

Fantastic Forces

Sinking and floating

Info:

You know that a stone sinks when you throw it in the pond and Styrofoam floats. But why does that happen? It was the Greek Archimedes who first investigated this. And he discovered some very interesting things.

Upthrust

Take a bath tub filled with water and a football. Try to push the football under water. You will find that this is very difficult. It seems as though there is a force pushing it back up. This force is called upthrust, which is caused by the pressure of the water against the ball. When you put the football in the water, two opposite forces are working. Upthrust wants your ball to go up and the weight of the ball (gravity) wants it to go down.

How big is the upthrust?

When you push your ball into a bath tub filled to the top, some water goes out. The water was pushed out by the football. Archimedes discovered that the upthrust working on the object is the same as gravity working on the weight of the water it pushes aside.

Does it float or sink?

When the object pushes away more water than its weight, the ball floats and the upthrust is bigger than the weight of water. When it pushes away less water than its weight it will sink.

Ships

So how does a ship that weighs thousands of tons, built of steel, float? This has to do with the surface. When you take a ball of aluminium foil and throw it into the tub it will sink. When you fold a boat it will float.

This is because the volume surrounded by the aluminium surface is much bigger than the ball. The same applies to the ship. It has a very large surface. It is built so that it pushes away so much water (weight), that it's much more than the weight of the ship.

Submarines

And how do submarines work? A submarine contains special tanks. They can contain either water or air. The upthrust of the submarine is always the same (because it does not get any bigger)! When the submarine is on the surface the tanks are filled with air, so the amount of water the ship pushes away is the same as the upthrust.

Fantastic Forces

When it's diving the tanks fill with water. The submarine becomes heavier and sinks. When it goes back to the surface air is blown into the tanks and water pushed out to make the submarine lighter again.

Facts:

Divers wear special belts made of lead. Without it they would not sink, because their bodies are lighter than water.

You can test if an egg is fresh or old. Place your egg in water mixed with salt. Fresh eggs sink and old eggs float.

Experiments:

1. You need: plastic pen cap, model clay, a glass of water, a soft-drink bottle (with lid) filled with water, paper clips

What you do:

1. Take the pen cap and attach a small piece of modelling clay to it.
2. If there are holes in your pen cap, you have to seal them with modelling clay.
3. Now put your creation in the glass of water. The bubble of air trapped in the cap should be big enough to make it float.
4. Take your diver out of the glass and attach some paper clips to it as weights.
5. Put your diver in the bottle with water
6. Screw the lid on
7. Squeeze the bottle gently.
8. Release the bottle.
9. Experiment with the number of paper clips to see how your diver works with extra weight.

This is how it works:

When you squeeze the bottle, water is pushed into the cap. The air bubble becomes too small and your diver sinks. When you release the bottle the extra water goes away and the air bubble becomes bigger so that your diver goes up again.

2. You need: paper clips, dishwashing liquid, a tissue, aluminium foil and a tray filled with water

What you do:

1. Make your own water skaters using the aluminium foil and the paper clips. Give them six legs each.
2. Put your water skaters on the tissue. Hold it with both hands. Make sure you keep it tight and place it very carefully on the water.
3. Look what happens. Wait a moment and add some soap.

This is how it works:

Fantastic Forces

Molecules on the surface of the water attract each other. This is called surface tension. The surface is like a thin sheet of paper on which things can float. When you add soap, you break this tension and your skaters sink.

Famous scientist:

Archimedes of Syracuse (287 BC-212 BC)

Nationality: Greek

Life: Archimedes's father was a smart man and he wanted to become smart too. Therefore he went studying in Egypt. Archimedes lived in times of war but still discovered a lot of important things.

How he discovered sinking and floating: Of course he did not discover sinking and floating. But discovered why a stone sinks and a football does not. Archimedes worked for king Hieron. Hieron ordered Archimedes to find out whenever his crown was made of real gold.

Archimedes did not know what to do. And the time passed really fast. In the end he had a long bath to see if he would get any inspiration. When he stepped into the tub he discovered something unbelievable. Water was going out. He thought this must have happened because his weight pushed the water out. Turn over to read more...

Continuation of his life: And he ran out on the street shouting: "Eureka, Eureka!". Which is Greek for: "I've got it, I've got it!". And how did he solve the problem: He took a bath filled with water and put the crown into it. He then measured how much water disappeared. After that he took some real gold of exactly the same weight and repeated the process. He discovered that the water that disappeared was not the same and he proved the crown was not made of real gold...

Other inventions: Archimedes invented a lot of things beside his law on sinking and floating. He also discovered a device to irrigate the farmers land called Archimedes's screw. This is still used in Egypt today. He also discovered war machines, cranes, pulleys and many other machines.

Extra info:

Hot-air balloons

You can also float (and sink) in the air with for example a hot-air balloon . The balloon floats because hot air is used. Air is built up of molecules. When you heat the air the molecules come further from each other. So hot air is much lighter than cold air. As the balloon is lighter it will start floating. Maybe you understand that it is much easier to fly on cold days, because the difference in temperature is bigger.

Fantastic Forces

And there is also the pressure of the atmosphere. The higher you fly, the lower the pressure. So the balloon would get bigger the higher you go. Turn over to read more...

But the balloon is not closed completely and to stop the balloon from exploding they let some air escape. When you want to descend again, you slowly stop heating the air and the balloon gets heavier and goes down.

Whenever something sinks or floats also has to do with the density. Oil floats on water, because it is less dense. It means that the molecules are further from each other. An object that is very dense is also much heavier, so more gravity pulls it down (gravity gets greater as the object weighs more)

Bike

You can only discover sinking and floating if you throw your bike into the pond. Most likely your bike sinks (so maybe don't try this at home). Can you pressurise your tyres to make it float? Well, unfortunately not. Your tyres reach the elastic limit long before there is enough air in them. Maybe you can try to use balloons to make your bike float.