Laws/Principles of Matter - References

Bernoulli's Principle

$$\frac{v^2}{2} + gh + \frac{p}{\rho} = \text{constant}$$

Where v = fluid velocity, g = acceleration due to gravity, h = height, p = pressure, ρ (rho) = fluid density

Definition - As the speed of a moving fluid increases, its pressure decreases

- Airplane wing – its shape allows it to lift - "air particle love story"
- Frisbee – its shape allows it to lift
- Blow air over a roll of toilet paper on a rod with a leaf blower – *The toilet paper will fly off*
- Shower curtain – use sink and paper towel to demo – *Paper towel will move towards the water*
- Keep a ping pong ball in the air with a blow dryer – notice how it stills stays in the air even if you move the blow dryer to a forty-five degree angle
- Attach a ping pong ball on a string and place it into a running water faucet – the ball will remain in the stream of water
- Blow between two cans – *Cans should move together*
- Blow between a paper tent (paper folded in half) – *Paper should flatten*
- Hang two balloons and blow between them – *Balloons should move together*
- Hold paper to lips and blow across – *Paper should lift up*
- Fold thin piece of paper in half (length), tape edges, and place it on a ruler and blow the paper – *Paper should lift up*
- Hold two pieces of paper in front of your mouth (facing down), and blow between the papers – *Papers should come together*
- http://www.reekoscience.com/Experiments/LowerPressureBetweenCans.aspx
- http://www.seykota.com/rm/Bernoulli_approach/
- http://www.lessonplanspage.com/SciencePhysics-IntroToBernoullisPrinciple1012.htm
- http://www.centennialofflight.gov/2003FF/pressure/page2.htm
- http://www.allstar.fiu.edu/aero/Experiment1.htm
- http://www.msnucleus.org/membership/html/k-6/as/physics/6/asp6_4a.html
- http://quest.arc.nasa.gov/aero/teachers/ia2.html
- http://www.wackyuses.com/experiments/flyingricecrispies.htm
- http://www.newtonsapple.tv/results.php?search=bernoullis
- http://www.stevespanglerscience.com/experiment/00000037
- http://library.thinkquest.org/27948/bernoulli.html
- http://littleshop.physics.colostate.edu/Videos/Pressure/bernoulli/bernoulli.html
- Search www.Youtube.com for helpful videos

Archimedes' Principle

$$\text{Relative density} = \frac{\text{Weight}}{\text{Weight} - \text{Apparent immersed weight}}$$

Definition - a body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid

- Description of story of Archimedes using the crowns – *ideas of buoyancy and displacement → Eureka*
- Discuss examples of sinking and floating – *Things float because the buoyant force is greater than the weight of the object (buoyant force is equal to the weight of the displaced liquid)*
- http://www.pt3.gse.rutgers.edu/physics/fluids/archimedes/observations/archimedes.html
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- http://www.cite-sciences.fr/francais/web_cite/experime/citelab/ARCHIMED/ENGLISH/exper.htm
- http://physics.weber.edu/carroll/Archimedes/principle.htm
- http://www.aquaholic.com/gasses/archem.htm
- http://www.wikihow.com/Demonstrate-Archimedes%27-Principle
- Search www.Youtube.com for helpful videos

Charles' Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \text{or} \quad \frac{V_2}{V_1} = \frac{T_2}{T_1} \quad \text{or} \quad V_1T_2 = V_2T_1$$

Where V = volume and T = temperature

Definition – for a fixed amount of gas at a constant pressure, the volume of the gas increases as its temperature increases

- Hot air balloon – *Adding heat causes molecules to spread out → increase in volume → decrease in density → balloon floats*
- Add heat to a balloon or take it away – *Volume increases when heat is added and decreases when heat is taken away* – **works well with Mylar Balloons**
- Place a heated soda can in an ice bath – *the can will implode because decreasing the temperature will decrease its volume*
- http://www.chm.davidson.edu/ChemistryApplets/GasLaws/CharlesLaw.html
- http://phet.colorado.edu/en/simulation/gas-properties
- http://www.chemeddl.org/services/chemteacher/index.php?option=com_content&view=article&id=7
- http://www.grc.nasa.gov/WWW/K-12/airplane/Animation/frglab2.html
- http://phet.colorado.edu/en/simulation/gas-properties
- http://www.public.iastate.edu/~liuhc/flash/chemed/gaslaw/charles_law.html
- http://fsc.fernbank.edu/chemistry/charles.htm
- http://intro.chem.okstate.edu/1314F00/Laboratory/GLP.htm
- http://preparatorychemistry.com/Bishop_Charles_Law_Flash1.htm
- http://www.lerc.nasa.gov/WWW/K-12/airplane/aglussac.html
- http://www.mpcfaculty.net/mark_bishop/Charles_Law.htm
- http://home.flash.net/~table/gasses/charles.htm
- http://www.marymount.k12.ny.us/marynet/06stwbwrk/06gas/2slyscharles/2slysflash.html
- http://www.marymount.k12.ny.us/marynet/06stwbwrk/06gas/1esepcharles/esepcharles.html
- http://www.grc.nasa.gov/WWW/K-12/airplane/Animation/frglab2.html
- http://www.mhhe.com/physsci/chemistry/essentialchemistry/flash/gasesv6.swf
- http://www2.hn.psu.edu/faculty/dmencer/ideal/ideal1.htm
- http://video.google.com/videoplay?docid=-4506461547173401204
- http://fsc.fernbank.edu/Chemistry/charles.html
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- http://www.1728.com/charles.htm
- http://jersey.uoregon.edu/vlab/Piston/
- http://www.aquaholic.com/gasses/charles.htm
- http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/balloon.html
- http://paer.rutgers.edu/PT3/experiment.php?exptid=82&topicid=2
- http://www.ac.wwu.edu/~vawter/PhysicsNet/QTMovies/IdealGas/Balloon-Liquid-N2Main.html
- http://www.teachertube.com/view_video.php?viewkey=a2549b5872a8322dea91
- Search www.Youtube.com for helpful videos

Boyle's Law

$$p_1 V_1 = p_2 V_2$$

Where p = pressure and V = volume

Definition – for a fixed amount of gas at a constant temperature, the volume of a gas increases as its pressure decreases

- Person or object diving deep into the ocean – *Person/object will be crushed because of increase in pressure pushing on* object
- Person floating high into the atmosphere – *Person will explode because there is more pressure pushing out then pushing in*
- Balloon floating high into the atmosphere – *Balloon will pop because there is more pressure pushing out of the balloon than on it – vacuum pump can help show this*
- Ears "Popping"
- FLOAM - ?
- Heat up a can with a little water in it and when the water boils, flip the can upside down in a tray of cool water – *the can will implode because of the pressure differences created*
- http://fsc.fernbank.edu/chemistry/BOYLES.htm
- http://phet.colorado.edu/en/simulation/gas-properties
- http://www.chemeddl.org/services/chemteacher/index.php?option=com_content&view=article&id=1
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- http://www2.hn.psu.edu/faculty/dmencer/ideal/ideal1.htm
- http://www.grc.nasa.gov/WWW/K-12/airplane/Animation/frglab2.html
- http://www.aquaholic.com/gasses/boyle1.htm
- http://jersey.uoregon.edu/vlab/Piston/
- http://www.smartlearn.com/schools/gallery.html (around the middle of the page under science – gas laws – **takes a while to load**)
- Search www.Youtube.com for helpful videos

Pascal's Principle

$$P_2 - P_1 = -\rho g(h_2 - h_1)$$

Where P = pressure, ρ (rho) = density of the fluid, g = acceleration due to gravity, h = elevation

Definition – a change in pressure at any point in an enclosed fluid will be transmitted equally to all parts of that fluid

- Car braking system – *Pressure applied to the brake pedal will be evenly applied to all tires causing the car to stop in a controlled manner*
- Bottle with two holes in the bottom – *Water will come out of each hole in the bottle equally because the pressure applied by the air particles is evenly distributed onto the water*
- Water sprinkler - *Water will come out of each hole in the sprinkler equally because the pressure applied by the water in the hose is evenly distributed as the water enters and leaves the sprinkler*
- Play-dough thing (?) – this would not be a true example though, because Play-dough is solid
- http://www.mauilab.com/guests/hydrostatics/pascal-1/intro.html
- http://www.msnucleus.org/membership/html/k-6/as/physics/6/asp6_4a.html
- http://library.thinkquest.org/C001429/statics/Pascal.htm
- http://webphysics.davidson.edu/physlet_resources/bu_semester1/c23_pressure_pascal.html
- Search www.Youtube.com for helpful videos

Gay-Lussac's Law

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \qquad \text{or} \qquad P_1T_2 = P_2T_1$$

Where P = pressure and T = temperature

Definition – for a fixed amount of gas at a fixed volume, the pressure exerted by the gas increases as the temperature increases

- Heating a closed container – *Container will eventually explode since the temperature will cause such an increase in pressure that the container will not be able to withstand it*
- Pressure cooker - ?
- Bike/automobile tires in cold temperatures as opposed to warmer/hot temperatures
- Add heat to a balloon or take it away – *Pressure increases when heat is added and decreases when heat is taken away* – **works well with Mylar Balloons**
- A CO_2 cartridge becomes cold as the pressure is released
- "Dusters" or canned air becomes cold as the pressure is released
- A "fizz keeper" will increase the pressure inside a container and therefore the temperature too
- http://accad.osu.edu/~midori/GasLaw.html
- http://phet.colorado.edu/en/simulation/gas-properties
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- http://www.mpcfaculty.net/mark_bishop/pressure_temperature.htm
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