



Datalogging with Handheld Technology

KS3 Science

Unit 7K: Forces and their Effects

Why do things float?

This year 7 unit has many opportunities to exploit the learning potential offered by personal datalogging. Extensive use of Force sensors is at the heart of the datalogging in the aspect covered here. The focus of this session is taken from the QCA specification:

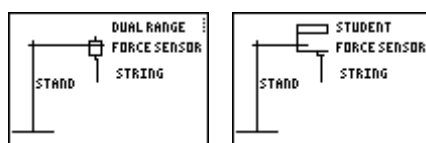
Why do things float?			
<i>Learning Objectives</i>	<i>Possible teaching activities</i>	<i>Learning outcomes Pupils</i>	<i>Points to note</i>
<ul style="list-style-type: none"> • how to measure forces • that when objects are immersed in water there is an upthrust on them • to draw conclusions from experimental results • that when objects float the upthrust is equal to their weight • that density is mass divided by volume • to choose which measurements and observations to make • that upthrust is different in different liquids 	<ul style="list-style-type: none"> • Review what pupils know about forces with a quick activity: weighing objects with a force meter. • Ask pupils to predict which objects will float, and to weigh them in air and immersed in water. Compile a table of results and ask pupils to identify patterns and draw conclusions from these. Ask pupils to record their results and explanations ... show how to calculate density. Displacement of water can be used to measure volume • Tell pupils of claims that it is easier to float in sea water than in fresh water. Ask them to suggest how they could test this. 	<ul style="list-style-type: none"> • use a force meter • state that all the objects weigh less in water than in air • explain their observations in terms of an upward force from the water 'cancelling out' some of the downward force of the weight • recognise that objects which float show a zero weight reading • state that an object will float in water if it is less dense than water • make measurements which enable them to test the claim • state that some liquids produce a greater upthrust on an object than others 	<ul style="list-style-type: none"> • Pupils may have met the term 'density' but will need help with calculations. • Extension: teachers may wish to extend this work to a discussion of density. • Pupils could be asked to find out about buoyancy aids and how these help them to float. • Pupils will measure the density of objects using displacement in unit 8H 'The rock cycle'. • Archimedes checked the purity of a gold crown by measuring its volume by displacement

Other datalogging activities in this unit: "How do different materials stretch?", "What is weight?", "What does friction do?" "What affects how quickly a car stops?"

Activity:
Why things float.

This activity will generate data on the weight of objects in air, in water and possibly in other liquids. Pupils will also have information on the displacement of the objects and the weight of the displaced liquid.

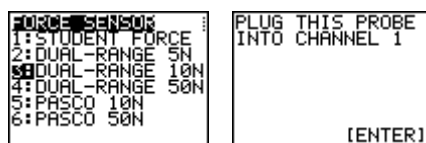
1. Attach the calculator to the CBL/CBL2.



2. Set up the retort stand, force sensor and string as in one of the diagrams shown above. Note that there are two force sensors in common use: the Student Force Sensor (grey in colour with a torsion bar), and the Dual Range Force Sensor (black with a hook underneath and a 10N/50N range option switch).
3. Run the Physics APP/program, press [ENTER] as invited.



4. Select the SET UP PROBES option. You are going to use just one probe, a force sensor, in the picture below a Dual Range Force Sensor in the 10N range was used.

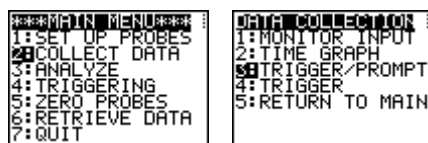


5. Attach the force sensor to channel 1 of the CBL/CBL2 as instructed.
6. You have the option of calibrating the sensor or using the calibration stored in the CBL/CBL2. Unless you have reason to suspect the accuracy of the sensor, it is acceptable to use the stored calibration.

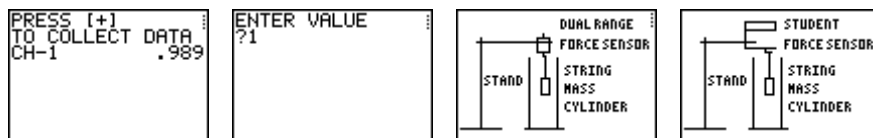


7. It is advisable to ZERO PROBES given that the force meter will already be registering the weight of the string. Remember that the sensor is in channel 1. Once the reading on the screen is steady carry out the instruction.

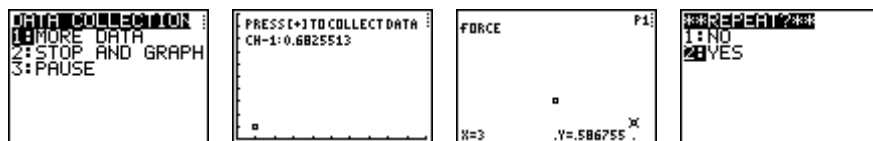
8. The force meter is set up to COLLECT DATA - the weights of the objects in air, ...



9. Attach the first object, say the "mass" to the string and select TRIGGER/PROMPT. When the reading is steady press [+] to record the weight (in N) displayed. Then key in a code to represent "weight in air", in the case below, 1 has been used.



10. Now the weight of the object in water will be found. Fill the measuring cylinder with a known volume of water, say 100ml - enough to ensure that the object is completely submersed (unless it floats). On paper, record the new level of the water, hence determine the displacement of the object.
11. Return to the data logger. Select "MORE DATA" and, when the reading has steadied, press [+]. Key in a new code (say 2 for "weight in water").



12. Now weigh the object, see steps 10 and 11, in another liquid, say sea water. The third diagram above shows the weights in one experiment were 0.99N, 0.68N, 0.59N in air, water, sea water.
13. Explore the difference in the apparent weight of the object and the weight of the displaced liquid (the densities of the liquids are needed). This exploration could be conducted using the graphing facility of the calculator (the weights are in list L2).
14. Use another object and REPEAT the process to find its weight in the three conditions. Detach the first object and repeat steps 9 to 13 for the next object, say a short blunt pencil.

Possible Extension Work

- ◆ The putty/clay/plasticine provides an opportunity for the pupil to explore further the concept of displacement of liquid (as opposed volume of object) by using it as a "blob", then shaping it as a boat/cup/glass so that it floats.
- ◆ Pupils could find out about buoyancy aids and how these help them to float.
- ◆ Teachers could engage pupils in discussions of density.

Links

- ◆ Further opportunities to use the force sensor are presented within this Unit: stretching, friction, weight versus mass.
- ◆ Pupils do more work on density in Unit 8H: "The Rock Cycle".
- ◆ Unit 9K: "Speeding up" covers the effect of balanced forces on a moving object.

Safety

Water and electricity!
This can be a dangerous combination, so care is needed.

Measuring cylinders are often made from glass, the objects may be hard and heavy. Care must be taken to avoid breakage.

Datalogging kit

- ◆ TI -73, TI -82, TI -83 or TI -83 Plus graphing calculator
- ◆ CBL or CBL2
- ◆ Dual Range Force Sensor or Student Force Sensor
- ◆ TI -GRAPH LINK™ and cable
- ◆ Physics APP (TI -83plus) or program group (TI -73 or TI -83)
- ◆ optional: VewScreen™, vs-calculator and OHP

Apparatus required

- ◆ retort stand
- ◆ string/cotton
- ◆ metal mass, dense objects
- ◆ lump of putty/plasticine/clay/...
- ◆ pencil (blunt!), wooden blocks
- ◆ transparent measuring cylinders
- ◆ water
- ◆ salt solutions e.g. sea water

Useful web sites

www.ti.com/calc/docs/graph.htm
www.vernier.com
www.oxford-educational.co.uk
www.qca.org.uk