<u>Unit 8: Fluids Lab Equipment</u>

- Aluminum Foil
  - A fun introductory activity for fluids is to provide each student a 6 inch by 6 inch piece of aluminum foil and have them fold it however they want to into a 'boat'. The student's place the boat in a bucket of water and one by one add metal washers until the boat sinks. You can begin talking about density (percent submerged), pressure (spreading out of the placement of the washers) and of course, buoyancy. This can be done with coins as well, but the metal washers are heavier and don't require as many to sink the boat. **(EKs 8.1.A.3, 8.2.A.1 & 8.3.B.3)**
- Metal Washers
- 2-gallon and 5-gallon buckets
  - The smaller bucket is good for the aluminum foil boat activity and for having a place for the water squirting out of the hole to go for the 2-Liter soda bottle Torricelli's Theorem Lab. The larger bucket is good for bringing water outside for the water blaster continuity equation experiment.
- Fluids of Various Densities (mineral oil, glycerin, water, soda, diet soda)
  - The density of a liquid can be found by varying the volume of the liquid measured with a graduated cylinder and measuring the mass with a scale. Graphing mass on the vertical axis and volume on the horizontal axis results in a linear relationship whose slope is the density of the liquid. **(EK 8.1.A.3)**
- Graduated Cylinders (10 mL, 100 mL, and 1,000 mL size)
  - Smaller sizes are good for labs wanting a higher tolerance and larger sizes are good for labs wanting a larger range of depths. The chemistry lab at your school probably already has these items.
- Scales (digital or triple-beam balance)
- Tire Pressure Gauges
  - The weight of a car can be approximated by determine the force each tire is applying to the ground and adding those together. The force can be determined by multiplying the pressure in each tire measured with a tire pressure gauge by the area of the tire touching the ground measured with a meterstick (length times width). This can be compared to the Gross Vehicle Weight Rating (GVWR) often printed on a sticker inside the driver's side door. The value experimentally determined will be larger due to not considering the tire tread. **(EK 8.2.A.1)**
- Metersticks and rulers
- Pressure Sensors / Gas Pressure Sensors (Ones that include rubber tubing that can be attached)
  - A pressure sensor (some companies call them gas pressure sensors) can be used to determine the densities of liquids. Students can vary the depth the rubber tubing attached to the gas pressure sensor is dipped into various liquids and measuring the absolute pressure. The liquid is in a tall graduated-cylinder and the depth is measured with a ruler. If the absolute pressure is graphed on the vertical axis and the depth is graphed on the horizontal axis, the graph will be linear with a slope of ρg. This can be used to determine the density of the liquid. The vertical intercept of the graph will be atmospheric pressure. The Chemistry teacher at your school may already have these for Gas Law Labs. **(EK 8.2.B.2)**

- Cell Phones
    - Many free apps will read out the pressure at the location of the phone to high tolerances. The same lab described using the gas pressure sensors can be done by varying the vertical position of the phone measured with a meterstick and recording the pressure using the cell phone app. A plot of pressure vs height will result in a linear relationship whose slope is ρg. This can be used to determine the density of air. **(EK 8.2.B.2)**
- Spring Scales / Force Sensors
- Tall / Large Objects denser than water
- String
- Overflow Cans
    - An overflow can filled with various liquids can be used to investigate the buoyant force. A tall, large, dense object (like a 1kg mass) is hung from string attached to a spring scale or force sensor. The object is slowly dipped into the fluid and the amount of fluid displaced is measured by measuring the amount of fluid that overflows out of the can into a graduated cylinder. The tension force can be graphed versus the volume of fluid displaced. The resulting graph will be linear with a slope of ρg. This can be used to determine the density of the fluid. **(EK 8.3.B.3)**
- Water Blaster Toys / Large Plastic Syringes
    - Long plunger type water squirter toys can be used to perform an experiment using the continuity equation. The toy can be filled with water from 5-gallon buckets filled with water that are brought outside. The water blaster is held parallel to the ground. The plunger is pressed in at a constant rate. A_1 is the cross-sectional area of the tube containing the water. v_1 is the speed at which the plunger moves which is determined by timing how long it takes the push in the plunger and taking the length of the tube divided by this time. The speed of the water leaving the small opening can be determined using projectile kinematics: where the range is how far the water squirts and H is the height of the water blaster. v_2 can be graphed versus v_1 and the graph will be linear with a slope of which can be used to determine the size of the small hole that the water squirts out of. **(EK 8.4.A.2)**
- Clear holiday ornaments of various diameters (https://tinyurl.com/yc4az7wt)
    - Required for the new lab for fluids that will be released summer/fall 2024. Each group will require a set of ornaments of various diameters that have been weighted to all have the same mass. **(EK 8.3.B.3)**
- 2-L Soda Bottles
    - A Torricelli's Theorem investigation can be conducted using a 2-Liter Soda bottle. A small hole is poked into the bottom of the cylinder portion of the bottle using a nail. The bottle is filled with water. The bottle is set on a lab table and the water is allowed to squirt out into a bucket. The speed of the water leaving the bottle can be determined using projectile kinematics: where the range is how far the water squirts and H is the height of the hole in the bottle above the ground. The depth of water in the bottle can be measured using a ruler. If the depth is varied and velocity is calculated from the varying range, a graph of v^2 versus depth can be created which will yield a linear relationship whose slope is $2g$. These bottles can be reused for many years. **(EK 8.4.B.3)**