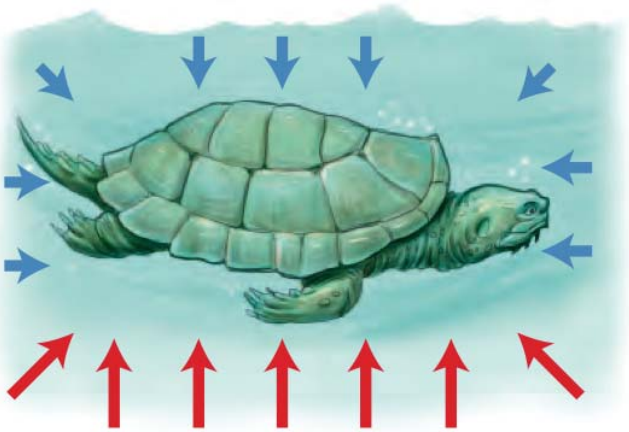
Grade 8 Science

Fluids

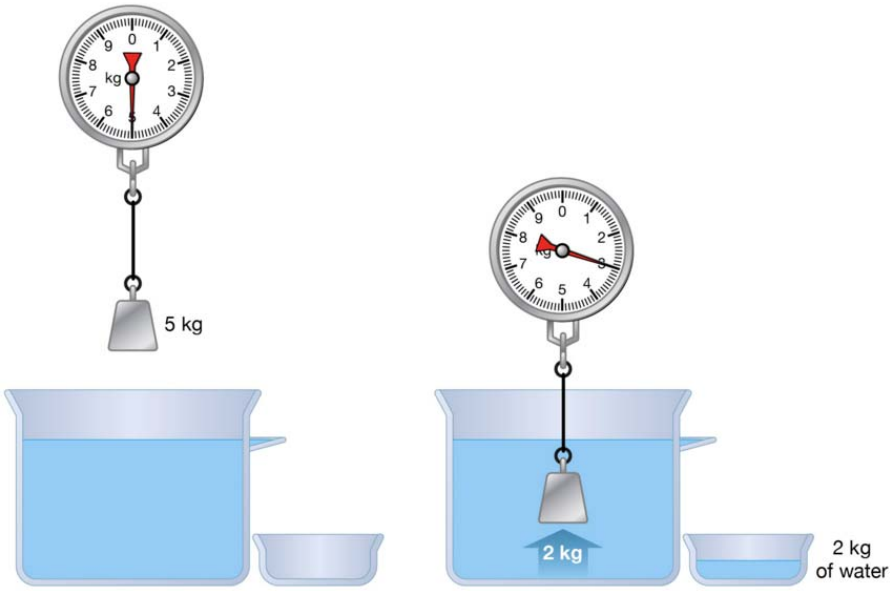
Class 12

Buoyancy

- Buoyancy – upward force that a fluid exerts on an object; determines whether an object sinks or floats



- Archimedes' Principle – the buoyant force is equal to the weight of the displaced water



- Force of gravity acting downward on a floating object is equal to the buoyant force of the water acting upward on the object

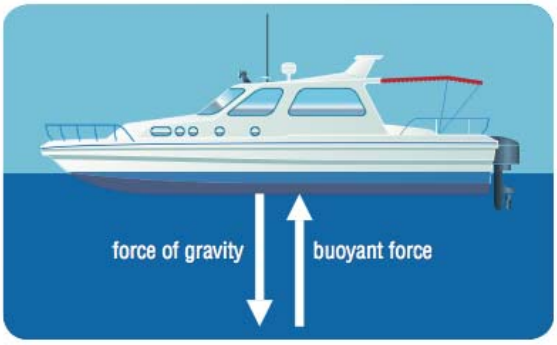
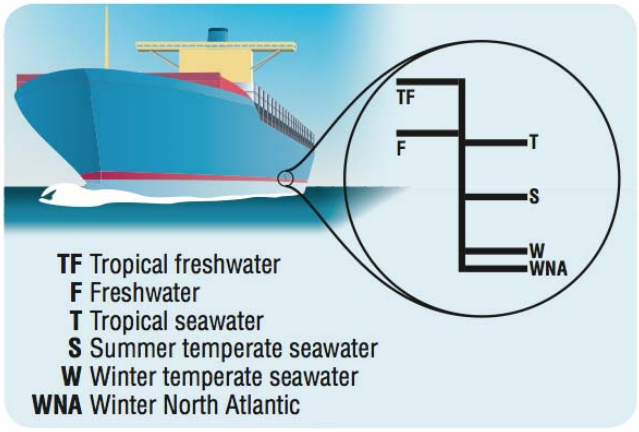


Figure 2 The buoyant force equals the weight of the water displaced by the object.

- Large ocean freighters can carry more cargo since the displacement of water is large so buoyant force is large

- Each fluid has a different buoyancy
- Ships have a Plimsoll line painted on their sides
- Markings show what level the ships will float in different types of water



- 20-ton piece of the hull of the Titanic was salvaged
- Large, diesel-filled flotation bags were attached to the hull
- Underwater trees can be rescued by attaching an inflatable, reusable airbag to each tree

Oil and Water

- Oil is usually less dense than water; floats on water
- Oil is harmful to organisms:
  - Contaminates their food
  - Blocks their breathing passages
  - Destroys insulating effect of their fur or feathers

- Oil spills can be cleaned up easier since oil floats on top of water
- Floating booms encircle oil spills
- Collection devices scoop, soak or suck up much of the captured oil

Airships, Balloons and Blimps

- May 6, 1937 – German airship *Hindenburg* caught fire while it was docking and burned within seconds
- Airship was made of hydrogen gas
- 36 people died from the accident

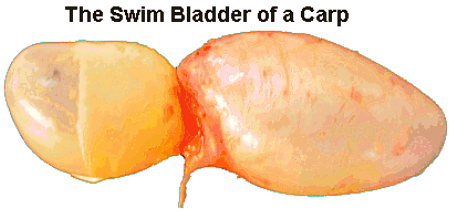
- Lighter-than-air crafts are now used mainly for advertising and recreation
- Some are made of helium, some are made of hot air
- As heated air rises into the balloon, cooler, heavier air moves out of the opening allowing the balloon to rise

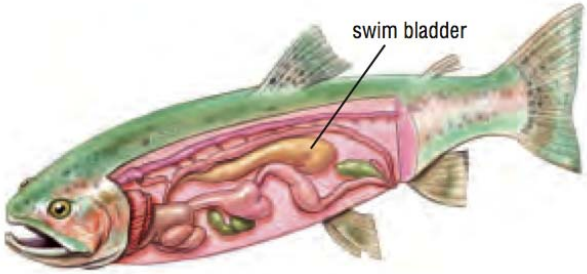
Importance of Buoyancy

- Water hyacinths have numerous air chambers in its stem to allow it to float
- Humans use flotation chambers that are similar to water hyacinths for life preservers, float plane pontoons and pool chairs

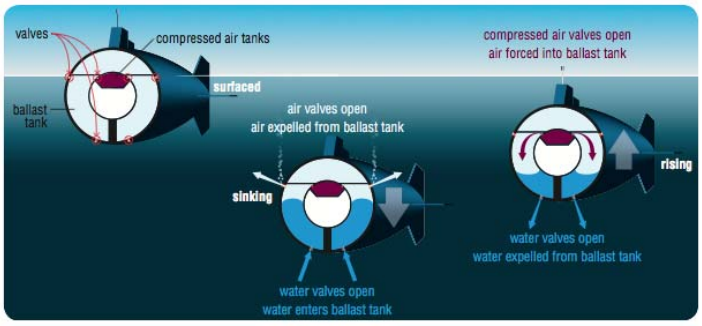


- Fish maintain their position in water through a swim bladder, a thin-walled sac that contains oxygen
- Oxygen comes from dissolved oxygen in the water and enters and leaves the bladder through the fish's blood

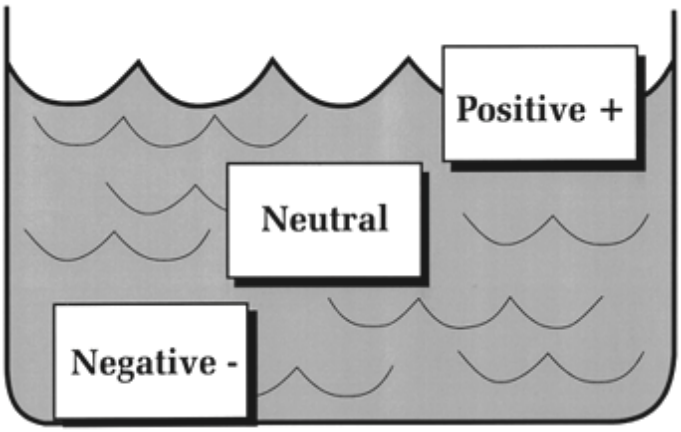




- Submarines contain ballast tanks in place of the bladders
- Ballast tanks can be filled with air or water to control the depth of the submarine
- To descend, water fills the ballast tanks
- To ascend, air from air tanks displaces the water



- Positive buoyancy – object begins to float upward
- Negative buoyancy – object begins to sink
- Neutral buoyancy – object remains in one place



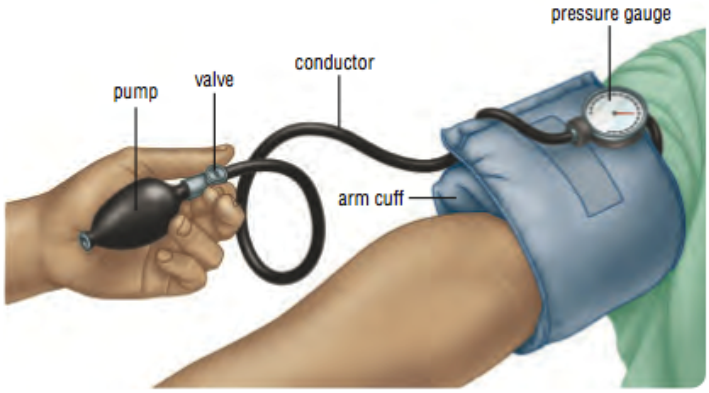
Compressibility

- Is it easier to compress air or liquid?
- Particles of a gas are much farther apart than those of liquids
- Compressibility – the ability of a substance to become more compact when squeezed

Types of Fluid Systems

- Pneumatic systems – use pressurized air or other gases to do work
- Hydraulic systems – use pressurized liquids (often oil) to do work
- Both are closed systems – no material enters or leaves the system

- Components:
  - Pump – forces fluids through a system
  - Conductors – provide a pathway to carry the fluid
  - Valves – keep the fluid moving in the desired direction at the desired time
  - Pressure Gauge – monitors pressure within the system



Pressure

- Pressure – force applied to a unit of surface area

$$p = \frac{F}{A}$$

- Unit: pascals (Pa) where 1Pa = 1N/m^2

Checkpoint

An aquarium is filled with water that weighs 10 000N. If the base of the aquarium has an area of 1.6m^2, what pressure does the water exert on its base? Use the GRASS method.

Checkpoint

If the atmospheric pressure is 101.2kPa and you are holding your hand out, the atmosphere is exerting a force on your hand. If the area of your palm is $0.006m^2$, calculate the force on your hand. Use the GRASS method.

Checkpoint

The weight of water in a glass is 4.9N. If the water exerting a pressure of 1700Pa on the bottom of the glass, what is the area of the bottom of the glass?