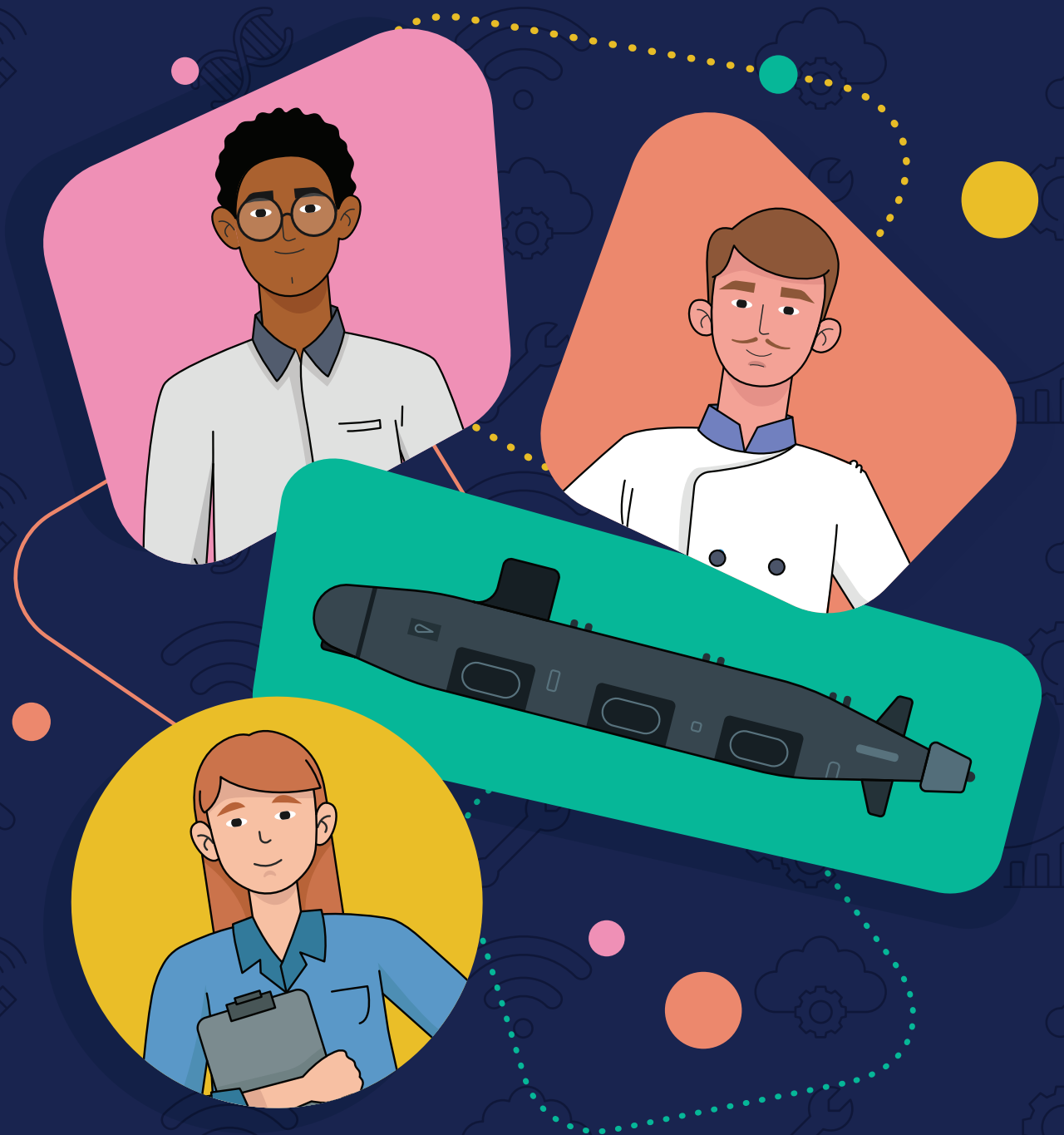


KS3 Science Workbook: SONAR, Sound and Water

Eko

Dive deeper into STEM

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.

We include some words and phrases in this workbook that you might not have seen or used before. To check out what they mean, take a look at our **glossary** at the end of the workbook.

Contents

Careers

Did you know that there are many jobs and careers that use science subjects you study at school? These include: Biomedical Scientist, Marine Engineer, Catering Services Chef, Communications and Information Specialist, Dental Officer, Engineering Technician, Logistics Officer, Cryptology Technician, Environmental Health Officer, Medical Assistant, Nursing Officer, Radiographer, Musician. And there are many more!

Sarah, Will and Kofi work for the Defence Nuclear Enterprise and they need your help with the activities in this workbook. Let's find out a little bit more about what they do.

Sarah, Warfare Officer (Submariner) Working with SONAR

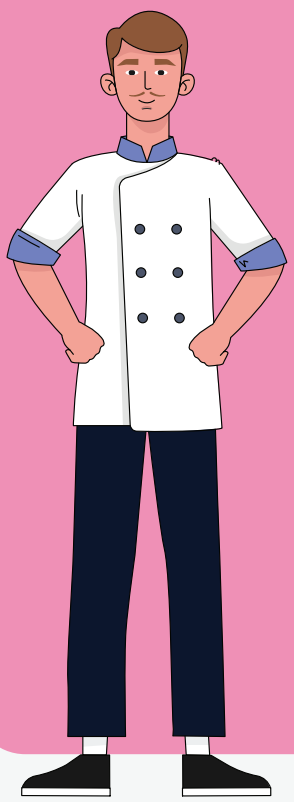
Sarah is a specialist in the use of sophisticated submarine SONAR equipment. SONAR stands for SOund Navigation And Ranging. It is a system that uses sound to detect objects in water.

"I work on a submarine and my job is to ensure that the submarine has power and the technology is working correctly. I have skills in engineering and the use of technology - which means I use some of the most advanced underwater equipment as part of my job."

Find out more about this career.

CLICK OR SCAN ME

Will, Catering Services (Chef) (Submariner)



Will prepares meals and cooks for his submarine's crew. He also delivers high end front of house service to visiting VIPs and royalty when the submarine is in port.

"I think I have the best job underwater. I keep all the crew healthy with great food and a lot of choices. My kitchen is run like any commercial restaurant and as a chef I have all the ingredients I need for our long journeys around the world."

Find out more about this career.

CLICK OR SCAN ME

Kofi, Accelerated Apprentice Scheme (Submariner)

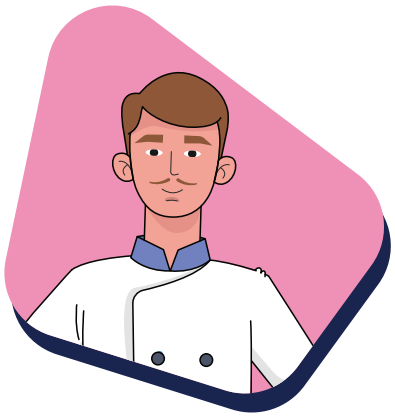
Kofi spends most of his working day maintaining some of the most advanced technology ever developed. He really enjoys learning about how submarines work whilst working as an Apprentice.

"I'm really excited to be part of an Apprenticeship Scheme as it gives me the opportunity to work on some of the most advanced submarines in the world, working with specialist teams."

Find out more about this career.

CLICK OR SCAN ME

Nuclear Powered Submarines

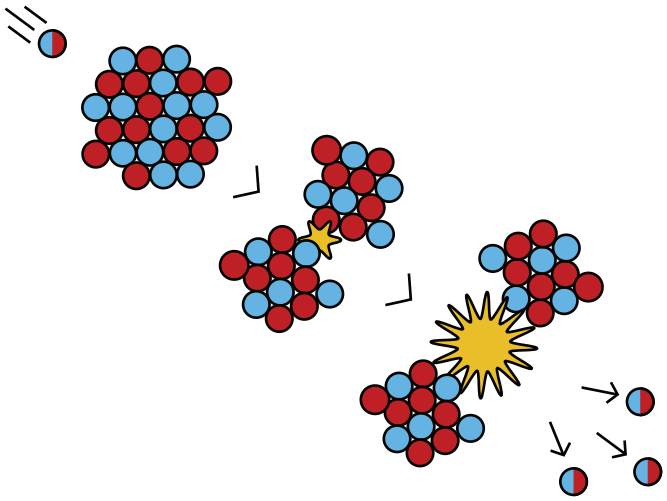


Will works as a chef on a submarine that is powered by nuclear energy. Nuclear power is the energy in the nucleus, or core, of an atom.

Nuclear energy can be used to create electricity, but it must first be released from the atom. To make this happen, the atoms must be forced to break apart. A nuclear reactor allows this to happen in a safe way. As the atoms split, they release tiny particles. This causes a chain reaction and energy (a lot of it) is produced.

Uranium is the fuel most widely used to produce nuclear energy. That's because uranium atoms split apart relatively easily and can generate lots of power or energy.

Here's how the process works, a neutron splits the nucleus of a uranium atom. These, in turn, hit other surrounding atoms, which also split. This process continues in a fraction of a second and lots of energy is produced.

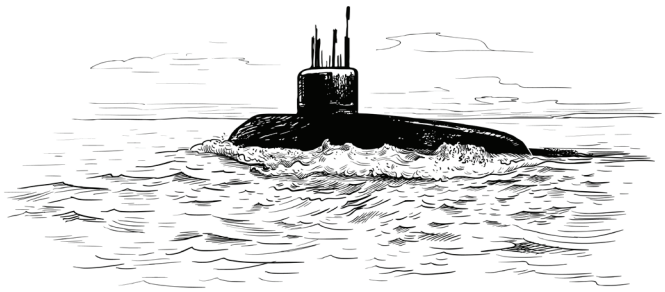


Power can be created in a number of ways. Powering machinery and vehicles, such as submarines requires a lot of power. Nuclear power is an effective way to provide power, but did you know how it is generated?

To create nuclear power we need a special type of material - uranium. When uranium atoms are split they release energy in a process called nuclear fission. This energy heats up the uranium. This heats water to produce steam that can turn the blades of a turbine to make power in a power station, on a ship or even a submarine.

The USS Nautilus was the world's first nuclear-powered submarine. It was launched in 1954 (in the USA). In the UK, HMS Dreadnought was the first nuclear powered submarine - built in the 1960s. The submarine remained in service until 1980 and visited many places around the world, proving the reliability of nuclear power.

During its service, HMS Dreadnought achieved a number of firsts, including during March 1971, when it became the first British Nuclear Submarine to surface at the North Pole.



Find out more about what HMS Dreadnought looked like inside.

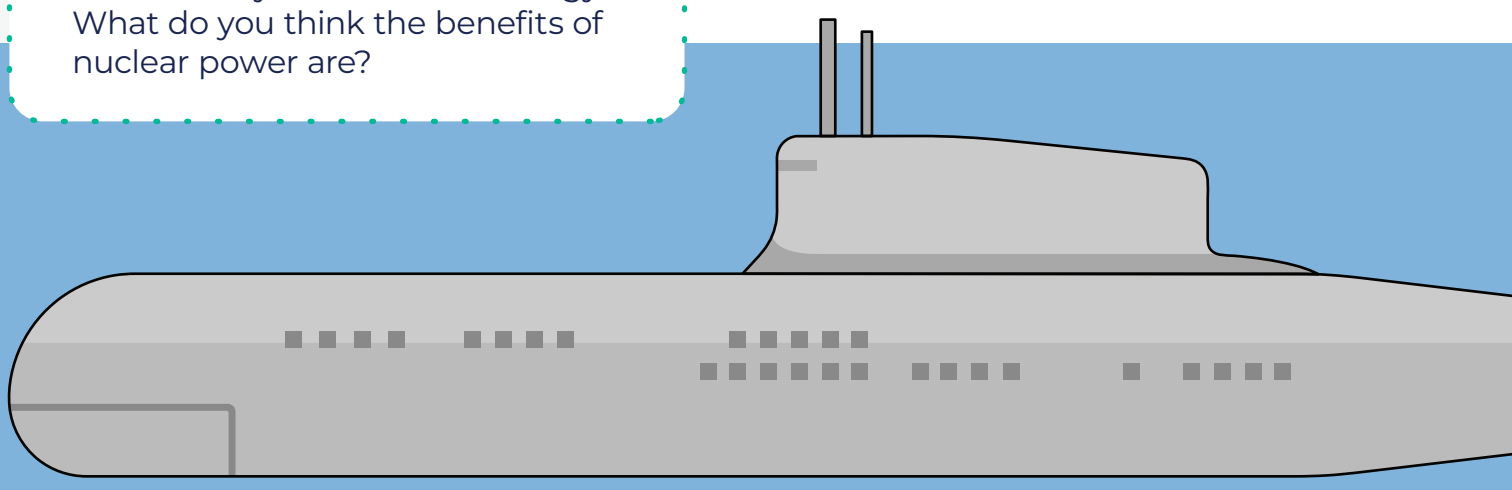
CLICK OR SCAN ME

The UK generates about 15% of its electricity from nuclear power. It will rise to 25% by 2050.

Watch this video to find out what it is like inside a nuclear reactor.

CLICK OR SCAN ME

Why is the UK generating more of its electricity from nuclear energy? What do you think the benefits of nuclear power are?



SONAR Quiz

Sarah uses lots of research skills in her job to solve complex problems. She would like you to use your research skills by searching for the answers to these questions about SONAR. You can check your answers against hers at the bottom of the next page.

Q1 What is SONAR and when was it invented?

Q2 How do marine biologists use SONAR to study dolphins?

Q3: Why do marine biologists listen for echoes when studying dolphins?

Q4: How are sound waves in SONAR similar to the echoes you hear when you shout in a cave?

Q5: What is the purpose of using SONAR in submarines?

Sarah's answers

Q1: SONAR stands for "Sound Navigation and Ranging." It is a technology that uses sound waves to navigate and detect objects underwater. It was developed by the French inventor Paul Langévin in 1916, but his machine was too bulky and was never used on any ships.

Q2: Marine biologists use SONAR by sending out sound waves into the water. These sound waves travel through the water and bounce off objects, such as dolphins. By listening to the echoes of these sound waves, marine biologists can gather information about the dolphins and their surroundings.

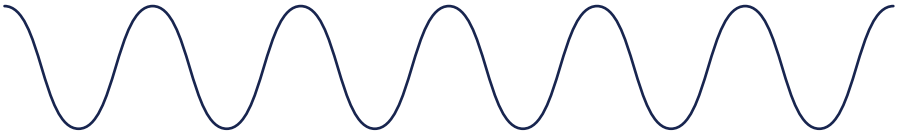
Q3: They listen for echoes because the echoes provide information about the location, size, and shape of objects underwater. By analysing the echoes, marine biologists can learn about the presence and behaviour of dolphins and other marine life.

Q4: Sound waves in SONAR are similar to the echoes you hear when you shout in a cave because both involve the reflection of sound. When you shout in a cave, the sound waves bounce off the walls of the cave and return to your ears as echoes. Similarly, in SONAR, sound waves are emitted and bounce off underwater objects, returning as echoes that can be detected and analysed.

Q5: The purpose of using SONAR in submarines is to detect and track other underwater objects, such as boats, ships or underwater obstacles. SONAR helps submarines navigate safely and remain aware of their surroundings, even in dark and murky waters. SONAR helps submarines detect and track other objects underwater by emitting sound waves called pings. These sound waves travel through the water and bounce off objects, including enemy ships or underwater structures. By listening to the echoes of the pings, submarines can determine the presence, location, and movement of these objects.

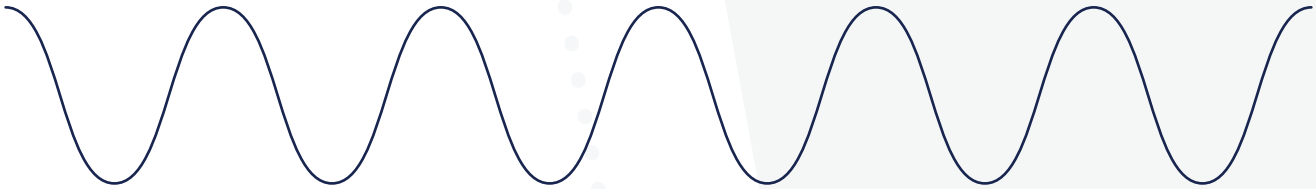
Doppler Effect

Sarah learns about sound waves such as this one:



They can sometimes go through the Doppler effect where the waves squash as the object emitting them moves closer to the observer, increasing the pitch of the sound.

As the object moves away, the waves will stretch, decreasing the pitch. **Can you help Sarah identify which sound wave has been stretched and which has been squashed in the Doppler effect and if their pitch will be high or low?**



The sound wave has been

Its pitch is

Can you think of examples of a sound that might demonstrate the doppler effect? Can you think of any examples where the pitch of the sound changes as the sound moves closer to you?

Pitch is how high or low a sound is, whereas volume is how soft or loud it is.

The sound wave has been

Its pitch is

The doppler effect works with all types of wave (not just sound). **Can you name some of the other wave types?**

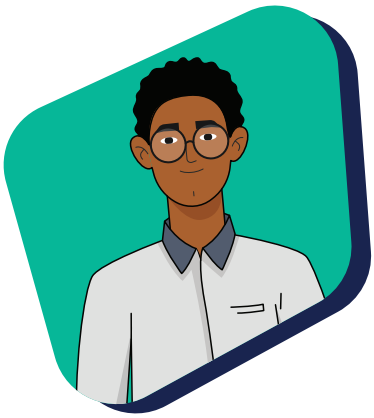
Other wave types include

The police use the doppler effect when they catch speeding motorists using their speed cameras. They don't use sound waves to do this though, they use radio waves and RADAR. Find out what RADAR means and how it is used by the police and others to locate objects and vehicles.

Read more about the Doppler Effect.

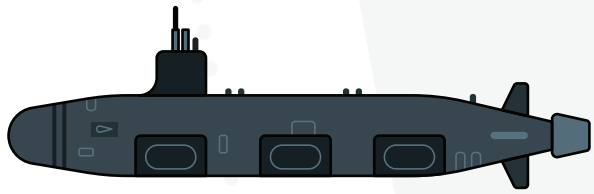
CLICK OR SCAN ME

Power Propulsion



Kofi really likes to learn about what powers submarines and other vehicles. He knows that propulsion of a nuclear submarine occurs when the nuclear reactor provides heat. This heat provides steam to drive a turbine which propels the submarine forward in the water. There are a number of forces that affect the movement of a submarine in the water. **Can you add these to the submarine image below?**

Engine Force	Weight	Water Resistance	Buoyancy



Which of the above forces are vertical forces on the submarine, and which are horizontal forces?

Vertical forces are	
Horizontal forces are	

A propulsion system is a machine that produces a thrust. A thrust is a force that pushes objects like airplanes and rockets forward and through the air.

Travelling Sound

Sound can travel through solids, liquids, and gasses. It travels at different speeds depending on the state of matter. This is because sound travels faster when molecules are closer together. As the molecules in solids are packed tightly together, sound travels faster through solids!

To work out the speed of sound through any state, Sarah says we can use this calculation:

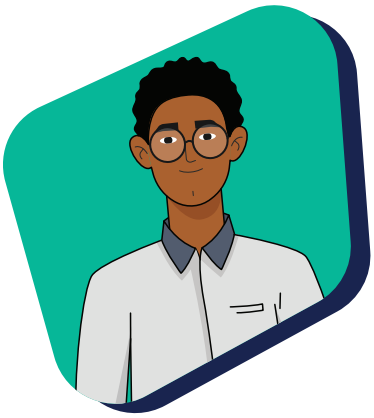
$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Can you work out the speed of sound in these states of matter?

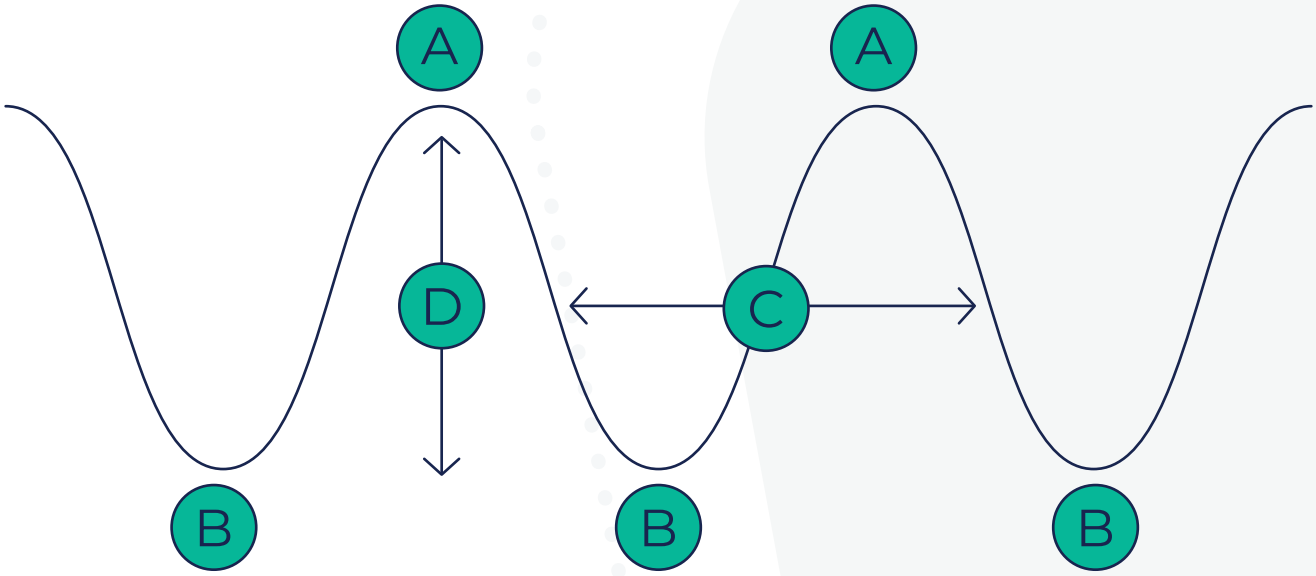
State of Matter	Distance (m)	Time (s)	Speed of Sound (m/s)
Wood (Solid)	390m	0.1s	
Water (Liquid)	4500m	3s	
Air (Gas)	170m	0.5s	
Steel (Solid)	408m	0.08s	
Caster oil (Liquid)	795.96m	0.54s	

Which has the slowest speed?

Parts of a Sound Wave



Sounds come in the form of waves. There are different parts to a sound wave. Kofi has been asked to look at these for some work he is carrying out as part of his Apprenticeship. **Can you help Kofi to match the words on the next page to the different parts of the wave below?**



A =

B =

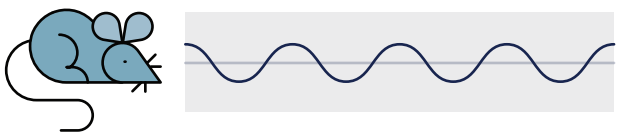
C =

D =

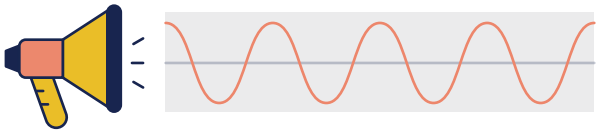
Longitudinal waves are the most common form of sound wave. Traverse waves are less common.

Word	Definition
Crest	Highest vertical point in the wave.
Amplitude	Maximum distance between the wave and the equilibrium point (centre of the vertical distance).
Troughs	Lowest vertical point in the wave.
Wavelength	Distance between identical points in neighbouring waves e.g. neighbouring crests/troughs.

A lower amplitude will result in a quieter sound. A high amplitude will result in a louder sound.



Low Amplitude - Quiet Sound



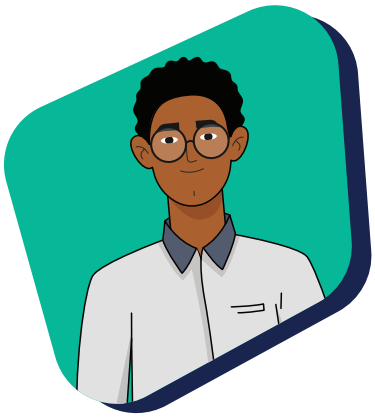
High Amplitude - Loud Sound

Frequency is the time it takes for one wavelength to pass a certain point.

Read more about sound waves.

CLICK OR SCAN ME

Hearing Sound Waves



Sound waves have a frequencies that are measured in Hertz (Hz). Humans can only hear sound waves in the range 20-20,000 Hz. **Can you help Kofi identify which sounds he will be able to hear by circling the frequencies in this range?**

1 Hz	60 Hz	300 Hz	1 million Hz
1,000 Hz	20,500 Hz	0.6 Hz	2,364 Hz

Wavelength range of human hearing

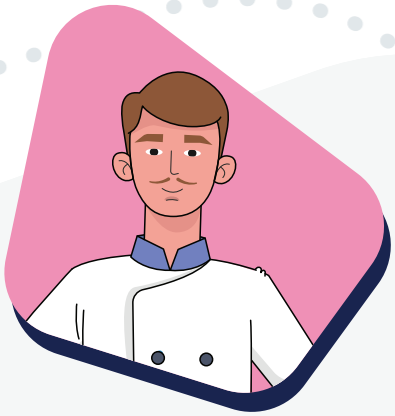
Using the equation: wavelength = wave speed ÷ frequency, you can calculate the boundaries of the human hearing range in terms of wavelength.

Take the speed of sound in air to be 330m/s and Hz is equal to 1/second. You do not need to change it's units.

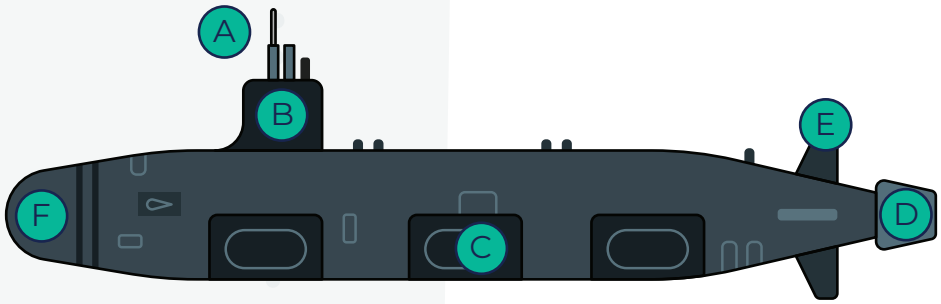
Lower end of range (20Hz) =	
Higher end of range (20Hz) =	
Wavelength range =	

Most dogs can hear sounds between 65-45,000 Hz. Dog whistles have very high frequencies. When you blow one, dogs can hear it really clearly, but we can't hear anything.

Parts of a Submarine



Will really enjoys his job working on a submarine as a chef. He likes preparing the meals and making sure everything is nutritious. The submarine he works on is quite large. **Can you help him to identify the different parts of his vessel by matching the words below to the correct part of the submarine?**

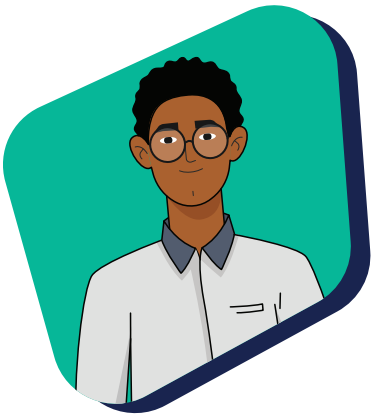


A =	B =	C =
D =	E =	F =

Word	Definition
Rudder	Part of the submarine used to steer it through the water.
SONAR Dome	Protects the SONAR technology in the ship from damage by the water or external factors.
Sail	Tower-like structure for an observation point when above water and a vertical stabilizer when below.
Ballast Tanks	Fill with water or air to respectively sink or float the submarine.
Propeller	Uses mechanical force to push the submarine through the water.
Periscope	Allows the crew to view the water above the submarine.

What do you think is the most important part of the submarine from this list? Of course, there are lots of other devices, machines and equipment on a submarine. Can you think of what they might be and why they might be important?

Measuring Frequency and Wavelength



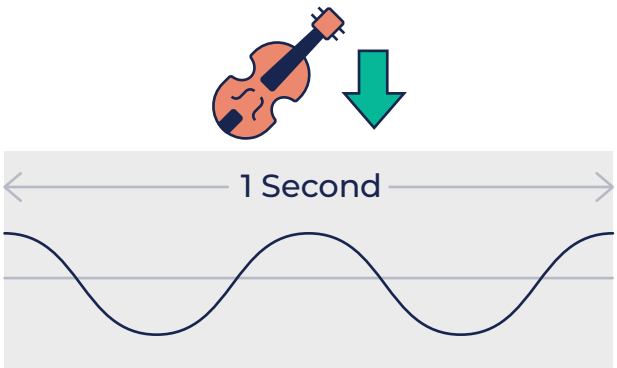
Kofi knows that all sound waves travel at the same speed of 343 metres per second in air, but their frequency and wavelength will change. **To find out the frequency of a sound wave we use an equation of wave speed divided by wavelength.**

$$\text{Frequency} = \frac{\text{Wave speed}}{\text{Wavelength}}$$

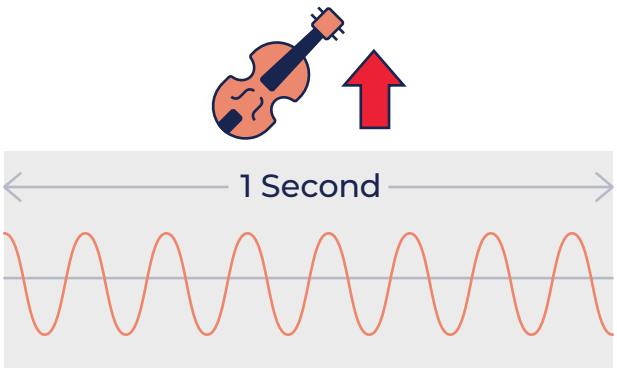
Can you help Kofi to work out the frequency of the sound waves below by completing the calculations?

Wave speed (m/s)	Wavelength (m)	Speed of Sound (m/s)
343	17	
343	10	
343	0.2	

Lower frequency means lower sounds. Higher frequency means higher sounds.

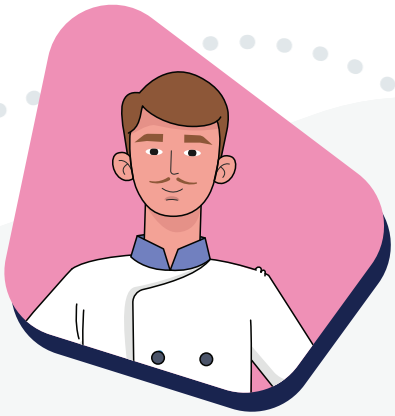


Low Frequency - Low Sound



High Frequency - High Sound

Rainfall Calculations



Will relies on a good supply of drinking water in order to carry out his work as a Chef. Did you know that only 1.2% of Earth's water can be used as drinking water. This means that we need to make sure it isn't wasted!

Will has been looking at the rainfall figures for the UK during recent months. Can you help him to work out the average rainfall for the 6-month period?

Month	Rainfall
June	36.9mm
July	4.0mm
August	23.4mm
September	101.8mm
October	87.0mm
November	167.2mm

Hint: Percentages are calculated by using the formula: Amount x (percentage ÷ 100)

Average rainfall for 6 months =

If only 1.2% of the rainfall over the 6-month period is collected for drinking water, how much drinking water do we get from it?

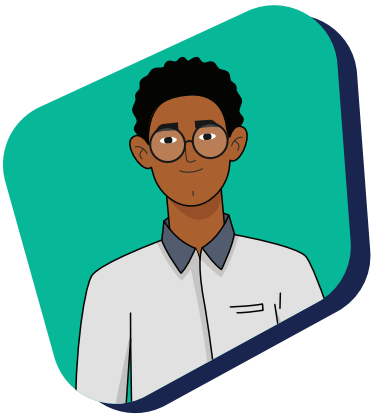
Amount of drinking water collected from rainfall =

Will is also interested in the range of rainfall (the difference between the month with the least rainfall and the month with the most rainfall). Can you help him to calculate this?

Range of rainfall across 6-months =

Most submarines have machines on board that can take in seawater and produce fresh water. These distillation devices heat the seawater to water vapour, which removes the salts, and then cools the water vapour into a collecting tank of fresh water. This can then be used as drinking water for the crew, but it is also used to cool down some of the machinery on the submarine.

Echoes



Echoes are an important aspect of how SONAR works. As humans, we hear reflected sound waves as echoes. With the right information, we can work out how far a sound has travelled. We can use this equation:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Can you use the information above to work out the answer to Will's task?

The submarine Will is working on sounds an alarm.

The echo from the nearest cliff is heard after 10 seconds (that's 5 seconds to reach the cliff, and 5 seconds to bounce back to the submarine)

Given that the speed of sound is 340m/s, can you calculate the distance between the submarine and the cliff?

Distance between the submarine and the cliff is =

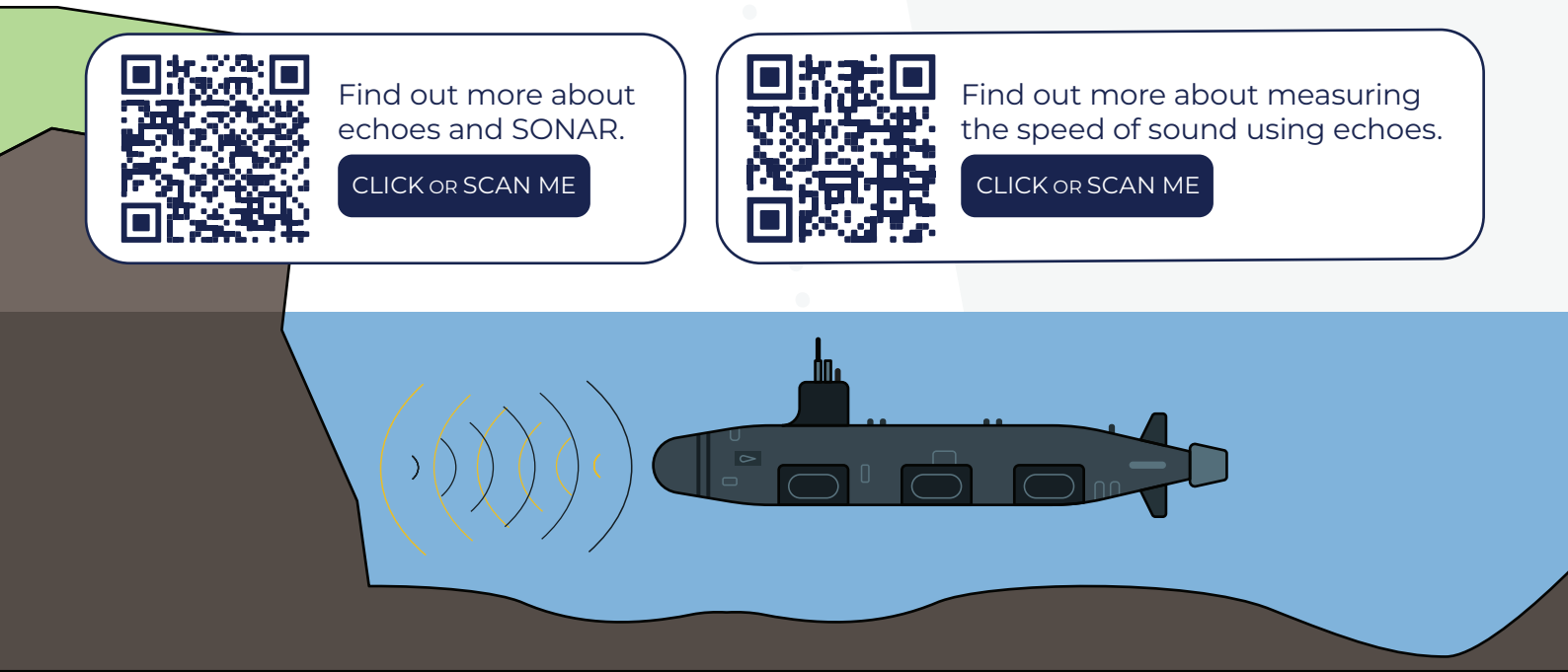
If the cliff was twice as far away how long would the sounds take to echo back to you?

Find out more about echoes and SONAR.

CLICK OR SCAN ME

Find out more about measuring the speed of sound using echoes.

CLICK OR SCAN ME



Density

The submarine that Sarah works on is made of a variety of materials, including steel, aluminium, titanium, acrylic plastic and glass. Steel is one of the most used materials because of its strength and reliability as a building material.

Sarah knows that different building materials have different densities. Density is a measure of how close together particles are. It is expressed as g/cm^3 or kg/m^3. Particles that are closely packed together have a higher density than particles that are spread out. We can work out the density of an object using this equation:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Can you work out the answers to the following questions to help Sarah with her work?

If a steel cube has a volume of 12cm^3 and a mass of 130g, what is the density?

Density =

If a wooden cube has a volume of 9cm^3 and a mass of 5g, what is the density?

Density =

If an iron cube has a volume of 10cm^3 and a mass of 98g, what is the density?

Density =

If a polystyrene cube has a volume of 157cm^3 and a mass of 6g, what is the density?

Density =

Sarah is also interested in the difference in density of polystyrene and steel. Can you help her to calculate this?

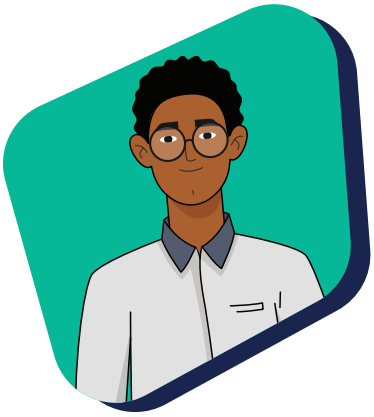
Difference in Density =

Find out more about density.

CLICK OR SCAN ME

All materials have a density, including the human body! Do some research work to find out the average density of the human body.

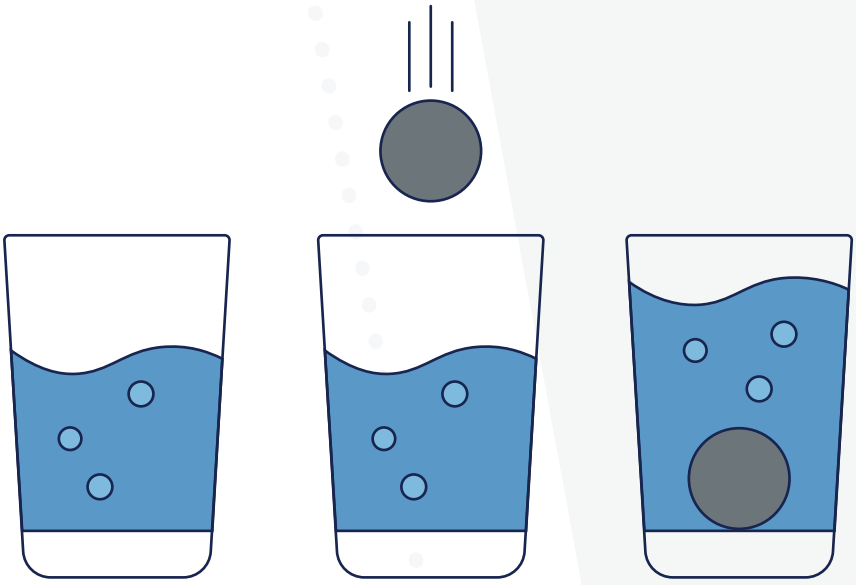
Eureka!



Kofi has been researching the science behind why objects float in water. He has come across the expression 'eureka' which was coined by the physicist Archimedes. He used the displacement of water in a bath to tell if the King's crown was made of gold through its density. You can also observe the effect of the different densities that different objects have by using the same displacement experiment as Archimedes.

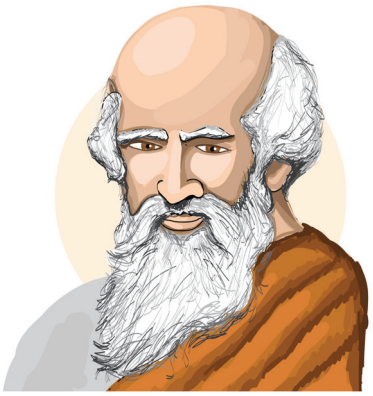
Get a large glass and fill it about half way with water.

Drop a stone into the glass and observe the rise in the water level and watch what happens to the stone. It will sink as the density of the stone is much greater than that of water. An object that is denser than water will weigh more than the water that it displaces.



What would be the result if you dropped a ping pong ball into the glass. Would the water level rise as it has done for the stone? Will the ping pong ball sink or float? What would the result mean about the density of the ping pong ball?

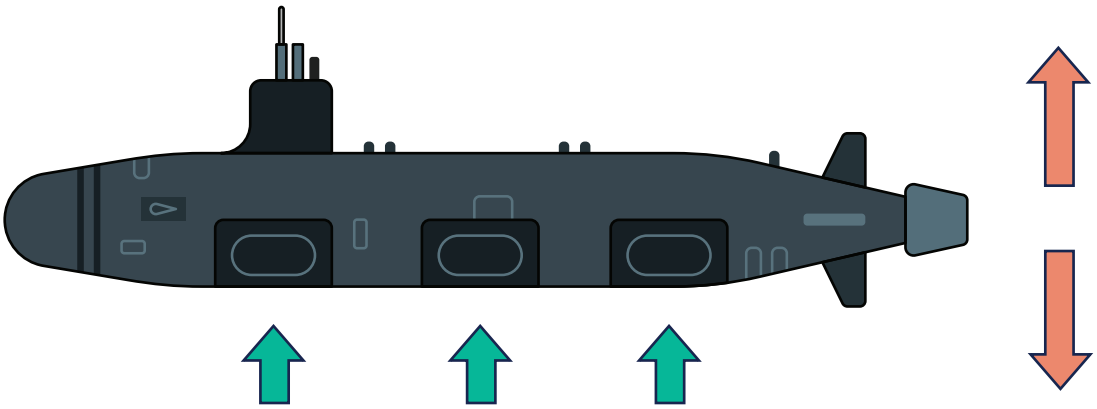
Conduct an experiment with other items, including: a cork, a piece of sponge, a coin, a piece of wood. How will you be able to work out which of the items has the greatest densities using the principles discovered by Archimedes.



Archimedes was one of the greatest mathematicians in history. He was also a great inventor and scientist. He was born in Syracuse, Sicily (then part of Greece), in about 287 B.C., He travelled to Egypt at the age of 18 to study at the great library of Alexandria. Upon completing his studies, he returned to Syracuse, where he spent the remainder of his life.

Archimedes was obsessed with mathematics and he was well known for his inventions and scientific discoveries. The most famous of these were the Archimedes' Screw (a device for raising water that is still used in crop irrigation and sewage treatment plants today) and Archimedes' principle of buoyancy. He is reported to have discovered this principle while in the bath, where he noticed that the more of his body he submerged in the water, the greater the amount of water that over-flowed the bath. Upon making this discovery, he is said to have run naked through the streets of Syracuse, shouting "Eureka!" (Greek for "I have found it!").

A submarine can float because the weight of water that it displaces is equal to the weight of the submarine. This displacement of water creates an upward force called the buoyant force and it acts in an opposite way to gravity, which pulls the submarine down in the ocean. A submarine can control its buoyancy by filling tanks with either water or air. When they are filled with water, the submarine will sink or dive, when they are filled with air, the submarine will rise or float.



Fill tanks with water or air

Water Cycle Crossword

As an engineer, Sara needs to understand how things work and where they come from, including water. She has decided to work on this crossword about the water cycle. **Can you help her to identify the words from the clues available?**

Clues

Across:

2- Drops of water coming together to form these in the sky.

3 - The processes by which water circulates between the earth's oceans, atmosphere, and land.

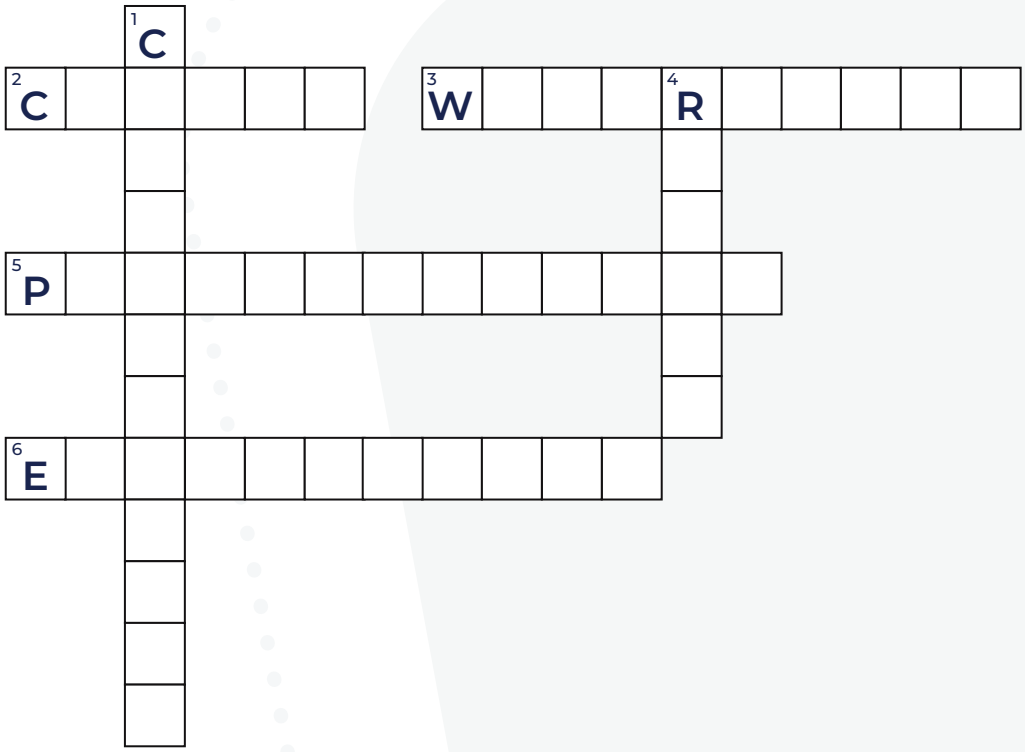
5 - Water falling from the clouds in the form of rain, snow, sleet, or hail.

6 - What happens when water turns into vapour from oceans, lakes, and rivers.

Down:

1 - What happens when vapour cools and turns back into liquid form.

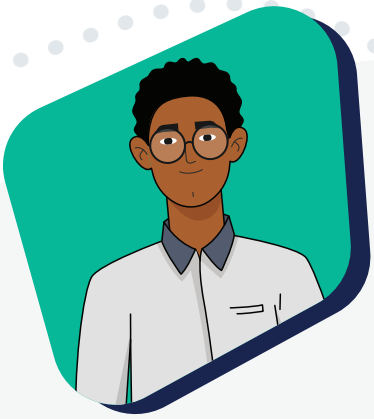
4 - Water soaking into the ground or going into rivers, lakes, and oceans.



Climate change is leading to variations in the availability of natural resources, including water. Can you think of how climate change might be affecting the availability of water and the water cycle? For some hints, take a look at the site here.

CLICK OR SCAN ME

Energy Sources and Their Uses



Kofi is studying different types of energy for his work as an Apprentice. He has identified two different kinds of energy resources, renewable and non-renewable. Renewable energy resources do not run out. Non-renewable energy resources are finite, and therefore will run out. **Can you think of 2 advantages and disadvantages for each of the energy types below? Which of these are renewable and which are non-renewable?**

Fossil Fuel	Solar Power
Advantages:	Advantages:
Disadvantages:	Disadvantages:
Renewable?	Renewable?

Fossil fuel is a term used to describe non-renewable energy sources such as coal, natural gas, and crude oil.

Look at the advantages and disadvantages of renewables and non-renewables here. Which do you think are the most important about each energy source?

CLICK OR SCAN ME

Depth and Pressure

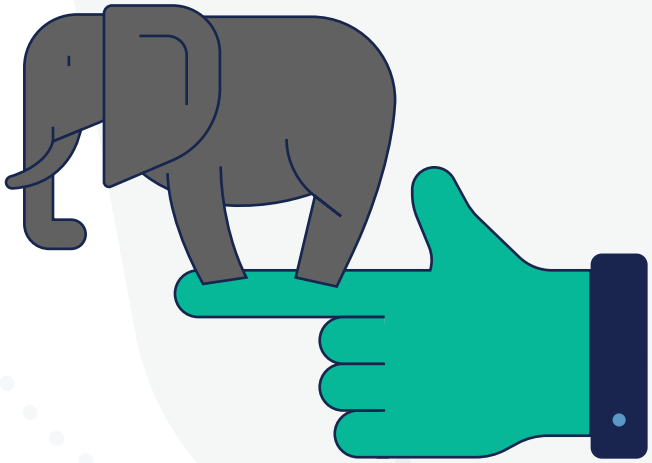
An important part of Sarah's work involves measuring the effects of working beneath the sea for the crew on a submarine. At sea level the atmosphere exerts a pressure of 1 bar. This is the normal pressure that we feel everyday. People who have been in an airplane, up a mountain or dived in the ocean, might sometimes feel their ears pop. This happens because of the air pressure changing.

Pressure underwater increases at 1 bar for every 10 metres (or 33 feet). This means that at 50 metres below the surface the pressure is 6 bars (this is the surface pressure of 1 bar + 1 bar for each 10 metres below the surface). Deep sea divers know all about this and have special training so that they can withstand the extra pressures.

Submarines can go very deep. They must be designed carefully to handle the enormous water pressure at those depths. At the bottom of the ocean the pressure is equivalent to an elephant standing on your finger, so submarines have to be very strong indeed!

The deepest point in the ocean is the Challenger Deep, which is 10,994m (36,070 feet) deep. It is located in the Pacific Ocean, near the Mariana Islands group. The pressure here is about 1,100 bars.

The bar is a measurement unit of pressure. 1 bar is equal to 1,000,000 dynes per square centimetre (baryes), or 100,000 newtons per square metre (pascals). The word bar is of Greek origin, báros meaning weight.

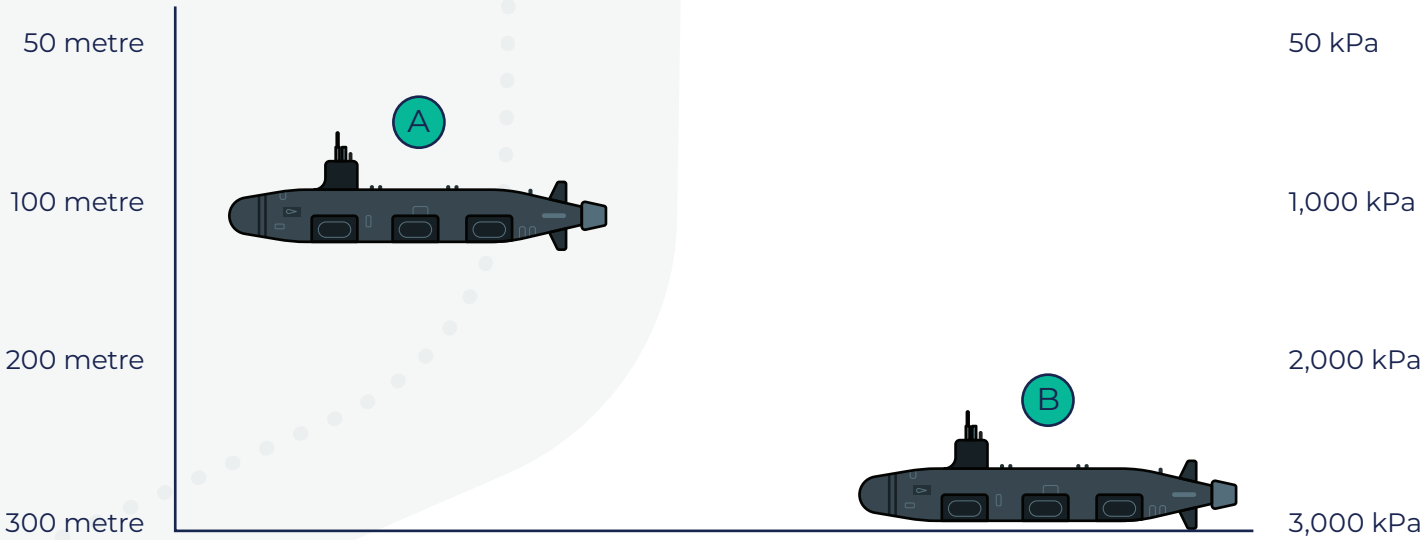


Take a look at the submarines below, which one is the deepest?

What is pressure on the submarine nearest the surface?

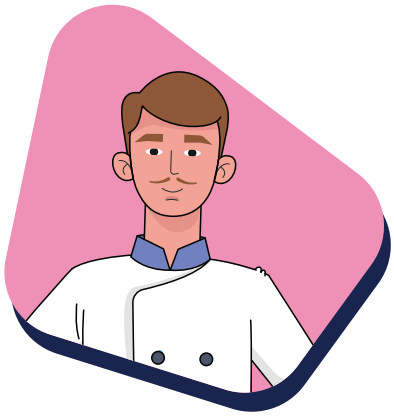
What is the distance between the two?

What is the difference in pressure between the two?



When a submarine descends beneath the ocean, the crew won't feel the effects of the sea pressure. This is because the interior of the submarine is kept at an approximate pressure of 1 bar atmosphere, which is what you feel at the surface.

Water and the Body



Water is very important to keep our body functioning properly. Will says that it is important that we drink enough to stay healthy and he makes sure there is enough to drink for all the crew on the submarine that he works on. He says that this is around 6 to 8 cups of fluid, per day, for each crew member.

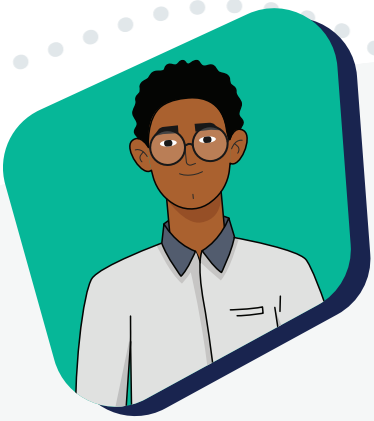
A good supply of water provides our bodies with the fluid we need to function properly. **Can you match the body part to the function of water that pairs with it? Use a line to connect the body part with the correct function.**

Body Part	Function
Eyes	Water helps to remove waste and toxins we don't need
Kidneys	Water aids digestion of food and transport of nutrients around the body
Digestive System	Water provides moisture to prevent irritation
Body Temperature	Water cushions these to allow them to move freely
Muscles and Joints	Water allows us to remove excess heat through sweat so we don't get too hot

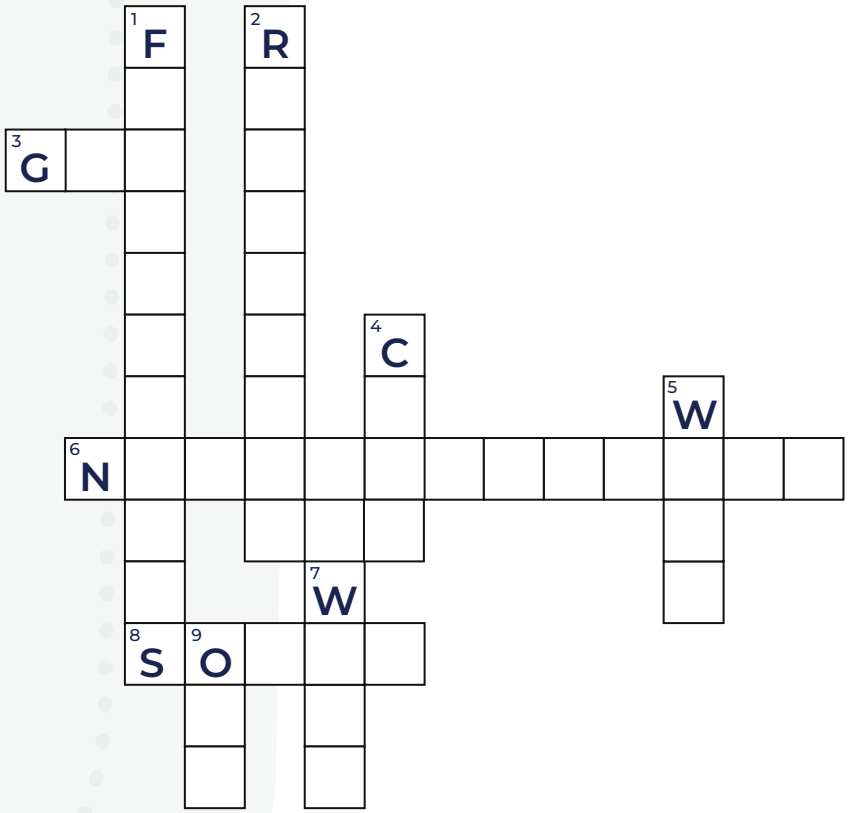
Did you know that water has an amazing property called the triple point. This is a temperature where all three states (gas (steam), liquid (water) and solid (ice)) coexist at one temperature - provided that specific pressure and volume conditions are met. Take a look at this amazing video clip showing it happening in a laboratory space.

CLICK OR SCAN ME

Energy Crossword



Kofi is on his break and is relaxing in the office where he works. As an engineer he is really interested in different energy sources and has decided to try and complete this crossword puzzle on energy types. **Can you help him to solve the puzzle?**



Clues

Down:

1 - Energy taken from fossilised materials.

2 - Energy that is created from natural resources and can be recycled.

4 - Type of energy material burnt on a BBQ/fire.

5 - Energy type harvested from the movement of air.

7 - Energy type harvested from the motion of the sea.

9 - Energy type that can also be used in cooking e.g. Olive ...

Across:

3 - Energy type that is a state of matter e.g. Oxygen and steam are types of this.

6 - Radioactive substances combining to produce energy.

8 - Energy taken from the sun.

On 15 May 2023 the UK produced its trillionth kilowatt hour (kWh) of electricity generated from renewable sources – enough to power UK homes for 12 years based on average consumption. Based on current projections it will take just over five years to reach the next trillionth kWh.

Find out more about how renewable energy is being used to provide the UK's energy.

CLICK OR SCAN ME

Glossary

Amplitude: The distance from a peak or a trough, to the rest position.

Apprentice: A person who works and studies to gain skills and knowledge in a specific job.

Atom: The smallest particle of an element. They act as the 'building blocks' of everything. They are made from protons, neutrons, and electrons.

Ballast tanks: A compartment within a boat, ship, or submarine that holds water. It controls the buoyancy of the vessel.

Crest: The highest surface part of a wave.

Defence Nuclear Organisation: An organisation under the Ministry of Defence.

Density: The amount of mass per unit volume.

Doppler effect: When sound waves squash as the object emitting them moves closer to the observer, increasing the pitch of the sound.

Echo: The reflection of sound.

Frequency: The time is takes for one wavelength to pass a certain point.

Gas: A state of matter which does not have a fixed shape or volume, can be squashed, and expands to fill the shape and size of its container.

Hertz: The unit of measurement for frequency of one cycle per second.

Liquid: A state of matter which has a fixed volume, flows easily, and can change shape depending on the shape of the container.

Mass: A measure of the amount of matter an object is made out of.

Nuclear energy: The energy released during nuclear fission or fusion. It can be used to generate electricity.

Nucleus: The centre of an atom.

Periscope: A long, vertical tube containing a set of mirrors that allows you to see what is above you.

Pitch: How high or low the sound is.

Propeller: A rotating fan-like structure that is used to propel a submarine by using the power generated by the main engine.

Propulsion: To push forward or drive an object forward.

Rudder: A structure used to steer the submarine.

Sail: A tower-like structure found on the top side of a submarine.

Solid: A state of matter which has a fixed shape and volume. It can be held and can be cut.

SONAR dome: This is where SONAR equipment is contained on a submarine.

SONAR: Sound navigation ranging. It is a system that uses sound to detect objects in water.

Trough: The lowest point of a transverse wave.

Uranium: A chemical element that can be used as fuel for nuclear power plants.

Volume: A quantity that shows the amount of three dimensional space occupied by an object.

Water pressure: A force that makes a flow of water strong or weak.

Wave speed: The distance a wave travels in a given amount of time.

Wavelength: The distance from one peak to the next, or the distance from one trough to the next trough.

Defence Nuclear Enterprise

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

Eko

AWE

babcock

BAE SYSTEMS

Strategic Command

Defence Nuclear Organisation

Ministry of Defence

ROLLS ROYCE

ROYAL NAVY

Submarine Delivery Agency

Eko

Dive deeper into STEM