611-2160 (30-155) Pressure Paradox Kit

Additional Materials Needed:

- Top-loading Balance
- Ruler

Theory:

What is density? It can be defined as: the amount of matter within a given area.

What is volume? It can be defined as: the amount of three dimensional space an object occupies.

What is pressure? It can be defined as: the force per unit area applied on a surface in direction perpendicular to that surface.

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

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Experiment: Pressure Paradox Demonstration

1. Pass both the small steel ball and the Styrofoam ball around the classroom, so that each student can hold one ball in each hand and get a feel for which one is heavier.
2. Write the conclusion from the class consensus on the board (e.g., steel ball is heavier and Styrofoam ball is lighter).
3. Ask the students if they feel certain that they are correct and have them give reasons as to why they are right.
4. Using a top loading balance, weigh each object and record its mass below. You may need to use a weighing dish to contain the objects. Be sure to tare the balance.

Mass of steel ball = _____(g)
Mass of foam ball = _____(g)

5. Using a rule measure the diameter of each ball and record the results below.

Diameter of steel ball = _____ (cm)
Diameter of foam ball = _____(cm)

6. Calculate the volume of each sphere according to the formula below.

$$V = \left(\frac{4}{3}\right) \cdot \pi \cdot \left(\frac{d}{2}\right)^3$$

d = diameter of sphere

Volume of steel ball = _____(cm3)
Volume of foam ball =_____(cm3)

7. Calculate the density of each sphere according to the formula below.

$$D = \frac{m}{v}$$

m = mass (g)
v = volume (cm^3)

Density of steel ball = ____(g/cm^3)
Density of foam ball = ____(g/cm^3)

8. Discuss the density results with the class.
9. Discuss pressure. Pressure may be defined as follows:

$$P = \frac{F}{A}$$

F = Applied Force
A = Surface Area

Thus, if students apply the same force with their hands to each ball the pressure value for the steel ball will be less than for the Styrofoam ball because the surface area of the Styrofoam ball is greater and pressure is inversely proportional to surface area.

Explain to students that they may have misinterpreted their sense of touch as a gauge for weight based on the fact that the steel ball has a smaller radius thus giving a smaller surface area as per the equation shown below.

Surface Area = $4\pi r^2$
Where r = radius

Students when holding the steel ball versus the Styrofoam ball experience how the surface area and mass of the steel ball is spread over a smaller surface area of their hand versus the much larger surface area of the Styrofoam ball being spread over a larger hand area. Thus, the pressure exerted on the Styrofoam ball is dispersed over a larger hand surface area making the ball feel as though it weighs less.

30-155 Pressure Paradox Kit
teaching concepts
Physical Science:
Concepts Taught:
Pressure; Volume; Density
Curriculum Fit:
Force and Motion; Properties of Matter

Related Products:

Science First® *manufactures many low-cost items that can be ordered. For more information, please visit us at www.sciencefirst.com.*

40-105 Center of Gravity Paradox - Our angular momentum apparatus is weighted at one end. Try to balance the one meter rod with the heavier end down; intuition tells most people this should work. In actuality, the opposite is true - turn the rod over and balance it easily on a mere fingertip. This is a hands-on way to introduce the concepts of the center of gravity, angular acceleration and moment of inertia. Mass is movable. Instructions included.

25-115 Centripetal Force Paradox - Similar to the rotating candle experiment, this illustrates centripetal force. Ask your students what they expect the floats to do when the platform on which they sit is spun. Our two floats serve as buoyant pendulums inside transparent jars filled with water. Since they are buoyant, they move in the same direction as the accelerating force - which is toward the axis of rotation, or toward the center. Includes tripod base with rod; two sturdy plastic jars with caps; bobber with cord; instructions.

25-110 Greek Waiter's Tray - The waiters in Greek cafes are famous for their dexterity as they swing heavily loaded trays between tables with nary a spill. This sturdy device illustrates the principle in a way that will amaze your class. Place a clear container of water on the platform of the tray and start swinging from side to side. With practice, you should be able to swing in wide circles and even upside down. The container stays put because the net force acting on it is always directed radially, toward the center. This pins the container to the tray along with its contents. Our durable wood tray includes an attached pendulum and instructions.

15-059 Energy Transformation Kit - Merely striking our two precision machined balls together will create enough heat at the point of contact to burn a hole in a sheet of paper. You'll see no flame, but a charred hole appears instantly along with a smell of burning paper. Why? The First Law of Thermodynamics states, "Energy can neither be created nor destroyed." In other words, it merely changes its form - in this case, from mechanical energy (striking two balls together) to heat (evidenced by the hole burned in the paper).

35-165 Vacuum Lifter - Study the effect of air pressure and lift up to 50lbs! This 10.5 inch black rubber disk will appear to "adhere" to any flat smooth surface. Place the disc on a table and try to lift it off with the handle, it is almost impossible. Air pressure is approximately 15lbs per square inch, when all of the air is evacuated from under this disc this adds up to 1300lbs of pressure being applied to the Vacuum Lifter! With just a lift of the edge air is allowed under the disc and it will lift off easily.

35-070 Magdeburg Hemisphere Kit - Duplicate the experiment of 1652 in Magdeburg, Germany - try to pull these spheres apart. Astonish your class with the force of air pressure. Now priced for the tightest budget and almost indestructible, this plastic science lab withstands 180 pounds of force. Includes: Two hemispheres, 4.75" in dia; plastic exhaust valve to fit 1/4" pressure tubing; molded handles; instructions. Needs pump.

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