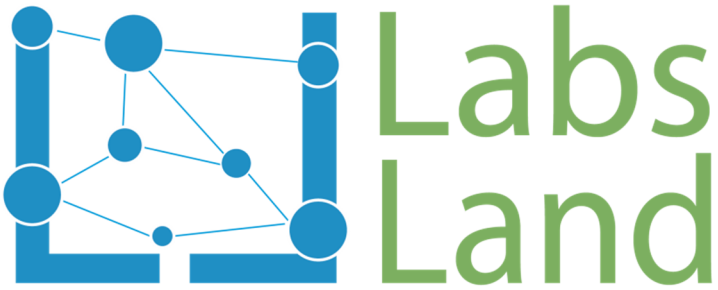

ARCHIMEDES REMOTE LAB: why do objects float?

Rev: 1.0 (Feb/2018)

Authors: Unai Hernández (unai@labsland.com)
Javier Garcia Zubía (zubia@labsland.com)

Labs Land

Content

1 The Lab

The Remote Laboratory to experience the Archimedes principle offered by the University of Deusto allows the user to experimentally check when and how much a body sinks or floats depending on its volume and mass.

The remote lab called Archimedes offers several tubes filled with different liquids. Each tube has a suspended object so that it can be lowered by an arrow. When lowering the object, you can see if it floats or not, and you can also see if it floats "too much or too little".

To access this laboratory, you only have to register at labsland.com and access through the link indicated by the following figure:

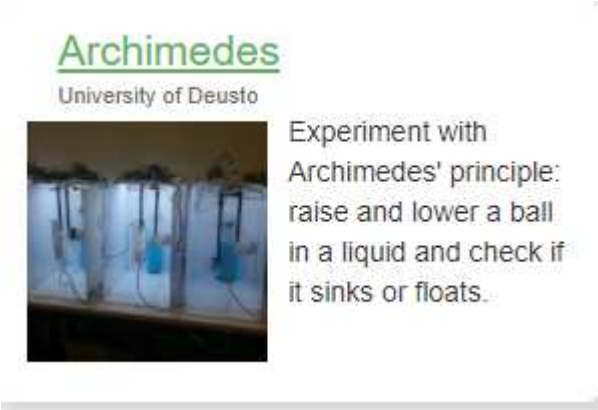

Figure 1. Access to the Archimedes Remote Laboratory of the University of Deusto from LabsLand site

Each of the objects has an associated mass and volume. This data can be viewed on the remote lab user interface.

Below you can see some additional images. To the left a ball full of marbles before lowering, and to the right the same ball after activating the lowering arrow has submerged, does not float.

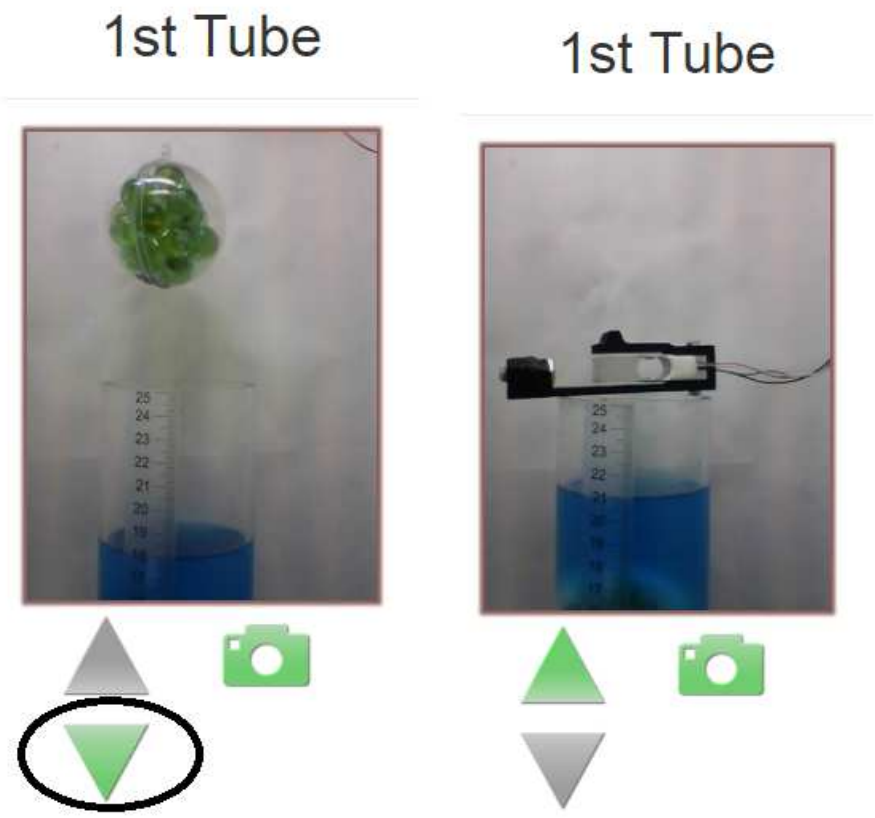

Figure 2. Example of how to raise and lower a ball in the Archimedes experiment

In detail, in this laboratory the user can find:

1. Tubes of 7 centimetres in diameter which are provided with a ruler to visualize and measure the level of the liquid they contain.
2. The tubes are filled with water and alcohol and another liquid with different densities.
3. Different objects to be introduced and removed from the liquid. Objects will be similar and different from each other: the same volume and different weight, the same weight and different volume, different weight and volume, but the same density, etc.

In addition, the user has a control interface with:

4. Two arrows that allow you to raise and lower objects in the tubes. These arrows are connected to a motor that executes the user command.
5. A webcam to observe the experiment in real time and see if the object floats or not.
6. A "camera" function that allows you to take pictures of objects in and out of the liquid

7. A graph showing the object's weight change over the course of the experiment

Finally, the interface provides a series of values with information about each of the experiments:

8. A panel with information regarding the object: its mass, diameter, density and volume.
9. A panel with information about the liquid: its density and the diameter of the tube.
10. The information captured by the sensors of the experiment in real time: object weight and liquid level in the tube.

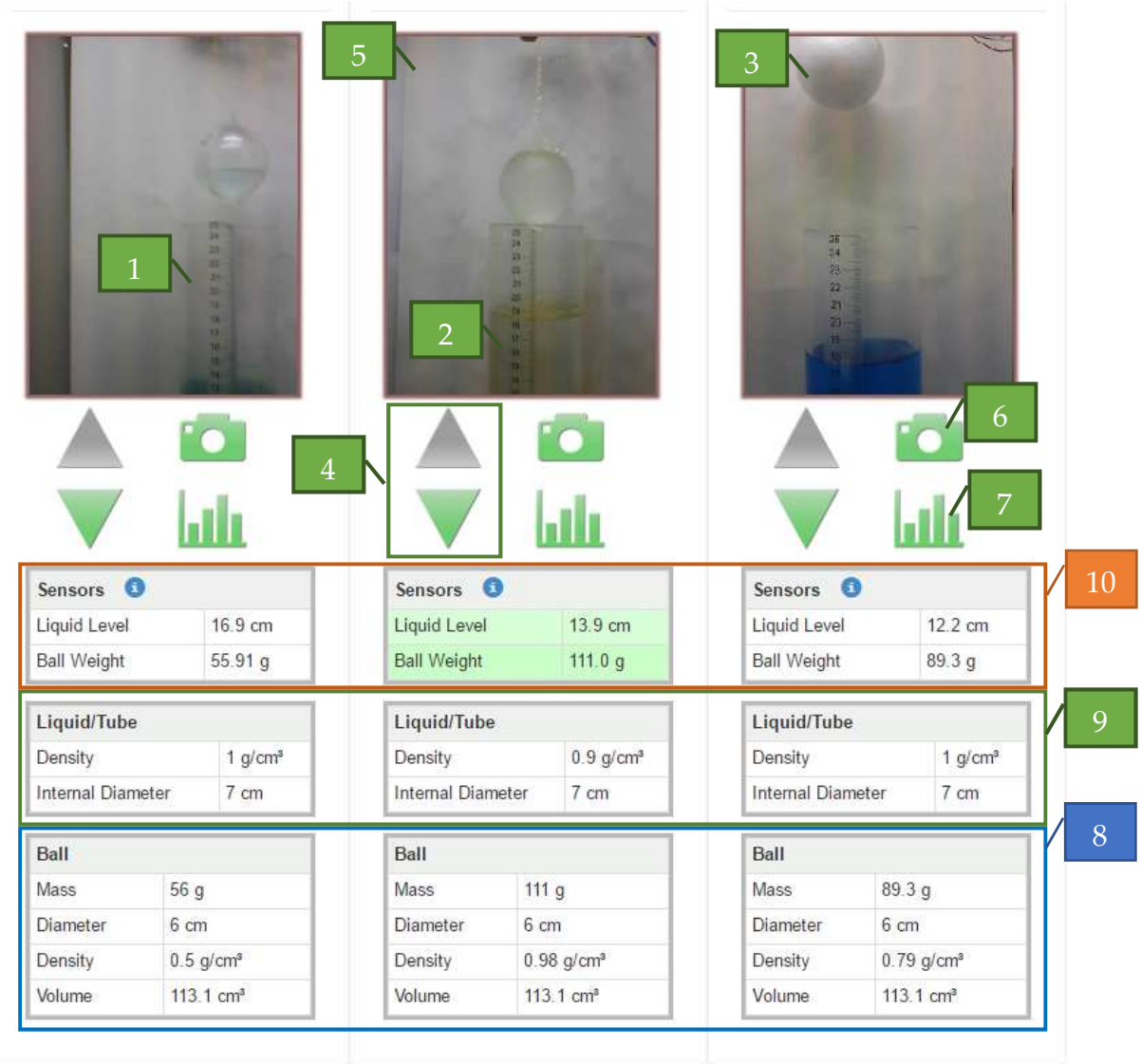

Figure 3. Archimedes Remote Laboratory user interface

2 Hypothesis that may arise during the experiment

Well, at this point it makes sense to make assumptions based on the following questions:

- Does it depend on the mass alone whether an object floats or sinks?
- Does it depend on the volume of an object floating or sinking?
- Does it depend on mass and volume whether an object floats or sinks?

3 Experiments to validate responses to the hypotheses put forward

The experiment is very simple, although it is very formative because it allows the scientific method to be approached with rigour. Basically, it consists of fixing the variables that affect the observed fact (mass and volume), changing a variable (the mass) keeping the other one fixed (the volume) and observing and writing down whether the object sinks or floats and then repeating changing the variable varied (volume) keeping the other one (mass) fixed.

The attached table should help you carry out the experiment.

Object	Mass	Volumen	Sinks	Floats	
Object 1: ball full of marbles	135 g	113,09 cm^3	X		
Object 2: ball full of gliceryn	140,2 g	113,09 cm^3			
Object 3					
Object 4					
Object 5					
Object 6					
Object 7					
Object 8					
Object n					

You must fill in the table carefully. You can share this work or the results with colleagues.

4 Conclusions

Conclusions must now be drawn based on the obtained data. To do this, you should look for answers to the three questions above:

- Does it depend on the mass alone whether an object floats or sinks?
- Does it depend on the volume of an object floating or sinking?
- Does it depend on mass and volume whether an object floats or sinks?

The answers are given in the table above. Here's a clue:

- Do all objects float with equal volume? do they all sink? some sink and some don't? what conclusion do you draw?
- Do all objects float with the same mass? do they all sink? some sink and some don't? what conclusion do you draw?

If in the two previous situations the answer is "some sink and others don' t", then it turns out that only mass or volume alone is not decisive.

In this case the question is, can you find a relationship between mass and volume that indicates when an object sinks or floats? This relationship must be evident.

At this moment you have probably already discovered the concept of density, its usefulness and how to calculate it, that is, now you can predict whether an object will sink or float before throwing it into the water. why doesn't a ship sink? What calculation do you think you must make if you're going to load the boat full of bananas?