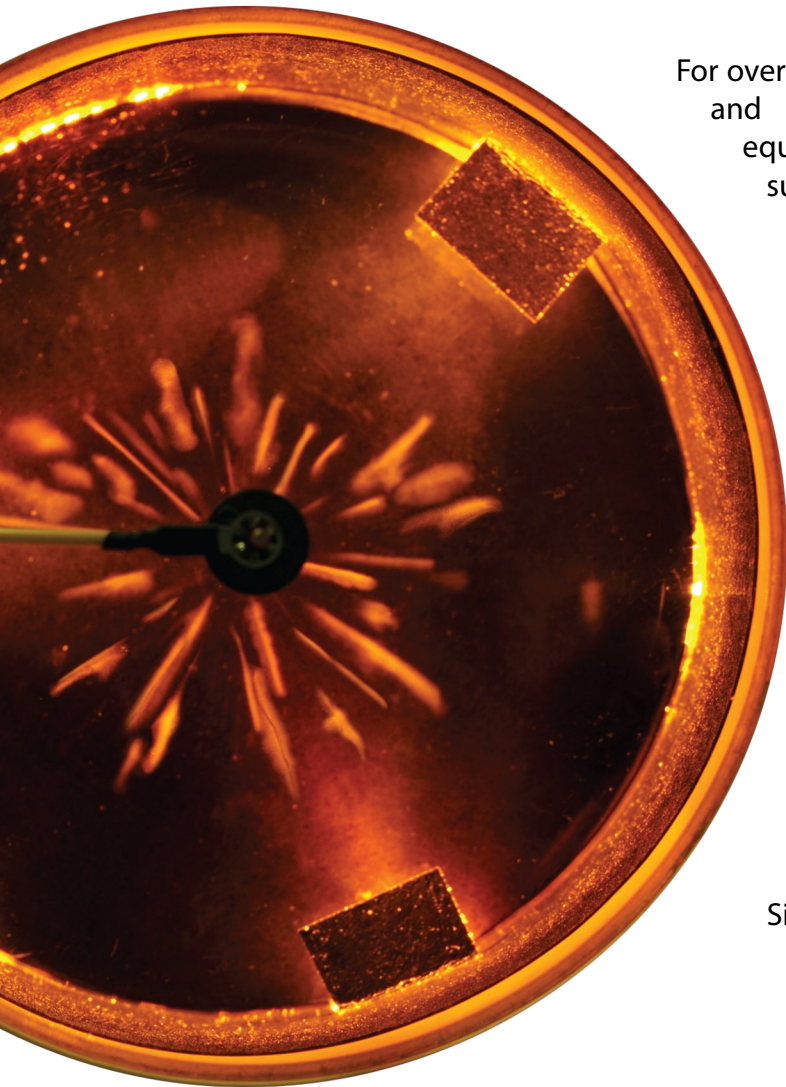


TEACHING  
EQUIPMENT FOR  
SCIENCE



For over thirty years, Physics Enterprises has been designing and manufacturing unique and affordable teaching equipment for demonstrations and lab experiments suitable for elementary, high school, and college science classes.

During this time, we have established many valuable business partnerships with companies such as PASCO Scientific, Vernier Software & Technology, American 3B Scientific, TEL-Atomic, and VWR Sargent-Welch.

Our products have been provided to numerous domestic and international customers and have received national recognition from the American Association of Physics Teachers in the Apparatus Competition.

I hope that you will enjoy discovering our unique teaching equipment designed to make your science classes exciting!

Sincerely,

Handwritten signature of Lubica Mueller in red ink.

Lubica Mueller  
Business Developer

# Adiabatic Gas Law Apparatus

## INTRODUCTION

Adiabatic and isothermal processes are difficult for beginning physics students to understand. The Adiabatic Gas Law Apparatus provides the ideal demonstration. It is used to investigate the compression and expansion of gases. Sensitive transducers in the setup measure the pressure, temperature, and volume of the gas as the gas is compressed or expanded rapidly under near adiabatic conditions, or slowly under isothermal conditions.

Analog signals from the sensors are monitored by computer interface, that includes a three channel analog-to-digital data acquisition system. This connects to a computer workstation, which functions as a three channel storage oscilloscope. The data acquisition program, Data Monitor, can plot graphs of pressure, temperature, and volume.

## TRANSDUCER FEATURES

- **Volume Transducer:** A linear potential divider is mounted on the side of the piston. A 5-Volt source from the computer is applied across the potentiometer element. The voltage from the commutator brush on the cylinder is used to indicate the position of the piston and the volume of the confined gas.
- **Pressure Sensor:** A solid-state, piezoresistive device that forms part of a bridge circuit is mounted at the base of the cylinder.
- **Temperature Sensor:** Mounted in the cylinder on the top of the base. The active element is fine nickel wire with a high surface-to-mass ratio. The wire's temperature and resistance changes rapidly as the gas compresses or expands.

## A VERSATILE LAB TOOL

- Compare the final pressure and temperature: values predicted by the Adiabatic Gas Law
- Measure the work done on the gas: compare it to the change in internal energy and the theoretical work performed
- Determine gamma: the ratio of specific heats for the gas ( $C_p/C_v$ )
- Use monatomic, diatomic and polyatomic gases: determine the effects of molecular structure on gamma
- Investigate isothermal compression and expansion

## INCLUDES

- Adiabatic Gas Law Apparatus
- Signal Cables 3.5mm plug into 5-pin DIN
- Power Adapter 9V DC at 1A
- Manual

## REQUIRED

- Gases: argon (monatomic), air or nitrogen (diatomic), carbon dioxide (triatomic)
- A computer with an interface that will accept three analog signals simultaneously via 5 or 8-pin DIN connectors

INVESTIGATE  
GAS THERMODYNAMICS





# Diffusion Cloud Chamber

## INTRODUCTION

The Diffusion Cloud Chamber is used to view high energy alpha particles, lower energy beta particles, and electrons that are produced from such sources as radioactive material, cosmic rays, and other forms of naturally occurring radiation. Unlike most cloud chambers on the market, this unit does not use dry ice! Simply connect the unit to a source of cold running water, or use the included pump and a container to recirculate ice water for hours of continuous use!

With most cloud chambers, it is often necessary to purchase other equipment for proper operation. Whether it is a source of illumination, or a high voltage power supply, this just adds to the overall cost and increases the time and complexity of operating the cloud chamber. With our Diffusion Cloud Chamber, a high voltage source and illumination source is built in. With visible tracks showing in as little as 15 minutes, the Diffusion Cloud Chamber is a wonderful demonstration tool that can be easily set up and operated just about anywhere!

## HOW IT WORKS

The bottom of the chamber is cooled by circulating ice water through the base and further cooling it to  $-35^{\circ}\text{C}$  with a Peltier device. Alcohol placed in the chamber wicks up the inside chamber lining where it evaporates in the warmer region of the chamber and diffuses downward. The alcohol vapor is then cooled near the chamber bottom and becomes super-saturated. As energetic alpha and beta particles from a radioactive source pass through the alcohol vapor, the vapor condenses, forming droplets which appear as tracks in the strong chamber cross-lighting.

## INCLUDES

- Cloud Chamber (5"/12cm or 6"/15cm diameter)
- Power Adapter (12 VDC, 6 A)
- Water Circulation Pump (120V/60Hz or 220V/50Hz, 3W, 180liter/hr)
- 2 Rubber Hoses (0.25" ID/6.4mm ID; 60 cm long)
- Extraction Pipette and Funnel
- Source Holder and Stopper High Voltage Connection
- Cable (22cm long, Banana plug to ring plug)
- SpecTech™ Coupon for Pb-210 Source Needle
- Manual

## SPECIFICATIONS

- Built-in High Voltage Source ( $\sim 800$  VDC with 1080hm protection resistor)
- Display (8 Amber LEDs)
- 110V Power Supply for domestic shipments and 220V for international shipments

## REQUIRED

- Ice Water

## PRODUCTS

- Large Diffusion Cloud Chamber (6"/15 cm diameter)
- Regular Diffusion Cloud Chamber (5"/12 cm diameter)
- Pb-210 Replacement Radioactive Needle Source

SEE EVIDENCES OF  
**RADIOACTIVITY**  
IN **15** MINUTES  
*No dry ice!*



# Dual-Range Force Sensor

## INTRODUCTION

The Dual-Range Force Sensor can be easily mounted on a ring stand or dynamics cart or used as a replacement for a hand-held spring scale. Use it to study friction, simple harmonic motion, impact in collisions, or centripetal force. This force sensor is used for experiments in physics, physical science, and middle school science lab manuals.

It is available as DFS-BTA ready to interface to Vernier interface equipment (as shown above) or as DFS-DIN with an 5-pin DIN connector ready to interface to a PASCO interface.

## FEATURES

- Two ranges:  $\pm 10\text{N}$  or  $\pm 50\text{N}$

## INCLUDES

- Dual-Range Force Sensor
- PASCO Cart Adapter
- Sensor Handle
- Manual

## RELATED PRODUCTS

- **Dynamics Track Adapter:** This adapter is specifically designed to attach to a Vernier or PASCO Dynamic Track. Multiple mounting options allow for sensor-to-sensor or sensor-to-cart collision measurements. Includes two magnetic bumper attachments.
- **Air Track Adapter:** Allows the Dual-Range Force Sensor to be mounted on the end of an air track for collision studies. Compatible with most air tracks. Includes two magnetic bumpers.
- **Force Table Adapter:** Use your Dual-Range Force Sensor with your force table for resolution of vectors experiments. Includes mounting clamp.

VERSATILE &  
EASY TO USE



# Force Plate

## INTRODUCTION

The Force Plate is a large force sensor - tough enough to jump on. About the size and shape of a bathroom scale, the Force Plate measures forces of stepping, jumping and other human-scale actions. For example, you can observe the change in normal force during an elevator ride, or measure the impulse delivered by the floor when you jump.

## FEATURES

- Two ranges - up to 3500N for larger forces and a more sensitive 800N range for pushing experiments
- Used with Vernier interfaces (Logger Pro for computers, DATA Pro for Palm OS™, and DataMate for TI calculators)

## INCLUDES

- Force Plate
- Manual

## RELATED PRODUCTS

- Force Plate Handles

# MEASURE HUMAN-SCALE FORCES



# Wave Motion Demonstrator

## INTRODUCTION

The Wave Motion Demonstrator allows mechanical waves to be created to demonstrate the behavior and properties common to many types of waves.

## HOW IT WORKS

A series of steel rods is attached at their centers to a torsion wire. When a rod is displaced and released, a wave propagates along the rod. Velocity depends on the torsion constant of the wire and the moment of inertia of the rods.

## DEMONSTRATIONS

- Wave Propagation
- Velocity in Different Media
- Wavelength versus Velocity and Frequency
- Reflection at Fixed and Free Boundaries
- Constructive and Destructive Interference
- Standing Waves and Resonance
- Reflection and Transmission at Media Boundaries
- Complete Wave Motion Demonstrator

## FEATURES

- 2.3 Meters Long - plenty of room to watch the wave develop and interact
- Three Wave Sections - each section has rods of different lengths, allowing reflection and transmission demonstrations
- Folds for compact storage
- Easy setup

## INCLUDES

- Module 1: 92 cm long with 73 rods each 46 cm long
- Module 2: 92 cm long with 73 rods each 23 cm long
- Module 3: 60 cm long with 47 rods, 46 cm long at one end, 23 cm long at the other end
- Clamp for rigid termination
- Dash Pot for liquid damping
- Manual

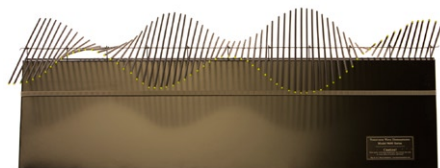
## SINGLE WAVE MOTION DEMONSTRATOR

### INCLUDES

- Module 1: 46 cm long rods
- Clam for rigid termination
- Dash Pot for liquid damping
- Manual

**ELUCIDATE  
WAVE** PROPERTIES





---

In case of further questions, please, do not hesitate to contact us:

Ron Johnson, Director Tel: (269) 471 3503 • Email: [johnsonr@andrews.edu](mailto:johnsonr@andrews.edu)  
Lubica Mueller, Business Developer Tel: (269) 471 3724 • Email: [lubica@andrews.edu](mailto:lubica@andrews.edu)

A. U. Physics Enterprises, Andrews University – HYH 212, Berrien Springs, MI 49104-0384

For more information about all we have to offer, visit us online at: [www.physicsenterprises.com](http://www.physicsenterprises.com)