

### WHMIS Symbols



Flammable



Compressed Gas



Biohazardous



Corrosive



Oxidizing



Highly Reactive



Toxic



Poisonous

Safety guidelines and procedures are in place in the school science lab to help make it safe for students when doing inquiry experiments.



Danger



Warning



Caution

### FLUID USES

A fluid is anything that has no fixed shape and can flow.

Fluid properties help us to use them in association with other substances.

Fluids can move solids, by mixing with solids to make SLURRIES.

Solids are often made from fluids, because they are easier to move and form into specific shapes.

Fluids can hold other materials making it easier to use these materials.

### CLASSIFICATION of MATTER

All matter is classified into two forms: pure substances or mixtures.

PURE SUBSTANCES are those types of matter made up of the same particles with unique characteristics or properties. Pure substances can be either elements or compounds.

MIXTURES are two or more substances that are combined. Mixtures can be heterogeneous, or homogeneous

Variations of these mixtures are mechanical (you can see the different parts), solution (the substance appears to be one substance), suspension (a cloudy mixture in which tiny parts of one substance are held in another) and colloid (similar to the suspension, but the parts cannot be easily separated out).

### PAPER CHROMATOGRAPHY

To determine what fluids are pure substances and which are mixtures a scientific technique is used.

Paper chromatography is a test that determines if a fluid is pure or not.

A piece of filter paper is placed just touching the top part of a test substance.

If the test substance is pure (made up of only one type of matter) then the fluid will be absorbed by the filter paper moving up only one level. If the test substance is a solution, each part of the substance will move up to different levels.

The filter paper showing evidence of the test substance is called a chromatogram.

### SOLUTES & SOLVENTS

A SOLUTE is a substance that dissolves in a fluid. The fluid that does the dissolving is called the SOLVENT. Water is called the UNIVERSAL SOLVENT and a solution that uses water as the solvent is called AQUEOUS.

### CONCENTRATION

The amount of solute that dissolves in a solvent is called CONCENTRATION. The more solute dissolved, the higher the concentration. To compare solution concentrations you need to know the amount of solute in the same volume of solvent for each solution.

A CONCENTRATED solution has a large amount of solute in a solvent compared to a DILUTED solution which has a smaller amount of solute in the same volume of solution.

### SOLUBILITY

The maximum amount of solute that can be dissolved in a given volume of solvent at a certain temperature is called SOLUBILITY.

A solution that will allow you to continue to dissolve solute is called an UNSATURATED solution. A solution that will not allow you to dissolve any more solute is called a SATURATED solution. Every solution has a SATURATION POINT, where no more solute can be dissolved at a given temperature. If the temperature of a solvent changes, the saturation point can also change.

Solutions are not always solids dissolved in liquids. Solutions can also be gas and gas, gas and liquid, liquid and liquid, solid and solid.

### The PARTICLE MODEL

To describe the structure of all matter, scientists developed a theory and a model. The ATOMIC THEORY is represented by the PARTICLE MODEL and has four distinct parts:

All matter is made up of tiny particles, with each substance having its own unique particles.

All the particles of a substance are always moving and vibrating.

All particles in matter can be either attracted to each other, or bonded together.

All particles in matter have spaces between them, no matter what state they are in.

### VISCOSITY

The rate at which a fluid flows is called VISCOSITY. This property is often referred to as 'thickness'. It is determined by a fluid's internal resistance or friction that keeps it from flowing.

The greater the resistance to flow the higher the viscosity or thickness of a substance. High viscosity fluids are thick and flow very slowly, while low viscosity fluids are thin and flow easily. Temperature can affect viscosity, by slowing or speeding up the particles, increasing or decreasing resistance between the particles.

To measure viscosity of different substances, the RAMP METHOD is used. Pour the substances down a ramp at the same time and time the different flow rates to compare viscosities.

### DENSITY

The amount of matter in a given volume is a property called DENSITY.

Each type of matter has its own density, making it a distinguishing property of matter.

To calculate the density of a particular type of matter you divide the mass of the sample by its volume.

$$d = M / V$$

Density can be changed by temperature. One substance can have different densities depending on its temperature.

A device used to measure density of a liquid directly is called a hydrometer.

## BUOYANCY

The tendency of an object to float when placed in a fluid is called **BUOYANCY**.

The forces acting on a substance in a fluid are the force of gravity and the force of buoyancy. When the force of buoyancy is greater than the force of gravity an object **floats**, also referred to as **positive buoyancy**. When the force of gravity is greater than the force of buoyancy the object will **sink**, also referred to as **negative buoyancy**. When the force of gravity and force of buoyancy are equal, **neutral buoyancy** occurs.

The **Plimsoll** line is a reference line painted on boats - indicating safe loading levels - depending on saltwater or freshwater concentrations where the ship travels.

## COMPRESSION

As particles - within an enclosed space - have force applied, they will fill a smaller volume - this is called **compression**.

Objects under compression tend to deform in their shape.

Fluids can be compressed - Gases can be compressed much more than liquids, because of the greater space between the particles.

Because there is very little compression in a liquid, they are considered to be **incompressible** (just as solids are).

## PRESSURE and 'Pascal's Law'

**Pressure** is the amount of force that is applied to a given area.

Pressure is measured in pascals. 1 pascal is equal to the force of 1 Newton over an area of 1 meter<sup>2</sup>.

It is calculated as follows:

$$p = F / A$$

**Pascal's Law** states that the enclosed fluid transmits pressure equally in all directions throughout the fluid.

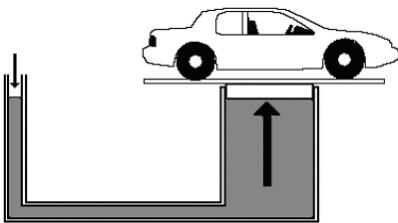
Pascal's Law led to the invention of hydraulic and pneumatic systems

## HYDRAULICS

Hydraulic devices use an enclosed liquid to transfer force throughout the device equally in all directions.

This application of Pascal's Law enables us to use these systems to gain very large force advantages.

Hydraulic systems can be used to lift very heavy objects, such as this hydraulic lift.



## PNEUMATICS

Pneumatic devices use an enclosed gas which is compressed and transfers force throughout the device equally in all directions.

This application enables us to have a great deal of force when the device releases the pressure.

Pneumatic systems can be used to apply a lot of force in a particular direction, such as this pneumatic nailing gun.



## SOLUBILITY TECHNOLOGIES

Different substances have different solubilities. This knowledge enables us to utilize this property of a fluid in different applications, such as



washing machines and



hyperbaric chambers.

In both of these technologies knowing what is soluble and what isn't and how solubility of different substances can be changed helps to make these technologies very useful.

## DIVING & DECOMPRESSION

As a diver dives below the surface of the water, increasing pressure is exerted by the water on the body.

Nitrogen gas in the body dissolves at a much higher rate under these pressures.

As the diver resurfaces the nitrogen gas bubbles out of the blood and tissues very quickly causing extreme pain. This condition is often referred to as the '**BENDS**'.

To treat this condition, the diver is placed in a decompression chamber, called a **hyperbaric** chamber.

## PUMPS & VALVES

A **PUMP** is a device that moves a fluid through or into something. Different types of pumps include:

**Bicycle pump** - has a piston moving up and down inside a cylinder.

**Diaphragm pump** - has a flexible diaphragm that is pushed and pulled inside a compartment by a piston.

**Archimedes screw** is a pump used to move water by rotational motion.

**Pipeline pig** - as the fluid is pushed through a pipeline, the 'pig' cleans and monitors the inside of the pipe.

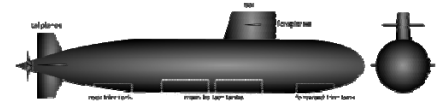
**Valves** are devices that control or regulate the amount of flow, or the level in a container. A **ball valve** works by turning in one direction allowing the fluid through, or by stopping the flow. A **compression valve** is opened by a pin that has a hole to allow the fluid in.

## SUBMARINES

A deep ocean submersible is called a **bathyscaph**. It is designed to withstand extreme pressure on the ocean floor.

A **SUBMARINE** is a hollow tubelike ship that has tanks between the inner and outer shells, called **ballast tanks**.

Submarine control surfaces



These tanks can be filled with water or air. When they are filled with water the submarine can dive. To resurface, the water in the tanks is forced out and replaced with air. This action changes the density of the submarine, allowing it to 'sink or float'.