Buoyancy and floating

Physics > Mechanics > Mechanics of liquids & gases

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f4d4f55ce572a000382d638

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Teacher information

Application

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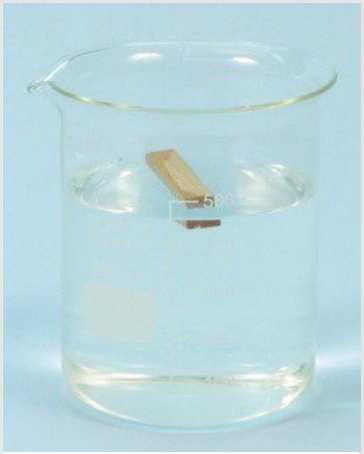

Floating wooden column in a container filled with water

In this experiment, students will learn the relationship between the weight of a body and the resulting absorption force in relation to the swimming or sinking of a body. If an object is placed in a resting fluid - in this case water - its weight force F_G and the resulting buoyancy force F_A in opposite directions:

$$\Sigma F_y = F_A - F_G$$

The strength of the static lift results from the Archimedes' principle, i.e. it depends on the weight force that has acted on the fluid displaced by the body. Often the density of the body is compared with the density of the fluid in order to make a statement about sinking, floating or rising of the body. Is F_G is fully compensated, the body floats on the water surface like the column in the illustration.

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Other teacher information (1/2)

Prior knowledge

Students should already have a basic understanding of the weight of bodies, their density and volume.

Scientific principle

A body immersed in a fluid at rest seems to lose weight. This phenomenon is called buoyancy. The weight of the body F_G there is a buoyancy force F_A which, depending on the nature of the body, can even completely compensate for the weight force.

Other teacher information (2/2)

Learning objective

The students should learn from different bodies what the nature of the body is that determines whether a body floats or sinks in water.

Tasks

To do this, the students are to place different bodies in a beaker of water and observe whether they are swimming in water or not. They should also check whether the volume of the bodies or their shape has an influence on their buoyancy.

Note: Since the plasticine mass is not to be exactly defined, the number of balls that the shuttle can carry is also undetermined. It is important that the students realize that if a certain mass is exceeded, the load-bearing capacity is no longer sufficient, and the shuttle will sink.

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Other teacher information (2/2)

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Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

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Student Information

Motivation

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Ship on water

As you know, ships float on water. The reason for this is the static lift a body experiences in a liquid. This buoyancy can, as is the case with a ship, even overcompensate for the weight of a body. Thanks to the buoyancy force, a ship weighing many hundreds of tons is able to float on the water without sinking.

However, you cannot load ships with arbitrary weight. At a certain load, every ship would start to sink.

In this experiment you will learn on which parameters it depends whether a body is oscillating or sinking.

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Equipment

Position	Material	Item No.	Quantity
1	Beaker, Borosilicate, low form, 600 ml	46056-00	1
2	Aluminium column	03903-00	1
3	Wood column	05938-00	1
4	Rubber ball,diam.15 mm	03921-00	1
5	Tubing connect.,T-shape,ID 8-9 mm	47519-03	1
6	Rubber stopper 26/32, 1 hole 7 mm	39258-01	1
7	Plasticine, 10 sticks	03935-03	1

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Procedure (1/3)

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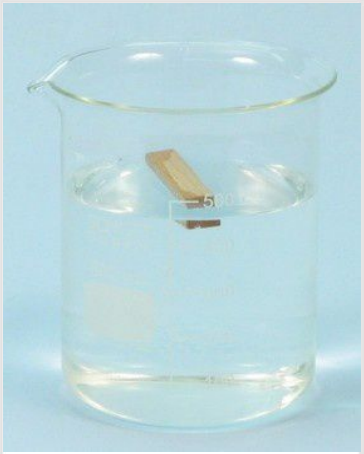

Floating piece of wood in a beaker

- Fill the beaker to about 3/4 with water and place the aluminium and wooden column, the rubber ball, the piece of plasticine, the connecting piece (plastic) and the rubber stopper one after the other in the water.
- Observe whether the bodies sink or swim and record your observations in the log.

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Procedure (2/3)

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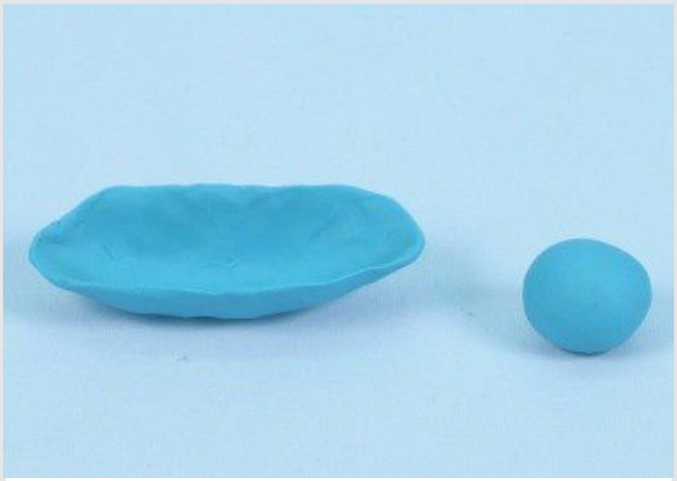
- Divide the plasticine mass into two halves of approximately equal size. Form one half into a ball, the other into a plate from which you knead a boat.



Shuttle and ball made of plasticine

Procedure (3/3)

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Shuttle in a beaker filled with water

- Place both parts in the water and check if they sink or swim. Enter the results in the table in the protocol.
- Now form a shuttle from the ball and a ball from the shuttle. Put both parts back into the water, repeat the experiment and note the results in the table.
- Divide the plasticine ball into about ten small balls of the same size, place the boat on the water and load it with the small balls one by one. Write down your observations in the protocol.

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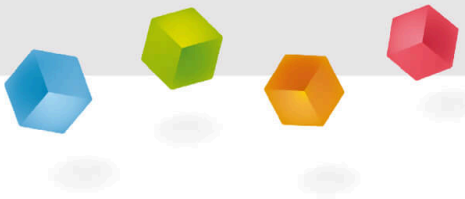

Report

Table

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Note your results in the table.

	object floats? (yes/no)
(a) Bullet	
(a) boats	
(b) Bullet	
(b) boats	

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Task 1

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Distinguish the investigated materials into floating and non floating materials.

(Note: Sort the materials per category in alphabetical order)

Floating materials: _____ , _____ , _____

Non-floating materials: _____ , _____ , _____

plastilina

wooden column

rubber ball

aluminium column

Rubber plug

joint

Check

Task 2

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Does the buoyancy depend on the material of which the body is made?

- ○ Yes, the buoyancy depends on the material.
- ○ No, the buoyancy is independent of the material.

Check

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Task 3

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Is there a connection with density?

(Think of the density of water $\rho = 1\ g/cm^3$)

- ○ Yes, if the density of the body is lower than that of water, it sinks into water.
- ○ Yes, if the density of the body is lower than that of water, it floats.
- ○ No, the buoyancy of a body depends only on its volume.

Check

Task 4

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Does the buoyancy of the body depend on its volume?

- ○ No, the buoyancy does not depend directly on the volume, but only on its shape and the resulting displaced water volume.
- ○ Yes, the buoyancy depends only on the volume of the body. The shape and the amount of water displaced does not play a role.

Check

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Task 5

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Why does the ball made of plasticine sink, but the shuttle made of the same material and mass does not?

- ○ The ball goes down because the mass is increased when the ball is formed.
- ○ The amount of water displaced is much greater in the boat form than in the sphere, so that the boat made of plasticine floats despite the same mass and density ρ > 1 g/cm³.

Check

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