

# Soy Sauce Diver

## Materials

- Soy sauce fish (from sushi)
- Food colouring
- Blu Tac
- Clear plastic bottle with lid
- Jug of water



## Instructions

1. Squeeze all of the soy sauce out of the fish and rinse the fish out with water.
2. Add a drop of red food colouring to some water.
3. Fill the fish until it is about  $\frac{3}{4}$  full of water, with a bubble of air remaining.



4. Screw the lid onto the fish and wrap some Blu Tac around the base of the lid.
5. Place the fish in the jug of water. If the fish sinks, tear off some Blu Tac until it barely floats. If the fish floats high in the water, add some more Blu Tac until it only just floats.



6. Fill the bottle with water until it is as full as possible.
7. Push the fish into the bottle and screw the lid tightly onto the bottle.
8. Squeeze the bottle and watch the fish dive!



**HINT:** If it doesn't work the first time, empty the water out of the bottle, take out the fish and repeat Step 5. Adjust the amount of Blu Tac on the fish and test it by pushing the fish down into the water. The fish must always float back up to the top for the diver to work.

### What happens?

The Soy Sauce Diver is a classic science toy that is also known as a 'Cartesian Diver'. There are a couple of different forces acting on the fish to make it either sink or float. When the fish is floating, the 'buoyant force' pushing it up is greater than the force due to gravity pulling it down. When the fish sinks, the force due to gravity is greater than the buoyant force.

When the bottle is squeezed, a force pushes in on the fish and the air bubble in the fish is squashed. The air bubble becomes smaller, making the fish less buoyant, and the fish sinks. When the squeezing force is removed, the air bubble becomes bigger, the fish is more buoyant, and the fish floats.

Another way of thinking about how the fish floats or sinks is to consider the overall density of the fish. Density is the amount of mass in a given volume. When the fish is floating, it has a lower overall density than the water in the bottle. When the bottle is squeezed, the air bubble is squashed to a smaller volume and the overall density of the fish becomes greater than the density of the water, so the fish sinks.