

## FREE FALL TUBE MODEL GS-315 & GS-316

This unit, sometimes called the Guinea and Feather Tube, is used to show that in a vacuum all objects fall at the same rate regardless of their mass. That is to say, when the effect of air resistance is removed, both a light and heavy object will fall at the same speed. It may also be used to show the fountain in a vacuum and the characteristics of an electrical discharge through rarified air.

**DESCRIPTION OF EQUIPMENT:** This unit consists of the main plastic tube with two expandable stopper assemblies, a tripod base, a connection block with valve, a feather and a penny. The Model GS-315 has a tube of 3.8 cm diameter by 65 cm long while the Model GS-316 has a tube 5 cm in diameter by 100 cm long.

**SETTING UP EQUIPMENT:** The stoppers are inserted into the ends of the tube and the handles turned until sufficiently expanded to give a tight seal to the sides of the tube. The base connection block with valve is then screwed on to the stopper assembly which has the threaded extension and the tripod base is then in turn screwed on to the connection block. Whenever in the course of use it is necessary to either tighten or loosen the lower stopper assembly, the connection between the stopper assembly and the connection block should be broken so that the stopper handle may be readily turned. For best operation it is advisable to keep the junction between the connection block and the lower stopper assembly covered with a vacuum grease.

**TO USE AS A FREE FALL TUBE:** A heavy object such as a coin or metal disk and a very light object such as a bit of cotton, foil, or feather are placed in the tube and caused to slide to the top end. The tube is held in a horizontal position (without tripod base attached) and evacuated to the limit of the pumping system. For this experiment it is only necessary to reduce the pressure to a millimeter or two of mercury. The tube is then quickly raised to a vertical position to show that both objects fall at the same speed. Occasionally static electric charges on the cylinder wall keep the light object from falling. Wiping the tube with a damp cloth will help keep these charges from collecting. Anti-static liquids for use on plastics are also available and are extremely effective.



**FOUNTAIN IN A VACUUM:** The tube with its stoppers in place is mounted on the tripod. The tube is exhausted by connection to the vacuum system. The valve is closed and the connection to the vacuum system is removed and replaced with a short length (2-3 ft) of rubber tube. The free end of the hose is then placed under the surface of a water supply and the valve opened. Water is forced into the cylinder by outside air pressure in a powerful jet which rapidly fills the cylinder.

**ELECTRICAL DISCHARGE IN AIR:** The interior of the tube should be clean and dry and the seals carefully tightened against the ends of the tubes. Set the equipment up on the tripod and connect the valve to a vacuum pump having a final vacuum of about one micron or better. Before starting the pump connect a high voltage neon sign transformer or tesla coil across the tube. Note that both expansion plug stoppers have metal parts which extend into the tube. Start the vacuum pump, and as the pressure decreases the electrical discharge will be seen to go through its various phases.

**NOTE:** Remove expansion plug stoppers from plastic tube for storage as they may stick if left expanded for long periods of time. The stoppers can be loosened by soaking with warm soapy water, if needed.