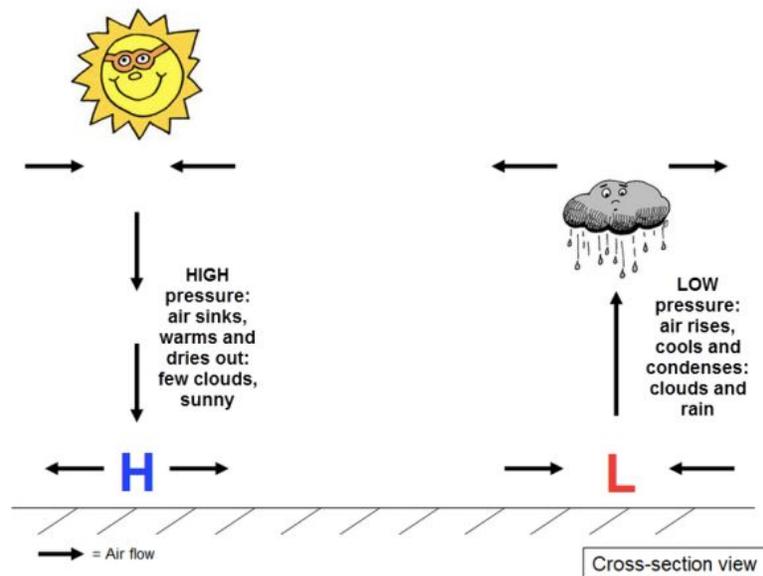


PROPERTIES OF GASES AND FLUIDS

“He who believes in Me, as the Scripture has said, out of his heart will **flow** rivers of living water.” John 7:38

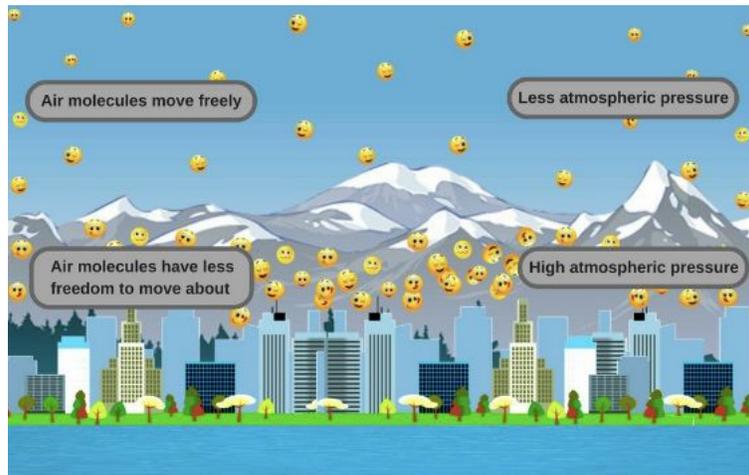
Pressure in Gases

- Atmospheric pressure = 14.7 psi (pounds per square inch)
- Barometer: device used to measure air pressure (p. 51)
 - mercury barometer: good weather = air is sinking toward surface → rising barometric pressure; bad weather = air is rising from the surface → falling barometric pressure
- A high-pressure area is where the atmospheric pressure is higher with respect to its surroundings. Air descends from the troposphere in its core. The descending air is warmed by compression, causing cloud water to vaporize to water vapor thus frequently giving good weather.
- A low-pressure area is where the atmospheric pressure is lower with respect to its surroundings. The air flows inwards from the surroundings and causing vertical motion, as a result the water vapor in the air condense and forms cloud which frequently gives rain. Therefore, bad weather generally occurs in low-pressure area.



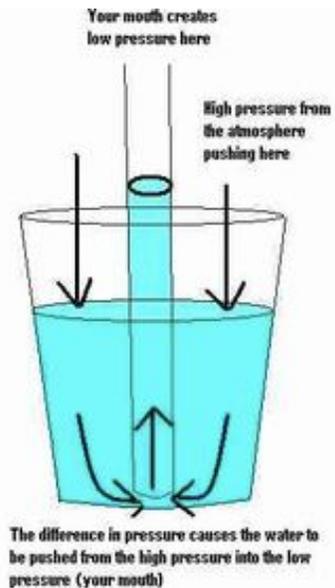
- Aneroid barometer: without liquid; thin, flexible walls of airtight box flex in and out with changes in atmospheric pressure; not as accurate as mercury barometers
- units
 - inches of mercury (inHg) used mainly in U.S.
 - millibars (mb) used by meteorologists
 - Pascals (Pa) SI unit of pressure used worldwide
 - atmospheres (Atm) air pressure at sea level at 59°F

- Altimeter: device used to measure altitude; atmospheric pressure varies with elevation; higher elevation = less air pressure → drop in mercury level / lower elevation = more air pressure → rise in mercury level
 - Death Valley is 86m above sea level - atmospheric pressure = 14.8psi
 - Denver, CO is 1.6km above sea level - atmospheric pressure = 12psi



- Fluids tend to move from areas of high pressure to low pressure

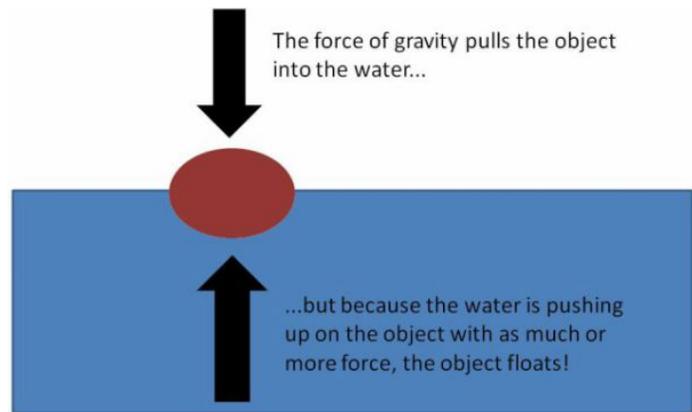
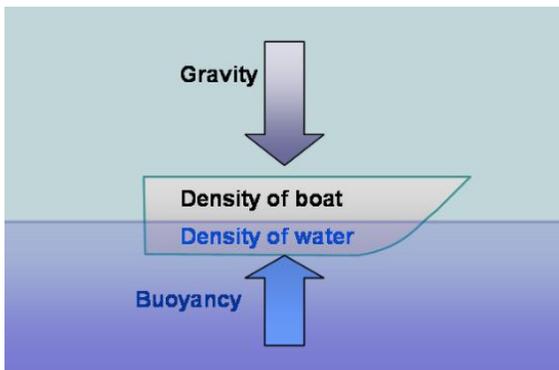
Ex: drinking from a straw reduces the pressure above the liquid enough for atmospheric pressure to push it into your mouth; longer straw requires greater pressure reduction



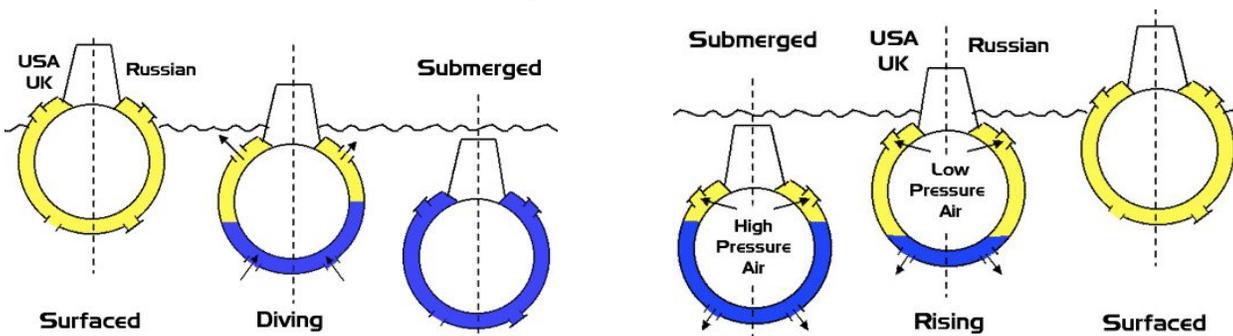
- Siphons: simple devices used to move liquids over obstacles without pumps; when siphon primed, two columns of liquid formed (p.53); difference in pressures of columns not balanced so longer column falls, reducing pressure at top of siphon, allowing atmospheric pressure to push the shorter column upward; greater difference in height between liquid surfaces increases speed of liquid flow
- Air pressure and breathing
 - Ex: lungs

Fluid displacement

- Fluid pressure allows certain objects to float in liquids and gases
- Buoyancy: tendency of a solid object to float when placed in a fluid; objects appear to lose weight when immersed in water
Archimedes' principle of buoyancy: the buoyant force experienced by an object is exactly equal to the weight of the fluid displaced
- Flotation: an object in a fluid will float if it is lighter than an equal volume of the fluid; an object in a fluid will sink if it is heavier than an equal volume of the fluid (p.56)
- If the object floats, enough of the object will submerge to displace a volume of fluid that has the same weight as the object; the rest will remain above the fluid;
weight acts in the opposite direction as buoyancy
[Application p. 57]



- Ship floats bc it is a hollow steel box of air; ship sinks into water until buoyant force pushing up due to weight of water displaced equals total gravitational force downward due to weight of ship and cargo
Submarines float like ships; in order to sink, water allowed to flood into ballast tanks to increase weight; neutral buoyancy: point where weight of submarine exactly equals weight of water displaced and submarine is completely submerged but not sinking

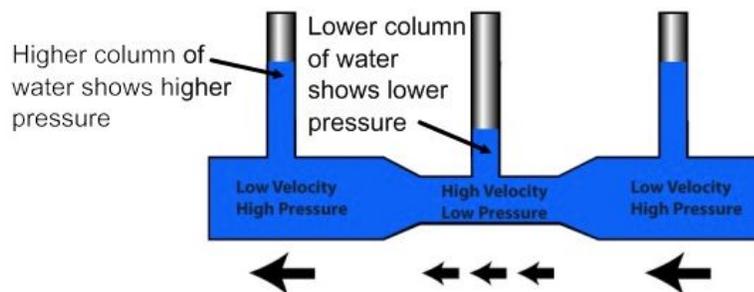


- Buoyancy in air exemplified by helium balloon floating in air
- Thinning of atmosphere with increased elevation limits the height that airships (blimps) can attain; atmosphere above the airship is too thin to support it and the atmosphere below is too dense to permit it to sink

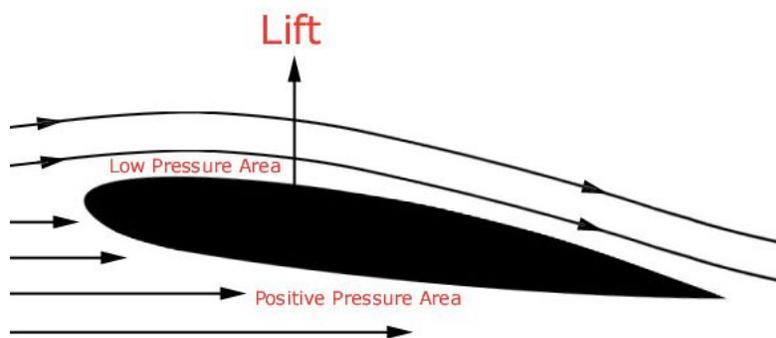
Bernoulli's Principle

Bernoulli's Principle

Fast moving fluid generates low pressure. Slow moving fluid generates high pressure.



- Airfoil: structure that changes the flow of air to produce force ; shape causes air over the top of the wing to speed up relative to the air beneath the wing → faster air on top exerts less pressure upon the wing than the slower air below
Ex: Lab 8



- Lift: upward force from difference in air pressure on wing; wing pushed up toward the lower pressure; lift of wings must be greater than weight of the plane
-proportional to plane's speed, area of wing, tilt of wing
-lift only generated when aircraft/object moves first
- Thrust: force that propels a plane forward through the air, allowing the wings to produce lift; produced by spinning blades, jet engines
- Drag: force that tends to slow an object moving through a fluid; must be overcome for lift to work; reduced by streamlining, which efficiently pushes air aside and allows it to smoothly recombine behind the craft (p.65)
→ Controlling flight means controlling thrust, lift, drag

- Curve balls: rapid sideways spin of the ball causes air on one side to move faster than air on the other side → pressure on one side is lower than pressure on the other side → ball moves toward side with lower pressure, curving the ball [Curve ball diagram p.67]