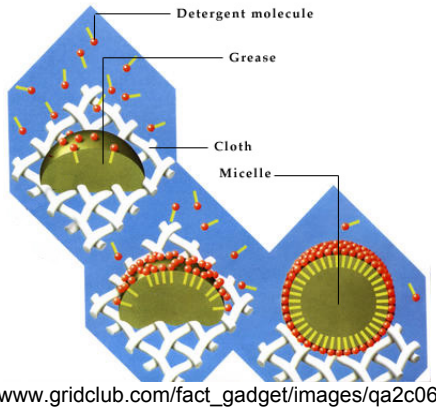
Mix and Flow of Matter

Section 4.0 – Many technologies are based on properties of fluids.

4.1 Technologies Based on Solubility

Fat & dirt are most times "**hydrophobic**" (meaning "*afraid of water*"). Hydrophobic materials do not solve in water. A detergent is a substance that can remove dirt from fabrics.

Most detergents are liquids or powders that are soluble in water. They contain a cleaning agent called a **surfactant**. Soap (the surfactant) encapsulates the fat & dirt molecules in the water, removing them from the fabric. In this way the dirt and water forms an ***emulsion***, which can then be drained away.



http://www.gridclub.com/fact_gadget/images/qa2c06f3.jpg

See also Textbook Illustration **(Figure 4.1** p. 63**)**

Phosphates were once used in detergents, but the environmental side effects were bad. Because phosphates encourage plant growth, the phosphates would cause weeds to overgrow in water systems and choke out the sunlight.

Typical Laundry Detergent Ingredients

Ingredient	Function	Ingredient	Function
surfactant	cleans fabric	*builder*	softens water
filler	prevents clumping	*corrosion inhibitor*	prevents rusting
suspension agent	prevents reattachment	*enzyme*	removes protein stains
bleach	removes stains	*optical whitener*	adds brightness
fragrance	adds scent	*colouring agent*	gives detergent colour

Diving and Decompression

Going below the surface of the water is now possible because of the (*Self-Contained Underwater Breathing Apparatus*) **S.C.U.B.A.** gear (air tanks and regulators) that was invented to help a diver breath underwater. When going deeper, nitrogen can dissolve in the divers body cells and tissues in a higher concentration than normal. As the diver rises slowly back to the surface, the nitrogen will leave the body gradually. If the diver ascends too quickly the nitrogen gas bubbles out of the blood and tissue, or collects in different parts of the body causing extreme pain. ***"The bends"*** can be treated in a **hyperbaric chamber**, which forces the nitrogen to re-dissolve back into the blood and tissue.

How Does DRY CLEANING work?
– Find out at - http://science.howstuffworks.com/dry-cleaning.htm

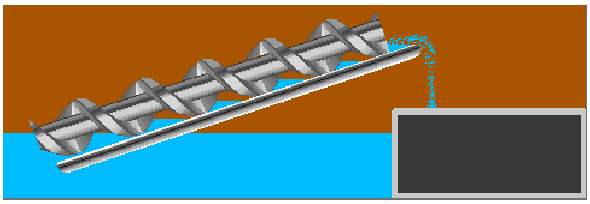
4.2 Technologies Based on Flow Rates and Moving Fluids

Pumps

Visit: **Glossary of Pumps** ... it's fantastic as a resource for this Topic.
http://www.animatedsoftware.com/pumpglos/pumpglos.htm

To obtain water from below the surface (the groundwater) and to move a fluid through a fluid system, you need to use something that will work against the pull of gravity, a **pump**.

One of the first pumps invented was **Archimedes Screw** (***invented to remove water from the hold of a ship***).



Other Applications include:
... Pumps in a city to move water to an elevated reservoir (so the force of gravity can allow the water to flow into all the homes - you see this in a small town as well - a water tower is usually the tallest structure in this town).
... Pumps are also use to move oil, natural gas and other fluids through pipelines.
... Pumps are located in automobiles to get the gasoline from the fuel tank to the engine.
... Pumps are also use to force air into tires.
... Your mouth is also a pump that can be used to draw a fluid up a straw and into your mouth.

See if you can find more information about the operation of a **sphygmomanometer**
http://www.sahaj.com/sphygmostetho.html

Valves

Valves are devices that ***regulate the flow of a fluid***.
Today's **valves** can **control** not only **the flow**, but **the rate**, **the volume**, **the pressure** or **the direction** of liquids, gases, slurries or dry materials through a pipeline, chute or similar passageway.

Valves can:
... turn on and turn off, regulate, modulate or isolate.
... control flow of all types, from the thinnest gas to highly corrosive chemicals, superheated steam, abrasive slurries, toxic gases and radio active materials.
... handle temperatures from cryogenic region to molten metal, and pressures from high vacuum to thousands of pounds per square inch.
... range in size from a fraction of an inch to as large as 30 feet in diameter
... vary in complexity from a simple brass valve available at the local hardware store to a precision-designed, highly sophisticated coolant system control valve, made of an exotic metal alloy, in a nuclear reactor.

Practical Applications: (for Valves)
A Valve is a product rarely noticed by the average person, yet it plays an important role in the quality of our lives.
… It is essential to virtually all manufacturing processes and every energy production and supply system. Yet it is one of the oldest products known to man, with a history of thousands of years.
… Each time you turn on a water faucet, use your dishwasher, turn on a gas range, or step on the accelerator of your car, you operate a valve. Without modern valve systems, there would be no fresh pure water or automatic heat in your home. There would be no public utilities, and beyond wood and coal, almost no energy of any kind. Plastics would be unheard of, as would many inexpensive consumer products.

4.3 Designing a Working model of a Fluid-Using Device

A deep-diving submarine used to explore the ocean is called a **submersible.** Submersibles are usually smaller than submarines. They are often equipped with external cameras, manipulating arms, and special lights. **Submersibles** are built to do specific jobs, not for long-distance travel. We use them to help us recover "black box" flight recorders from wrecked airplanes, bury cables in the sea floor, investigate ancient shipwrecks, map the ocean floor, look for signs of undersea earthquakes, study marine life, repair damaged offshore oil wells, take rock samples of the ocean floor, and study ocean currents.

LINKS	*Explorer Submarine Specs*	*How Subs work*

SUBMARINES

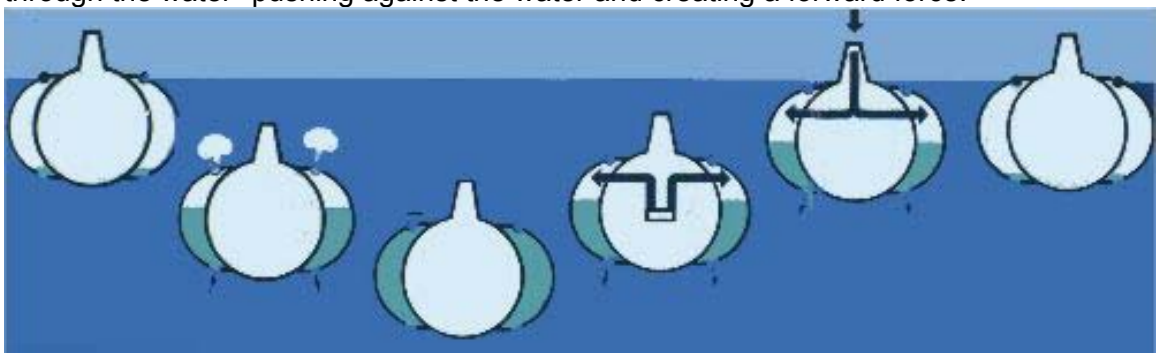
Inside a submarine there are containers called ballast tanks. If these are full of air, the submarine will float. Even though it is made of steel, the average density of the submarine is less than that of water. By pumping water into the ballast tanks, the submarine can sink. This is because when its ballast tanks fill with water, the submarine has a greater density than water.

History of Submarines

Submarines are ships that can operate both under and on top of the water. One of the first submersible vessels was built around 1620 by a Dutchman named Cornelius van Drebbel. We don't know that much about Drebbel's vessel, but diaries and books written at the time tell us his sub was really just a rowboat covered with a waterproof leather skin. Apparently 12 people with oars moved the vessel through the water. It could submerge to about 4.5 metres and go up to 8 kilometres before it needed to surface. It must have had some type of portholes to let in the light because one passenger wrote that people could see well enough underwater to read.

How Submarines Work

Submarines are designed for use at great depths. Their rigid, double-walled hulls allow the crew to live and work normally underwater for as long as air and power supplies last. Submarines are steered by turning a rudder left and right. A propeller moves the sub through the water--pushing against the water and creating a forward force.

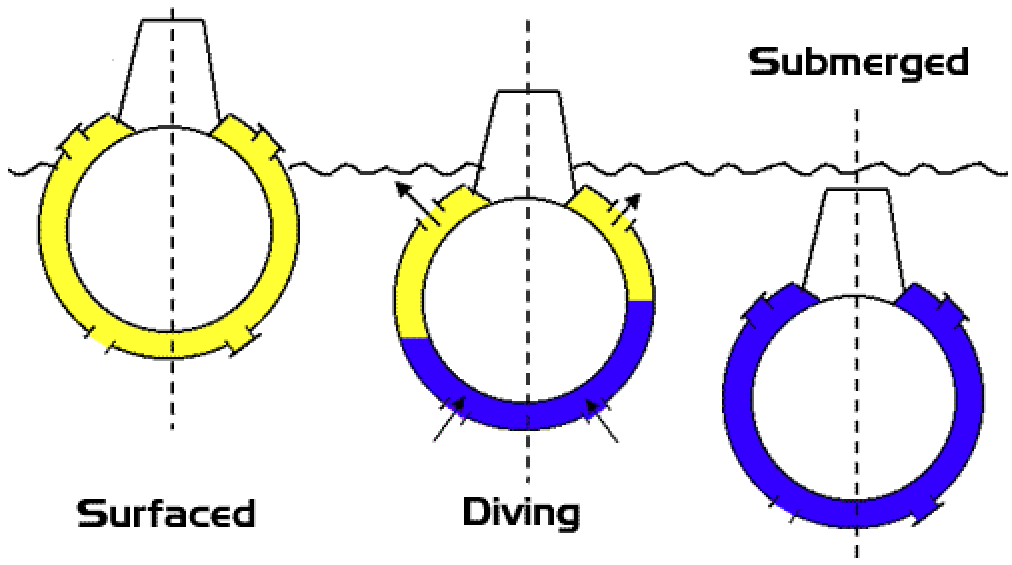


Buoyancy is the upward force of water pushing against the submarine.
When an object is underwater, it pushes aside (or "displaces") an amount of water equal to its volume.

An object floats if it displaces enough water to support its weight. Subs don't sink because their metal shell (or "hull") surrounds a volume weighing less than an equal amount of water.

Subs can sink, rise, and float underwater (maintain "neutral buoyancy"). Subs do all this by adjusting the amount of water and air in their **ballast tanks**. When the tanks are full of air, the sub weighs less than the volume of water it displaces and it floats. When the ballast tanks are flooded with water, the sub weighs more than the water it displaces, and it sinks.

To rise again, the sub reduces its weight by pushing compressed air into the ballast tanks. The air forces the sea water out, and the sub goes up toward the surface. To move beneath the surface and to hover, the amount of water in a submarine's ballast tanks is made equal to the weight of the water it is displacing.



Submarine Facts

Trieste is a **bathyscaph**, which went 11km beneath the surface to the bottom of the ocean in 1960. A submersible, called Alvin, was used to recover a hydrogen bomb accidentally dropped from an air force bomber back in 1966.
Japan also has a bathyscaph called Kaiko that can dive over 11 kilometres. In 1994, Kaiko went down to the Mariana Trench, the deepest spot in the ocean! While the largest submarines stretch up to almost 200 metres, the smallest working submarine, the Water Beetle, is only 2.7 metres long! It can go down to 30 metres and stay underwater for four hours.