



CARTESIAN DIVER



AIR PRESSURE

Air molecules move incredibly fast. A single molecule is traveling at hundreds of miles an hour. They fly around bumping into everything they touch. The force (push) from these bumps is known as air pressure.

FLOAT OR SINK

Occasionally great science happens in a bath. Archimedes, a scientist from ancient Greece, noticed how his bath overflowed when he sat down in the tub. This was the spark for Archimedes' Principle, which states: that an object immersed in water will experience an upward, buoyant force equal to the weight of the water it displaces. To be able to float, an object has to displace its weight in water. Objects float or sink depending on their density, or in other words how heavy they are compared to their size. Dense objects such as rocks, cannot displace enough water to support their weight, so they sink. Less dense objects like wood, can displace their weight in water and will float.

CARTESIAN DIVER

A Cartesian Diver is a closed system used to demonstrate Archimedes' Principle. Cartesian divers are made with an air bubble, which causes them to just float when placed in water. In a sealed bottle of water, the Cartesian diver will just float at the surface. When the bottle is squeezed the pressure inside goes up and the air bubble gets smaller. As the bubble is compressed the diver fills with water causing it to lose buoyancy and sink. Releasing the pressure causes the bubble to expand again pushing out water and allowing the diver to float again.



AIR PRESSURE

A force exerted due to the movement of air molecules.

BUOYANCY

The ability or tendency to float in water or some other fluid.

DENSITY

A measurement of how tightly packed together the molecules in a substance are.

FLOAT

To rest at the surface of a fluid.

GAS

A substance that is neither solid nor liquid and can expand to fill a container. *(The air we breathe is made up of gases such as nitrogen and oxygen.)*

MOLECULE

A unit of matter; two or more atoms bound together chemically to form a substance.

SINK

To move downward, to settle at the bottom of a container of fluid.

GRAB YOUR CARTESIAN DIVER.

Gather the kids and tell them that you have invented a string so fine and lightweight that it is invisible! Tell the group that you have tied the string to the float and threaded it out the bottom of the bottle. Hold the bottle between thumb and your fingers. Act as if you are trying to grasp the “string” at the bottom of the bottle. After some difficulty trying to find it, gently pantomime pulling the “string” down. As you drop your hand, gently squeeze the bottle to make the float sink. Then release the sides of the bottle, and the “string,” to make the float rise back to the top. Invite the group to carefully examine the bottle. Have different children attempt to pull down on the “invisible string”.



Did I invent invisible string? *Open answers.*



What makes something float? *Guide them to think about weight and size.*



When you try to push a bottle filled with air under water what happens? *It is very hard. The bottle pushes water out of the way and the water pushes back on the bottle.*



How is our float in the bottle made? *It has a bubble in it.*



What happens to the bubble when I squeeze the bottle? *The bubble gets smaller and the float sinks.*



what YOU WILL NEED



1 Empty clear plastic bottle
with the label removed



1 Tall cup



1 Nut (5/16")



1 Pipette (Amazon)



1 Squid fishing lure (optional)

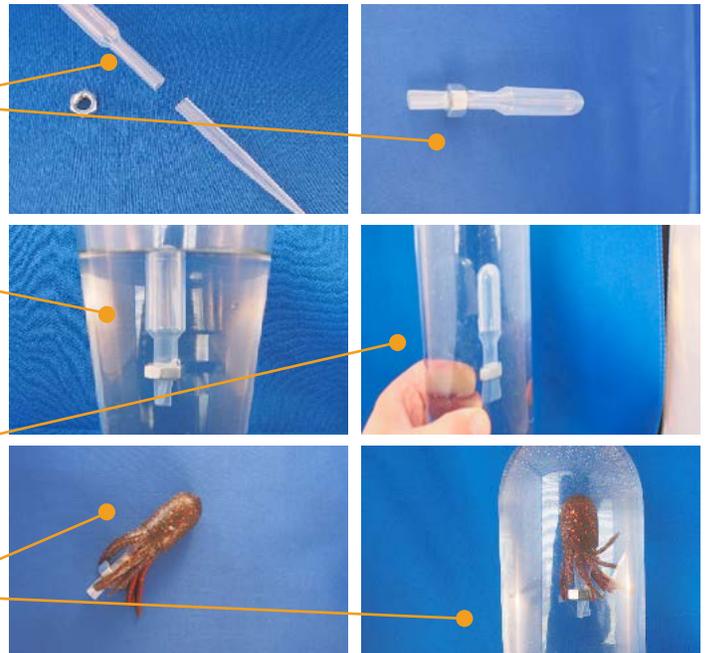
& before YOU BEGIN

Fill the cups and bottles with water. Build a Cartesian Diver before the activity and practice making the diver sink and float.

EXPLORE & EXPERIMENT

BUILD A CARTESIAN DIVER

- 1** Cut the tip off a pipette, so the pipette is about 3 inches long. Twist the end of the pipette, so the nut can be slide onto it.
- 2** Gently lower the pipette into the cup of water. Squeeze the bulb of the pipette to slowly remove air. Experiment with the size of the air bubble, so the top of the pipette's bulb just sticks out of the water.
- 3** Place the pipette in the bottle of water. Twist the cap on the bottle on to seal it. Squeeze and release the bottle to make the diver go up and down.
- 4** To make the diver look like a sea creature, use a squid shaped fishing lure and slide it over the bulb of the pipette.



EXPERIMENTS

- 1** Provide the group with pipettes, different sized nuts, clay and cups of water. Challenge the kids to find the right combination of pipette length, weight and bubble size to get their divers to just float.
- 2** Have young people bring bottles from home and experiment to determine if the size of a bottle affects how well the diver works.
- 3** Add a cup of salt to the bottle of water and shake to dissolve it. How does salt water effect the performance of the divers? Does the bubble have to be bigger or smaller?

EXTEND & EVALUATE

Provide craft materials such as craft sticks, cups and plates. Challenge young people to make a boat capable floating while supporting a ball of clay. Their boats will need to displace enough water to support the weight of the clay.

make THE CONNECTION



SCUBA DIVERS AND SUBMARINES HAVE TO BE ABLE TO FLOAT AND SINK JUST LIKE CARTESIAN DIVERS. Scuba divers use a tank of air to swim under water. That tank acts just like the bubble. To sink, scuba divers have to wear weight belts to counter the effect of their tank “bubbles”. Submarines are built with huge empty tanks inside them. To sink they fill these tanks with water. This makes the submarine denser and causes it to sink. To surface they blow air into their tanks. This air creates a bubble that makes the submarine less and dense and cause them to float.