How many people can she serve pizza?

People served =

Sarah knows that 17 of the people she is serving are vegetarian. How many people are not?

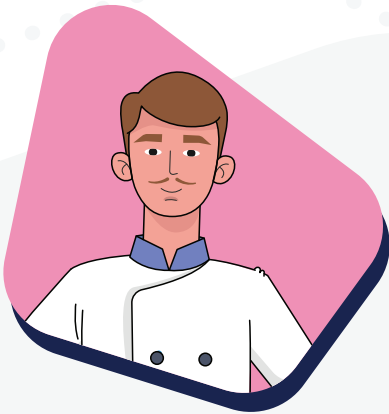
Not vegetarian =

Help Sarah to divide this pizza into eight equal slices. Draw lines on it to make eight pieces.





# Food Waste

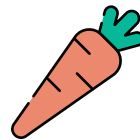


Will has to be mindful of the food waste on board as he cannot remove it from the submarine until it docks.

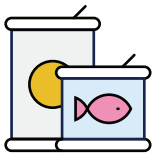
Can you help him to categorise the waste below by ticking all of the examples of organic matter that can become food waste?



Apples



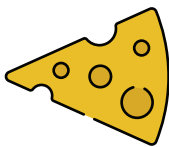
Carrots



Metal Cans



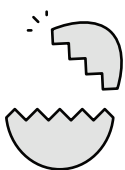
Plastic Bags



Cheese



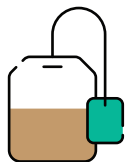
Cling Film



Egg Shells



Glass Jars



Tea Bags



Fish



Find out more about food waste and how to reduce it.

CLICK OR SCAN ME



# Changing States of Water



Sarah knows that water can be found in 3 states: gas (steam), liquid (water) or solid (ice).

Each state has different properties and uses. For example, steam turbines use water in gas form to generate electricity. Can you name some uses for the other states below?

**GAS** - What do we use water for in this state?

*To generate electricity*

**LIQUID** - What do we use water for in this state?

**SOLID** - What do we use water for in this state?



# Waste and Recycling



As a Chef, Will understands the importance of reducing waste. Any waste that is produced on a submarine (like the one he works on) has to be stored so that it can be disposed of when the submarine is back in port.

Can you help Will to sort these items for recycling when the submarine is back in port?

GLASS

METAL

PLASTIC

JAM JAR

YOGHURT POT

FOOD TIN

JAR LID

FOIL

WATER BOTTLE

DRINKS CAN

SAUCE JAR

WASHING UP LIQUID BOTTLE

FOIL TRAY

MILK CARTON



# How Dolphins Use SONAR



Sarah has been doing some research around SONAR and has found out that dolphins use a special kind of SONAR called 'echo-location'. This works in a similar way to SONAR.

Sounds made by the dolphins are bounced off objects and the echo created helps the dolphin to work out what the object is! This helps them to identify different sized objects and types of fish in the water.

Can you help Sarah to work out which objects a dolphin has identified with echo-location in the picture opposite?

This object is the largest object:

This object is the furthest away from the dolphin:

This object is the nearest to the smallest object:



Find out more about echo-location and which animals use it.

[CLICK OR SCAN ME](#)



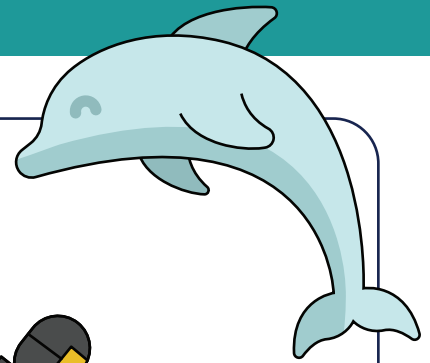
SHELL



TURTLE



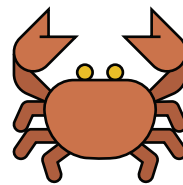
DIVER



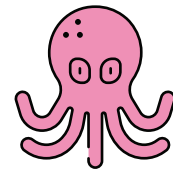
FISH



CRAB



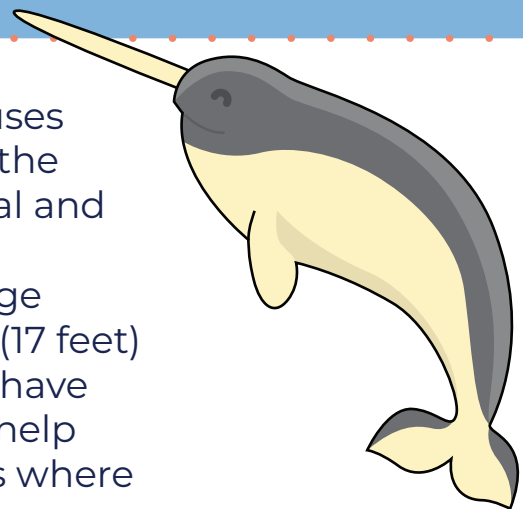
OCTOPUS



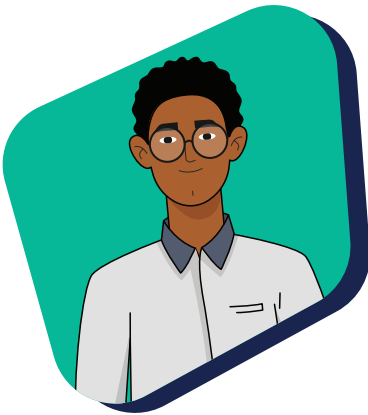
STARFISH



One other animal, living in the sea, that uses echo-location is the narwal. Often called the 'unicorns of the sea', narwhals are unusual and beautiful creatures with very long tusks protruding from their heads. They are large creatures and can grow to over 5 meters (17 feet) in length. Scientists aren't sure why they have such long tusks, one reason might be to help them navigate the large and dark oceans where they live.



# Musical instruments



Kofi knows that there are many different jobs you can do when working with the Defence Nuclear Enterprise, some of them use sound more than others. One of these jobs is the work carried out by a musician (someone who would play music at important events and ceremonies).

Different instruments can be used to create a variety of different sounds from low or quiet sounds to high pitched or loud sounds. How many musical instruments can you name that are either quiet or loud? Write them out in the box below.

Quiet sounds

Loud sounds

I named

instruments





# Defence Nuclear Enterprise

There are many organisations who are part of the Defence Nuclear Enterprise (DNE). These include the following:



Strategic  
Command



Defence Nuclear  
Organisation



Ministry  
of Defence



Submarine  
Delivery Agency





Get going with STEM