Engaging in Primary Science

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MYSTERY: Test your Lung capacity

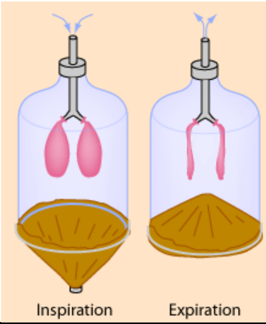
Materials

Energy & Forces

Living Things

Engage: Capture pupils' attention	
What's the mystery?	**Test Your Lung Capacity!** All that is required for this test is two sport drink bottles, two balloons and two volunteers. On the count of 3, the volunteers are asked to blow the balloons up inside the sports bottles as quickly and as big as possible. The bigger the balloon is blown up inside the bottle, the higher the lung capacity. Why is difficult to inflate the balloon within the bottle?
Strand: Materials **Strand Unit:** Properties & Characteristics of materials **Strand:** Energy & Forces **Strand Units:** Forces **Strand:** Living Things **Strand Unit:** Human Life	• Recognise that a gas, such as air, occupies space, has mass and exerts pressure • Become aware of and explore how moving water and moving air can make things move • Become aware of and investigate breathing • Appreciate the need for oxygen from the air • Understand that air is drawn in through mouth and nose and passes through windpipe to lungs. • Learn about the presence of atmospheric pressure. • Learn that atmospheric pressure acts in all directions. • Identify and explore how objects and materials may be moved, using trapped air pressure (pneumatics) • Extension- Link: investigate the effect of altitude on atmospheric pressure
Class	3RD & 4TH 5TH & 6TH
Safety/Supervision	For hygiene purposes, you may wish to change the balloon used at the mouth of the bottle for different participants. Alternatively, a balloon pump may be used For safety, the teacher should pierce the hole in the plastic bottle carefully with a screw driver/ nail/ thumb tack.
Preparation & List of Materials	3-4 coloured balloons, two empty with strong plastic bottles (Gatorade sports drink bottles work best) and a thumb tack/screwdriver.

Explore: Collect data from experiments
• The pupils invesigate the bottles more closely to explore why the balloon can be inflated in one bottle and not in the other. • The pupils may hypothesise and test different possible factors e.g. trial different balloon colours / types through exploration, trial the same bottle with different pupils etc. (linking the concepts of fair testing) • The pupils should discover that there is a hole in the bottle that enables the balloon to inflate. • (After the pupils have noticed the hole): To guide the pupils' exploration to lead to explanation- the following probing questions may help: o Why does the balloon stay inflated when the hole in the bottle is covered? o Is it possible to inflate the balloon in the bottle with the hole without exhaling into the balloon at the neck of the bottle?
Explain: What's the science behind the mystery?
Blowing up a balloon involves forcing additional air particles from your lungs into the balloon. Air exerts pressure, or pushes, on things. The air particles from your lungs hit the inside walls of the balloon creating enough pressure to force the rubber of the balloon to expand and the balloon to inflate. The collision of these particles with the walls creates a high-pressure environment inside the balloon relative to the atmospheric pressure around it. This is why when a balloon is released, the high-pressure air flows out of the balloon to the low-pressure air surrounding it. When the balloon is placed inside the bottle, it will not inflate, since the bottle is already filled with air particles with no escape route. **This demonstrates that air takes up space.** The air inside the bottle compresses a little bit but not enough to permit the balloon to inflate. However, when you punch a hole in the bottle, the air particles in the bottle have an exit. They are pushed out as the balloon fills the space inside, resulting in room for the balloon to inflate. If the hole is then plugged, the balloon stays inflated even when the mouth is removed. This is because the air pressure in the balloon pushes outward harder than the low air pressure in the bottle. The air in the balloon pushes out against the walls, keeping it inflated. When the hole is unplugged, air flows back into the bottle. The air pressure in the bottle increases and collapses the balloon. **Scaffolding the explanation:** Let's the pupils begin with by exploring an 'empty' bottle with a basin of water. Try to fill the bottle with water, what do you notice when you submerge the 'empty' bottle in the basin of water? (bubbles of air are displaced by the water). The molecules of air are invisible. When you turn a bottle filled with water upside down, the water pours out and air rushes into the bottle. It is an even exchange of water for air.

You might think that poking a tiny hole in the bottom of a bottle would cause it to leak, and it does if air molecules can sneak into the bottle. When the lid is on the bottle, air pressure can't get into the bottle to push on the surface of the water. The tiny holes in the bottom or sides of the bottle are not big enough for the air to sneak in. When the lid is uncapped, air sneaks in through the top of the bottle and pushes down on the water (along with the force of gravity), and the water squirts through the holes in the bottle.  Source: http://www.stevespanglerscience.com/lab/experiments/do-not-open-bottle/
Extend: What other related areas can be explored?
• Pressure can be further explored using scenarios investigating the effect of altitude on atmospheric pressure. ○ What happens to atmospheric pressure as altitude increases? ○ Why does your packet of crisps appear to inflate when you are mid-flight? • Pressure cookers could be used to provide a stimulus for classroom discussion about the effect of pressure on boiling point etc. 
Evaluate: Check the level of student scientific understanding
Cross-discipline links could be used to evaluate the pupils' understanding. The pupils could gbe asked to use what they have learned in the lesson to design and make a model of the respiratory system (lungs, wind pipe, diaphragm) using straws, a large plastic bottle, plastic glove, small balloons. The pupils should be able to explain how the movement of the diaphragm enables the lungs to inflate. 

Before the Lesson:
Prepare two plastic bottles with balloons before the lesson begins. Make a small hole in the side / base of one of the plastic bottles. (Ensure that this hole is small and discrete so that it will not be easily noticed by the pupils). Leave the other bottle.

Engagement: Ask two pupils to volunteer to 'test their lung capacity'. Give one bottle and a balloon to each student. Ask both pupils to secure the balloon over the neck of the bottle. Both pupils try to inflate the balloon.
Only one pupil will be able to inflate the balloon (the balloon within the bottle with the hole).
Pupils may want to use different balloons etc. within the one bottle. A third volunteer may be asked to join the lung capacity test etc.

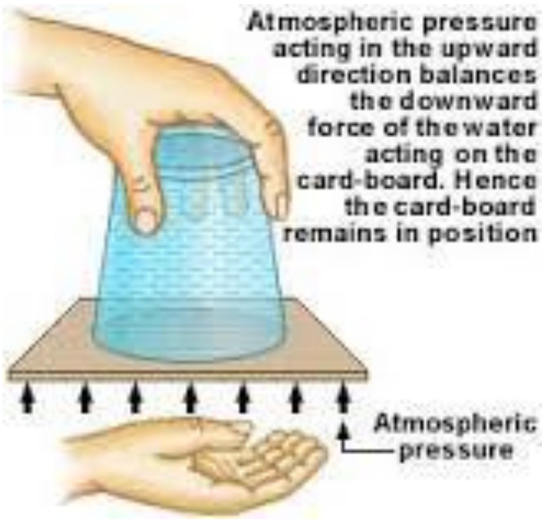
IS THERE ANYTHING THERE?

Strand	Materials	
Strand Unit	Properties & Characteristics of Materials	
Class	5TH & 6TH	
Objective	Recognise that a gas, such as air, occupies space, has mass and exerts pressure	*Investigate evidence for atmospheric pressure explore the effect of air resistance design and make a glider*
Strand	Energy & Forces	
Strand Unit	**Energy**	
Class	5TH & 6TH	
Objective	Identify and explore how objects and materials may be moved	*Using trapped air pressure (pneumatics) Using trapped liquid under pressure (hydraulics)*

ENGAGE:

Teacher Demonstration

Inverted full glass of water with a piece of card at the rim of the glass.



There are a couple places where pressure is pushing against the card. First the atmospheric pressure or the tiny air molecules all around us are randomly colliding with the bottom of the note card. This pressure holds the card up, but why doesn't the weight of the water push the note card down? Isn't the weight of the water enough to overcome the atmospheric pressure pushing against the card? That's what most people would think, but if you look at the top of the glass of water (formerly the bottom), you'll notice a small pocket of air. Actually there isn't much of an opportunity for air to get into that space, so what we've created is a small pocket of low pressure (a place where there really isn't that many air molecules). There are more air molecules pushing up against the bottom of the note card, creating a higher pressure area compared with the lower pressure area inside the air pocket in the glass. The force from the atmospheric pressure holds the card up and the low pressure zone in the glass prevents the water's weight from pushing the card down.

(source: http://www.physicscentral.com/experiment/physicsathome/magicwaterglass.cfm)

EXPLORE:

Air Storage container:

Materials: container, marshmallows (large, small, chocolate coated), balloons, Ziploc bags, bag of crisps, balloon pumps.

1. What happens when you place something in the vacuum container?
2. What causes this?
3. Is this change reversible?
4. Explore with the other materials available to develop your explanation.

Try using a small balloon in place of the marshmallows or fill the storage container with soap bubbles. What would happen if you placed a small bag of potato chips into a large storage container and removed the air? Let's say the goal was to shrink the marshmallows – how would you do it? Place the marshmallows into one of the plastic storage bags that came with the vacuum packer. When the air is removed from inside the bag, you get to see the power of the air in the atmosphere as it compresses the marshmallows.

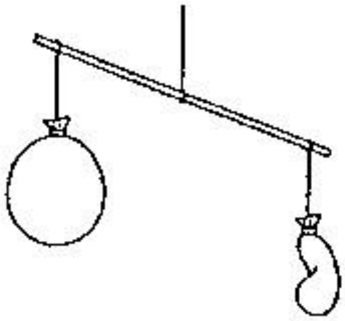
(source: https://www.stevespanglerscience.com/lab/experiments/growing-marshmallows/)

EXPLAIN

Observe the evidence that air has a mass:

Materials: Weighing scales, balloons, metre-stick, twine.

Use the materials provided to show visual evidence that air has a mass.



EXTEND

The concepts of pneumatics and hydraulics could be explored in extension Design & Make activities. Pneumatics involves the use of trapped air to move something. This could be investigates using plastic bags or balloons. Hydraulics involves the use of trapped water to move something. This could be investigated using syringes and tubing.

Further ideas are outlined on the Discover Primary Science and Maths webpage.

CENTRE OF GRAVITY

Strand	Energy & Forces
Strand Unit	Forces
Class	5TH & 6TH
Objectives	Come to appreciate that gravity is a force. Become aware that objects have weight because of the pull of gravity

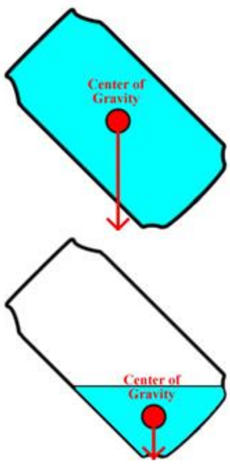
ENGAGE:

Try it out!

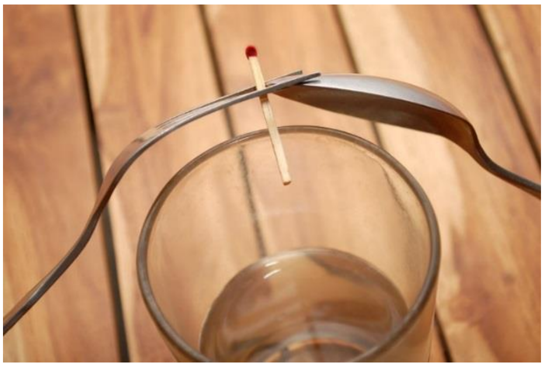
- Sit straight up on a chair, with your arms down beside you.
  Can you get up without using your arms or leaning forwards?
- Stand with your back and heels against a wall.
  Drop a coin on the floor in front of you.
  Can you pick it up without falling over?
- Stand with your feet apart, one foot, shoulder and head all touching the wall, and raise your other leg.
  Dead easy- or is it?
- Stand with two feet apart with your feet, both shoulders and head against the wall.
  Now try to lift one leg. Can you?

EXPLORE:

How can you balance the can, as illustrated in the picture below?



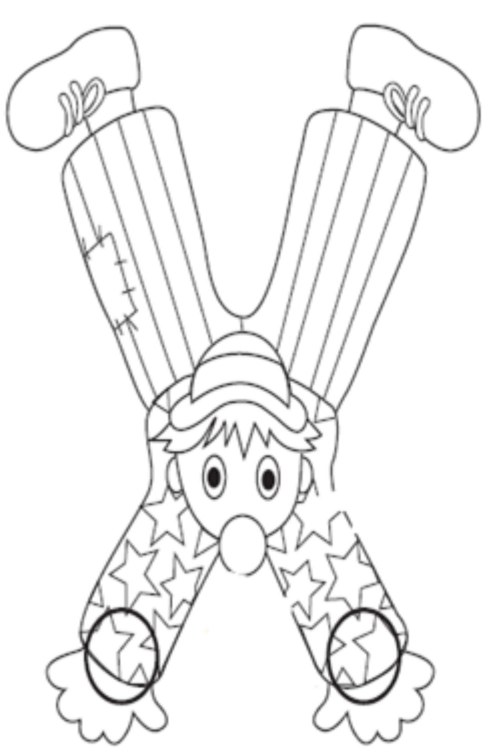
When we balance an object, we are finding its balance point, or centre of gravity. When we lower the amount of liquid in the can, we also lower and move the centre of gravity. Now the centre of gravity is directly over where we are trying to balance the can.



How can you balance the spoon and fork on the glass?

EXPLAIN:

Where should you position the additional weights (coins / plasticine) to help the clown to balance? All objects have a balancing point, called the centre of gravity. The lower you make the centre of gravity the more stable the object is.



Source: Discover Primary Science and Mathematics webpage.

EXTEND:

Link to observations from everyday life. This is why a double decker bus should fill up the bottom deck first with passengers – i.e. make the bottom heavier; the bus is less likely to topple over.

LIQUIDS-MIXING IT UP!

Strand	Materials	
Strand Unit	Mixing, separating and other changes	
Class	5TH & 6TH	
Objective	Investigate how a wide range of materials may be changed by mixing.	Exploring liquids that will not mix
Strand	Environmental Awareness & Care	
Strand Unit	Caring for the Environment	
Class	3RD & 4TH	
Objective	Identify and discuss a local, national or global environmental issue.	

ENGAGE:

Use the image of the oil spill to begin the lesson.
You can also simulate the scenario using oil, water (and additional props, island, boats) in a baking tray.
The purpose of the engagement part of this lesson is to scaffold a class discussion about the global environmental issues e.g. oil spillage, damage to marine and bird life.
Through observation using the image or teacher demonstration, pupils should notice that the oil is not mixing with the water.
Pupils can make additional observations e.g. oil floats on top etc.

EXPLORE:

Predict & Observe using Oil & Water

Materials: Water, Cooking oil, plastic droppers, Food colouring, small bottle (750ml), plastic cups, alka-seltzer tablets or other dissolvable tablets (e.g. Vit C tablets), non-dissolvable tablets (e.g. Panadol).

SAFETY: Care with tablets. Children must not consume them. Food colouring may stain hands, so some children may wish to put on plastic gloves.

- Put some water into a clear jar. Add a non-effervescent tablet. What happened? Did the tablet dissolve in water?
- Put some water into a clear jar and add a piece of Alka-Seltzer tablet. What happened? What did you see? What did you hear? What happened after a while?
- Put some water in a clear jar, and add a few drops of food colouring and mix. What happened?
- Put a little oil into a clear jar; add a few drops of food colouring. What happened?
- Put a little oil into a clear jar and add a piece of Alka-Seltzer tablet. What happened?
- Put some water in a jar and add a little oil. What happened? Why?

EXPLAIN:

Design & Make: Lava Lamp

Use the materials that were explored in the previous activity to Design & Make a Lava Lamp.

1. Find out the capacity of the plastic bottle. How would you do this?
2. Calculate a quarter of the capacity of the bottle, and put this amount of water in the bottle.
3. Now calculate two-thirds of the capacity of the bottle; measure out this amount of vegetable oil in the measuring jug.
4. Add the oil to the water in the bottle.
5. What happens?
6. Do the oil and water mix?
7. Wait until the oil and water have separated.
8. Now add about 10 or 12 drops of food colouring to the bottle.
9. What happens to the food colouring? Explain.
10. How can you make the lava lamp work?

Pupils explain their construction (layering of liquids, solubility of the food colouring, reaction of the alka seltzer with water and not with oil etc.)
The lamp can be enhanced using a torch in a dark room etc.

EXTEND:

Link to SESE: The engaging scenario in this lesson links closely to Geography.
Integration with other Science strands- Living Things: Human life processes (food as source of energy; healthy diet/indigestion/ Alka-Seltzer)

SINKING & FLOATING

Strand	Energy & Forces	
Strand Unit	Forces	
Class	INFANTS	
Objective	Investigate how forces act on objects	Group objects that will float or sink Push objects into water.
Class	1ST & 2ND	
Objective	Investigate how forces act on objects	Investigate floating and sinking with a wide range of materials and objects. Make and test predictions about objects that will sink or float.
Class	3RD & 4TH	
Objective	Investigate the pushing force of water	Compare floating and sinking in fresh and salty water.

ENGAGE:

Predict & Observe

Teacher Demonstration-

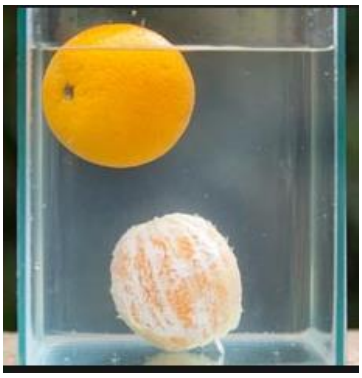
Ask the pupils to predict (examine the cans- look, feel etc.) whether each of the cans of coke will sink or float. Ask the pupils to observe each can when placed in the water.

Pupil Engagement-

Allow pupils to 'push' (various) objects into the water- to feel the force of the water causing some objects to float and allowing others to sink. Water is a force pushing against the object, enabling it to sink / float.

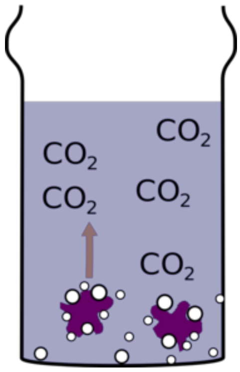
EXPLORE:

1. Can you make an orange sink?
   Materials: Large deep basin, oranges, water



The peel of an orange is full of tiny air pockets (which help give it a lower density than water), making it float to the surface. In a sense, the air pockets behave like a 'life jacket' or buoyant aid for the orange.
Removing the peel (the life jacket) makes it sink. The peeled orange has a higher density than water.

2. Why do the raisins dance?
   Materials: tall glass, 7-UP, raisins



- What happened when you first dropped the raisins in the glass?
- Why did they sink? Record your observations.
- Record your observations after 5 minutes.
- Once they started "dancing" did the raisins stay at the top?
- What else did you notice happening to the raisins? Did they look different?
- Do you think the same thing would have happened if you put raisins in water?
- What other objects do you think would "dance" in 7 UP?

Fizzy drinks are made 'fizzy' by adding carbon dioxide gas under high pressure. Check the ingredient list on a fizzy drink to see if 'carbonated water' is listed. This high pressure causes the carbon dioxide gas to dissolve in the drink. When you open a fizzy drink, the noise you hear is produced by the carbon dioxide gas as it rushes out of the can. When the can is opened, the decreased pressure allows some of the carbon dioxide gas dissolved in the liquid to escape. This is what makes the bubbles. As the drink is left sitting (in an open glass in the open air), the carbon dioxide gas continues to escape. This will also be observed by the change in taste i.e. the loss of 'fizz' from the drink. The bubbles of carbon dioxide gas rise to the top and burst at the surface of the liquid.

The surface of the raisins are rough, and so allow the bubbles of gas to attach / fir into them. These bubbles behave like a buoyant aid, enabling the raisins to raise to the top of the surface of the liquid. At the surface, the bubbles burst (life jacket is burst) and so the raisins fall to the bottom of the glass again.

3. <u>What is the difference between Diet and regular coke?</u>
   Materials: coke cans, sugar sachets, sugar cubes, can of diet and regular soft drink, weighing scales, balance.

   The pupils can set up an investigation to compare the differences between the two cans of coke (diet and regular). It is effective to allow the pupils to compare the mass of both cans. Pupils can visually add the mass of sugar to make up the difference in the mass between the two cans.

4. <u>Float in the Sea- 'Eggsperiment'</u>
   Materials: Table salt, two tall containers / glasses, spoon, tap water, 2x raw eggs

   - Have you ever tried swimming in the sea?
   - Did you notice that you could float more easily in the open waters than when you're swimming in fresh water or even in a swimming pool?
   - This 'eggsperiment' will help you understand why!

1. Fill the two containers with tap water.
2. Add about 6 tablespoons of salt in one container and stir it well with a tablespoon until the salt has completely dissolved in the water.
3. Place one egg in each of the containers and observe which one of the eggs float in the container and which one sinks.

The egg placed in saltwater floats and the one in tap water sinks. This is because saltwater is denser than fresh water, the egg does not end up sinking like it usually does!
Density refers to the amount of matter contained in a given space or volume. However, it is important to highlight that density and weight are not the same thing. (Weight refers to the vertical force exerted by a mass of object when subjected to gravity).

The the egg is denser than tap water, it pushes away the fresh water particles so it can make space for itself hence it sinks.
In the salt water, the egg floats. This is because salt water is heavier than the ordinary tap water (this can be shown by placing equal volume of both waters on an electronic balance). The salt water is more capable of holding the egg up - hence the egg floating. In easier words, objects sink when their own density is greater than the liquid's density.

CARTESIAN DIVER

DESIGN & MAKE:
This is a suitable activity to use to engage pupils in learning, to ask and answer questions, to develop and test their own ideas etc. The pupils can also develop skills through the Design & Make process: explore, plan, make and evaluate.

Materials:
2L (or tall 1L) plastic bottle, plastic dropper (if available), sachet (ketchup/vinegar/soy sauce), paper clips, cup / bowl of water.

Using plastic droppers:
If using plastic droppers, cut the long end of the dropper. Explore how much water to add to the dropper to allow it to float vertically in the bowl of water. You may need to add a weight (paper clip / hex nut) to the dropper.

Using sachets:
If using sachets (e.g. ketchup), do not open the sachet. Test to see it floats in the bowl of water when scrunched up. It needs to be able to float when scrunched up. Note: Different brands behave differently, due to different densities.

1. Fill the plastic bottle full to the brim with water.
2. Carefully add the 'diver' (dropper / sachet) as prepared and tested.
3. Screw on the cap.
4. Squeeze the sides of the bottle and hold the squeeze.
5. You should notice that the 'diver' sinks.
6. Let go and the 'diver' rises.

By squeezing the bottle, you are increasing the pressure inside the bottle. This increased pressure causes the ketchup to push against the air bubble in the packet. This causes the volume of the air bubble to decrease. As the air bubble decreases in volume the soy sauce packet will "dive" down to the bottom of the bottle.
Squeezing the capped bottle does not change the amount of air, just how much space it occupies. Essentially, squeezing the bottle causes the air molecules to pack tightly together. When the bottle is released (not tightly pressed), the pressure is lessened and the bubble volume returns to normal causing the packet to float again.

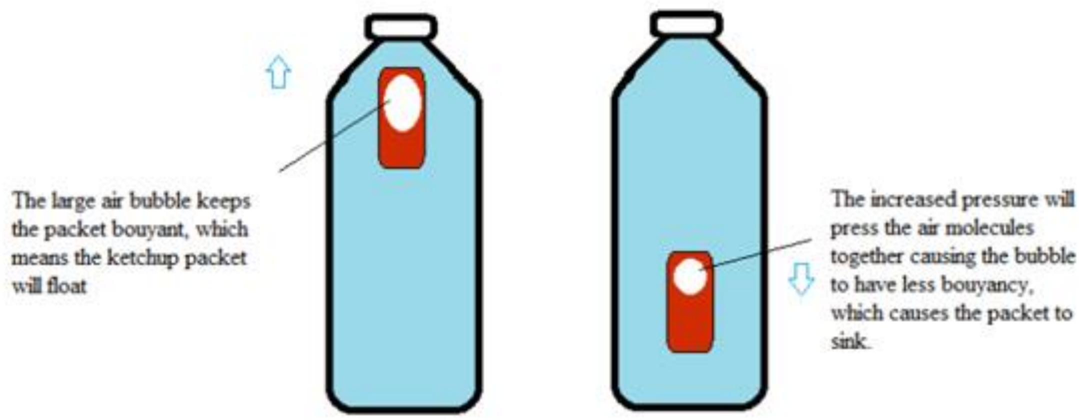


Image source: https://www.roanestate.edu/classroomunderthesea/labs/10%2009%20History%20(bends).pdf

Extension:
This Design & Make activity could be linked to other strand units e.g. study of living things in water- to design and make an underwater environment e.g. sinking and floating jelly fish.

5 STAGE PLANNER

TITLE

AIM **LEARNING OBJECTIVES**

ENGAGE

ELABORATE / EXTEND

EXPLORE

EXPLAIN

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INVESTIGATION RECORDING SHEET

INVESTIGATION	I THINK…..	SECOND THOUGHTS….	I STILL WONDER…