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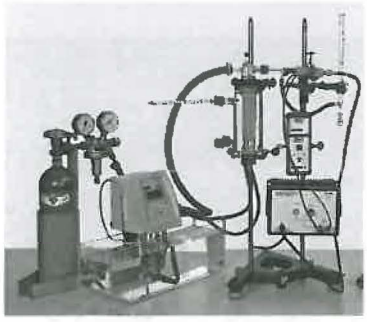
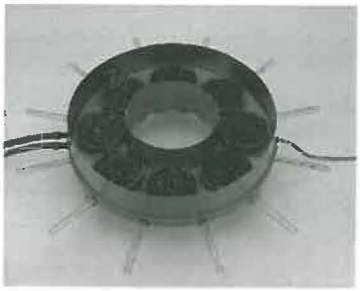
Chemistry



Chromatographic Separation Process
Item No. P3031760

- Chromatographic procedures allow a separation of substance mixtures with the aid of a stationary separation phase and a mobile phase
- Determine the retention times of different gases and perform a chromatographic material separation of a mixture of butane gases
- Separate and identify the components of a two-component mixture consisting of ethanol and ethyl acetate chromatographically

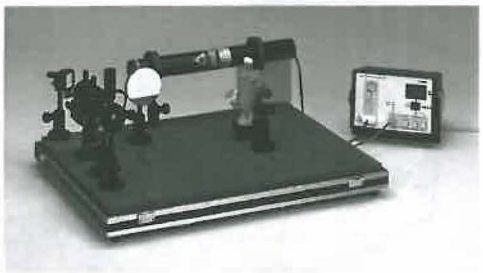
Biology



Effect of Soil Temperature on the Germination of Growth
Item No. P4060100

- Genetically determined growth processes in plants are primarily triggered or inhibited by special phytohormone
- External factors such as light, temperature, water, oxygen and air humidity play a decisive role in the process

Applied Science



Recording and Reconstruction of Holograms
Item No. P2260300

- In contrast to normal photography a hologram can store information about the three-dimensionality of an object
- To capture the three-dimensionality of an object, the film stores not only the amplitude but also the phase of the light rays

Physics

XRE 4.0 X-ray Expert Set
Item No. 09110-88

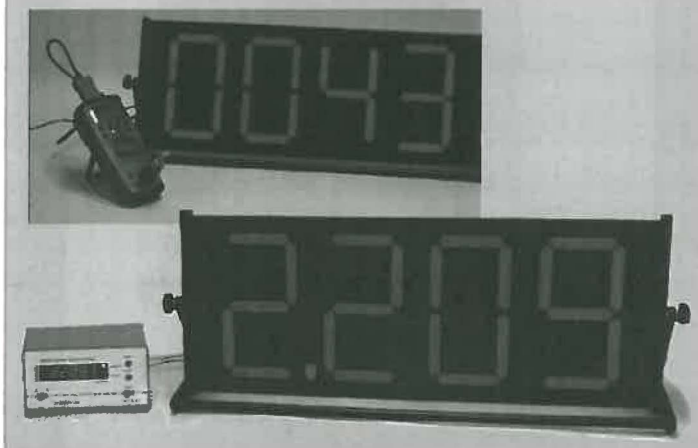
- Basic set covering the fundamental principles and areas of applications of X-rays
- Used for fluroscopy experiments and X-ray photography
- Can be extended by upgrade sets for specific applications and topics

DAEDALON® - INSTRUMENTAL

ET-41
Electronic Stop Clock

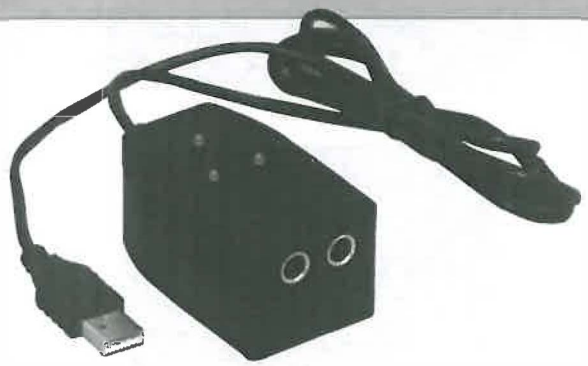
The six-digit Electronic Stop Clock provides memory and period measurement with a resolution of 0.0001s. A 40 kHz quartz-crystal oscillator with a lifetime accuracy of ± 0.02% generates the time base. Operates with one or two Photogates. In memory mode, will time two interruptions of a single gate and store the results. In period mode, measures the interval between the first and third break of a single Photogate. The ease of timing the period of the motion makes a good lab in harmonic motion.

Includes: Photogate & **ET-21** pushbutton.



ET-50
Digital Display

Clearly display digital results to the last row of the lecture hall! Designed for large audiences, this provides a highly readable output from Daedalon™ devices with LED meter and serial output connection. High intensity 4-digit LED readout; auto-ranging decimal; rotating face; wall mountable; daylight readable; durable aluminum & ABS construction. 27x10x6". 69 x 30 x 25.4 cm. *Wt. 5.5 lbs (2.5kg)*



EC-41
Computer Timing Interface

Collect timing data efficiently while maintaining them in their raw form. It is designed to connect up to two Photogates or other logic-level switches to any Windows PC via USB. The included Timer software records rising and falling-edge events to 1 us in an easily exportable table. The interface's electronics and status-indicating LEDs are housed in impact-resistant machined ABS.

ET-48
Photogate Module Adapter

This lets you to use EA-24 Photogate with ET-39 or ET-41 Stopclock. It also lets you use EA-24 Photogate with EC-41 Computer Timing Interface.

DAEDALON® - INSTRUMENTAL

EG-01 **Specifications:**
- Frequency Range: 100 Hz - 99 kHz three ranges
- Waveform: square, triangle or sine wave
- Output: sine or triangle; 5 V peak to peak into a 5Ω load
- Connections: 2 pairs banana jacks

EG-01
Function Generator

How to supply sine, triangle or square function waveforms through the audio spectrum and beyond? We include three calibrated scales and an internal power amplifier. A TTL square wave output is continuously available on the rear panel jacks for testing and monitoring frequency. The front panel has an output-level control, waveform selector, frequency multiplier switch, frequency setting scale and color-coded, 4 mm banana output jack pair. Output is floating; case is grounded. Internal power supply is well-regulated and independent of line voltage variations. 9.5 x 17 x 14 cm (3.8 x 6.7 x 5.5")

EG-50 **Specifications:**
- Center Frequency
- High - Low: 5 kHz, 500 Hz, 50 Hz
- Frequency Control: 3-turn potentiometer
- Frequency Readout: (4) 1.4cm LED's
- Resolution, high/mid: 1 Hz
- Resolution, low range: 0.1 Hz
- Accuracy: ±0.1% or one count
- Output: 4 Vac rms into a 4 load
- Waveform: <0.6% distortion, 2 W output

EG-50
Audio Driver

Here's a reliable source of mechanical motion at known frequency acoustic experiments (often needed for Sonometers, Kundt's tube & Chladni plates). A sine wave oscillator combines with an audio amplifier through the frequency range of 3 Hz to 10 kHz in three ranges, indicated by a four-digit display. On the low end of the frequency range, the readout is multiplied ten times so that the resolution is 0.1 Hz, important for accuracy at low frequency. The output waveform is a low-distortion sine wave to drive low impedance loads like our EG-52 Electromechanical Driver. A three-turn potentiometer on the front panel easily sets frequency. Jacks on the rear panel provides a square wave output to synchronize an oscilloscope to view the signal easily without jitter.

EG-03
Speaker

This small loudspeaker can be used with EG-01 Function Generator and EG-50 Audio Driver. Setting two of these speakers a short distance apart and plugging them into the same oscillator, produces a beautiful sonic interference pattern.

EG-52
Electromechanical Driver

This converts electrical output of the Audio Driver into linear motion and produces variable frequency and amplitude linear motion for harmonic motion experiments. Originally designed to excite vibrations in the cases of stringed instruments, it can drive Chladni plates, sonometers, stretched strings and more. The EG-01 Function Generator provides the Driver with a limited range of amplitude.
Required accessories: EG-50 Audio Driver

DAEDALON® - INSTRUMENTAL

EV-02
Universal Power Supply

Here are all supplies needed for most student experiments! Four high-voltage outputs (125, 250, 375, 500 VDC) operate your vacuum tube or cloud chamber. Well-regulated ±8 VDC supplies run semiconductor experiments. Regulated, adjustable 5 VDC and 3 A supply drives motors and electromagnets. Six Vac and 2 A supply lights vacuum tube filaments and AC experiments. The color-coded outputs on front panel are protected against accidental overload. Outputs are isolated from ground. Case is grounded for safety.

EV-04 Specifications:
Voltage: 1-12 VDC, 1-14 Vac not sinusoidal
Current: 0-5 ADC, 4 AAC. Ripple: <5% rms volts
Controls: voltage, AC/DC, on/off switch, pilot light
Connections: 2 color-coded 4 mm banana jacks

EV-04
AC/ DC Power Supply

This popular power supply puts out low-ripple power at a low cost and serves most of the everyday needs of the laboratory! A phase-controlled triac adjusts the voltage without heat dissipation. The control circuit senses overload and shuts down, eliminating the need for fuse replacement. 9.5 x 17 x 14 cm (3.8 x 6.7 x 5.5 in)

EV-11
High Voltage Power Supply

Two separately regulated, independent supplies provide 0-1000 Vdc at 10 mA, 0-50 Vdc at 10 mA and filament voltage taps supplying 1, 2, 3, 4, 5 or 6 Vac. A 7.5 cm panel meter monitors the high voltage supply. All supplies float relative to ground and interconnect.

EV-12
Lab Power Supply

This has an adjustable output of 0-15 VDC and 3 A for particularly critical loads. A pair of operational amplifiers provides both current and voltage display simultaneously on a pair of system taut band meters. The output is isolated from the ground.

EV-14 Specifications:
0-5 kVDC, 6.3 VAC filament output: limits 2.5kV
Output Current: 1 mA at 5000 VDC
Line Regulation: >1% for 10% voltage change
Load Regulation: 3% for 0 to 500 µA
Ripple: 0.2% at maximum current
Meter: three 1.4 cm high digits
Connect: 4 mm high-volt insulated banana jack

EV-14
Kilovolt Power Supply

Here's a safe, sturdy and reliable high voltage power supply. Shielded banana jacks provide the 5 kilovolt output from the rear panel, safely away from hands. A digital voltmeter accurately displays the output voltage. With 6.3 VAC filament supply on the rear panel. Output current is limited for safety. 9.5 x 26 x 22 cm (3.8 x 10 x 8.5")

DAEDALON®- INSTRUMENTAL

EV-17

EV-18
140W Power Supply
Good when you need current up to 10A. DC output, measured on two digital meters, is protected against short circuits. AC output, not sinusoidal at low voltages, drives small motors and incandescent lamps.

EV-17
75 W Power Supply
This High Current Power Supply is designed for those loads that need current up to 5A. Direct current output is measured on two analog meters. Output is controlled by a front panel control and is short circuit proof. The ac output is not sinusoidal at low voltages but accurately drives small motors and incandescent lamps.

EP-20 Specifications:
- Tube Diameter: 13 cm
- Electron Gun: indirectly-heating cathode, accelerating anode
- Helmholtz Coils: Radius: 15 cm Separation: 15 cm. Turns: 132 per coil
- Magnetic Field: 7.8 mT/A
- High Voltage: 100-500 Vdc adjustable with front panel control
- Coil Current: 0-3 A adjustable with current regulated supply.
- Meters: two 3-digit LED panel meters

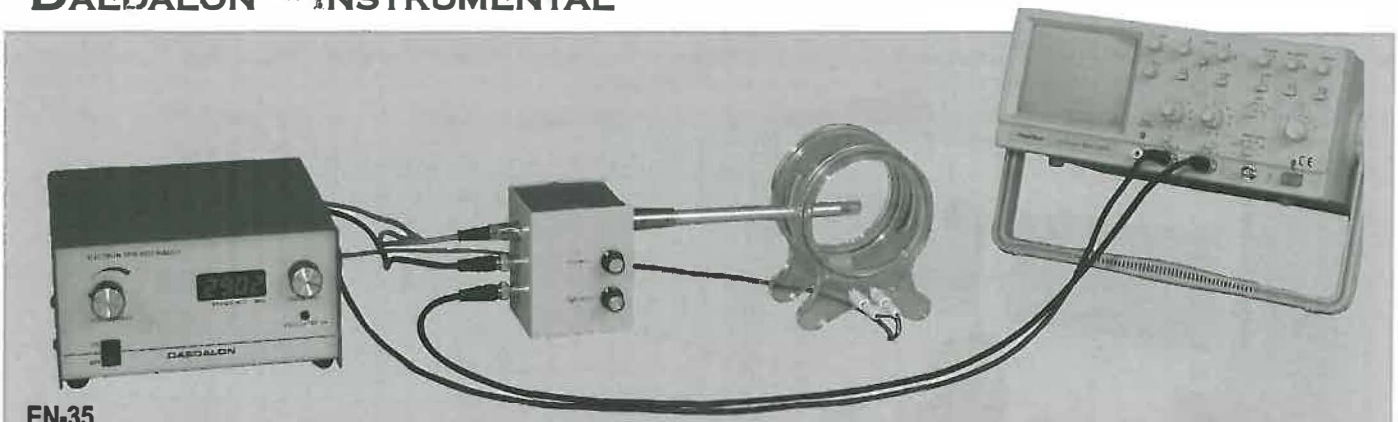
Putting Science *First* since 1960

EP-20
e/m Apparatus
This classic experiment consists of a vacuum tube with an electron beam inside. The tube is surrounded by two Helmholtz coils which provide a transverse magnetic field. The magnetic field bends the electron beam into a circular path, made visible by Helium gas at low pressure fluorescing inside the tube. The regulated accelerating voltages can be varied from 100 to 500 Vdc. The Helmholtz coil current adjusts from 0 to 3 A. The orbit diameter is measured on an internal glass scale with fluorescent radius marks. The mark lights up when the beam strikes it, making it easy to determine the exact beam diameter. A pair of three-digit panel meters display the power supplies output.
30 x 40 x 38 cm (11.8 x 15.7 x 15")

EP-07 Specifications:
Phototube: R727 mount in case
Ultra low leak current FET op-amp: Dual FET op-amp
Current Sensitivity: 1 pA minimum
Spectral: red, green, blue gel filters

EP-07
Photoelectric Effect
Show that the energy of a photoelectron depends on wavelength, not intensity. As monochromatic radiation irradiates the photocathode, the voltage required to stop current flow is proportional to the energy of the photoelectrons. Plotting this voltage as a function of wavelength can be used to calculate Planck's constant. A dual-FET ultra-low leakage current input operational amplifier close to the phototube amplifies photocurrent. Amplifier has a minimum detectable current of 1pA. Includes 3-color filters for spectral separation. 17 x 9 x 11 cm (3.5 x 6.7 x 4.0") *You need: digital voltmeter or datalogger.*

DAEDALON® - INSTRUMENTAL



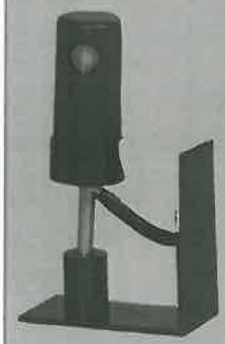
EN-35
Electron Spin Resonance

In 1925, Uhlenbeck and Goudsmit showed that small discrepancies between Bohr's quantum description of the hydrogen atom and experimental values could be explained if the electron behaved as if it had angular momentum and a magnetic moment. Intrinsic angular momentum is now one of the fundamental properties of a particle. This elegant apparatus, designed by Dartmouth College, lets you measure the value of a single electron's magnetic moment. The parametric organic compound DPPH (diphrenyl-picri-hydrazyl) has an unbound electron that orients in an external magnetic field. The electron spins like a top in the polarizing field proportional to the magnitude of the field. The electron's precession varies in frequency with a change in the polarizing magnetic field. If you set up a weak high frequency field at right angles to the primary field, the weak field will interact with the electron when their frequencies are the same. A pair of Helmholtz coils, powered by AC current, set up the polarizing magnetic field. A probe with DPPH is inserted into the field. A tiny coil surrounds the crystals and supplies the transverse, high-frequency signal. The coil mounts in a sturdy metal probe with an acrylic end cap. As the magnetic field varies from positive to negative and back, the electron's frequency matches the oscillator's frequency. The oscillator detects the energy transfer and displays it on the oscilloscope.

ES-16 **Specifications:**
Intensity: 45 candela
Color Temperature: 3000 K
Expected Life: 2000 hours
Current Regulation: ±0.5%

ES-16
Halogen Lamp/ Power Supply

Our tiny halogen lamp is a very intense, constant, compact source of 45 candela, higher than most other sources. The lamp and socket are pin-mounted to fit the Optical Bench Carriers (shown), available separately. Filament 3 x 1mm.



ES-18
Small Mercury Arc

Our small low-pressure lamp is an ideal monochromatic radiation source. **Includes** power supply (not shown) & metal stray light shield.

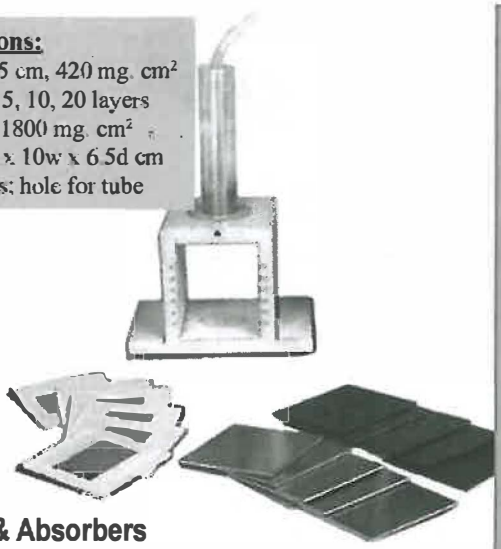
EM-09
Universal Spark Generator

This produces high voltage pulses at five fixed frequencies. Precisely timed sparks leave a permanent series of dots, useful for dynamics experiments. On an Air Track, spark paper attaches along the bottom track edge. Wire attaches to the glider with an insulated nylon screw. A trolley wire stretches between the end stops with insulated hardware. The spark jumps from the wire on the glider, then through the paper to the grounded track, leaving a mark for each pulse.
9.5 x 26 x 22 cm. (3.8 x 10 x 8.5")

EM-09 **Specifications:**
Frequencies: 60, 30, 20, 15, 10
Voltage: 30 kV
Connections: 1.2 m with alligator clips
Trigger: Manual push button

DAEDALON® - RADIOACTIVITY

EN-06 Specifications:
Aluminum: (5) 5 x 5 cm, 420 mg. cm²
Mounted Foil: 1, 2, 5, 10, 20 layers
Lead: (5) 5 x 5 cm, 1800 mg. cm²
Support stand: 7.2h x 10w x 6.5d cm
Slots for 5 absorbers; hole for tube



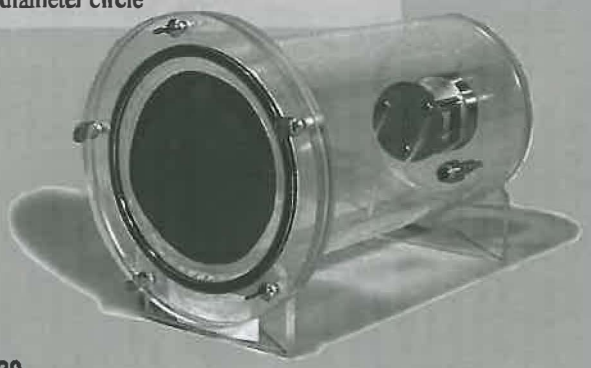
EN-06
Geiger Stand & Absorbers
Stand holds 5 x 5cm square absorbers in six slots. Absorbers consist of thicknesses of mounted aluminum foil, aluminum plate and lead. *You need: Geiger Counter, Tube and Sources.*

EN-07
Radioactivity Source
(Pack 5)
As in **EN-03**, above, plus Tl-204 1uCi (beta) & Cs-137 1uCi (gamma) emitters.

EN-03
Radioactive Source
(Pack 3)
Three discs for your experiments and demos. **Includes** Alpha (Po-210) source; Beta (Sr-90) source; Gamma (Co-60) source; clear plastic storage box.

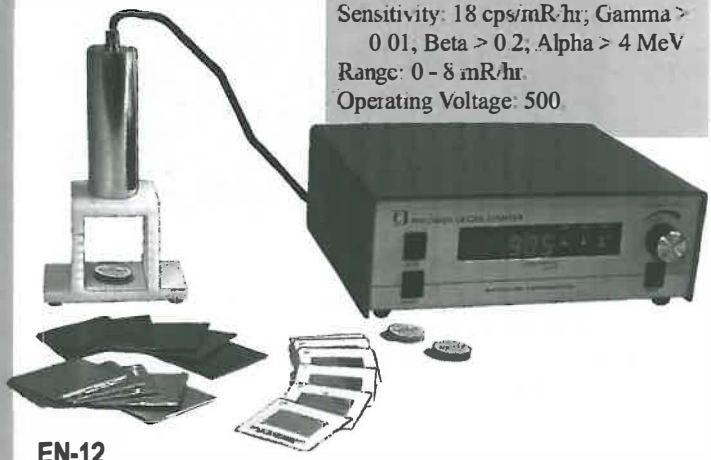
EN-01
Geiger-Muller Tube
1.5cm dia tube has a 2-3 mg/cm³ mica end window, with 450V operating plateau. **Includes:** 1m coaxial cable and coax-to-banana jack adapter.

EN-20 Specifications:
- Source: Po-210, half-life 138 days
- Beam Angle: 2.5°
- Deflecting Angle: ±20° symmetrically around the axis
- Detector: particle-sensitive film, 8.6 cm² diameter circle



EN-20
Rutherford Scattering
Designed by **Professors Leming and Garrison** *at Henderson State University*, the apparatus allows students to repeat the famous alpha particle scattering experiment suggested by Ernest Rutherford in 1908. Fundamental to the discovery of the atom's structure, the experiment demonstrates that the charge of the atomic nucleus is concentrated at the center of the atom.
Includes: Five sheets Alpha Particle sensitive film; Alpha Particle Source. *You need:* Vacuum pump (15-20Pa) to evacuate the chamber; stereo microscope (20-50x) to view films; beaker and heater for film processing

EN-12 Specifications:
Detector: Halogen-quenched Ne; SS Geiger Mueller tube
Sensitivity: 18 cps/mR/hr; Gamma > 0.01, Beta > 0.2; Alpha > 4 MeV
Range: 0 - 8 mR/hr.
Operating Voltage: 500



EN-12
Precision Radioactivity
Enough for course in radioactivity. Large **EN-04** tube collects data quickly and accurately. Measures count rates from a preset total count. Also measures the radioactivity of natural objects. **Includes EN-03** Radioactive Source Set (for absorber measurements) and **EN-30** Precision Counter, which functions as a computer interface with included software.

DAEDALON® - RADIOACTIVITY

EN-15 **Specifications:**
Count Range: 99 counts/minute
Time Base: 1 minute
Count: LED & audible chirp (switchable)
Geiger Voltage: 900 or 450 Vdc
Color-coded 4mm banana jacks

EN-15
Daedalon® Geiger Counter

A compact, rugged six-digit Counter. LED digits show counts per minute or continuous counting. An LED and an audible chirp signal indicate radioactivity. The internal 900/450 Vdc power supply provides the voltage required. The front panel has power and mode selector switches for count rate or continuous counting. A push button resets the display. The rear panel has a tube voltage selector and audio mute switch.

EH-15
Stefan Boltzman Source

When used with the Radiometer, the tungsten lamp provides a radiation source that can measure the energy radiated as a function of temperature. This relation was first set down from theoretical considerations by physicists Stefan and Boltzmann. Determine the termperature from the current through the lamp and the voltage across it. The energy varies over four decades, so the results are very convincing.

EN-30 **Specifications:**
Operating Modes:
- Fixed time: 15 sec, 60 sec; Fixed Count: 100,1000,4000
- Tube Voltage: 300 – 1200 Vdc adjustable & stablilized

Display: Count while counting, counts/m when complete
Show tube voltage in "Volts" mode
Count: Audible chirp (switchable)

See pg. 116 for more Geiger Counters

EN-30
Precision Geiger Counter

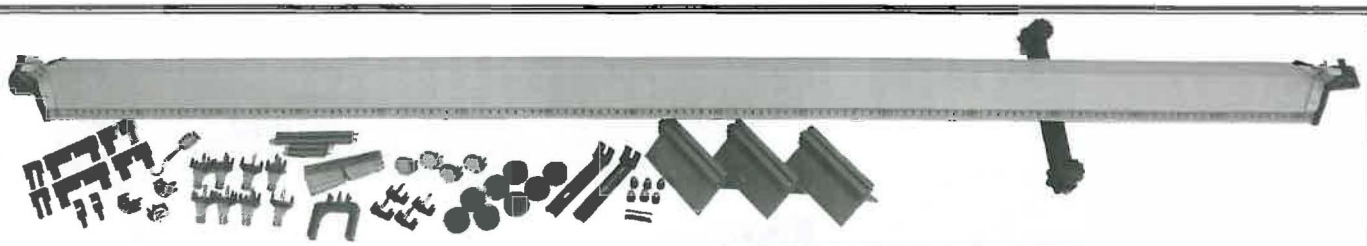
This versatile instrument puts out a computer-compatible signal which permits data logging with a computer. It connects to a serial report and sends out measured count rate to the computer. Select modes of operation via a front panel push button. In the fixed count mode, it counts up to a preset number of counts, then divides the counts by the time period and displays the result with a fixed statistical accuracy. Measurement times are unlimited, so it is possible to measure background or natural low-level sources with high precision. In the "Volts" mode, the display shows the tube voltage. With six-digit digital readout front panel display. **Includes** full software for recording and computing data. *9.5 x 26 x 22 cm (3.8 x 10 x 8.5")*

EG-45 **Specifications:**
Detector: 28 junction thermopile
Spectral Range: 0.3 to 15 µm
Sensitivity: 1000-1 W/m² - 4 ranges
Controls: range, zero adjust, shutter

EG-45
Radiometer

Calibrated in Watts/meter², this measures the energy of direct sunlight or the warm spot left by a hand. The thermopile detector has tiny thermocouples wired in series in an aluminum housing. An intregal shutter cuts off incoming radiation when adjusting the amplifier. The detector has a flat spectral response from 0.3 µm (ultraviolet) to 15 µm (infrared). The detector area of about 2 mm² can measure the energy in a laser beam. For broad radiation sources, the instrument is sensitive through a 60° cone angle.
12 x 9.5 x 22.5 cm (4.7 x 3.7 x 8.7")

DAEDALON® - AIR TRACK



EA-01 • **Air Track**
EA-20 **Air Source**

Daedalon® Basic Air Track (1.5m)

Here's a great value in a student air track. Study one-dimensional motion, collisions & conservation of memontum at low friction. Our sturdy triangular aluminum track is lightweight yet durable with smooth surface and high linearity due to precision machining. One row of 0.95mm diameter holes on each side. Re-engineered spring bumpers have lower friction loss than previous design. Updated gliders have lower center of mass. Accessories are less massive to improve accuracy • Ships oversize in one box. *Requires EA-20 Air Source.*

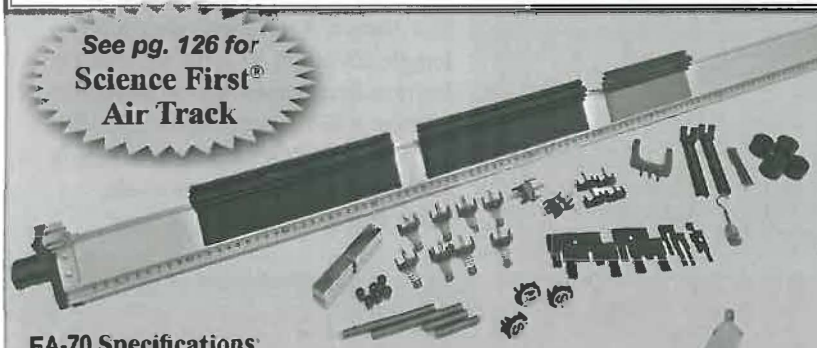
EA-01 **Specifications:**

- Track Length: 1.5 m
- Cross Section: 90° apex isosceles triangle/stiffening bar
- Air holes: 0.95 mm dia, 1 row each side
- Straightness: 0.04 mm - working length
- Support: Crossfoot, adjustable foot
- Measurement: Meter tape; photogate flag
- End stops: Launcher & end pulley
- Pulley: high accuracy ruby
- Extra masses: 300g (12 x 25g); can hold 200g additional mass
- Bumpers: 3 magnet, 2 hook/loop (sets), 8 spring

EA-01 included accessories:

- 3 - 100g Gliders
- 8 spring bumpers, 4 spring attachments
- Glider launcher, spool thread, weight hook, end pulley with ruby bearing
- 6 thumbscrews, 8 incline adjustments
- 4 stainless springs: 2 - 2.5cm; 2 - 5cm
- 4 - 5g masses for pulley
- 3 magnetic bumpers for collisions
- 8 flags f/ photogates, 2 photogate holders
- 12 - 25g masses
- 2 photogate holders

See pg. 126 for **Science First® Air Track**



EA-70 • **Air Track, 2m**
EA-20 **Air Source**

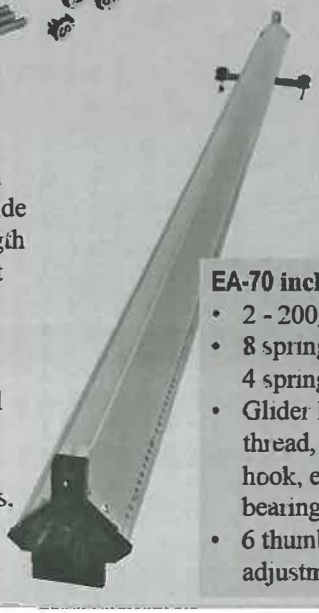
Daedalon® Intermediate Air Track (2m) -

You need EA-20 Air Source

Study one-dimensional motion, collisions & conservation of momentum at low friction. Our sturdy triangular aluminum track is lightweight yet durable, with smooth surface and high linearity due to precision machining. Two rows of 0.9mm diameter holes on each side. Re-engineered spring bumpers have significantly lower friction loss than the previous design. Updated gliders have a lower center of mass. Accessories are less massive to improve accuracy • Ships oversize in one box.

EA-70 **Specifications:**

- Track Length: 2 m
- Cross Section: 90° apex isosceles triangle
- Wall: 3 mm thick, base width 9.4 cm
- Air holes: 0.9 mm dia 2 rows each side
- Straight: 0.04 mm over working length
- Support: Crossfoot & adjustable foot
- Meter tape & photogate flags
- End Stops: Launcher, End Pulley
- Extra masses: 300g (12 x 25g). Each glider can hold up to 200g additional mass
- Glider: (2) red, horizontal mass bar
- Bumpers: 3 magnet, 2 hook/loop sets, 8 spring
- Pulley: high accuracy ruby bearing



EA-70 included accessories:

- 2 - 200g Gliders; 1 - 100g
- 8 spring bumpers, 4 spring attachments
- Glider launcher, spool thread, weight hook, end pulley with ruby bearing
- 6 thumbscrews; 8 incline adjustments
- 4 - 5g masses for pulley
- 4 stainless springs: 2 - 2.5cm; 2 - 5cm
- 3 magnetic bumpers for collisions
- 8 flags f/ photogates; 2 ea, 4 sizes
- 12 - 25g masses
- 2 photogate holders
- 2 hook/ loop bumper sets

DAEDALON® - AIR SOURCE

See pg. 126 for Science First® Air Track

Specifications
Cross Section: isosceles triangle, angle at apex 90°, wall thickness 0.3 cm, base width 9.4 cm
Air Holes: two rows each side, 0.9 mm dia, 2.4 cm separation between rows
Measurements: full-length meter tape
Spark paper groove opposite side
End Stops: fitted with bumper springs,
Rubber band glider launcher
Beam: heavy extruded I-beam with double web for stiffness,
Adjustment: threaded #10-24 studs 10 cm long spaced 30 cm apart connect the track to the beam You can achieve linearity of 0.1 mm.

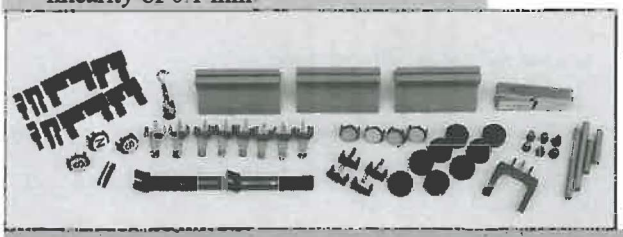
EA-75 1.5m track
EA-76 2.5m track
EM-09 Universal Spark Gen

Daedalon® Precision Air Track (1.5, 2.5m) -

Needs EA-20 Air Source

Demonstrate most principles of dynamics on one sturdy, easy-to-use, friction-free track - conservation of momentum; velocity and speed of gliders; equal and unequal collisions; acceleration; magnetic repulsion; harmonic motion.

Daedalon® air tracks are made of custom aluminum extrusion with a hollow triangular cross section. Air feeds into one end and escapes through four rows of holes along the track's length. Escaping air provides virtually friction-free support for the aluminum gliders. A full-length metric tape is set into the extrusion with a guide groove for spark paper on the other side. **Includes:** accessories & manual.



Included accessories:
4 Aluminum gliders, 2 - 300g, 2 - 150g
8 Re-engineered spring bumpers
6 Thumbscrews
1 Spool of thread
4 Stainless springs, (2 - 2.5cm, 2 - 5cm springs)
1 Weight hook
4 5g masses for pulley
1 Glider launcher
3 Magnet bumpers for damping & non-contact collisions
8 1cm incline adjustments
8 Flags for photogates, (2 ea. of 4 different sizes)
12 25g masses
1 End pulley with ruby bearing
2 Hook and loop bumpers (sets)
4 Spring attachments
2 Photogate holders

EA-20 **Specifications:**
Compressor: 750 W series-wound motor, 110Vac 60Hz
Pressure: 11 kPa, 8.6 kPa
Volume: 2.6x104 cm3/s [4.8x104 cm3/s (2) tracks]

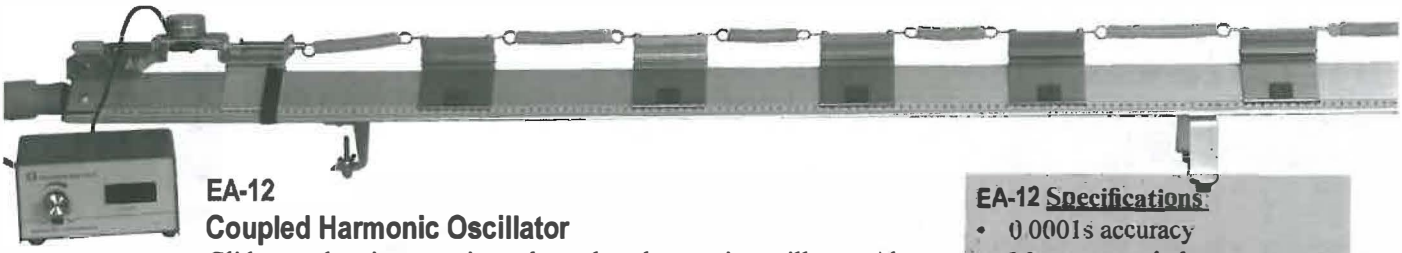
EA-20 Air Source

Superior sound absorbing characteristics due to three thick foam sound absorbers in the air input. The straight-through air path avoids pressure loss and unnecessary turbulence. Operates one Precision Air Track, Intermediate Air Track, or two Basic Air Tracks as well as longer tracks. **Includes** 2m hose. *30 x 17 x 16 cm*

EA-01, EA-70 EA-75 Parts & Accessories *Sold Separately:*

EA-041 Glider, 100g.
EA-042 Glider, 200g
EA-043 Glider, 300g
EA-383 Glider Launcher
EA-387 Riser Block Kit, 8
EA-373 Magnetic Bumpers, 3
EA-372 Hook/Loop Bumpers, 2
EA-371 Spring Bumpers, 2
EA-389 Spring Attachment Bracket, 2
EA-381 25g Weights, 2
EA-388 Track End Pulley
EA-331 Springs, 2.5cm, 10
EA-332 Springs, 5.0cm, 10
EA-384 Pulley Weight Assembly
EA-382 Thumbscrew, 2
EA-386 Photogate Flag, 8
EA-385 Photogate Holder, 2
EM-09 Universal Spark Generator
EA-14 Spark Wire Kit
EM-02 Spark Paper, Roll
EA-20 Air Source w/ Hose
EA-21 Air Source Hose, 2m

DAEDALON® - AIR TABLE

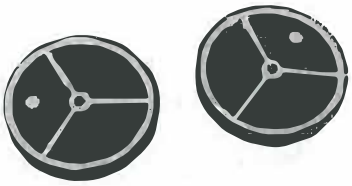


EA-12
Coupled Harmonic Oscillator
Gliders and springs on air tracks make a harmonic oscillator with sharp resonances. Single Glider and two springs have one resonant frequency. Add a second Glider and spring for a second resonance (and so on). **Includes:** (5) 150 g Gliders; (6)stainless steel springs (2.5cm); (5) ceramic magnets to damp random motion. With manual.

EA-12 Specifications:
- 0.0001s accuracy
- Measures period
- Stores time intervals
- Works with 1 or 2 photogates
- A course in vibration theory!
- For all our air tracks

EA-52
Acrylic Puck
Very light (90gr) 7.5cm diameter acrylic puck for collisions between very unequal masses.

EA-53
Aluminum Puck
7.5cm diameter, 210gm aluminum puck for collisions between unequal masses. A smaller effect than with EA-52 but with better energy conservation.



EA-55
Magnetic Puck (Set of 2)
Strong magnetic field enhances physical contact and makes for strong collisions. Photo-ready decals installed on a repelling pair.

Basic Air Table includes:
- Spark Generator & foot switch
- Air supply with hose
- Two steel pucks
- Velcro puck collars
- Springs
- Puck weight
- Edge pulley
- Recording paper kit
- Instruction manual

Deluxe Air Table has, in addition to the Basic:
- Acrylic puck
- Aluminum puck
- Pair of magnetic pucks
- Paper guide

See pg. 126 for **Science First® Air Tables**

EA-50 Basic
EA-62 Deluxe
Daedalon® Air Table
The Air Table has a flat glass surface that supports the recording and carbon paper. Light surgical tubing supplies compressed air to the pucks. The air exits from the bottom of the puck, causing it to float over the recording paper. Spark recording marks the motion of the pucks. Fine metal chains run down the air tubes, providing a connection to the spark generator. The spark jumps from a contact in the center of the puck, leaving a mark on the recording paper. The spark gap is completely enclosed and cannot be seen or heard during operation. The spark source operates at 10, 15, 20, 30 and 60 Hz when used with 60 Hz line power.

EA-51
Recording Paper Kit
4 sheets special carbon paper; 400 sheets newsprint, 56 x 56cm.

EA-58
Paper Guide
59cm long acrylic rod with internal spring. Compressed between inside edges of an Air Table, it acts as a guide in recording simple harmonic motion.

DAEDALON®

EM-14 **Specifications:**

- Pulley: 15.2 cm dia; ball-bearing hub; spokes
- Mass holders: 100 g; 4 slotted riders
- Mount: Cast aluminum wall bracket

See pg. 144 for
Science First® Atwood Machine

EM-14
Atwood Machine

Study both linear and angular acceleration! A string carrying two weight holders passes over a ball-bearing pulley with white and black spokes. The linear and rotational inertia of the system are equal. Add light weights to one weight holder to produce acceleration. Time with a stop watch because the motion is slow. Or use with a computer (in conjunction with EC-41 Timing Interface). Plotting the angular velocity computed from the data recorded by the photogate, versus the time, gives an accurate measurement of the angular acceleration.)

EB-17
Beck® Angle Mass Holder

The finest weight hangers made! Of virtually unbreakable, welded stainless steel. They accept most slotted masses that are held in place by the hanger's angle. Masses slip on and stay on. *Masses not included.*

EC-42
Digital Pulley

Large, end-stop mounted, ball-bearing pulley sends motion to a computer. Has spokes which can be viewed by a photogate.

Beck®

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

Beck® products offer sturdy construction, precision results and true teaching value.

EB-05
Beck® Crane

Here's a solid, dependable equilibrium crane designed for basic labs and demonstrations. Show that static equilibrium is achieved when both forces and moments are in equilibrium. An interesting demonstration in the resolution of forces and moment, it's particularly suited for first year engmeering laboratories.The structure is aluminum with a clear anodized finish and stainless steel pulleys and knurl nuts. Mounting and working sections separate for storage. Fastens to a bench with an integral heavy duty clamp. Height above table is 105 cm. **Includes:** Angled Mass Hanger, three dynamometers and a slotted 50 g weight. *Shipping weight 18 kg.*

DAEDALON®

Beck®

See pg. 122 for Science First® Inertia Products

EB-06
Beck® Inertia Device

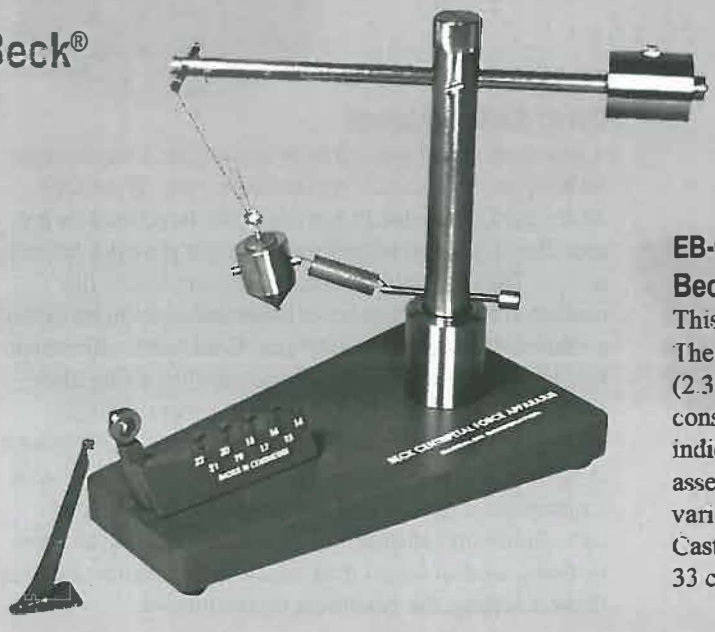
Here's a simple way of studying rotational dynamics. A 40 cm diameter aluminum disk is machined such that three masses can be placed at any of seven radii. Masses screw into threaded holes so they can be repositioned with great accuracy, varying moment of inertia. Simple geometry makes calculating the moment of inertia of the masses easy and verifiable by experiment. Rotational torque is provided by a mass attached to a light cord passing over a pulley and around the hub. Since its mass is only 50 grams, disk acceleration is very slow - almost 15 seconds to fall a meter! Obain accurate, reproducible measurements using only a meter stick, stop watch, and balance! EC-42 *can send data for computer analysis using* EC-41 *Interface.*

Beck®

EB-07
Beck® Torque Table

This gigantic table (60cm diameter) provides a hands-on approach to torque and center of gravity. Its focuses attention on the actual forces involved, similar to a force table, but with moments replacing forces. Students claim "it resembles a wheel balancer". The disk, made of 4.8 mm aluminum plate, balanced on a ground tool steel point, is free to rotate or tilt in any direction. To provide reference points and a means of hanging weights, 360 holes are drilled through on 2 1/2 cm centers. X and Y axes are identified by broken recessed lines. The circular level is set in the top of a hub. Both hub and center support post are stainless steel. All parts are interchangeable for storage and setup. **Includes** 5 Angled Mass Hangers, but additional masses can be hung for a more complicated solution. *Ship weight 11 kg.*

Beck®



See pg. 145 for Science First® Centripetal Force

EB-04
Beck® Centripetal Force

This surprisingly heavy device produces excellent data. The rotating assembly alone weighs more than five pounds (2.3 kg). Mounted in two large ball bearings, it has smooth, consistent rotation. Radius points for the test mass are indicated at 14 through 22 cm by a machined aluminum assembly. Radii of the inboard end of the spring can be varied through a range of 5 cm. Steel parts are stainless. Castings have an enamel finish. Length and height are about 33 cm. *Ship wt: 9.5 kg.*

DAEDALON®

EM-12
Kater's Reversal Pendulum

After two centuries, still the most elegant determination of g! In 1817, Kater, influenced by Bessel, developed a device that made possible an extremely accurate measurement of the acceleration due to Earth's gravity, g. The reversible pendulum is a pendulum that can be swung from either of two pivot points. When the mass distribution of the pendulum is adjusted so that the periods are the same from either pivot, then the period is the same as a simple pendulum having a length equal to the distance between the pivots. This simple property has great power in determining the value of g. During a typical three-hour lab session, you can measure g to an accuracy of ±0.1%. Crafted from nickel-plated steel with polished brass bobs. Full experimental manual and steel wall-mount bracket are included.

EM-16 Specfications:
Height: 90 cm. Bobs (dia): 19 mm
Material: Brass & acrylic
Mass holder: 50g with 10g, 20g, 20g, & 50g weights
Springs: Helical, 25, 50 & 75 mm
Force constants: 3.2, 2.5, & 1.8 Newtons/m

EM-16
Basic Pendulum Set

Study the simple harmonic motion of swinging and bouncing pendulums. Pendulums hang from a horizontal rod which clamps onto a vertical support rod containing a meter scale and cast-iron tripod base. The swinging pendulums have a 19mm diameter brass bob and an acrylic bob of the same diameter together with a length of flexible cord for suspending them so that students can measure the effect of length and bob mass. **Includes:** springs of three lengths (25, 50 and 75 mm) so you can examine the effect of spring length on the force constant. A mass holder hangs on the end of the spring to measure displacement as a function of mass (Hooke's Law).

Replacement parts:
- Projectile ball (EB-03/02)
- Ratchet rack (EB-03/01)
- Push block (EB-03/127)

Beck®

See pg. 133 for **Science First® Pendulums**

EB-03
Beck® Ball Pendulum

A fine time-tested pendulum with the following features: Ballbearing-mounted A-frame swing arm: Eliminates losses (and error) due to torsion of the pendulum swing arm. Precision, sealed ballbearing pivot provides smooth action. Durable stainless steel catch arm inside the machined aluminum catch cylinder has tension provided by a rubberband.Three-velocity gun. Consistent, adjustment-free initial velocities mean reproducibility, firing after firing.Replaceable pawl and ratchet system. A light-acting, gravity-sprung stainless steel pawl – hand ground to optimize performance – provides positive action with a minimum of frictional loss. High mass. Enameled cast aluminum construction means nearly 10kg of mass resisting inertial losses from recoil or imbalance. Even at its highest setting, the pendulum doesn't move.

DAEDALON®

See pg. 163 for Science First® Optics

EO-10
Complete Optics System

The system provides all the accessories you need to perform experiments in optics. Students can study such topics as image formation by thin lenses, simple telescopes, dispersion by prisms and gratings, polarization of light and much more. Detailed manual describes many experiments. Set **includes:**

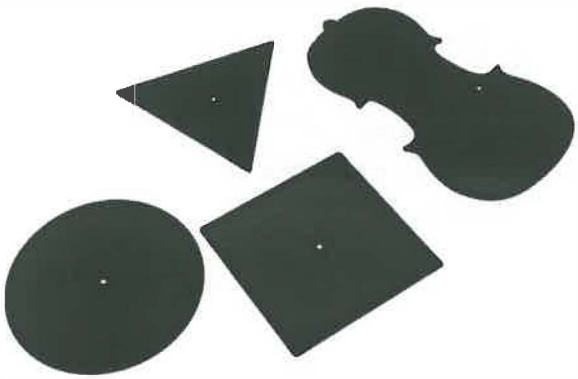
- Optical bench carrier, 30 mm (EO-01), 5; 65 mm (EO-02)
- Adjustable lens holder (EO-20), 3
- Lateral arm (EO-22); prism table (EO-30) (EO-32)
- Centering point pin (EO-23)
- Filter holder (EO-25)
- Opaque screen (EO-26); diffusing screen (EO-27)
- Stray light screen; polarizing filter (EO-33), 2
- Lenses (EO-48), set 6
- Concave mirror, -30 mm FL (EO-52)
- Equilateral prism (EO-59)
- Filters: red (EO-62); yellow (EO-63); green (EO-64); blue (EO-65)
- Single slits, three patterns (EO-72); double slits, 3 patterns (EO-73)
- Target (EO-75); diffraction grating (EO-77)
- Lamp with unregulated power supply (ES-17)

EO-12
Geometric Optics

This includes all components needed for experiments in geometric or Gaussian optics. Students can study such topics as image formation by thin lenses, and power of lenses in combination. **Complete system includes:**

- Optical Bench Carrier, 30 mm (EO-01), 5
- Adjustable Lens Holder (EO-20), 3
- Centering Point Pin (EO-23)
- Filter Holder (EO-25), 2
- Opaque Screen (EO-26)
- Diffusing Screen (EO-27)
- Stray Light Screen (EO-28)
- Set of Six Lenses (EO-48)
- Concave Mirror, -30 mm FL (EO-52)
- Red Filter (EO-62)
- Yellow Filter (EO-63)
- Green Filter (EO-64)
- Blue Filter (EO-65)
- Lamp with Unregulated Power Supply (ES-17)
- Instruction Manual

See pg. 172 for Science First® Wave & Sound Products



EG-54 Chladni Plates
EG-52 Electromechanical Driver

Chladni Plates

Daedalon® Chladni Plates are specially designed to fit on the EG-52 electromechanical driver, which illustrates the vibration modes of thin plates. The black anodyzed aluminum plates attach to the driver and vibrate as free-edge plates. The patterns rapidly increase in complexity as the frequency increases, which are highly visible with the addition of white sand. **Includes** four plates, each with 0.9 mm thickness: 13 cm x 13 cm square, 15 cm diameter circle, 15 cm equilateral triangle and 20 cm x 13 cm violin shape. Also includes shaker of white sand.

FIELDMASTER® - Water Sampling

623-2050 120cm
623-2055 60cm

Turbidity Tube

Measure turbidity (clarity of water) in streams where a Secchi disk cannot be used. Clear polycarbonate tube has a 4.5cm diameter Secchi design attached to a removable rubber stopper. Drain the tube with hose and finger crimp. 120cm length is good for the GLOBE program.

611-2275

Salinity Refractometer

Determine the percentage of salt in water with this portable instrument. Just 2-3 drops of solution are enough for accurate readings. Solid-aluminum construction, rubber-gripped body, automatic temperature compensation, easy to focus prism and lens. **Includes:** 2 pipettes, calibration screwdriver; hard plastic case, cotton cleaning cloth; cleaning solution, instructions.

663-0381 Kit
663-0405 Replacement filters, 100.

Accent Science™ Filtering Kit

Filter sediment or precipitated solutions with our portable kit. Separate by vacumm filtration in lab, class or field. **Includes**: hand vacuum pump; filter flask, 500 mL; Buchner funnel; filter paper, 90mm dia; large bore #8 stopper; instructions. Extra filters available.

663-0661 pH Meter
3-105-A55 Calibration solution

pH Meter

0-14, 0.1 pH resolution. +/-0.1 pH unit accuracy. 0-50° C. 2 point calibration

See pg. 80 for **Science First® Water Samplers**

623-2310 Basic Bottle
623-2300 Replacement line and float

Basic Water Sampler

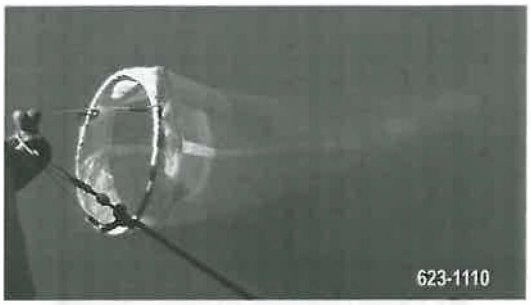
Our durable plastic water sampler is the right choice for schools. Impact resistant PVC body with soft rubber seals holds 1.4 liters. Custom closing mechanism needs no messenger - jerk line to close. **Includes** 20m line, styrofoam winding float. *Qualitative only.*

623-2315 Advanced Bottle
623-2300 Replacement line and float

Advanced Water Sampler

This clear polycarbonate 1.2 L bottle is ideal for long drops. Messenger activated, it has a custom injection molded closing mechanism. Polyurethane end seals, stainless steel parts. **Includes**: 20m polyester line on winding float, solid messenger and instructions. *Qualitative only.*

FIELDMASTER®



Plankton Nets (Nitex® fabric)

Here is real sampling equipment in 3 durable Nitex® nylon fabrics, known for its mesh size accuracy, which guarantees you'll know the smallest size plankton collected. Two sizes: 5" (130mm) in diameter and 15" (380mm) long; and 8" (200mm) in diameter and 20" (500mm) long. **Includes:** patented adaptor and 125 mL plastic sample bottle.

623-1120	**5" (130mm) dia**	**80 micron**
623-1123	**5" (130mm) dia**	**153 micron**
623-1125	**5" (130mm) dia**	**363 micron**
623-1130	**8" (200mm) dia**	**80 micron**
623-1133	**8" (200mm) dia**	**153 micron**
623-1135	**8" (200mm) dia**	**363 micron**
623-1100	**Sample bottle**	**125 mL**
623-1105	**Hose/pinchcock**	**(optional)**

623-2110

Collapsible Dipper

Bring a truly portable dipper on your next field foray for critters. This is great for collecting aquatic larvae. Lightweight and easy to use since it's collapsible. Telescoping aluminum handle extends from 25" (625mm) to 46" (1150mm). Plastic dipper, pour spout, graduated measurements.

623-1210

Mini Surber

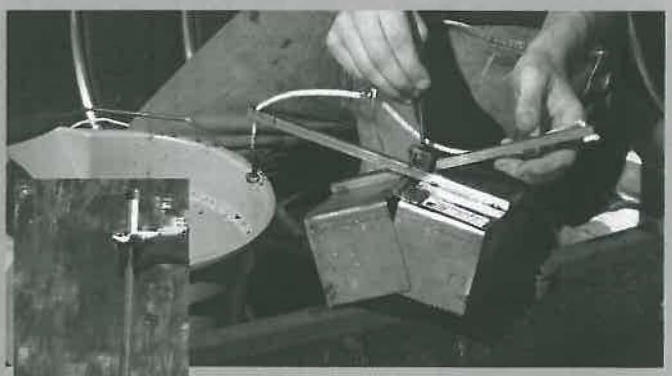
A surber net is placed on the bottom of shallow streams to sample for benthic invertebrates quantitatively. Ours is just the right size for schools. Stainless steel frame, 500 micron Nitex® net and taffeta wings. 6" x 11", samples 1/4 foot^2.

623-1110 ● **Complete net**
623-1111 **Replacement net**

Dip Net

Our sturdy D-frame net is ideal for stream sampling. Its 36" (90cm) aluminum handle is easy to wield in the field. With 18" (45cm) deep cone, 11-1/2 x 12" (29 x 30cm) hoop, 800 to 1200 micron mesh. Replacement net available.

● *Complete net ships oversize.*



623-3110

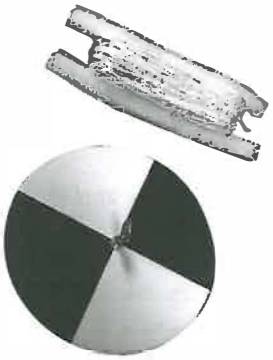
Mighty Grab™ (With pole)

Sample the bottom of ponds or lakes with this student-sized (1.2L) benthic grab. Lowers on a line or closes with a pole in shallow water. **Includes:** stainless steel scoops, 43.5" (110cm) long sampling pole, 20m polyester line, instructions.

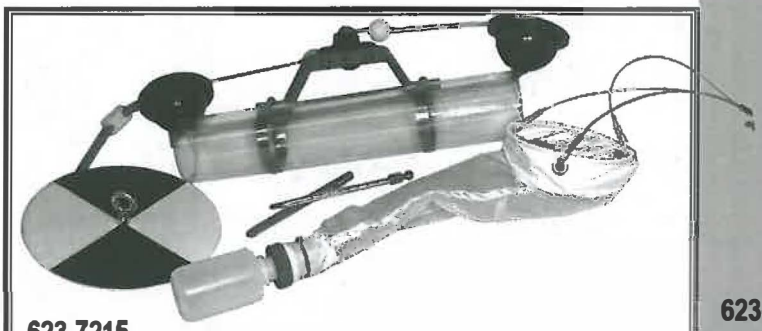
FIELDMASTER®

623-8120
View Bucket
Peer beneath the water surface with our clear-bottomed bucket. Durable plastic pail has tapered base glued with special adhesive to prevent leaks.

623-8110
AquaVue™ Underwater Viewer
Use this to peer below the surface of the water. Our 26" (66cm) tube with polycarbonate bottom avoids surface glare and has no internal reflection. Crush-resistant, black interior, flotation collar, neoprene viewing mask and handle.

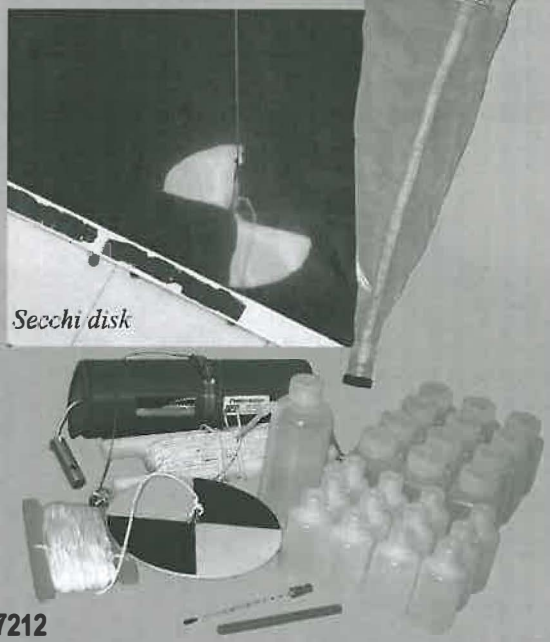


623-2010
Secchi Disk
Determine water turbidity (clarity) in lakes or ponds. Our classic plastic student Secchi disk has 2 white and 2 black quadrants. Lower into water until colors are no longer distinguishable. **Includes**: weight, 20m line on styrofoam float, instructions.

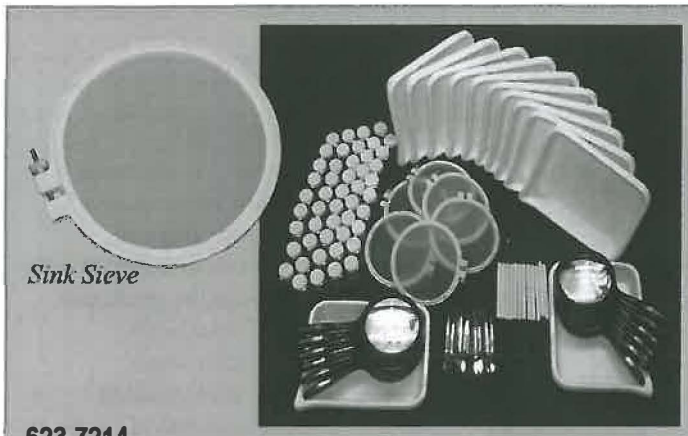


623-7215
Water Sampling Field Kit
A complete kit with everything you need to obtain samples of water and plankton, determine water transparency and measure water depth. Kit **includes**:
- Plankton net, 153µm
- 125 mL sample bottle
- Polycarbonate water bottle, 1.2 L
- Secchi disk, 20m line and float
- Armored thermometer
- Plastic carry case

Everything is reusable!



623-7212
Plankton Field Kit
Obtain samples of phyto- and zooplankton from lakes and ponds. Everything is reusable!
- Secchi disk with line and float
- Armored thermometer
- Plankton net, 80 micron mesh
- Water bottle, 1.75L, with line and float
- 125 mL polyethylene sample bottles, 12
- 250 mL polypropylene square bottles, 12
- 500 mL polyethylene wash bottle
- Set of basic teacher instructions



Sink Sieve

623-7214

Aquatic Invertebrate Lab Kit

Everything you need to sort through samples taken from the bottom of streams, lakes, ponds. Use in the field or bring samples back to the lab. **Includes**:

- Small white "Critter Pickin™" pan, 12
- Forceps and teasing needles, 12 each
- Sink sieves, pack of 6
- Plastic vial, 48
- Clear plastic ruler and hand lens, 12 each
- Invertebrate ID sheet and instructions

Magnifiers

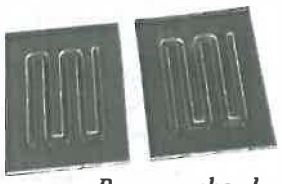
Everything is reusable!

623-7213

Plankton Lab Kit

Everything you need for sorting and identifying zoo- and phytoplankton from lakes, ponds and streams. **Includes:**

- Bogorov chamber, 6
- Gridded Petri dish, 12
- Insect forceps, 12
- Plastic vial, 24
- Disposable pipette, 100
- Clear plastic ruler, 12
- Teasing needle, 12



Bogorov chamber

Everything is reusable!

623-7211

Stream Sampling Kit

Obtain samples from flowing water with durable, easy to use equipment. Basic teacher instructions. Kit **includes**:

- Turbidity Tube, 60 cm long
- Armored glass thermometer (-40 to +120°F)
- 500 mL polyethylene wash bottles, 6
- 500 mL polypropylene square sample bottles, 12
- D-frame nets, 6

623-7210

Lake Bottom Sampling Kit

Durable equipment provided - no flimsy throwaways here. **Includes**.

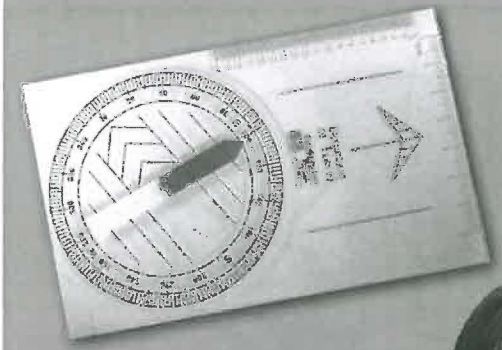
- Wash Bucket
- Armored glass thermometer (-40/+120°F)
- Mighty Grab™ with line and pole
- 500 mL square wash bottles, 12

FIELDMASTER®

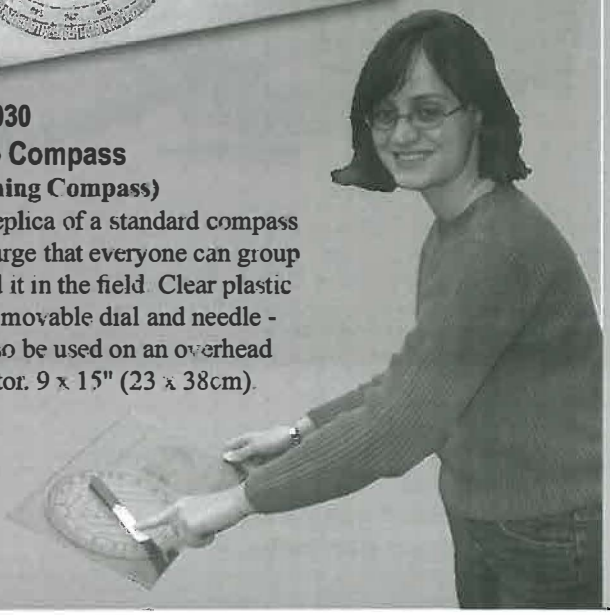
657-5010
Orienteering Kit
(For 24 students - 12 pairs)
Here is everything you need to get started with map and compass work. Teacher Guides help direct your students in class and out. **Includes:** student compasses, 12; teacher demonstration compass; metal student safety whistles, 12; economy stopwatch; sheets to make 12 control makers and cards; alphabet stamp set; "Orienteering and Map Games for Teachers", USGS "Topographic Map Symbols", "Find Your Way with Map and Compass"

621-7150
Soil Permeability Kit
Take the guesswork out of finding soil porosity! Show relationships between particle size, shape & uniformity. Place two samples in side-by-side high-quality graduated tubes with snug bottom seals (16", 1-1/2" dia.) Insert equal amounts of water with included syringes. Measure the rate of flow to determine porosity. Fully assembled with precision cut styrene housing.

624-5110
Soil Thermometer, Economy
Rugged thermometer reads -15° to 65° C. 12.5" (32cm) long with a push ball for inserting into soil.



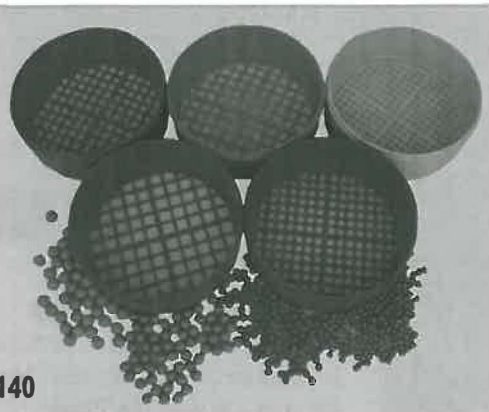
657-4030
Demo Compass
(Teaching Compass)
This replica of a standard compass is so large that everyone can group around it in the field. Clear plastic with a movable dial and needle - can also be used on an overhead projector. 9 x 15" (23 x 38cm).



657-4010
Orienteering Compass
Graduated 0 to 360° in 2° units, with liquid-filled capsule, luminous points, acrylic base, 4x magnification, lanyard. Instructions. Northern hemisphere.

657-4020
Lensatic Compass
Use this military style compass to follow a course over the ground. Compass card with degree scale; rotating bezel; sighting wire top cover; thumb hook; lens. Graduated in 0 to 360° in 5° increments. Shock resistant. Instructions. Northern hemisphere.

FIELDMASTER®

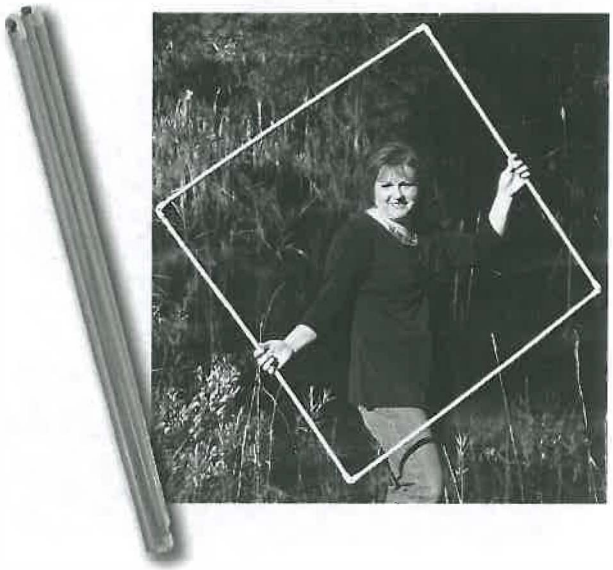


621-7140
Sifter & Bead Set
Don't have soils, or don't want the mess? Simulate soil separation with this kit. Drop beads (included) in the column, watch various sizes separate out.

621-7135
Plastic Sifter (Set of 5)
Similar to **621-7140**, above, but without beads, this low-cost set does a fine job of separating soil according to particle size. One piece molds.

621-7130
Elementary Sieve Set
Soil sorting just got easier with this colorful set. **Includes:** 4 sieves (8" diameter with 3, 5, and 9 mm holes), container pan, lid, instructions with activities.

621-7120
Shaker Sieve
This is great for soil and general particle sifting. 24 x 16 x 3" (61 x 40.5 x 7.5 cm) with 2mm aperture (2000 micron) to correspond to US Sieve Size 10. Wood frame, steel mesh.



622-6120 One square meter
622-6125 One quarter square meter
Sampling Square
Quantify the results of your field study with our folding plasic square. Cleanly and quickly mark off either a *quarter meter* ($0.25m^2$) or *meter square* ($1.0m^2$) on land or in water. It snaps open with a durable shock cord inside the plastic legs. Connections are made with T-connectors which allow the frame to sink. Collapsible. Instructions. *(Color may vary.)*

See pg. 172 for **Science First® Sieves**

Metal Sieve Set (Separately or Set of 6)
Economical stainless steel mesh sieves with zinc plated steel frames stack together to help separate soil or sediment particles. Set has lid & catch pan. Will rust if used in salt water.

621-7110	**Set of 6 (With lid & catch pan)**	
621-7111	**US Standard #5**	**4000 micron**
621-7112	**US Standard #10**	**2000 micron**
621-7113	**US Standard #35**	**500 micron**
621-7114	**US Standard #60**	**250 micron**
621-7115	**US Standard #120**	**125 micron**
621-7116	**US Standard #230**	**63 micron**

LINX®

2175
LINX® Universal Pack Consumables

Here are enough materials to build 50-60 models - from simple machines to complex models using cams, gears, pulleys, electricity, pneumatics and hydraulics. Can be used in conjunction with #2130 or as a refill. Good for a full year or more of classroom fun!

Kit **Includes**:

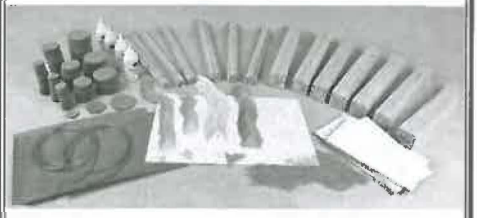
21208 Glue pot & spatula, pack 12
21219 LINX® card set
21301 Sticks, wood, (40cm), 50
21310 Strips, wood, (40cm), 40
21320 Dowels, wood (3/16 x 16"), 25
21346 Wheels, cardboard 3 Sizes, 40 each
21350 Spacers, plastic, pack 100
21360 Triangles, cardboard, gold, pack 300
21362 Triangles, cardboard, green, pack 100
21364 Triangles, cardboard, white, pack 100
21382 Glue, 4 oz bottle, 6
21388 Grid/graph paper, 11 x17, pack 25
21401 Propulsion bands, assorted
21404 Junior hacksaw, 3
21407 Reamer
21408 Metal safety rule, 2
21412 Wire stripper
21514 Matchsticks, Headless, Pack 2,000
21416 Battery Snaps (for #21414), pack 10
21417 Ring magnet, 19 x 6mm, pack 10
21418 Motor, DC 3-6 V, 10
21422 Pulley, Fits All Motors, pack 10
21424 Clip & screw (for #21418), pack 10
21426 Clip/ self adhesive base, pack 10
21428 Piston, 12cc, pack 10
21432 Cotton reels, pack 25
21434 Pipe insulation (Fits #21432), 50cm
21436 Buzzer, (3-6v operation), 3
21440 Propulsion band, rubber, pack 10
21444 Crocodile clips/leads, pack 10
21445 Gear box, simple
21446 Reed switches, pack 10
21448 Pulleys, plastic asst, pack 16
21450 Wire, red connecting, 100' Reel
21452 Wire, black connecting, 100' Reel
21458 Linx jointer, 2
21464 Clothes pins, pack 50
21468 Springs, pack 100
21510 Piston, 35cc, pack 5
21511 Piston, 60cc
21512 Clear plastic tubing
21518 Popsicle sticks, pack 150
21522 Bulb holders, Batten, pack 10
21524 Bulbs, Mes round, 2.5V, pack 10
21529 Slide Switches, On-Off-Rev, pack 5
21542 T-Bush, pack 20
21547 Cams, assorted, pack 10
21552 Gears, assorted, pack 12
21554 LED- 2 each, red, green, yellow
21631 Low temperature glue gun
21636 Sanding block
21638 Small Phillips screwdriver
21623 Glue sticks, pack 30
21646 Paper fasteners & washers, pack 100
21660 Push button switch, pack 5
21669 Bench hook with miter box, 2
21681 Balloons, round, balloons, long
21683 Craft sticks, Jumbo, pack 75
21414-2 Battery Holder (for 2-AA), 10
21414-4 Battery Holder, (for 4-AA), 10

2130
Challenger Kit, Hardware

Our class pack of tools and fixture is enough for 30 students and should last for years, to boot! **Includes:**

- Set of LINX® cards; hand drills and bits
- Sawing fixtures, dovetail saws, 4 each
- Drilling fixtures; gear assembly fixtures, 2 each
- Assembly boards, 12
- Miter boxes, 3· 45° (2), 30-60° (1)
- Glue pots & spatulas, 12 each

Design & Build with Linx®



2135
Challenger Kit, Consumables

Build 50 to 60 models from simple machines to static structures. Use with 2130 or as a refill. Will last a full year or more. **Includes:**

- Wood sticks (1 x 1 x 40cm), 175; wood dowels (3/16 x 16"), 75
- Wood strips (1 x 0.4 x 40cm), 60; plastic spaces. 3; plastic tubing, 6 feet
- Wood wheels (3 sizes), 120; carboard wheels (3 sizes), 180
- Cardboard triangles (3 sizes), 1500; glue, 16 oz.
- Sandpaper sheets, 4, 4; grid paper (11 x 17), 25

LINX®

2110
Discovery Kit (Individual Kit)
Enough to build 8 to 10 models - for example, 8 to 10 rolling cars.

Includes:
- Set of LINX® cards
- Sawing fixture, gear assembly fixture
- Dovetail saw; drill fixture
- Hand Drill and Bit
- Assembly board
- Miter box, 45 degree
- Wood sticks (1 x 1 x 40cm), 25
- Wood Strips (1 x 0.4 x 40cm), 20
- Wood Dowels (3/16 x 16"), 25
- Wood Wheels (3 sizes), 30
- Cardboard Wheels (3 sizes), 60
- Cardboard Triangles (3sizes), 500
- Plastic Spacers, 100
- Plastic Tubing, 3 feet
- Glue, 4 ounces; glue pot; spatula
- Sandpaper Sheet
- Sheets of Grid Paper (11 x 17"), 25

2125
Explorer Kit
This workstation for a group of students is ideal for a science club, after school program, or science-technology corner in a classroom. Enough to make 15 to 20 models (i.e.15-20 land yachts).

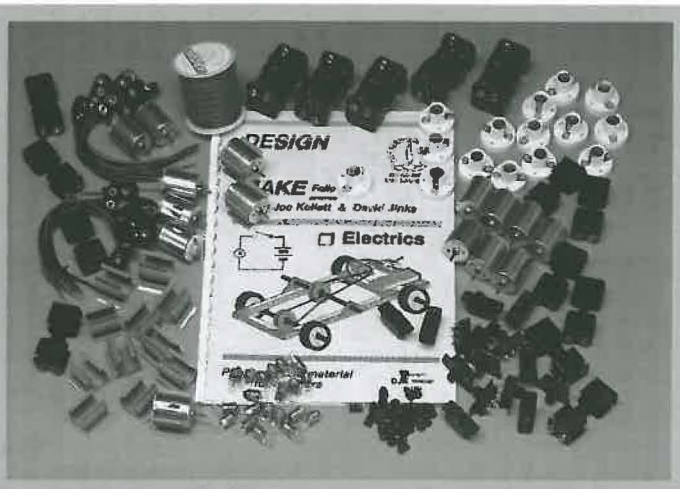
Includes:
- Grid Paper (11 x 17"), 25
- Sawing Fixture
- Mitre Box, 45°
- Drilling Fixture
- Hand Drill and Bit
- Assembly boards
- Gear Assembly Fixture
- Plastic tubing, 3'
- Cardbd Triangle (3 sz), 500
- Plastic spacers, 100
- Glue pots & spatula, 4
- Glue, 8 ounce
- Sandpaper, 2 sheets
- Set of LINX® cards
- Wood Wheel (3 size), 60
- Dovetail Saws, 2
- Wood Dowel (3/16 x 16"), 50
- Wood Stick (1 x 1 x 40cm), 75
- Wood Strip (1 x 0.4 x 40cm), 40
- Cardboard Wheel (3 size), 120

Putting Science *First* since 1960

LINX®

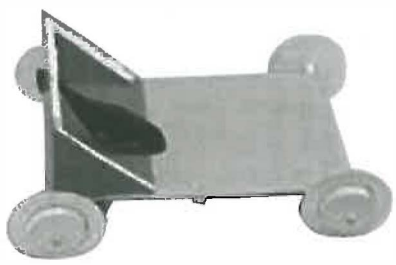
21575
Pneumatics & Hydraulic Class Pack
Introduce students to pneumatics and hydraulics and how they can be used to lift and move structures. **Includes** instructions with class activities. **Contains**:
- Assorted pistons; piston mounting clips, 30 each
- Plastic Tubing, 50 feet
- Straight Connectors, 40
- T-Connectors, 20
- 3-Way Valves with Connectors, 10

Folio: Mechanisms 3



21573
Electricity Class Pack
Introduce students to electricity and electric circuits and their practical applications! Detailed guides. **Includes**:
- Motor mounts, pulleys, 15 each
- Motor Bushings, 20
- Connecting Wire, 200'
- Switches, bulb holders, 15 each
- Bulbs, battery holders, 30 each
- Battery Snaps, 20

Folio 9: Electrics



21610
Vehicle Engineering Kit
This kit, developed by former teacher Ed Lee, lets you construct a working balloon-powered vehicle from cardboard, paper straws, and dowels - simple materials that present abundant design challenges. We provide enough material to build 15 models and an extensive teachers manual with tips on classroom time requirements, standard connections, and science background.

21872
Motorized Worm Gear Drive Vehicle
Easy-build kits have all the necessary parts (Glue and batteries not included). Instructions on how to make a car 10 x 24cm.

21870
Wind Racer Kit
We offer a number of easy to build kits. These kits come with all the necessary parts to construct the model except glue and batteries as required for some vehicles. Detailed instructions included. Constructs a wind powered land yacht.
No photo available.

Design & Build with Linx®

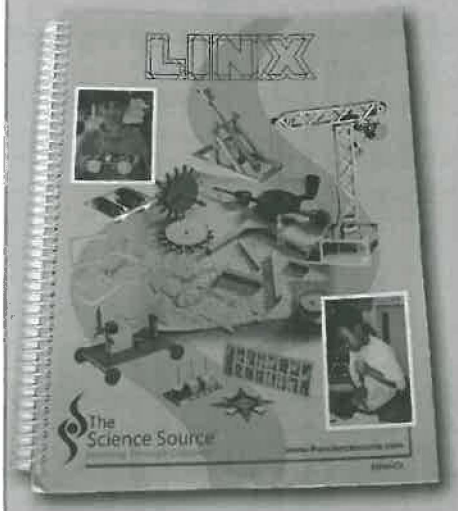
21598
Propeller Driven Vehicle
A fun, kit! All you need are glue and (for some models) batteries. **Includes** all materials plus detailed instructions for one electric vehicle and one rubber band drive vehicle.

LINX®

2127
LINX® Took Kit
Our sturdy, lockable, wooden carrying case holds enough real sawing and drilling tools to equip two class work stations. **Includes:**
- Junior hacksaws, 2
- Plexiglass guides, 2
- Replacement saw blades, 10
- Jax Joiner for 3-D construction
- Sanding Block
- Lynx Joiners, 8
- Hand Drill & Bits, 2; light vises, 2
- Round File

Design & Build with Linx®

Putting Science *First* since 1960

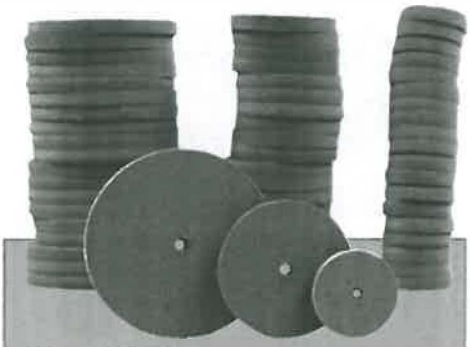


21219
LINX® Tech Cards
This features double sided cards in both Spanish and English that clearly show how to use the LINX® materials. There are cards with construction tips, cards showing how to build powered vehicles, cards that take you through the construction of wind powered vehicles, cards that describe the design process & much more!

180110
Kinetic Contraptions Kit
This is a great introduction to the intricacies of kinetics. It **includes** everything, aside from tools, necessary to build these 12 contraptions:
- Three-wheeler
- Two-wheeler (remote control)
- Airboat; motorboat
- Plane-on-a-Stick; flying caterpillar
- Spinning Surprise Tree
- Hopper; tornado; wave machine
- Solenoid and Electromagnet
- Motor = Generator = Meter

21673 Teacher Resource & Workcards
21674 Checkcard (Pack 50 sheets)
Checkcard Teacher Resource Book & Workcards
Construct models quickly and accurately. Our grid-printed, thick paper stock is 23-1/4 x 16 3/8" (594 x 420mm) in five bright colors. The 22-page Teacher Booklet discusses tools and techniques. Sixteen cards in four sections: structures, packaging, levers, and linkages, and pop-ups, along with interesting design challenges. Developed in England by Peter Sellwood

LINX®

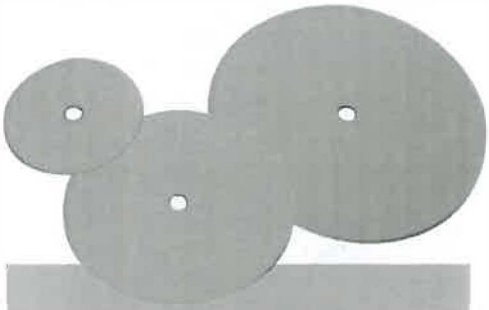


Wood Wheels

21330
Small Wood Wheels (Pack 20)
3/16" thick, 7/32" center hole.
1-1/4" diameter

21334
Large Wood Wheels (Pack 20)
3/16" thick, 7/32" center hole.
2-3/4" diameter

21336
Assorted Wood Wheels (Pack 60)
Three size wheels. 20 of each,
3/16" thick, 7/32" center hole.



Cardboard Wheels

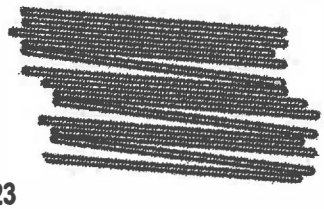
21340
Small Wheels (Pack 100)
1-1/2" diameter, 0.6mm thick

21342
Large Wheels (Pack 100)
2-1/2" diameter, 0.6mm thick

21346
Assorted Wheels (Pack 60)
20 each, three different sizes.

21348
Special Cardboard Disk
Our special "Hanover" disks fits the end of toilet paper rolls to make wheels of varying thickness. 41.2 mm in diameter. 0.6mm thickness.

21619
Plastic Wheels (Pack 40)
20 each - 4 & 5cm diameter
Two sizes. Will take 4mm axle. Drill to take 3/16" dowel

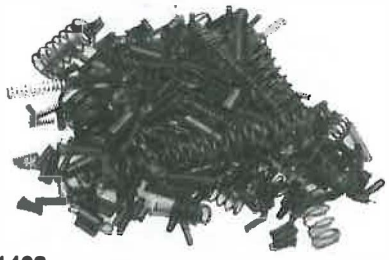


21423
Axles (Pack 10)
Metal axles, 150mm x 4mm (6" x 5/32").

21432
Plastic Reels
Plastic reels for use as wheels or pulleys. Will take a 3/16 dowel by inserting a spacer. Can also be used as spools.

21434
Pipe Fitting
Fits over Cotton Reels (21432) to make high traction wheels. Comes in 50cm (about 20") lengths, cut to size.

21641
Axle Clip (Pack 10)
This is a good way to attach an axle or shaft to a wood structure. Clip holds 3/16" dowel and allows it to turn freely.



21468
Springs (Pack 100)
100 small metal springs assorted lengths & diameters.

LINX®

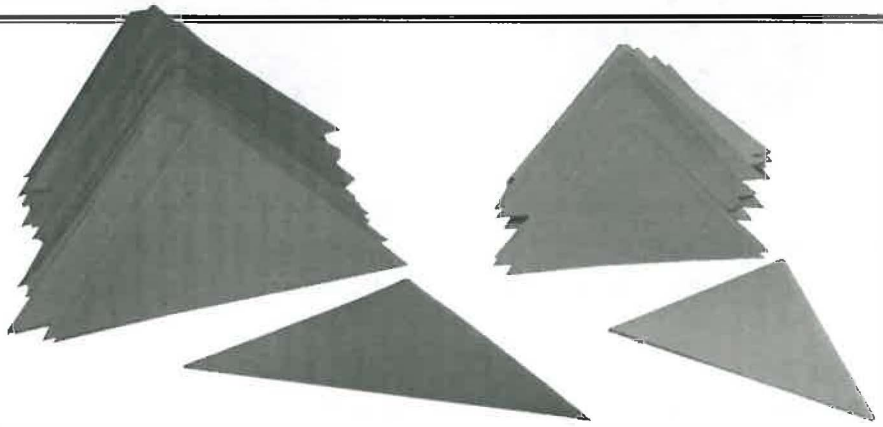
21429
T - Connectors (Pack 10)
To make a three way connection with 1.8" I.D. plastic tubing.

21350
Plastic Spacers (Pack 100)
Plastic tubing 3/8" long, 3/16" ID

21512
Clear Plastic Tubing, 10'
1/8" I.D. x 10' long. For connecting pistons (syringes) and control valves.

21513
Clear Plastic Tubing, 40'
1/8" I.D. x 40' long. For connecting pistons (syringes) and control valves.

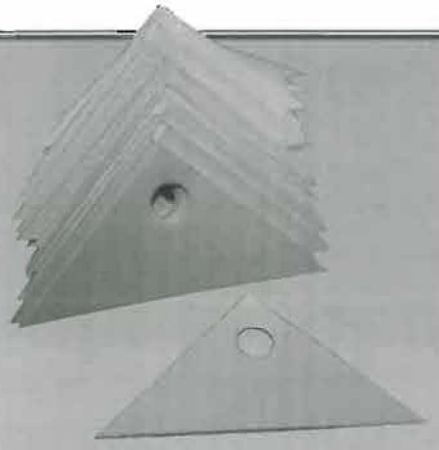
21370
Plastic Tubing, 3'
3' length, 3/16" ID, 5/16" OD



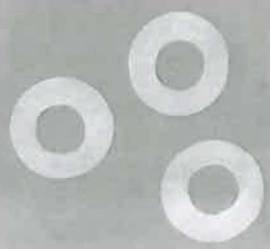
21362
Triangles, Green (Pack 100)
Large cardboard triangle, green, for 3-D work.

21360
Triangles, Gold (Pack 300)
Small cardboard triangle, gold, for 2-D work.

21431
3-Way Valve With Connector
Controls flow of air or water.



21364
Triangles, White (Pack 100)
White axle triangle, carboard

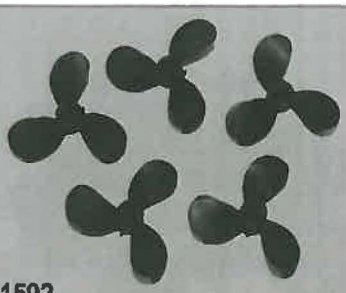


21365
Holes, Reinforcing (Pack 200)
For Axle Triangles
Reinforces hole in axle triangle when opening wears down.

21427
Straight Connectors (Pack 10)
To connect two pieces of 1/8" I.D. plastic tubing. For use with projects using pneumatics and hydraulics.

LINX®

21692
Propeller Blades (Pack 5)
Propeller with two blades, each 3" long



21592
Propeller, Boat (Pack 5)
Boat propeller with 3 blades, each 1 3/16" (3cm) diameter.

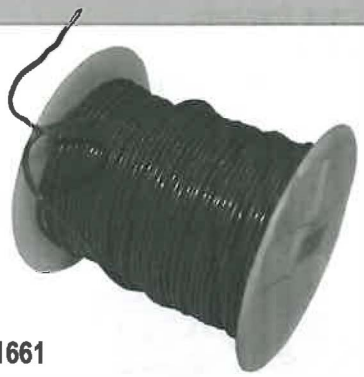
21437
Propeller, Hook & Eyelets
Propeller with 3 blades, each 2.5" diameter. **Includes** 2 hooks & eyelets for rubber bands.

Design & Build with Linx®

21682
Balloons, Long (Pack 50)
Propel vehicles or lift loads.

21681
Balloons, Round (Pack 50)

21675
Balloon Pump
Hygienic way to inflate balloons.



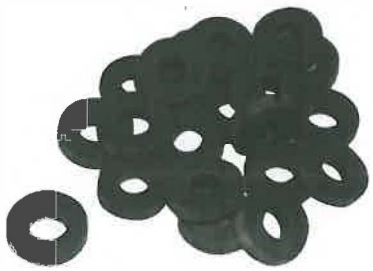
21661
Wire, Red (100' Reel)
Solid single strand connecting wire.

21662
Wire, Black (100' Reel)
Solid single strand connecting.

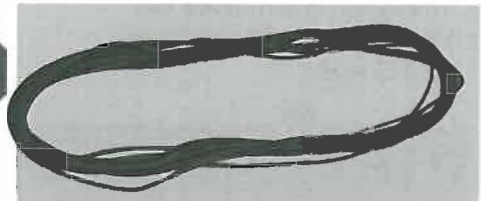
21450
Wire, Multistrand (100' Reel)
Multistrand red connecting wire.

21452
Wire, Multistrand (100' Reel)
Multistrand black connecting wire.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com



21466
Rubber Washers (Pack 20)
Can be used as spacers since they are a snug fit on a 3/16" dowel.



21440
Rubber Propulsion Band (Pack 10)
Use with pulleys & propellers.

21532
Open Eye Screw, Small (100)
For linking devices together and hooking propulsion bands.

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

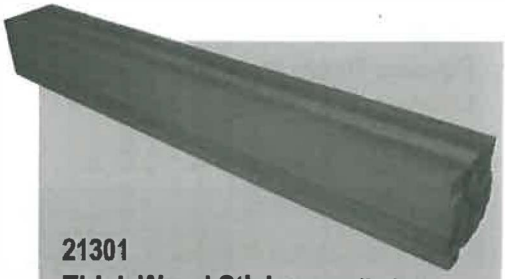
LINX®

21570
Corrugated Plastic Sheet (10)
Lightweight, bright, waterproof and buoyant. Use with wheels, pulleys & dowels. Cut with scissors or knife and join with tape or fasteners. 4mm thick sheets, 1' x 2', assorted colors.

21518
Popsicle Sticks (Pack 150)
Flat wood sticks for strengthening cardboard disks and for making linkages. 4.5" in length

21320
Dowels (Pack 25)
Hardwood 3/16" x 16". 25 dowels per bundle

21683
Jumbo Craft Sticks (Pack 75)
6" long, 3/4" wide, 75 per pack.

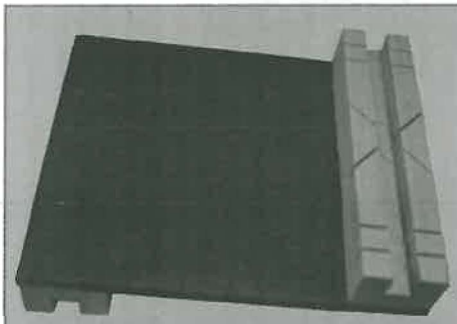


21301
Thick Wood Sticks (Bundle 25)
Basswood 1cm x 1cm x 40cm (15 3/4") 25 sticks per bundle.

Thin Wood Strips

21310
Short Wood Strips (Pack 20)
Basswood 1 x 0.4 x 40cm (15-3/4")

21658
Long Wood Strips (Pack 20)
Basswood 1 x 0.4 x 61cm (24")



21669
Bench Hook & Mitre Box
With 45 & 90° mitre boxes at both ends.

21501
Jax Joiner, Single
An aid in assembling and gluing 1 cm width wood sticks in 2-D and 3-D at 30, 45, 60 and 90°

21402
Bench Hook (Pack 4)
Saw small pieces of wood.

21458
Lynx Jointer
Very well designed and easy to use device for helping join two pieces of wood and a cardboard triangle at right angles. Accomodates wood sticks 1 cm in width.

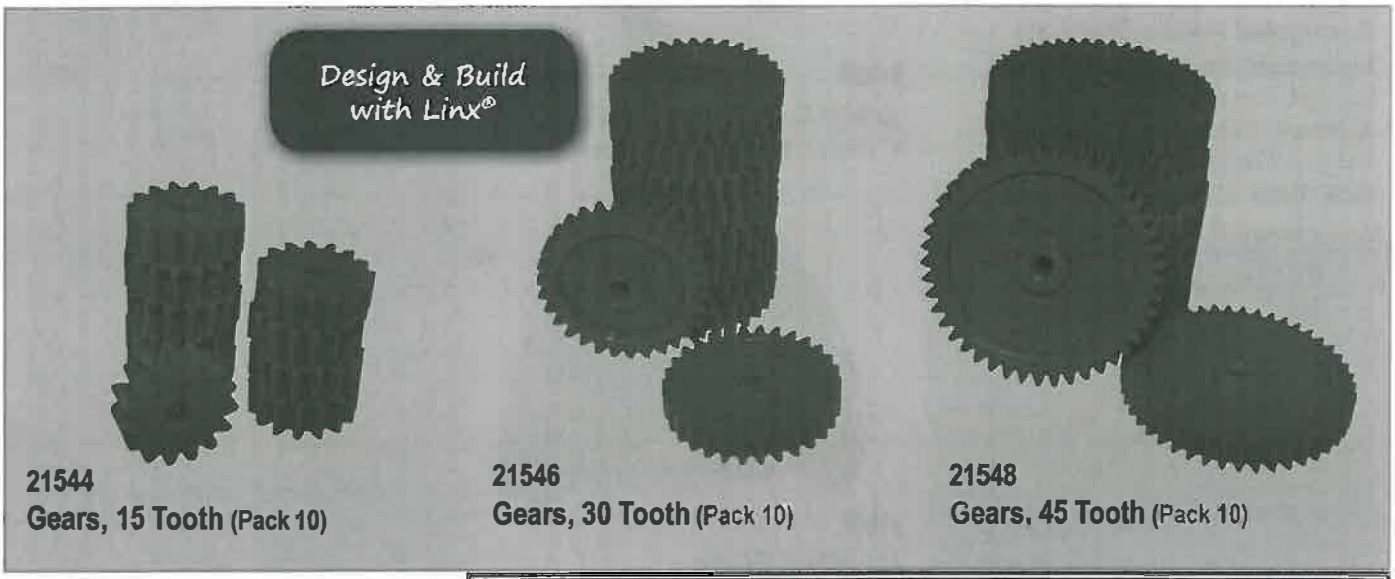
21514
Headless Matchsticks (2,000)
For model building.

LINX®

21550
Beveled Gears (Pack 10)
Change a shaft's rotation direction.

21551
Gear Rack
Linear, toothed bars used in rack and pinion systems. The gear rotates to drive the rack's linear motion. Gear racks provide more feedback than other steering mechanisms.

21553
Worm Gear (Pack 10)
Use with bevel/ spur gears or for large gear reductions. Reduce 4mm center to 2 to accept a small motor (with T-bushing, below). Center can also be drilled to accept a 3/16" dowel.



21544
Gears, 15 Tooth (Pack 10)

21546
Gears, 30 Tooth (Pack 10)

21548
Gears, 45 Tooth (Pack 10)

21445
Simple Gear Box
Fits the shaft of DC motor #21418 and drives a spur gear on a 4mm shaft. Reduces motor speed by a factor of 40. (Motor not included).

21552
Assorted Gears (Pack 12)
Contains:
- Gear Rack, 2 each
- Bevel Gear, 2 each
- 45 Tooth Gear, 2 each
- 30 Tooth Gear, 2 each
- 15 Tooth Gear, 2 each
- Worm Gear, 2 each

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

LINX®

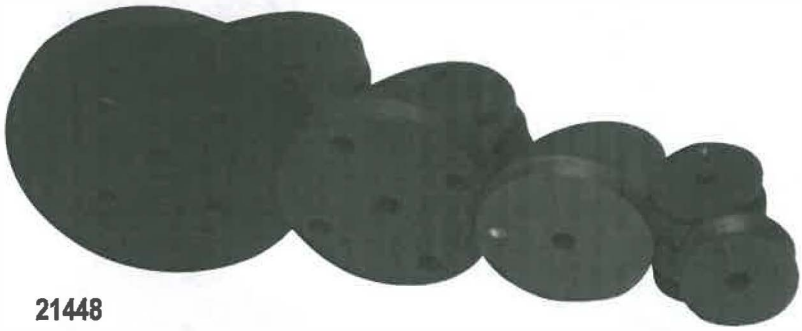
Design & Build with Linx®

21566
Small Plastic Pulley (Pack 10)
Center takes Motor-T-Bushing. Drill out for 3/16 dowel. 20mm wheels.

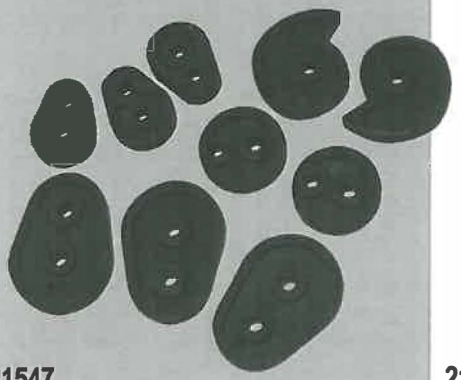
21567
Medium Plastic Pulley (Pack 10)
Center takes Motor-T-Bushing. Drill out for 3/16" dowel. 30mm wheels.

21568
Large Plastic Pulley (Pack 10)
Center takes Motor-T-Bushing. Drill out for 3/16" dowel. 40mm wheels.

21571
Extra Large Plasic Pulley (10)
Center takes Motor-T-Bushing. Drill out for 3/16" dowel. 60mm wheels.



21448
Assorted Plastic Pulley (Pack 16)
Center takes Motor-T-Bushing. Can be drilled out for 3/16" drill dowel.



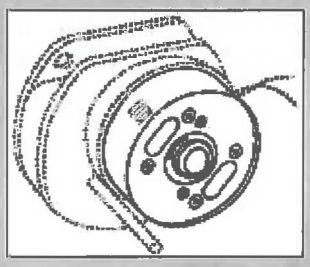
21547
Cams (Pack 10)
Assortment of four different cam profiles with 4mm bore, used to convert circular motion to reciprocating (up and down or back and forth) motion.

21545
Cams, Gears & Pulleys (oh, my!) Class Set
Introduce the use of cams, gears, and pulleys in solving design challenges. All have 4mm diameter centers which can be enlarged with a 3/16 drill bit. Add Bushing #21542 to accept shaft. With suggested projects. **Contains:**

- Cams, gears, & pulleys, 40 each
- Assorted wheels, 30
- Assorted Cardboard Discs, 60
- Rubber Bands

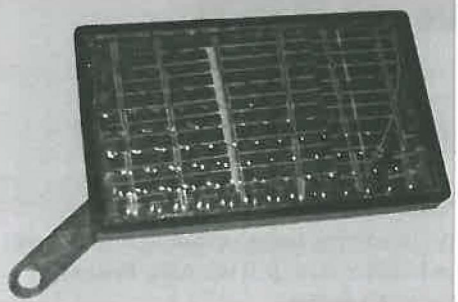
LINX®

21473
Solar Motor
Low torque, requires ~ 200ma to operate, for use with solar panels.



21686
Solar Motor & Gear Box
Increased torque through gear box reduction (max ratio 27:1). Power models with solar energy.

21469
Solar Cell, 1000ma
95mm x 65mm, 1000ma



21470
Solar Cell, 400 ma
75mm x 45mm, 400ma

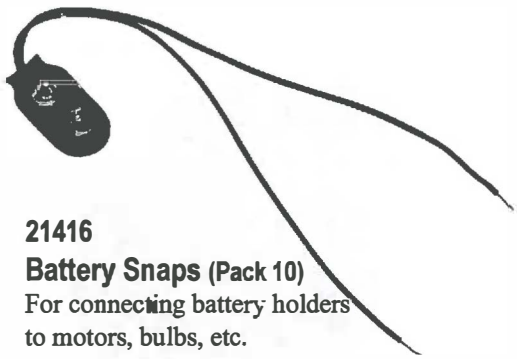
21684
Motor, Dc 1.5v-4.5v
Medium motor.

21418
Motor, DC 3.0v-6.0v
High Torque

21471
Motor, DC 1.5v-3v
The heart of any design! Use any 1.5V cell (or 2 in series for 3V) to power this low-cost prime mover! Styles may vary.

32920
Sensitive Motor (Low Torque)
Start and run solar cells. **Includes:** pulley on shaft, cardboard wheel, short tubing to use as a connector.

21444
Crocodile Clips & Leads (10)
Ready made leads in easy-to-track assorted colors.

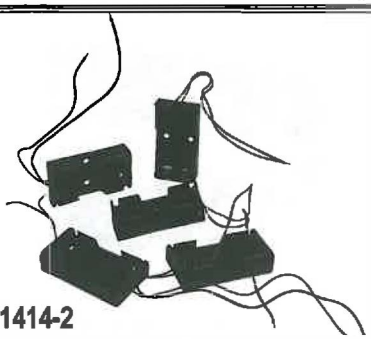


21416
Battery Snaps (Pack 10)
For connecting battery holders to motors, bulbs, etc.

21542
T-bushing (Pack 20)
Center hole fits shaft of small DC Motor; bushing fits gears & pulleys.

21422
Motor Pulley (Pack 10)
Fits #21418. Push fits onto all DC motor shafts; holds drive band in place.

21414-1
Battery Holder (Pack 5)
One "AA" battery (1.5V), wire connectors



21414-2
Battery Holder (Pack 5)
Two "AA" batteries, (3V), uses battery snaps.

21414-4
Battery Holder
Four "AA" battery (6V), uses battery snaps.

615-4001
Battery Holder with 2 Leads
Two "AA" battery holder (3V) with black & red leads

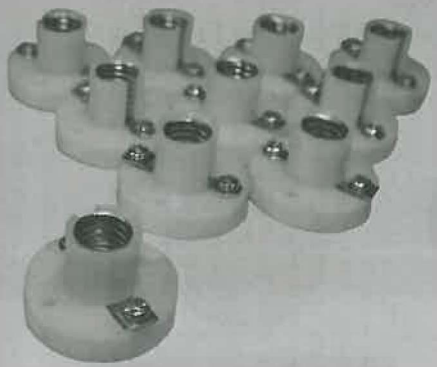
21349
Flashing Bulbs (Pack 10)
Flashing Bulbs, Mes Flash 2.5v

21524
Round MES Bulbs (Pack 10)
Mes Round, 2.5v

21538
Connector Strip (12)
12 in a strip, cut off as required. For joining wire and components.

21521
Economy Bulb Holder (10)
MES holder with tabs.

21520
MES Clip Bulb Holder (10)
Takes Mes Bulbs. MES plastic clip-on type, slides onto popsicle stick.



21522
Batten Bulb Holders (10)
Screwdriver needed to make connections.

LED, Flashing Bulbs
5mm, built in IC produces continuous flashing, no resistor required. Uses 4.7 - 12V, long leg connects to plus, short leg to minus

21554
LED, Flashing Red

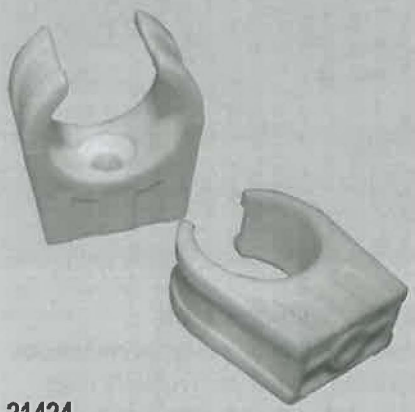
21556
LED, Flashing Green

21558
LED, Flashing Yellow

Design & Build with Linx®

LINX®

21436
Small Buzzer
Operates in 3-6V range.



21424
Clip With Screw (Pack 10)
To Fit #21418. Plastic clip with wood screw fits all DC motors.

21426
Plastic Clip
Holds #21684 and #21418 DC motors; self adhesive base for wood or cardboard.

Piston
For projects using hydraulics (water) & pneumatics (air)

21428
12cc Piston (Pack 10)

21510
35cc Piston (Pack 5)

21663
20cc Piston (Pack 10)

21511
60cc Piston

21430
Syringe Mounting Clip (Pack 10)
For mounting 12cc syringes.

Putting Science *First* since 1960

Design & Build with Linx®

21446
Reed Switch (Pack 10)
Reed switch alone.

21447
Reed Switch & Magnet (Pack 10)
Includes small magnet for closing the circuit.

21660
Push Button Switch (Pack 5)
On/off momentary type.

21528
Large Toggle Switch

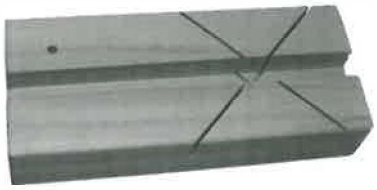
21526
Slide Switch, On/ off (Pack 5)
Small slide switch, on/off.

21529
Slide Switch, On/ off/ reverse (Pack 5)
Small slide switch, on/off/reverse.

LINX®

21201
Sawing Fixture
For safe, accurate sawing. Can be reversed for left handers. Centimeter measuring scale. Saw guide prevents saw from cutting through fixture base

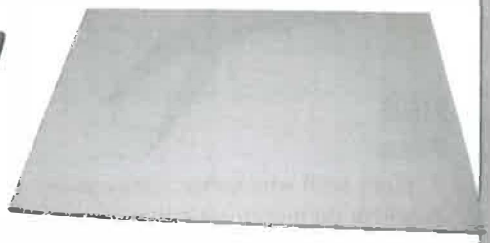
21202
Drilling Fixture
For safe, accurate drilling with hand drill. Prevents drill from going through base of fixture. For sizes: 1/8", 3/16" & 1/4".



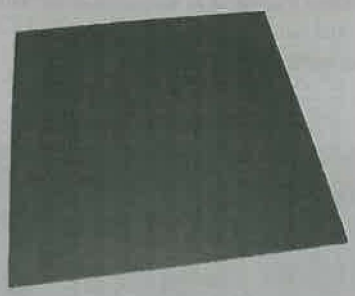
21205
Mitre Box (45°)
For fixture above. Allows easy sawing of 45°.

21205A
Mitre Box (30-60°)
For fixture above. For sawing at 30 & 60°

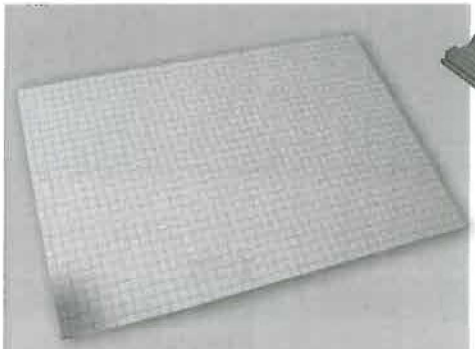
21203
Assembly Board
Just what you need for accurate right angle placement of wood prior to gluing. Easy to clean surface. **Includes** glue pot recess.



21390
Foam Board
Rigid foam cuts with a craft knife. Great for model building. Draw right on the paper! 3/16 x 10 x 15"



21627
Cutting Board
12" x 12" x 1/4" masonite.



21388
Grid/ Graph Paper
Cm squared grid/graph paper for designing models.
Lay sticks right on the grid!

21477
Art Straws
Calling students of all ages! What can you make with these? 41cm (16") straws 4mm & 6mm in diameter. Easy to cut, bend, & attach. 2 project booklets.

21517
Small Cutting Mat
Self healing, semi hard mat surface, eye-ease green, both sides can be used. 21 x 30cm

21516
Large Cutting Mat
Self healing, semi hard mat surface, eye-ease green, 1cm squares printed on one side. 30 x 42cm.

LINX®

21451
Round File
4.5" with wooden handle.

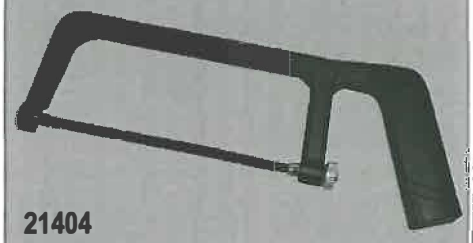
21216
Acrylic Saw & Drilling Guide
Acrylic sawing and drilling guide, allows 90 and 45° cuts, accomodates wood sticks 1 cm, 3/16 inch drill. For use with a vise (#21639).

21412
Wire Stripper
Use this for removing plastic sleeves from connecting wire, cutting spacers from plastic tubing, and cutting wire.

21635
Pliers
5" pliers with wire cutter, spring jaws, excellent for use on electricity projects.

21206
Reversible Back Saw
10" long, with 13 teeth per inch.

21640
Wire Cutters
Small, sturdy, 4" handle. With lock nut.



21404
Junior Hacksaw
With easy change blade facility; blade included.

21405
Junior Hacksaw Blades (Pack 10)
Replacement blades for #21404.

21631
Low Temperature Glue Gun
This handy, compact gun operates at a lower temperature than others and has an integral molded stand and rubber shroud on the nozzle for safety. Takes round glue sticks (#21631). Children must be supervised.

21623
Round Glue Sticks (Pack 30)
Low temperature.

21679
Glue Gun Stand
Our wood stand safely holds glue gun #21631.

21208
Glue Pot & Spatula
(Pack 12)
Closed canister. Fits the assembly board. Plastic glue spatula has flexible tip for easy glue application.

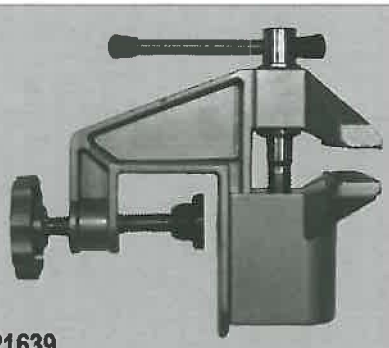
21382
Glue (4 ounce)
PVA glue, non-toxic, water soluble, fast drying.

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

21463
Hole & Eyelet Punch
Heavy duty! Eight tools in one. Punches 1/8" and 3/16" holes; sets eyelets & snaps. Penetrates almost any material- wood, paper, plastic. Make links with craft sticks (#21518 and #21683)

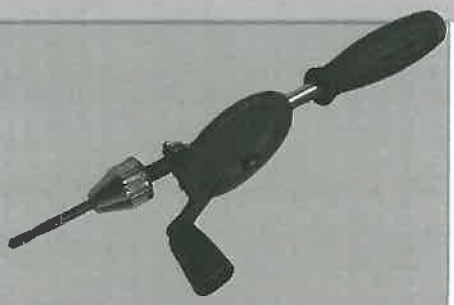
21326
Sand Paper (Pack 2)
9 x 11", 100-grit

21636
Sanding Block
Foam block, 4" x 3" x 1", great for small hands.



21639
Vise
Small, lightweight. 50mm (2") opening. 30mm clamp opening (1 1/4").

21677
Metal C-clamp
Durable, heavy-duty clamp. 3" throat, for attaching fixtures or materials to a table top.



21207
Hand Drill & Bit
For use with drill stand. **Includes** 3/16" drill bit

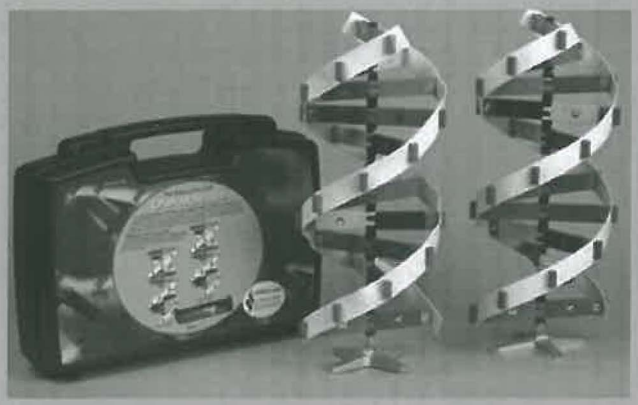
21629
Drill Stand With Drill
Easy, safe & accurate drilling! Place work on the printed grid and clamp. Set drill depth with adjustable stop. **Includes**: attached drill, 3 bits - 3mm, 4mm, 5mm

21472
Paper Drill & Cutters
This tool allows you to make holes in cardboard or corrugated plastic where a punch does not reach. Comes with 3, 4, and 6mm drill bits.

21474
Six Hole Punch
Punch holes in plastic sheeting and card stock. Revolving head holds six punches with dia. 2, 2.5, 2.8, 3.2, 4.0, and 4.8mm.

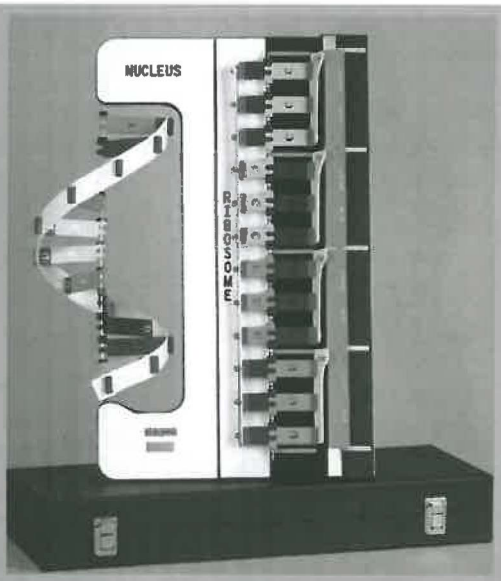
21407
Reamer
Hand tool for enlarging 3/16" holes to give a running fit to a 3/16" dowel.

Staco®



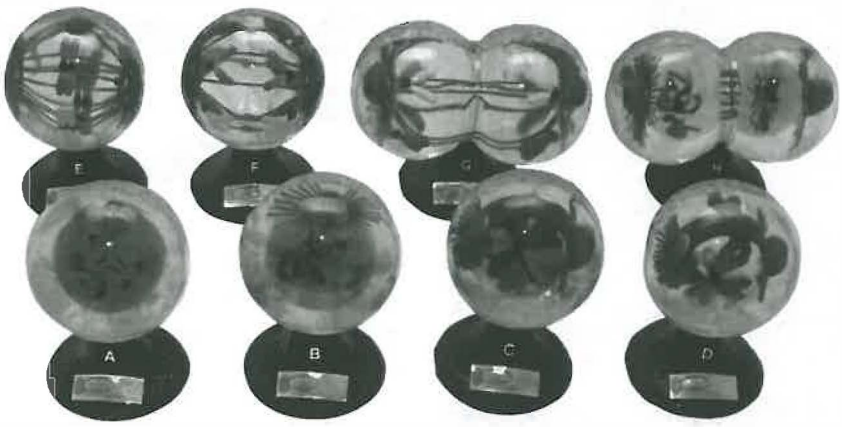
B107
DNA Model

Revolutionary! Everything needed to build two DNA molecules using nucleic acid bases C cytosine, A adenine, G guanine, and T thymine. Color-coded, molded plastic base form purine-purine and pyrimidine-pyrimidine pairing. Twelve pairs of bases snap onto a supporting rod; two stretchable phosphate backbone strands join the ends. **Includes**: 48 bases; 4 strands; 2 rods; pedestals; sturdy storage box; illustrated instructions; key cards. 17-1/2 x 3 x 7" (44 x 19 x 19cm). *3kg. 7-3/4 lbs.*



B118
RNA Protein Synthesis

Shows the full spectrum of RNA-Protein Synthesis in 6 brilliant colors. **Includes**: 12 each, injection molded acetate-butyrate plastic DNA bases, messenger RNA bases, transfer RNA bases; 4 amino acids, and 6 molded rubber strands representing the phosphate backbone. Also **includes** wood mounting frame, custom fitted case, instructions. 24 x 20 x 7". 61x51 x18cm. 5.4kg



B103
Animal Mitosis Model (Set of 8)

Our sequential models graphically illustrate the division of chromosomes and mitotic apparatus. Organelles and cell inclusions are embedded in strong, crystal-clear plastic globes containing: nucleus, nucleolus, double thread chromosomes (in different colors), centrioles, centromeres (kinetochores), aster, and spindle fibers. With key cards. **Models 1 - 6**: 5 1/4 x 3-1/4 x 3-1/4" (9 8cm dia, 13cm high). **Models 7 & 8**: 6 x 3-1/4 x 5-1/4" (13x15x8cm.) **Complete set**: 11 lbs (5.8 kg)

Staco®.

Exquisitely crafted large-scale plastic models showing accurate biological details in vivid color!

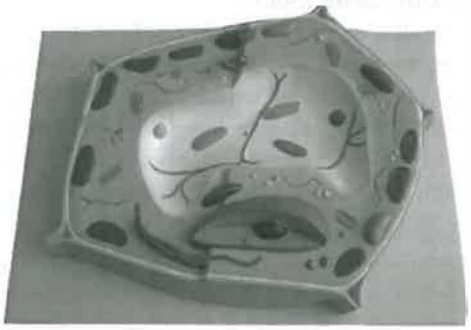
Putting Science *First* since 1960

Staco®

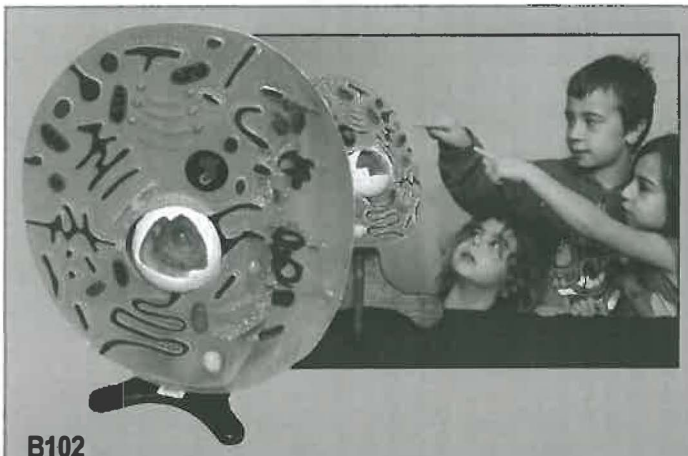
B140
Animal Cell Plaque
Large relief model shows every known organelle and two important cells. Heavy plastic vacuum-formed mold shows 20 structures identified by key cards. 18 x 24". 46 x 61cm. 1.2kg.

B142
Plant Cell Meiosis Plaque
This large relief model shows every known organelle and two important cells. Heavy plastic vacuum-formed sheets are molded to form 23 structures which are identified by accompanying key cards. 18 x 24". 46 x 61cm. *1.2kg.*

638-3251
Animal Cell Model
Hugely enlarged (20,000 times), this model shows the typical animal cell structure and all cellular organs. 43 x 30 x 10cm.



638-3250
Plant Cell Model
Hugely enlarged (20,000 times), this model shows typical plant cell structure with all types of organelle. 42 x 30 x 8cm.

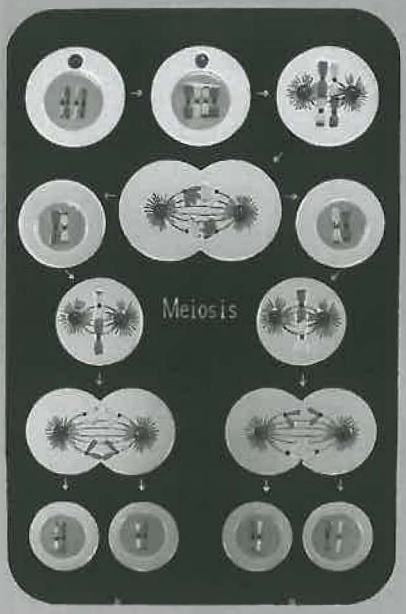


B102
Animal Cell Model
This detailed model depicts 21 different organelles and cell inclusions. Translucent, fiberglass-reinforced plastic looks like living matter. Durable, colorfast plastic molded parts. **Includes** rough and smooth endoplasmic reticulum, mitochondria, ribosomes, Golgi apparatus, centrioles, nucleus, nucleolus. A tangential cut shows endoplasmic reticulum, mitochondria, & vacuoles in 3 dimensions. Key cards included. 16.5 x 10.75 x 8.5" (42 x 27 x 22cm) 2kg

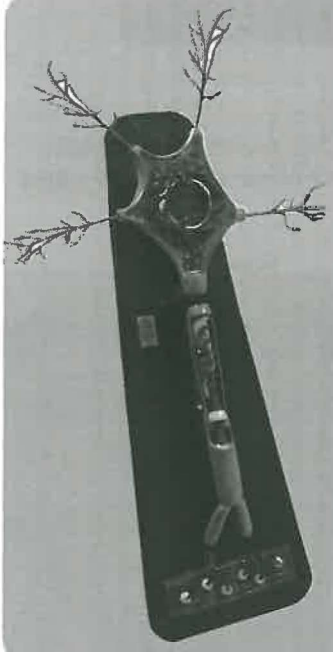
B105
Plant Cell Model
This detailed model depicts 25 different organelles and cell inclusions. Translucent, fiberglass-reinforced plastic looks like living matter. Molded plastic parts are durable and colorfast. Shows all known organelles and inclusions including: endoplasmic reticulum, cross-sectioned chloroplast with distinct grana and grana discs, large central vacuole, mitochondria, and ribosomes. The cell wall is clearly divided into several layers: middle lamella, primary wall, three secondary walls, warted tertiary wall, and plasma membrane. With key cards. 16x. 11-1/2 x 8". 41 x 29 x 20cm.

Staco®

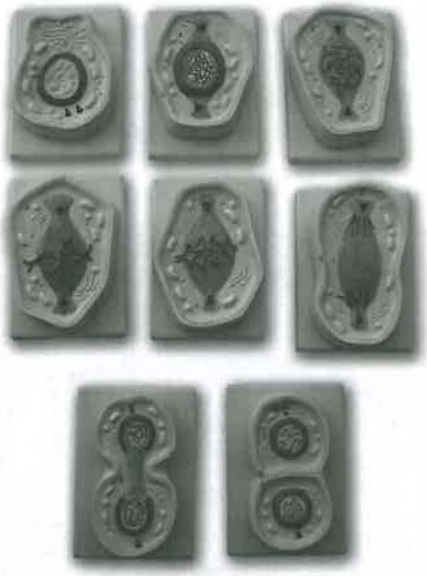
B104
Human Blood Cells (Set 6)
A set of 6 models representing the erythrocyte, lymphocyte, monocyte, eosinophil, basophil, and neutrophil blood cells. The models are colored after the Wright stain and enlarged 20,000X, maintaining scale. The sizes vary between 9 to 14-1/2" in height, and between 5-5/8 to 11-1/4" in width and from 1-1/4 to 8" in depth. Sizes: *23 x 14 x 3 to 37 x 29 x 20cm. 9.8kg set.*



B139
Animal Mitosis Plaque
This detailed plaque shows each stage of animal mitosis. Translucent cells in upright, opaque frames are dramatic in front of a light source (can also be front lit). **Includes** colored and black & white key cards (labeled & unlabeled).
60 x 25cm. *2kg*



B100
Motor Neuron Model
Lifelike model shows 22 organelles and inclusions. Mounted upright on an easel-type wood base. Clearly depicts cell body, dendrites, axon, Golgi bodies, nucleus, nucleolus, Schwann cell, Nissl bodies, node of Ranvier, myelin sheath, and motor plate endings embedded in striated muscle. Key cards. 28-1/2 x 19 x 10-1/2". 72 x48 x27 cm. *3.6kg*



638-3320
Cell Division Model
The eight parts of this model depict cell mitosis and shows how a cell typically reproduces and how DNA and RNA work together to duplicate the DNA strand. Each are mounted on base.
18 x 18 x 3cm.

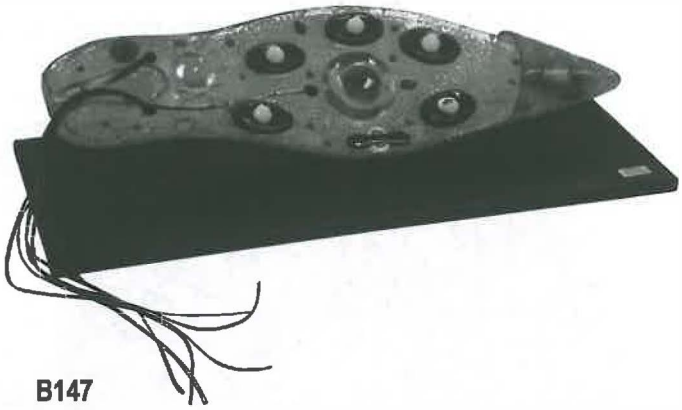
B115
Bacteriophage Model (Set 8)
This set of 8 crystal clear models depicts the destruction of a bacterium by a caliphage T2 virus in eight phases (described below) The bacterium is a generous 4 x 2-1/2 x 2- 1/2" (10 x 6 x 6cm) with overall dimensions of the model 5 x 3-1.3" (13 x 9 x 6cm) *(Model 8 is 8 x 6-1/2 x 3 1/2" [20 x 17 x 9cm]).* Key cards included. Weight, complete set: 10 lbs. (5.4 kg) **Base in black.**

Staco®

B160

Prokaryotic Cell Model

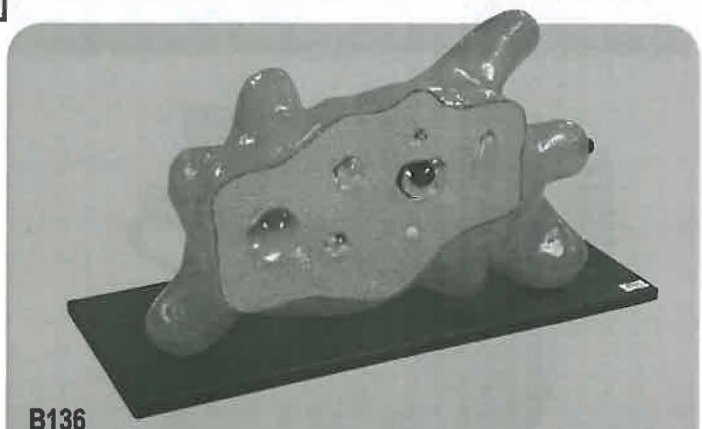
Our unique depiction shows external cellular structures enlarged 280,000X. Partial cut reveals: pili, flagella, chromosomal DNA, inclusion body, plasmids, ribosomes, cell envelope & plasma membrane. Removes from the stand. **Includes** key cards. 22 x 6 1/2". 56 x 17 x 17cm. *2.6kg*



B147

Euglena Model

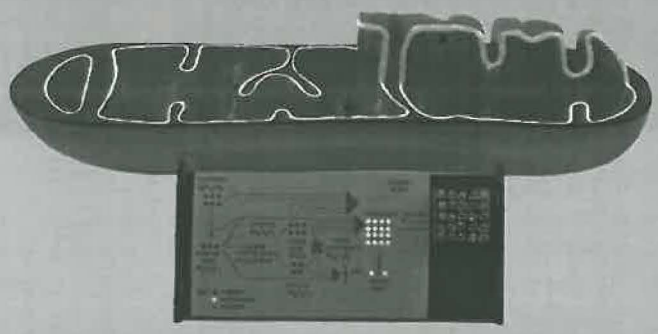
Shows all main structures and features visible in living and stained preparations. Made of translucent fiberglass. **Includes** flagellum, stigma, blepharoplast, contractile vacuole, chloroplast, pyrenoid, rhizoplast, nucleus, & endosome. Key cards. *7 x 19-1/2". 44 x 15 x 15cm. 2.4kg*



B136

Amoeba Model

A translucent model showing the main structures and movement of this important protozoan. Shows the nucleus, food vacuoles containing diatoms and bacteria, contractile vacuole, fat droplet, and granular and clear zones of cytoplasm. The position of pseudopods indicates the amoeba's movement. Key cards. 16-1/2 x 10 x 8". 42 x 25 x 20cm. *2.2kg*

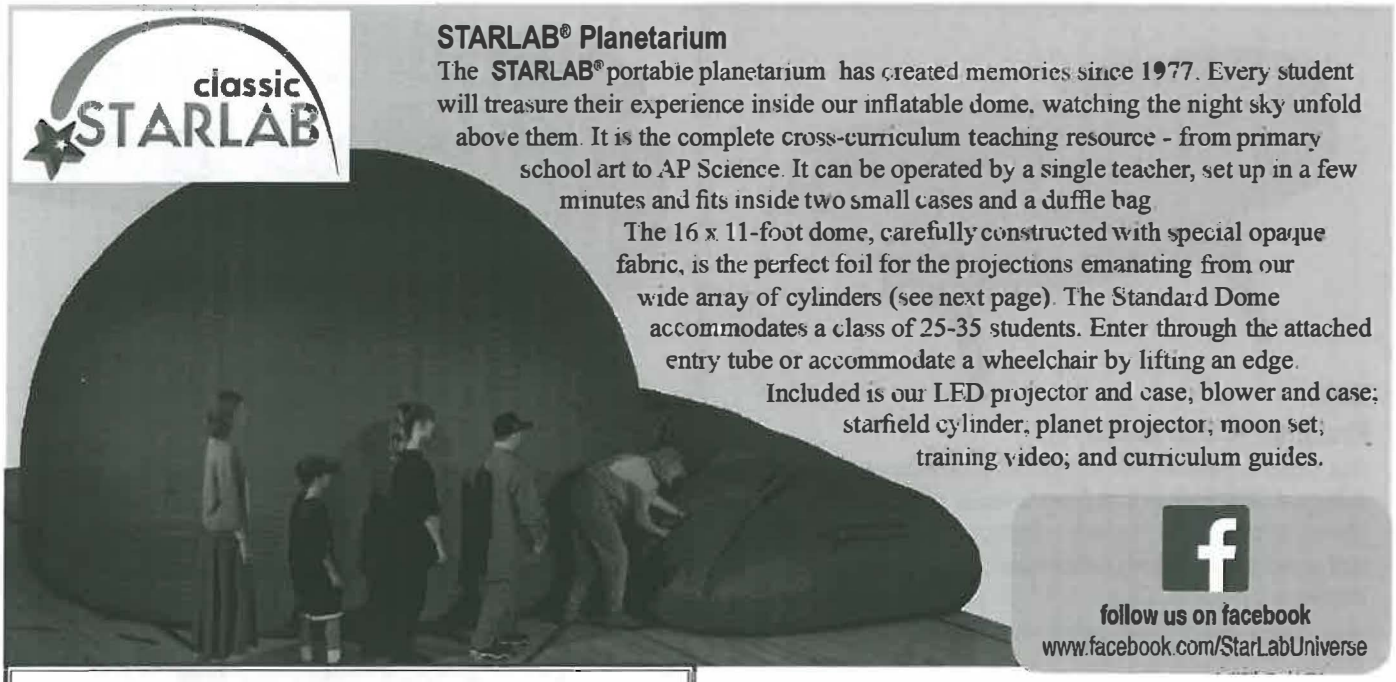


B117

Mitochondrion Model

Observe the "Mighty Mito" - powerhouse organelle! 3-micron unit is enlarged 190,000 times. Shows two wall cell membranes, cristae, subunits (elementary particles), matrix, & granules. **Includes** 1,000,000X cross section through the membrane and subunits on the base in molded relief & simplified schematic of the citric acid cycle (Krebs cycle). With key cards. 23 x 11 x 8" (58 x 28 x 20cm). *7 lbs. (4kg)*

STARLAB®



STARLAB® Planetarium

The **STARLAB®** portable planetarium has created memories since 1977. Every student will treasure their experience inside our inflatable dome, watching the night sky unfold above them. It is the complete cross-curriculum teaching resource - from primary school art to AP Science. It can be operated by a single teacher, set up in a few minutes and fits inside two small cases and a duffle bag.

The 16 x 11-foot dome, carefully constructed with special opaque fabric, is the perfect foil for the projections emanating from our wide array of cylinders (see next page). The Standard Dome accommodates a class of 25-35 students. Enter through the attached entry tube or accommodate a wheelchair by lifting an edge.

Included is our LED projector and case, blower and case; starfield cylinder; planet projector; moon set; training video; and curriculum guides.

follow us on facebook
www.facebook.com/StarLabUniverse

400-2000
(included with **STARLAB®** - also available separately)

LED Projector (Included with STARLAB®)

Introducing the latest innovation to our world-famous **STARLAB®** using the latest technology: LEDs. Instead of filaments or tiny balls of plasma, LED's produce light by exciting a silicon chip. This means that there are no filaments to burn out and no excessive heat damage to lamps! The main lamp now lasts thousands of hours (instead of hundreds). Need a new lamp? Our ready-made assembly installs in less time than it takes to change a bulb. Light output is comparable to that of the FiberArc with the simplicity of the standard. With no fiber optic line or complex parts, there are fewer components to fail. Afraid these new features won't work with what you have? Our LED projector uses the same chassis as our FiberArc, which makes cylinders and other parts interchangeable.

Classic STARLAB® System includes:

- Standard 5 meter Dome 5 or Giant 7 meter Dome
- Dome duffel bag
- Projector - introducing our new LED projector
- Projector travel case, which holds 2 cylinders
- Starfield cylinder - Northern or Southern Hemisphere
- Blower and travel case
- Planet projector (set of 5 planets)
- Moon set
- Tours of the Night Sky, CD and tapes
- Training video: set up, take down, use and standard operation of the **STARLAB®**

Basic STARLAB® System Package

400-1000 LED Projector/Standard Dome
400-1010 LED Projector/Giant Dome

Deluxe STARLAB® System Package

400-1100 LED Projector/Standard Dome
400-1110 LED Projector/Giant Dome

Super STARLAB® System Package

400-1200 LED/Standard Dome
400-1210 LED/Giant Dome

Ultra STARLAB® System Package

400-1300 LED Projector/Standard Dome
400-1310 LED Projector/Giant Dome

Also included:	Basic	Deluxe	Super	Ultra
Cylinders – in addition to Starfield	1	5	9	13
Cylinder (4) Travel Case	0	1	2	3
LED Arrow Pointer	1	3	3	3

Multi-part cylinders also available, see cylinder list on next page
Upgrade your starfield cylinder to multi-lens also available

With Standard Projector Only:				
Replacement Projector Lamp Bulb	1	12	15	15
Replacement Side Lamp Bulb	2	4	4	4

STARLAB®

STARLAB® Cylinders

Each cylinder is impeccably hand-crafted and painted to depict colorful illustrations which project upon the inner walls of the dome. The Inuit cylinder, for example, shows 7 small bones from the breastbone of the Ringed Seal (around Pleiades) and 3 bear hunters running towards Aldebaran with kamiks (Orion's belt). We include a wide array of cylinders to enhance any presentation. Up to 14 are included with your **STARLAB®** system.

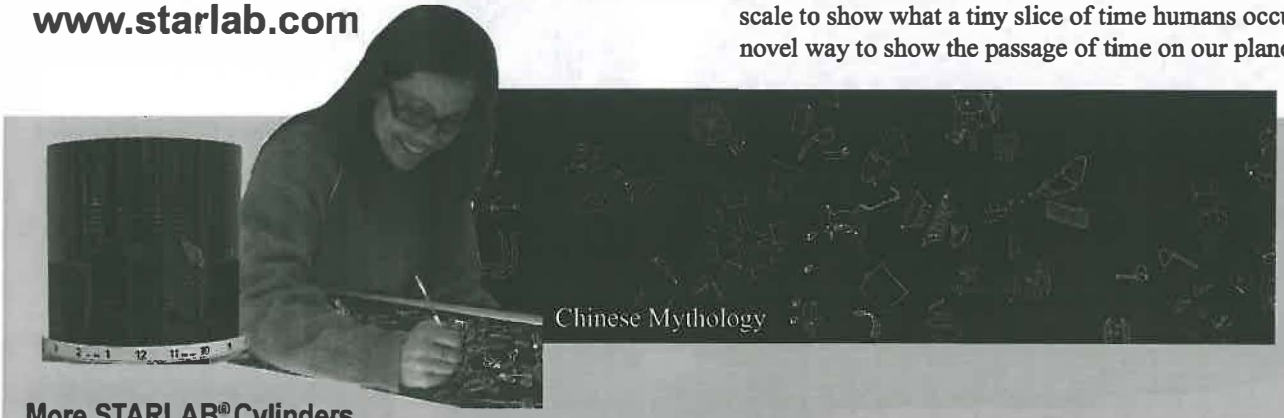
E-mail Summer Price:
StarLab@StarLab.com

www.starlab.com

400-3336

Geologic Time Cylinder

Show an abridged history of the planet around the **STARLAB®** dome. Notable life forms and events from Precambrian, Paleozoic, Mesozoic and Cenozoic eras are graphically represented. Each period is drawn to relative scale to show what a tiny slice of time humans occupy. A novel way to show the passage of time on our planet.



More STARLAB® Cylinders

400-3321 Starfield (Select N or S hemisphere)
400-3322 Constellations (Select N or S hemisphere
400-3324 Urban Starfield (Select N or S hemisphere)
400-3326 Celestial Coordinates (Select N or S hemisphere)
400-3327 Deep Sky Objects (Select N or S hemisphere)
400-3328 Solar System and Galaxy
400-3329 Lewis and Clark Celestial Navigation
400-3330 Civil War Sky
400-3333 Earth (Select N or S hemisphere)
400-3334 Plate Tectonics (Select N or S hemisphere)
400-3363 Polynesian Voyaging (Select N or S hemisphere)
400-3367 Transparent Cylinder, 4 pens
400-3335 Geocentric Earth
400-3336 Geologic Time
400-3337 Ocean Currents
400-3352 Greek Mythology
400-3353 Ancient Egyptian Culture
400-3354 Native American Mythology
400-3355 Hindu Mythology
400-3356 Ancient Chinese Seasons
400-3357 Ancient Chinese Legends
400-3358 Lapp (Sami) Mythology
400-3359 African Mythology
400-3360 Maya Skies
400-3361 Navajo Skies
400-3362 Radio Sky
400-3364 Inuit Star Lore
400-3365 Biological Cell
400-3368 Bird Migration
400-3369 Moon
400-3338 Weather

www.starlab.com

400-5541

LED Pointer

Don't use a laser which could cause eye damage or induce headaches. Instead, use this nifty LED arrow pointer. Light from a bright red LED is focused through a lens and is passed through a filter, giving it a 'V' shaped right hand arrow. Point out specific stars and constellations!

• New cylinders on page 92

STARLAB®

Digital STARLAB® System

This all-in-one, state-of-the-art digital projection system is created especially for use in portable and small fixed domes. It features best-in-class contrast and resolution for a truly breathtaking and realistic sky.

Our compact, user-friendly system produces high quality starfield images covering a full 180° x 360° on the dome. We include a laptop interface powered by impressive Starry Night Small Dome™ software. Create your own presentations, choose from pre-loaded content, or use pre-scripted, national standards-based lessons and curriculum modules.

Digital STARLAB® includes:

- Best-in-class, 1200 pixel resolution, digital light processing (DLP) projector
- Starry Night™ Small Dome software
- Custom fisheye lens projects small, bright, accurate stars at a full 180°
- Standards based curriculum
- Also projects images and movies
- Up to 4 hours of online training
- Lifetime customer service
- Available in PC or Macintosh

Our exclusive, custom fish-eye lens gives an accurate image all the way to the horizon!

E-mail Summer Price:
StarLab@StarLab.com

NEW!
Starry Night Small Dome®
Version 7 included in all new purchases of STARLAB®
Have Starry Night Small Dome® v6?
Upgrade available, call now!

Why are STARLABS® superior?

- **History.** Did you know we invented the portable planetarium? Stands to reason there isn't much we don't know about them
- **Easy to use.** Classic STARLAB® is simple enough for elementary students. Our digital version can be operated by anyone with basic computer skills.
- **User base.** There are more STARLABS® in use than any other portable unit.
- **Value.** STARLAB® is about giving you the most for your money. Per student, a STARLAB® is cheaper over time than field trips or star parties. Why travel when you can have your own STARLAB® at your location?
- **Ambassadors.** Need advice? Need a visit to your group? Contact us!

Digital Dome Options

(when purchased with a projection package)
STARLAB® domes made to our design
5 Meter
6 Meter
7 meter

Visit our STARLAB® facebook page to keep up with the stars!

LIKE US ON facebook

www.facebook.com/StarLabUniverse

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

STARLAB®

Is STARLAB® right for you?

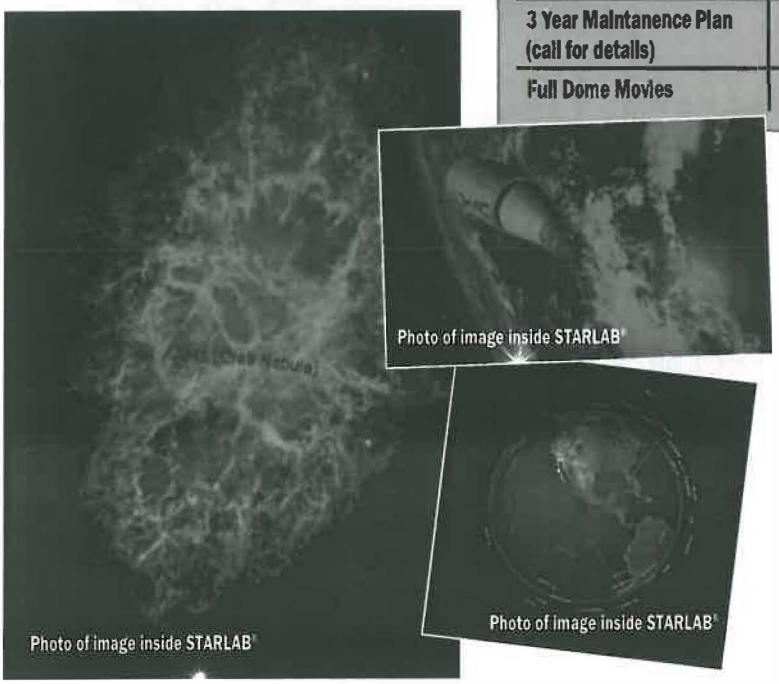
We know the **STARLAB®** is a high-ticket item. We know you need to discuss a potential purchase with your staff and colleagues. We know how challenging it can be to find the funds for just about anything, these days. However, we at **STARLAB®** can make the whole process a little easier.

- **Need help with funding?** We can point you in the right direction.
- **Need to see it to believe it?** Download an exciting video from our website.
- **Pinching pennies?** Check out our promotions and trade-ins, which can make a world of difference when it comes to affordability.
- **You're sold, but need to sell others?** Visit our website for a video or power point presentation about Digital and Classic **STARLABS®**.
- **Afraid of Starry Night™ Small dome?** Think you're not technical enough? We now offer a four-hour webinar for each new **STARLAB®** installation. You and your colleagues will learn straight from the horse's mouth - at no additional cost. The webinar is conducted by one of the creators of the Starry Night™ curriculum, an expert in the field, and a proven educator.

www.starlab.com

Package Contents	401-3300 Scout Space	401-3310 Scout Earth	401-3350 Scout Plus	401-4200 Saturn
1200 Pixel Projector	X	X		X
Custom Fish-eye Lens	X	X		X
Digital Case w/ Wheels and Handle (converts to stand)	X	X		X
Windows Laptop	X	X		
MacBook Pro Laptop			X	X
MacBook Pro Apple Care 3 Year Warranty			X	X
Starry Night Small Dome	X*			X
The Layered Earth Small Dome		X*		X
Basic Speaker	X	X		
Deluxe Speakers			X	
Elite Speakers				X
Projector Replacement Lamp			X	X
Digital Cylinder Bundle (5)			X	X
Starry Night High School (classroom software bundle)				X
The Layered Earth Geology (classroom software bundle)				X
Cables and Accessories	X	X		X
2 Hours Online Training	X	X		
4 Hours Online Training				X
3 Year Equipment Warranty	X	X		X
3 Year Maintanence Plan (call for details)				X
Full Dome Movies	X	X		X

*Add Starry Night® Small Dome 7 or The Layered Earth Small Dome to any Scout package - Call for pricing!

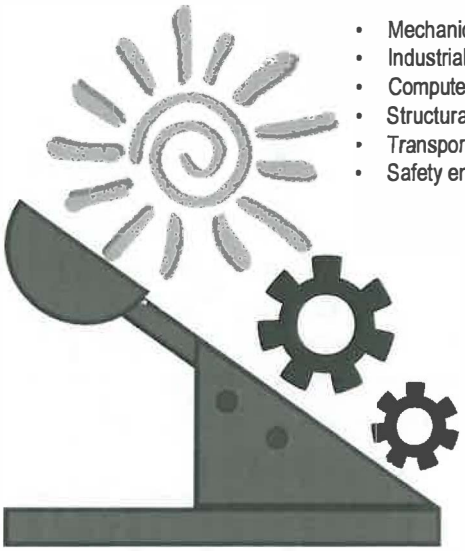


Digital STARLAB® *ARES*:

- Projector with outstanding 1600 pixel resolution
- Museum quality projection yet portable!
- Superior color, brightness, contrast
- Named after the planned cargo launch component of the NASA Constellation program for missions to Mars
- Three year warranty
- The finest portable planetarium in the world, bar none

Call for details!

techbridge



- Mechanical engineer
- Industrial engineer
- Computer scientist
- Structural engineer
- Transport engineer
- Safety engineer

2033000 Kit
2033500 Refill

Thrillbuilders (for 10 students)

Many of the products and places you experience every day have moving parts. Did you know many of these machines were designed by Mechanical Engineers? This unit uses a fun, exciting place—an amusement park—as a basis for understanding simple machines and how they relate to things we use every day. The Thrill Builders program-in-a-box introduces boys and girls to simple machines. Build simple machines in the form of amusement park attractions. While doing this, you'll explore energy sources, mechanics, and design. And maybe you'll get the chance to meet real Mechanical Engineers. An additional engineer is introduced in each activity. Each kit is packaged to serve 10 students.

For Grades 4 - 8
Learn about the world around you

techbridge

Each Kit offers:
- **Materials for 10 students**
- **Educator's Guide**
- **Refills available separately**
- **Recommended for 4th- 8th grades**

Science First® has now partnered with Techbridge to bring you Programs-in-a-Box!

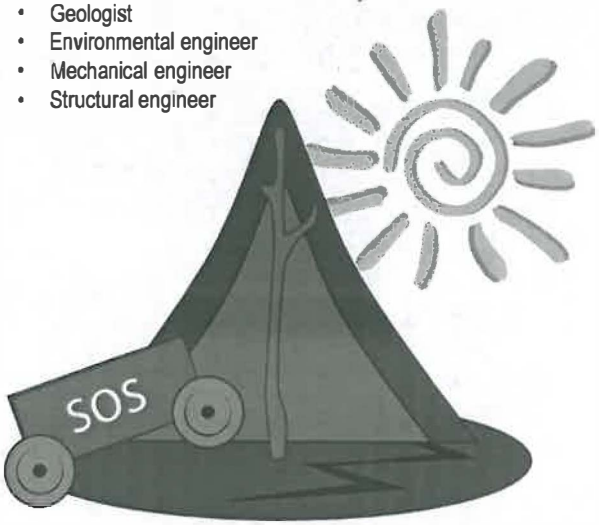
Private labeling opportunities available for Techbridge!
Contact us for more information
E-mail Justin Pascoe
justin.pascoe@sciencefirst.com

2031000 Kit
2031500 Refill

Engineers to the Rescue (for 10 students)

You're on a camping trip with your youth group at Yellowstone National Park. You've hiked, seen Old Faithful, and sung songs under the stars. You've also visited the Visitor's Center and met a park ranger. You learned that Yellowstone is situated on a bed of lava. Minor earthquakes are frequent. And tonight, although scientists didn't predict it, there was an earthquake which shook your tents for two minute! Unfortunately, this natural disaster has broken water pumps and disrupted generators in the park. To make matters worse, your cell phone battery is dead and you can't call for help. And worst of all: your animal-proof food box fell down a ravine! You're hungry! The good news is that your group is safe. And, wonder of wonders, you've got engineers as neighbors! The engineers have a lot of knowledge to offer as you rebuild your campground. As a team, you must develop a wind-powered crank to lift your food box, create a water filter to clean water for drinking, build a shelter to withstand any aftershocks, and design a car prototype that will make it over the terrain to deliver your message to potential rescuers. You've got common sense, science smarts, and a group of skilled engineers to help you. Each kit is packaged to serve 10 students.

- Chemical engineer
- Geologist
- Environmental engineer
- Mechanical engineer
- Structural engineer



*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

2037000 Kit
2037500 Refill

Make It Green (for 10 students)

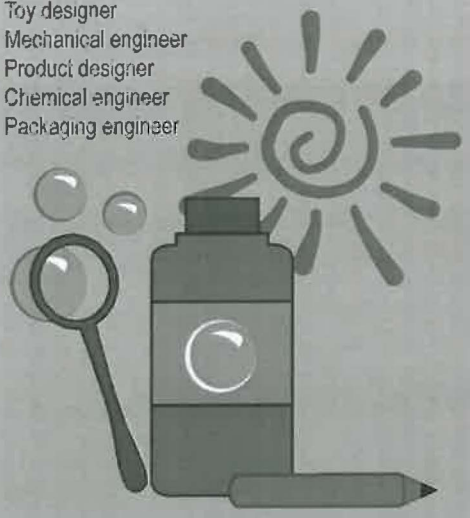
Construct a green studio from start to finish - from brainstorming an idea, to creating a floor plan, to building "green." Learn your energy usage and ways to change your habits to lessen their environmental impact. Each program-in-a-box has career components to help you to visualize a future in environmental engineering. For 10 students.

techbridge

Each Kit offers:

- **Materials for 10 students**
- **Educators's Guide**
- **Refills available separately**
- **Recommended for 4th-8th grades**

- Toy designer
- Mechanical engineer
- Product designer
- Chemical engineer
- Packaging engineer

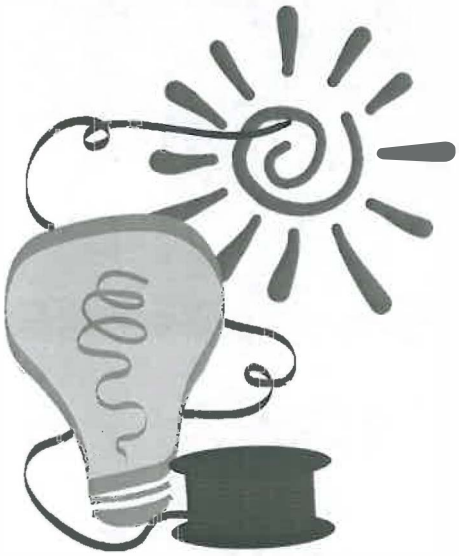


2035000 Kit
2035500 Refill

Design Time (for 10 students)

Work through the engineering design process and get your creative juices flowing with four playful designs. Customize pencil bags and creating unique bubble wands and bubble solution. Work in teams to brainstorm, sketch designs and build prototypes of toys. Name your toys and plan how to market them. Using job descriptions from Techbridge career cards and the scientific method of inquiry, develop real life skills and greater confidence in your science, engineering and technology abilities. For 10 students.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

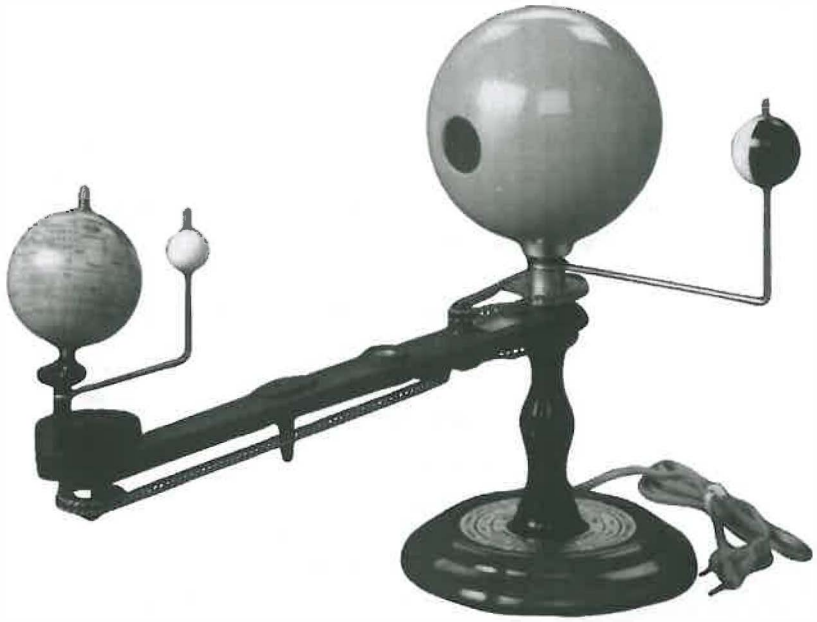


2039000 Kit (ships ground)
2039500 Refill (ships ground)

Power It Up (for 10 students)

Learn about electronics & circuitry through a hands-on investigations! Explore Snap Circuits™ and basic electronic components to build different kinds of circuits. Learn how to solder; make circuits that you can take home. Learn practical life skills and gain a better understanding of electrical energy. Contains batteries - must be shipped ground . For 10 students.

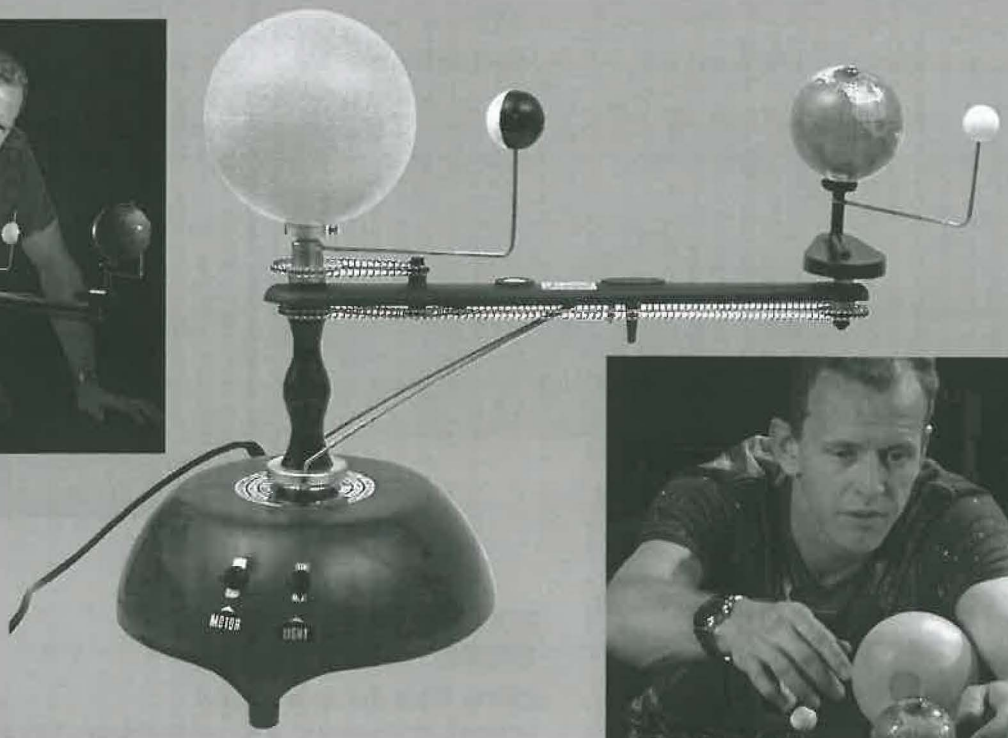
TRIPPENSEE

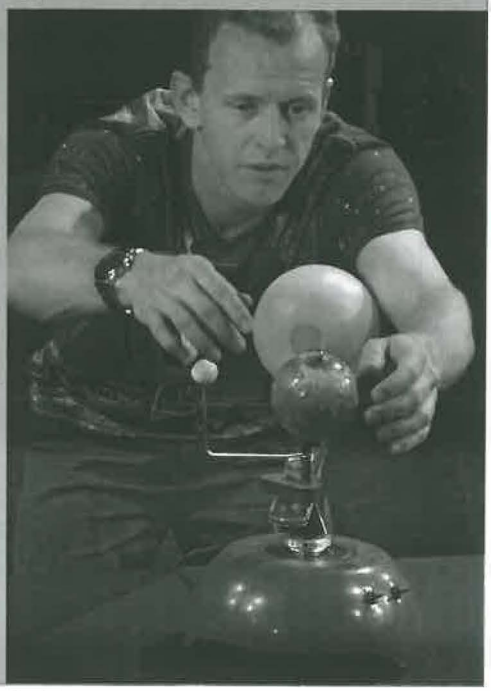


653-3010

Trippensee® Planetarium

Create the motions of the earth, sun and moon simultaneously using this Trippensee® planetarium. Move the arm to dramatically demonstrate these relationships. The light in the sun follows the revolving earth to show solar, lunar and annular eclipses; phases of the moon; seasonal changes; night, day and twilight. Complete instructions included. Height: 35.5cm. Arm length: 42cm. *220 volt available for export.*





653-3020 ●

Motorized Trippensee® Planetarium

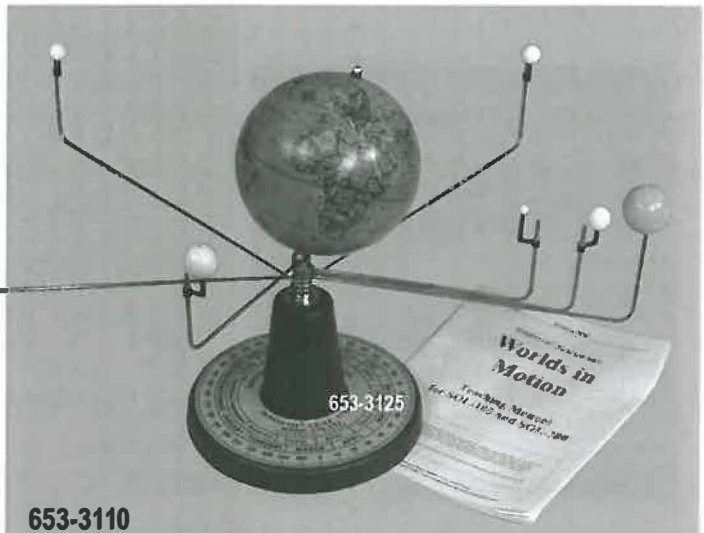
Our finest planetarium! This impressive unit demonstrates the same motions as the classic 653-3010, above, using two control switches located in the heavy-duty base. A wire arm from the motor may be easily moved aside to permit demonstrations by hand. Separate switches operate the motor and the light in the sun. Complete, detailed instruction book included. 220 volt models are available for export. Height: 35.5cm. Arm length: 42cm. ● *Ships oversize.*

TRIPPENSEE

653-3030 No light
653-3040 Lighted

Basic Planetarium

Here's an exciting model specifically for younger students. Shows basic relationships of rotation, revolution, night and day, seasons, phases of the moon, occurrence of tides, lunar and solar eclipses, location of the signs of the zodiac, and more! Each concept is shown by moving the arm or earth or moon by hand. Chain and gear drive maintains the north pointing axis of the earth. A light in the yellow plastic sun globe adds to the realism. Instruction manual. Runs on 110v.



653-3110

Ptolemaic Solar System

This earth-centered model helps bring alive a view of the solar system widely accepted for many centuries and provides interesting comparisons with 653-3120, right. Comprehensive, detailed instruction book.

653-3120

Copernican Solar System

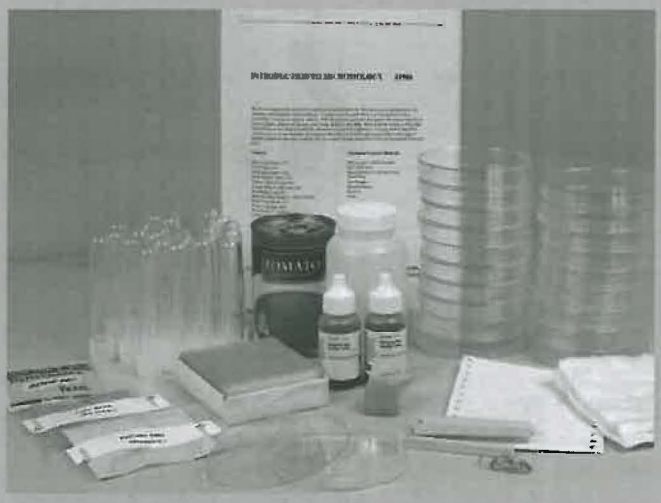
This sun-centered solar system shows the motions of the planets and their relative sizes and distances. All planetary orbits, including the asteroid belt, are included. If you set the planets month by month, you can watch the inner planets speed around the sun while the outer planets seem to move ever so slowly in space. *(With Pluto, no longer considered a planet)*

Microbiology Kits

1400
Bacterial Pollution
Test for coliform bacteria in water using a sterile culture medium that is ready to heat and sterile Bi-Petri Dishes. Detect E.Coli (human and animal enteric bacteria) and total bacteria in up to 20 natural water samples. Requires one 45-minute class period.

1700
Cell Structure (For 30 students)
An excellent intro to cell biology. Identify cell components, stain mitochondria, storage inclusions, cell walls, chloroplasts & starch granules, compare plant & animal cells, study cell membrane function. Requires two 45 minute class periods.

1800
Cellular Chemistry
Test cells of various tissue samples to determine the presence of polysaccharide, proteins and polypeptides, lipids, sugars and amino acids. Study the differences between plant and animal cells & cell specialization. For 15 pairs, requires two 45 minute class periods.

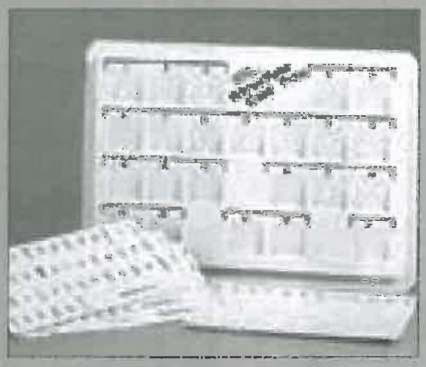


1900
Microbiology Introduction (12 pairs)
Examine mold yeast, bacteria, algae and protozoa in cultures of microorganisms using sterile techniques, prepackaged media and growth containers. Requires 45-minute class period, 4-5 days of observation.

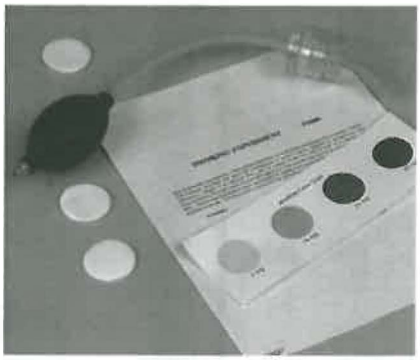
6800
Organelles (15 set ups)
Make your own experimental models. Observe organelles and mitochondrial activity and relate to cell structure and function. Investigate the selective permeability of membranes. Study specific enzyme activity in cells & cellular processing of metabolites. **Includes** teacher's guide and copymaster. You need potatoes.

Microbiology Kits

1000
How Poisons Work
Learn how poisons destroy the life of a cell by disrupting the activity of specialized molecules (enzymes). Observe the normal & abnormal conditions affecting enzyme activity by studying the effects of heavy metal poisons (lead & mercury ions). For 15 pairs. Needs two 45-minute class periods.

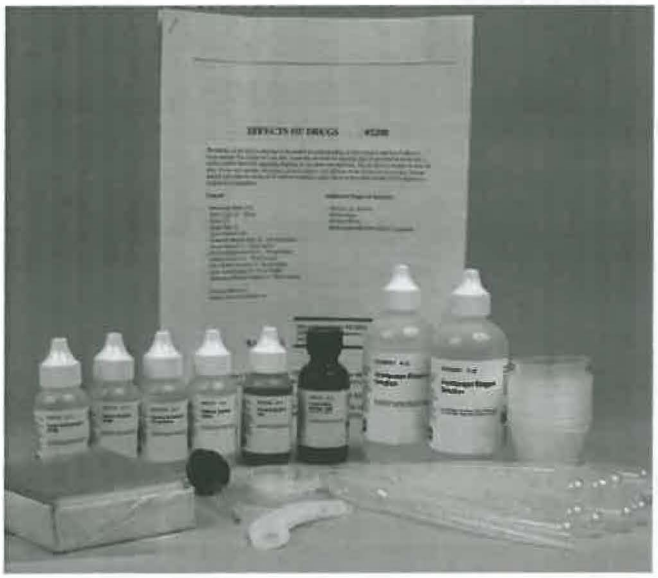


6900
Karotyping Kit
Show hhow karyotypes relate to certain genetic diseases. A normal male, Kleinfelter's & Turner's Syndrome can be classified by sorting chromosomes from cells frozen at the metaphase state. Cut out chromosomes and use karyotype trays to sort.



2800
Smoking Experiment
Clearly see the dangers of smoking by observing the amount & nature of tars & nicotine produced by cigarettes. A simple apparatus draws smoke from a lighted cigarette through a white fiberglass filter. The resultant residue is compared with a calibrated color chart. 25 filters.

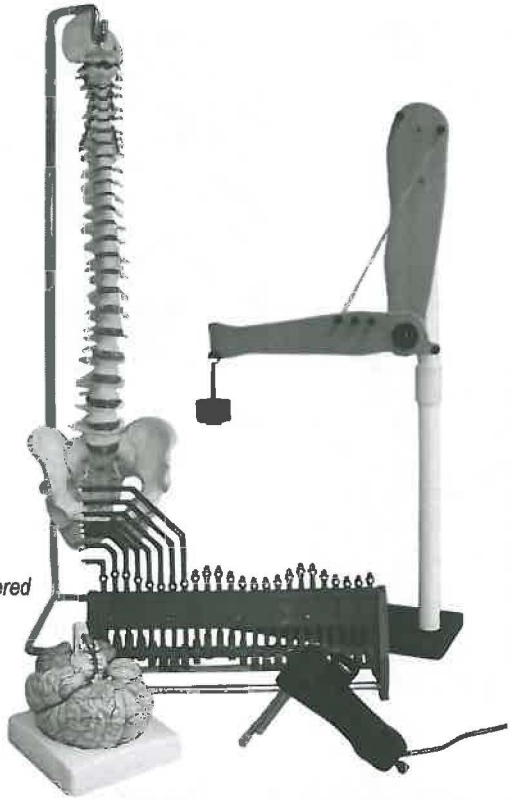
E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com



2200
Effects of Drugs (15 Pairs)
Explore the physiological effects of five common drugs and active chemical agents (dilute aspirin, caffeine, adrenaline, nicotine, ethanol) using daphnia as a model organism (not included). Requires 3-4 class periods of 45 minutes.

651-7210
Radioactivity/ Half-Life Kit
(Simulated - for 30 students)
Explore the complexities of half-life with plastic "radioactive" atoms. Calculate Carbon 14 measurements.
Includes: 15 atom sets & shakers, guides, instructions.

Anatomy - Human Biology



Empowered Kit

Health and Harmony Package

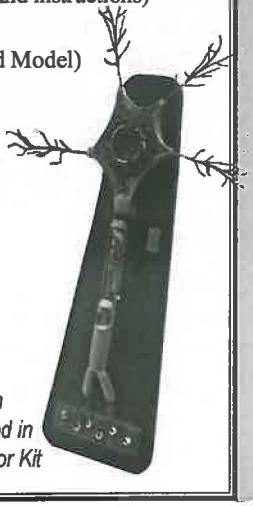
Well-rounded curriculum that incorporates STEM content. For use across four disciplines: Physics, Chemistry, Biology and Mathematics. Study the body's processing system, the nervous system, a complex system that relies on many working pieces that integrate with one another. Multiple activities that will examine how drugs impact neurotransmitters in the body, show the message transmission network through the body, and demonstrate wavelength and frequency. And much more!

638-5100 Empowered Package
(Includes Conductivity of Water Tester, Wave Model, Spine Model, Arm Model, Brain Model, Teacher Activities and instructions)

638-5110 Excellent Package
(Includes the Empowered Package plus Head Model)

638-5120 Superior Package
(Includes the Excellet Package plus Motor Neuron)

Head Model included in Excellent and Superior Kit



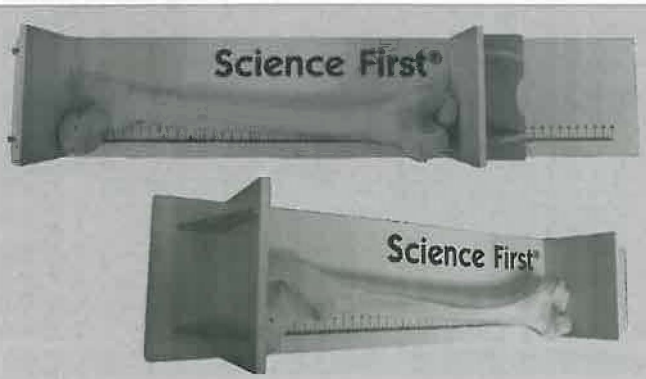
Motor Neuron included in Superior Kit

641-2400
Arm Model

The human arm is a masterpiece of engineering. Demonstrate its impressive musculature with this model and a few rubber bands. Show how the arm is able to bend over 90° with just two muscles (biceps and triceps).

634-6240
Lung Model

Simulate the function of the diaphragm with this simple kit. Pull down on the rubber skirt to create a partial vacuum within the bell jar. Air rushes into the balloons, inflating them like the set of lungs they resemble. With instructions.



634-6100
Osteometric Board (For measuring long bones)

Some bones, such as the humerus or femur, are simply too long to measure with calipers. Our plastic measuring board is equipped with a slider and a 60cm scale, making it ideal for any forensic science lab. Made of lightweight styrene for durability. Instructions. 70 x 13 x 11cm.

Human Biology

634-6110

Sphygmomanometer

(Blood pressure cuff)

This aneroid device features a self-adjusting cuff with gauge holder. Features large gauge without case.

622-6145 Spirometer
622-6146 Mouthpiece, 50

Digital Spirometer

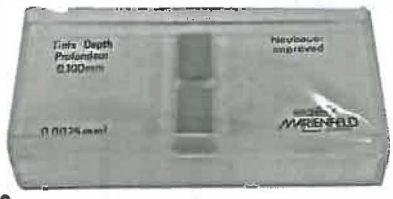
(With adapter & 50 mouthpieces)

Take the guesswork out of who's the biggest windbag. Duplicate professional instruments by accurately measuring lung volume. The large digital display gives instant volume readouts - no lengthy calculations. AC adapter included or use 2 AA batteries.

621-4015

Two Point Discriminator

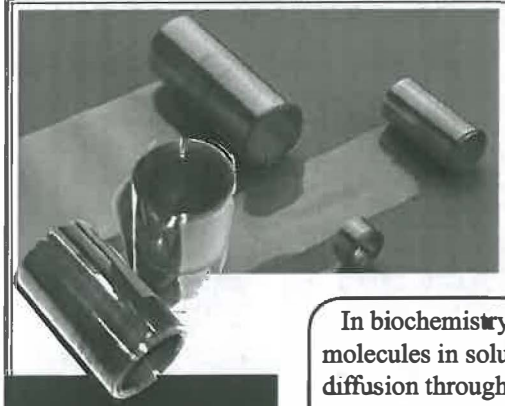
Low-cost plastic Vernier calipers accurately measures up to 100mm. Ideal for cutaneous sensation testing, since you can quickly switch from one to two points. Durable plastic molded parts.



634-6310

Hemacytometer

Ideal for counting blood cells, this has a Neubauer-improved double net ruling.



Our proprietary customized machine allows us to make small rolls of dialysis tubing in the configurations you need.

Dialysis Tubing

The semi-permeable membrane, created from a natural source of cellulose, allows passage of particles up to 14,000 molecular weight standards. Each length is packed in heat-sealed plastic bags to prevent contamination.

In biochemistry, dialysis is the process of separating molecules in solution by the difference in their rates of diffusion through a semipermeable membrane, such as dialysis tubing. Dialysis is a common laboratory technique that operates on the same principle as medical dialysis. In the life sciences, the most common application of dialysis is for the removal of unwanted small molecules such as salts, reducing agents, or dyes from larger macromolecules such as proteins, DNA, or polysaccharides. Also for buffer exchange and drug binding studies.

	Width	Length
2842.....	⅜ inch	10 feet
2844.....	⅜ inch	50 feet
2846.....	⅜ inch	100 feet
2852.....	1 inch	10 feet
2854.....	1 inch	50 feet
2856.....	1 inch	100 feet
2862.....	1 5/16 inch	10 feet
2863.....	1 5/16 inch	15 feet
2864.....	1 5/16 inch	50 feet
2866.....	1 5/16 inch	100 feet
2872.....	1¾ inch	10 feet
2874.....	1¾ inch	50 feet
2876.....	1¾ inch	100 feet
2882.....	3 inch	10 feet
2884.....	3 inch	50 feet
2886.....	3 inch	100 feet

Botany

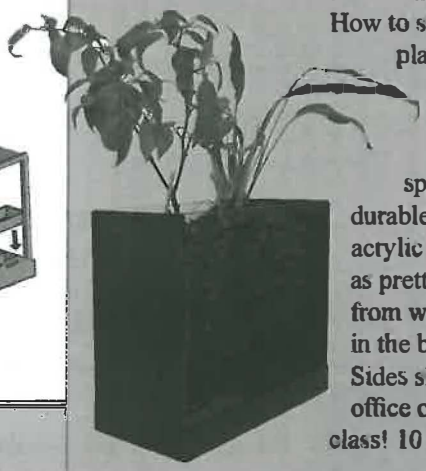
Simple assembly - parts merely snap together. No hardware necessary!

Greenbox™ Gardening System

Here's the "greenest" indoor gardening kit you can buy! With almost 700 square inches of growing space and an advanced lighting system, it can house a variety of plants. Fully watertight construction allows for hydroponics farming. All-plastic design slots together - no hardware needed! Assembly can be done by one of your students. Our unit is self contained and fits on a table. It **includes** a high power grow light, mounting arms and removable seed trays - everything but the plants!

- Advanced 54 watt fluorescent grow light - 2 year lifespan.
- Robust, all-plastic construction is easy to clean and impervious to rot and rust. We use 80% recycled ABS plastic.
- No hardware! Parts slot together - only minutes to assemble.
- **Includes** 6 seed trays (each holds 12 seedlings).
- Replacement trays available.

636-2000 **Greenbox™**
636-2005 **Replacement tray**
636-2100 **Root tray - Greenbox™ holds 12**

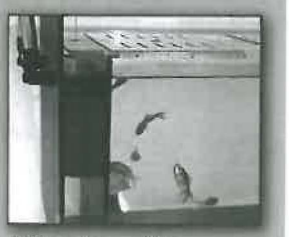


636-2100

Root Tank (Up to 12 fit in Greenbox™)

How to study a root without uprooting a plant? This will solve the problem. When plants are placed in our tank, the roots spread out to seize as much water as possible, spreading along sloped sides. Our durable unit is constructed of welded acrylic and ABS, making it tough as well as pretty. Integrated tray catches run-off from watering, limiting the mess. Holes in the bottom for easy draining. Sides slope 20°. Attractive enough for office or lobby - essential for the biology class! 10 x 4.5 x 8".

Upper Plant Deck



Filter Assembly

91000

Classroom Aquaponics

Study ecology, biology, earth systems, math, history and literature while pairing fish and plants in one integrated system! Every unit is equipped with an instructional manual and lesson plans from Maine's well-regarded Herring Gut's standards-based aquaponics curriculum. In addition to growing vegetables in a sustainable process, you can study germination rates, fish anatomy and the nitrogen cycle.

Zoology - Entomology

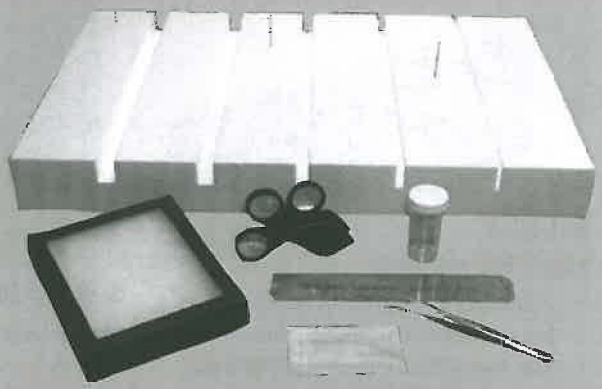
635-1930
Clear Plastic Tray
Who couldn't use a sturdy tray for their next science project? Shallow plastic tray is good for pickin' critters or studying small objects.
22.5 x 25cm (9 x 10")

Dissection Pans (With black wax)
633-1110 Small: 26 x 19 x 2cm (10 x 7 x .75")
633-1115 Medium: 32 x 22 x 4cm (12 x 8 x 1.75")
633-1120 Large: 32.5 x 27 x 5cm (13 x 11 x 2")

635-1710 ●
Insect Starter Kit (Individual)
This is an excellent beginner kit for tomorrow's entomologist. We provide everything you need to start your own insect collection. ● *Ships oversize.* Kit **includes:**
- Insect box; insect spreading board
- Insect pins, size 1 (100); glassine envelopes (20)
- Riker mount, small
- Hand magnifier and ruler
- Collection net and forceps
- Killing jar and aspirator
- Bug box: 1 large, 1 small
- Plastic vials (12)

See pg. 81 for
Science First® Invertebrate Lab Starter Kit

635-1720
Insect Field Kit (For groups of 12-24)
Here's everything your class needs to collect insects in the field. Pairs with 635-173 below. Instructions. **Includes** (12 each):
- Collection net (12)
- Insect killing jar (12); hand lens (12)
- Bug box, small (12), large (12)
- Clear plastic ruler (12)
- Clear plastic vial (12)



635-1730
Insect Lab Kit
For groups of 12-24
Preserve and study insects caught in the field.
This is a comprehensive complement to our Field Kit, above **(635-1720).** Kit **includes**
- Insect pins, #1, 2 , 3 (100 each)
- Spreading board (12)
- Entomology forceps (12)
- Clear plastic rulers (12)
- 3-lens magnifiers (12)
- Clear plastic vials (24)
- Glassine envelopes, medium (100)
- Riker mount, small (12)
- Basic instructions

Microscopes - Magnifiers

631-0220
Pocket Microscope
"The Green Thing"
- ABS construction
- 20x magnification
- Adjustable focus
- Inverted image

631-7010
Foldable Magnifier
This upright plastic magnifier locks into place and has an in/ cm grid for reference. Large, 4" (10cm) diameter plastic lens. 2X magnification.

633-3165
Probe & Hook
Nickel plated, 6" in length.

621-3110 Petri, 10
3-182-B20 Dice, 3 pack
Gridded Petri Dish (Pack 10)
Disposable, sterile, polystyrene dish has 36 small squares, identified vertically and horizontally to count and locate specimens. Create random numbers with 10-sided dice. 100 x 100 x 15mm.

631-0215
Hand Microscope
- Adjustable, easy to focus, condensing lens with built-in illuminator
- 30x magnification. Protective case
- A compact 13.5 x 4 x 2cm
- Uses two AA batteries, not included

3-7905-A20
Hand Lens
Natural position, molded plastic handle and rim, glass lens. 23cm focal length. 2x.

631-7050
1 Lens Folding Pocket Magnifier
1 lens. 3X magnification

631-7020
Hand-held Magnifier
Plastic lens has 2X and 4X magnifications. 3-1/2" (9cm) lens.

631-7030
Three-lens Magnifier
Pocket-sized magnifier has three 4X magnification plastic lenses

631-7055
2 Lens Folding Pocket Magnifier
2 lenses. 6X magnification

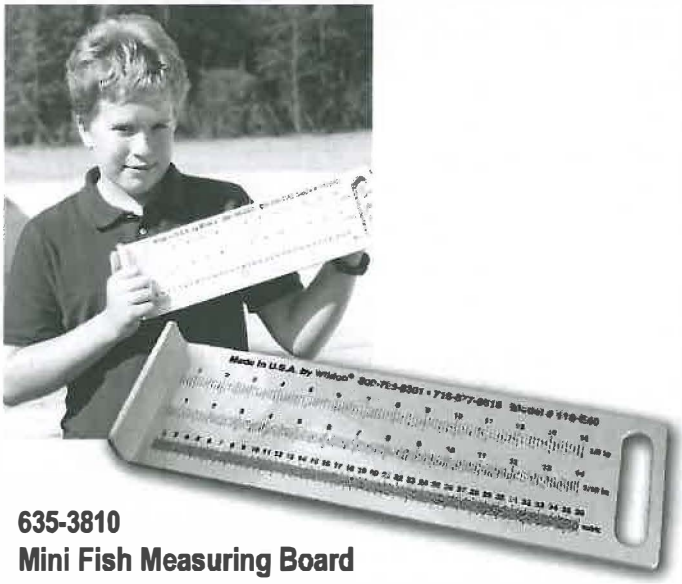
*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

Zoology

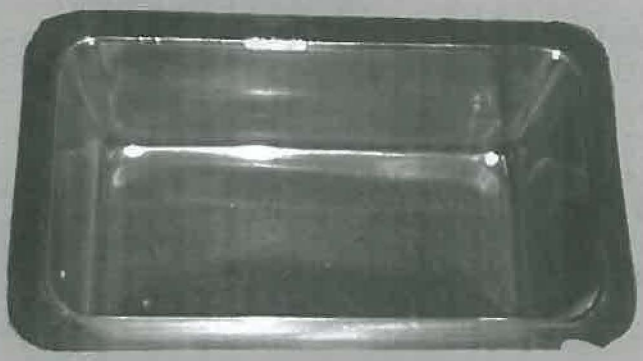
Need instructions?
Download from our website

635-1915
Volumeter Respirometer
This measures changes in gas volume within a closed system. It is useful for studying the metabolic rate of small plants and animals, since it measures the volume of oxygen consumption over time. Can also be used to determine fermentation rates and photosynthesis. With side-by-side control and experimental test tubes on a plastic frame. Instructions.

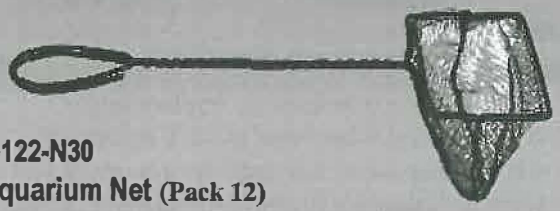
3-125-F40
Bucket Aerator
Keep your fish and samples oxygenated in the field. This quiet diaphragm pump and 60cm air hose can work in a 5-gallon bucket of fresh or salt water.



635-3810
Mini Fish Measuring Board
Measure small fish easily with our lightweight PVC board. One-piece design features built-in handle and raised lip for positioning fish. Three scales (tenths, eighths of an inch; centimeters) are silkscreened in high-resolution black. 38cm long (reads to 35cm).



635-1935
Aquarium Tank
Need a low-cost yet durable aquarium tank? Our clear polystyrene pan is 0.03 thick - substantial enough to keep, economical enough to discard. Rounded rim. 4.5 x 8 x 3". Order two for a cover.

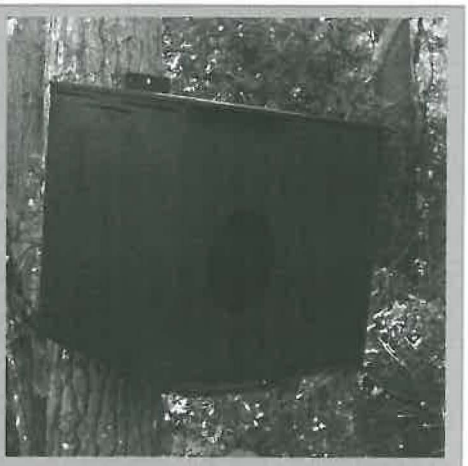


3-122-N30
Aquarium Net (Pack 12)
It's cheaper by the dozen! Use these fine-mesh nets inside or out. They feature an extra-strong, three-ply, vinyl-covered handle. 76 x 101mm. Use in the field or your fish tank.

Zoology - Entomology

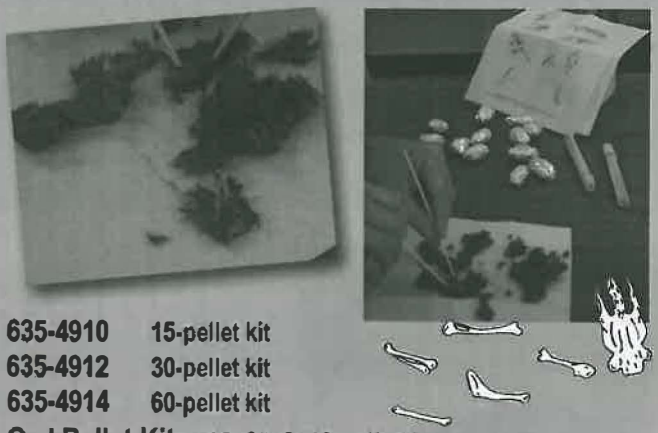
Putting Science *First* since 1960

635-1330
Spreading Board
28 x 43 x 4.5cm, Styrofoam board. 5 grooves (3 - 15mm) wide hold most specimens.



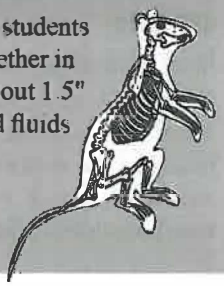
635-4970
Owl Box
Owls are secretive birds critical to the food chain. Because they are nocturnal, they can be difficult to observe. Our watertight nesting box provides a dark, safe place for chicks to be raised. Install a few on your school grounds to keep away rats. With 6" oval entrance hole, integrated perch and drain holes to keep the interior dry and fresh, our 1/4" ABS plastic box withstands the elements. 11 x 14 x 9".

635-1245 Single
635-1246 10 pack
Insect Fumigant Box
(Single & Pack of 10)
Fill these tiny boxes with fumigants, then place in specimen boxes, drawers and display cases to protect insect collections from living insects. Hard shell molded boxes withstand years of use. 1.25" square, 3/4" high.



635-4910 15-pellet kit
635-4912 30-pellet kit
635-4914 60-pellet kit
Owl Pellet Kits (15, 30 & 60 pellets)
Owl pellets are a time-honored biology lab because they tell us so much about the life of a classic predator. Pellets contain the indigestible portions of prey: beaks, bones, and hair, stored in the owl's crop and then regurgitated in a single mass. Because of this, it is possible to dissect a pellet and determine what the owl ate. Dissection itself is a worthy activity, and determining common prey animals is the perfect intro into discussions about the food chain, ecology, and relationships between animals.

Our kits are economical enough that students can have his own pellet or can work together in small groups. Each generously-sized (about 1.5" long) pellet is washed with antimicrobial fluids and then heat-sterilized for safety.



635-1900
Choice Chamber
Study the habits of picky arthropods! Explore habitat preference and animal behavior using small arthropods as test subjects. Isopods or "pill bugs" are a good choice. The chamber is equipped with a tight-fitting lid to contain the critters. An escape-proof passageway connects the two chambers. With lid. Good for AP Biology. (Live organisms not included)

Chemistry Kits

5500

Environmental Test Lab

Our kit **includes** extensive tests for evaluating both water and air quality. You will test for dissolved oxygen, water hardness, pH, phosphates, chlorides, lead, hydrogen sulfide, air particulates, gaseous pollutants and rain water chemistry. The kit allows for three repetitions of the testing of local environmental conditions in a variety of formats that might include demonstration, small group, and individual use.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

2100

Microorganisms in the Soil

(Enough for 12 pairs)

Culture soil samples from local sources to observe the nature of soil microbes. Investigate the nutritive and non-nutritive components in the soil samples. 12 pairs of students have materials for one 45-minute class. Follow with observations over the next three to four days.

2000

Chemical Composition of Soil

Perform chemical determinations on local soils to determine percentage of water, organic content, pH, and the presence of calcium, carbonates, magnesium, phosphates, sulfates, potassium, nitrate, ammonium and iron. Provides an accurate profile.

5800

How Clean is the Soil

Investigate the nature of soils. Observe and characterize soil based on physical examination. Study their chemical composition and the microbial community. Can be used for a demonstration, small groups, or several repetitions by one student; requires two 45-minute class periods.

Chemistry Kits

15030
Groundwater Demonstration
(Enough for 5 groups at once)
The study of ground water is an important national subject. Visually demonstrate the relationships between ground water, water tables, ponds, wells, salt marshes, and estuaries. Graphically track the distribution of pollutants. Instructions describe a raindrop's journey from the clouds to ocean and life in an estuary.

1500
Chemical Pollution of Water (4 groups)
Trace chemicals in water - a serious problem to health - are routinely monitored by regulatory agencies. Perform tests for pH, copper, sulfates, nitrogen compounds and oil with three unknown solution mixtures. Enough materials are provided for four groups of students over a minimum of two 45-minute class periods.

1400
Bacterial Pollution Kit (The Science Source®)
Test for coliform bacteria in water with our ready-to-heat sterile culture medium and sterile bi-petri dishes. Detect E.Coli (human and animal enteric bacteria) and total bacteria in up to 20 natural water samples. Requires one 45-minute class period.

5700
How Clean is the Water
Water pollution is a major public issue today. This kit allows students to test local water samples for pH, available phosphate, chloride and lead concentration, oil determination and bacterial contamination. This kit will support a demonstration, or small groups, or three repetitions for a single investigator and will require two 45-minute class periods, along with three or four days of observation.

16215
Heat Transfer
Observe & measure the transfer of heat by an aluminum bar between 2 water samples of different temperatures. Two insulated containers have foam lids & mounted thermometers.

Chemistry Kits

1200
Rates of Reaction
(For 15 students)
Explore the effect of concentration, temperature, particle size, and catalytic agents on chemical reaction rate in this classic collection. Translate the knowledge gained into daily context. Requires two 45-minute class periods.

6800
Organelles (15 set-ups)
Build your own experimental models. Observe how organelles relate to cell structure and function. Investigate the selective permeability of membranes, specific enzyme activity in cells, and cellular processing of metabolites. **Includes** teacher's guide and student copymaster. *You need potatoes or celery.*

1700
Cell Structure (30 students)
An excellent introduction to cell biology. Activities include identification of cell components; staining of mitochondria, storage inclusions, cell walls, chloroplasts and starch granules; comparison of plant and animal cells, and cell membrane function. Requires two 45 minute class periods.

2500
Thermal & Chemical Pollution (For 12 groups)
Explore the effect of temperature on biological oxygen demoand and dissolved oxygen in water, using yeast to represent oxygen consuming microorganisms or animals and relating this to the metabolism of an organism. Investigate chemical pollution by direct (lead irons) and indirect (phosphate ions) poisons by favoring the growth of one type of organism. The kit takes two 45 minute class periods and 2-3 days of observation.

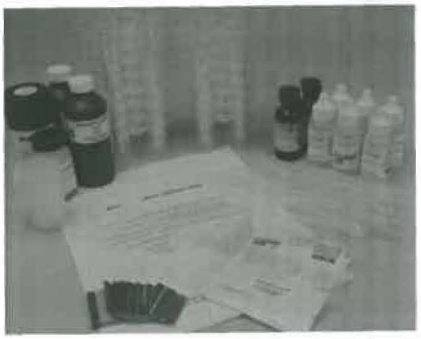
1800
Cellular Chemistry (The Science Source®)
Tests are performed on cells of various tissue samples to determine the presence of polysaccharide, proteins and polypeptides, lipids, sugars and amino acids. Differences between plant and animal cells and cellular specialization are investigated. Serves fifteen pairs of students and requires one or two 45 minute class periods.

Chemistry Kits

5600
How Clean is the Air
The Clean Air Act has brought increased focus on the state of the air we breathe. This kit allows students to investigate the effects of pollution on air quality. Tests are included that monitor air particulates, investigate the effect of pollutants on various materials, detect the presence of nitrous oxides and demonstrate the effects of pollutants on rain water chemistry.

15000
Air Sampler
Discover what is in the air you breathe. Air deposits particles on a high efficiency filter as it is drawn through at a calibrated volumetric flow rate. Perform chemical and radioactive tests, determine total mass in milligrams per cm. 40 cm tall unit operates on standard 115 VAC 60 Hz for indoor and outdoor use. **Includes** filters and manometer.

2200
Effects of Drugs (15 pairs)
Explore the physiological effects of 5 drugs & active chemical agents (dilute solutions of aspirin, caffeine, adrenaline, nicotine, ethanol) using the organism daphnia. Requires 3-4 class periods of 45 minutes. *Daphnia not included.*



1000
How Poisons Work
(Enough for 15 pairs)
Show that the life of a cell depends upon the activity of specialized molecules called enzymes, which may be disrupted by the presence of poisons. Observe normal and abnormal conditions affecting enzyme activity and the effects of heavy metal poisons (lead and mercury ions). Requires 1-2 class periods of 45 minutes.

2800
Smoking Experiment
Elementary through college level
Clearly see the dangers of smoking by exposing the amount and nature of the tars and nicotine produced by cigarettes. A simple apparatus draws smoke from a lighted cigarette through a white fiberglass filter. The resultant residue is compared with a calibrated color chart. Easy to perform, yet sophisticated. **Includes** 25 filters.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

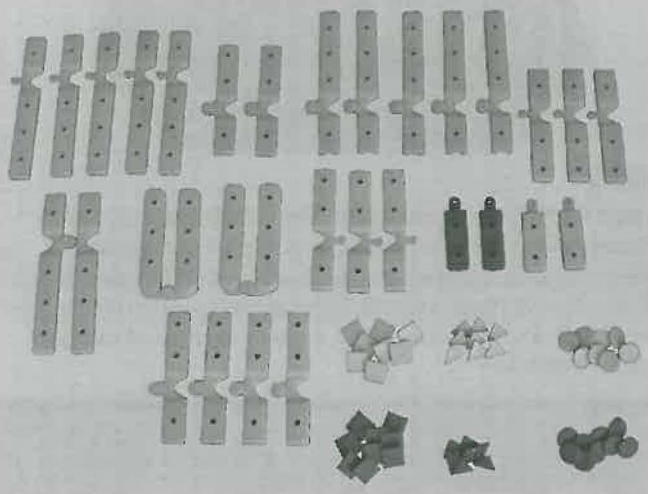
611-2170
BB Board
Visualize how molecules of iron behave when heated with this intriguing device. Two pieces of clear acrylic have BB's sandwiched between in a single layer. There is just enough room for the BB's to move two dimensionally. Place on your overhead projector and watch them line up in distinctive patterns to demonstrate annealing, hardening and tempering of a metal. With experiments and illustrated instructions.

Chemistry Kits

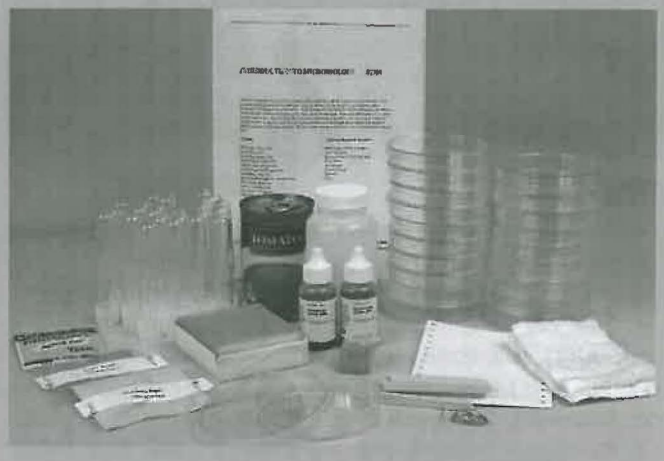
673-0000
Determine Chemical Formulas Kit
(Enough for 50 students)
Predict chemical formulas by reaction. Gain an understanding of percentage composition and molecular weight. Derive formulas from the amount of precipitate that results when you mix our compounds in different proportions. With student guides and manual.

1300
Analysis of Simple Mixtures
(For 6 groups)
Investigate the separation of mixtures. **Includes** materials to perform five standard methods: flotation; magnetic separation; sifting; solution & recrystallization; melting & resolidification. Requires one 45-minute class period.

15170
Anti-entropy Kit
A booklet of ideas and issues accompanies this provocative apparatus. Columns of dye in a viscous medium appear to mix, colors add the way they always do, and then the unthinkable happens – the dyes unmix. The situation seems to be reversible a large number of times. A clever demonstration becomes a springboard into discussions about energy and the ultimate fate of the universe.

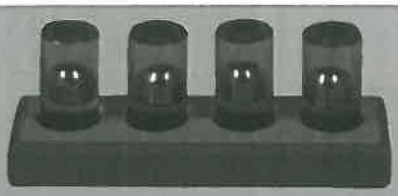


638-2500
Mitosis/ Meiosis Cell Models
Cell replication is a difficult concept for students at any level. Teach mitosis, meiosis, cellular division, genetic inheritance and more with this colorful set of snap-together plastic pieces. Chromosomes connect quickly to create a gene. You can also build alleles, small structures such as the gene for blue eyes. Illustrated instructions.

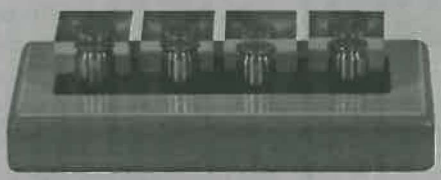


1900
Introduction to Microbiology (12 pairs)
Twelve pairs of students will spend one 45 minute class period and then 4-5 days observing cultures of microorganisms using sterile techniqu. **Includes** prepackaged media and growth containers for a close examination of mold yeast, bacteria, algae and protozoa.

Forensics



13055
Forensic Bullet Comparison Set (Set of 4)
Connect a gun to a crime scene by comparing four bullets: 3 fired from suspect guns and one from the crime scene. **Includes** 2 x 5 3/4" wooden tray; four - 0.45 caliber bullets wrapped in 2 x 7/8" diameter clear acrylic. Use a comparison microscope to match the rifling marks on each bullet created by the spin as they exit the gun barrel.



13056
Forensic Cartridge Casing Comparison Set (Set 4)
Compare cartridge casings - the pieces left behind after a bullet is fired - using a comparison microscope. Labeled casings are enclosed in clear acrylic and are 1 5/8 x 7/8 x 7/8" in size. Wood tray is 2-1/4 x 5".

13075
Deluxe Bullet Set with Barrel
Allows the instructor to easily teach ammunition knowledge and identification. Helps students understand the workings & components of firearm ammunition through a powerful visual teaching aid. Demonstrating & explaining ammunition is easy and students gain a much stronger understanding of firearm ammunition. **Includes:** Casings & shells. Primers (spent primer for safety), Powder (substitute powder for safety), Wad Bullets (Rifle: 3030 & Pistol: 45ACP), Casing/shell sampler for identification,38+P & 38 for cartridge identification, as well as rimfire & center fire. Rimmed, rimless & belted as well as rimfire & center fire, 12 and 20 gauge and high and low brass, Spent bullets showing rifling marks: Pistol: 45ACP & Rifle: 3030, Cutaway of an actual cartridge/shells, 4 Credit card size magnifying glass to allow students to easily check rifling mark and head stamps

13050
Forensic Bullet Class Size Demo (Set of 3)
Connect 2 different crime scenes using bullet fragments? Oversized simulated fragments have rifling marks from 2 "crimes". Which is from the main crime scene? **Includes:** 3 dissectible labeled magnetic plastic bullet fragments.

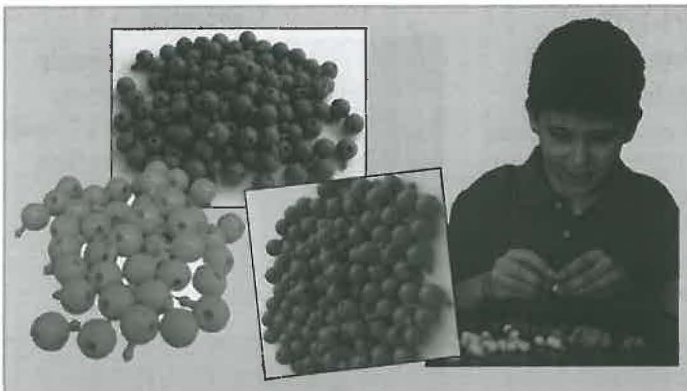
13060
Inert Cartridge Set (Set of 6)
Here's a safe, visual comparison of different bullet calibers. Each is fully jacketed to eliminate lead exposure & rendered inert by drilling & removing powder. **Includes:** 9mm, .38 special hollow point, .40 Smith & Wesson, .45 automatic, .223 Remington (standard military M16 round), .308 Winchester. All in an acrylic stand.

13070
Inert Cartridge & Shotgun Shell Cutaway (Set of 8)
Teaches the components of a Cartridge/Shell, Cartridge/Shell Firing Sequence and Ammunition Identification. **Includes:** Bullets (Rifle: 3030 & Pistol: 45ACP), Spent bullets showing rifling marks of a Pistol: 45ACP & Rifle: 3030, cutaway of an actual cartridge/shells, with base.

13058
Forensic Cartridge Case Set (Set of 15)
.22 caliber cartridge cases.

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

Molecule Models



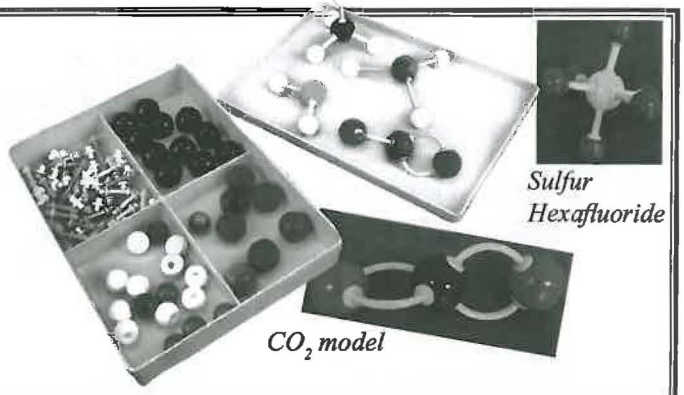
Pop Beads (Packs 150 to 300)

The time-honored way to model genes, organic molecules, chromosomes, even cellular organelles. Each bead has 1 tab and 1, 3 or 5 holes. Use 4 colors to create a DNA chain.

638-0320	Blue, 3-hole	(Pack of 300)
638-0321	Yellow, 3-hole	(Pack of 300)
638-0322	Orange, 3-hole	(Pack of 300)
638-0323	Red, 3-hole	(Pack of 300)
638-0324	Purple, 3-hole	(Pack of 300)
638-0326	Connectors	(Pack of 144)
638-0327	White, 3-hole	(Pack of 150)
638-0328	Pink, 3-hole	(Pack of 150)
638-0325	White, 5-hole	(Pack of 300)
638-0420	Blue, 1-hole	(Pack of 150)
638-0421	Yellow, 1-hole	(Pack of 150)
638-0422	Orange, 1-hole	(Pack of 150)
638-0423	Red, 1-hole	(Pack of 150)
638-0424	Purple, 1-hole	(Pack of 150)
638-0425	Green, 1-hole	(Pack of 150)

32390
Fused Molecule

A truly large (up to 3 in dia.) demonstration system consisting of 52 balls that have been shaved in the proper places so as to appear merged and with the expected bond angles and bond lengths. Included are: H, C, O, N, S, and a generic Halogen, along with single, double, and triple bonds.



Atom Snap 'Em™ (Atomic model sets)

Explore the nature of the very universe with our snap-together atomic models. Investigating the structure of different organic and inorganic compounds can't get any more hands-on! No flimsy plastic or shoddy wood here - just high impact resistant molded parts. Because they're custom molded, the hole size is consistent, which means your models do not disintegrate after you've built them. You'll hear the parts literally "snap" into place; pass them around for everyone to see. Each set contains all the parts listed along with a selection of connectors representing various bonds. **Includes:** specific atoms as well as generic atomic groups corresponding to the periodic table.

671-2005

Intro to Organic Set: 20 hydrogen, 6 halogens, 12 carbons, 7 oxygen, 2 nitrogen, 1 sulfur, 1 alkali and 1 transition metal.

671-2000

Advanced Organic Set: 40 hydrogen, 8 halogens, 2 alkali metals, 24 carbons, 6 black group 16, 12 oxygen, 4 silicon, 1 yellow group 14, 4 blue group 14, and 1 transition metal.

671-2010

Teacher's Organic Set: 12 hydrogen, 2 white alkaline earth metals, 8 halogens, 4 alkali metals, 14 carbons, 6 black group 13, 6 blue group 14, 12 oxygen, 1 yellow group 14, 1 yellow group 16, 4 silicon, 1 transition metal. Set also contains 18 pear-shaped connectors representing ions.

671-2015

Organic Set II: 20 hydrogen, 4 halogens, 1 alkali metal, 12 carbon, 6 oxygen, 2 blue group 14, 2 nitrogen, 1 yellow group 14, 1 yellow group 2, and 1 silicon.

671-2020

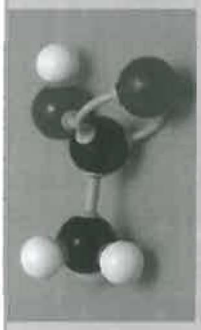
Organic/ Inorganic Set: 14 hydrogen, 6 halogens, 2 alkali metals, 6 carbon, 1 beige group 15, 1 nitrogen, 2 blue group 14, 6 oxygen, 1 red group 14, 1 sulfur, 1 yellow group 2, 3 transition metals, 1 gray group 15, 1 gray group 14, 1 grey group 2, 1 beige group 14, 1 beige group 13, 1 beige group 2. Also 5 purple connectors and three pear-shaped assemblies representing ions.

Molecules

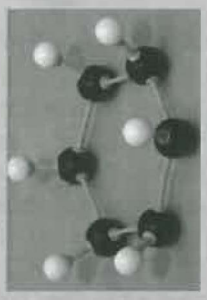
671-2114
Methane Molecule
A model of the hydrochloric acid molecule - CH_{14}. Includes 4 small connectors. Packed loose in a bag with assembly instructions.

671-2116
Propane Molecule
A model of propane - C_3H_8. Includes 10 small connectors. Packed loose with assembly instructions.

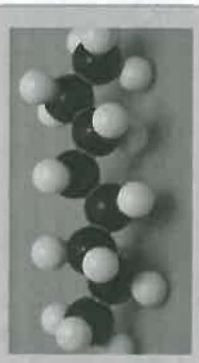
671-2109
Ethane Molecule
A model of ethane - C_2H_6. Includes 7 small connectors. Packed loose, assembly instructions.



671-2121
Vinegar Molecule
A model of the vinegar molecule, $C_2H_4O_2$. Includes 4 small, 2 medium and 2 long connectors. Packed loose in a bag with assembly instructions.

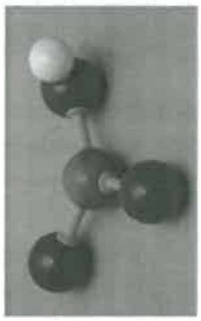


671-2103
Benzene Molecule
A model of the benzene molecule - C_6H_6. Includes 6 long and 6 medium connectors. Packed loose in a bag with assembly instructions.

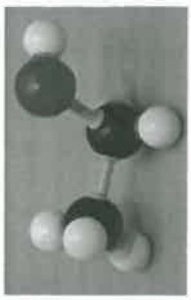


671-2111
Gasoline Molecule
A model of the gasoline molecule - C_5H_{18}. Includes 25 small connectors. Packed loose in a bag with assembly instructions.

671-2106
Calcium Carbonate
A model of the calcium carbonate molecule - $CaCO_3$. Includes 4 medium connectors. Packed loose in a bag with assembly instructions.



671-2115
Nitric Acid Molecule
A model of the ethanol molecule - HNO_{13}. Includes 1 small and 3 medium connectors. In bag with instructions.



671-2110
Ethanol Molecule
A model of ethanol- C_2H_6O. Includes 6 small and 1 medium connector. Packed loose in a bag with assembly instructions.

Small, Medium & Long Molecule Connectors

671-2150
Short Connectors
(Pack of 50)
Fifty short connectors for molecule kits

671-2151
Short Connectors
(Pack of 250)
250 short connectors for molecule kits

671-2153
Medium Connectors
(Pack of 50)
Fifty medium connectors for molecule kits.

671-2154
Medium Connectors
(Pack of 250)
250 medium connectors for molecule kits

671-2156
Long Connectors
(Pack of 50)
Fifty long connectors for molecule kits.

671-2157
Long Connectors
(Pack of 250)
250 long connectors for molecule kits

Atom Bulk Packs

671-2168
Nitrogen Atom
(Pack of 20)
20 nitrogen atoms for molecule kits.

671-2166
Oxygen Atom
(Pack of 20)
20 oxygen atoms for molecule kits.

671-2160
Hydrogen Atom
(Pack of 20)
20 hydrogen atoms for molecule kits.

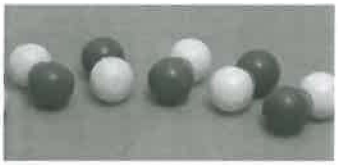
671-2163
Carbon Atom
(Pack of 20)
20 carbon atoms for molecule kits.

671-2161
Hydrogen Atom
(Pack of 100)
100 hydrogen atoms for molecule kits.

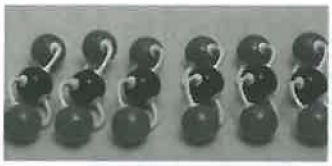
671-2164
Carbon Atom
(Pack of 100)
100 carbon atoms for molecule kits.

Molecules

671-2123
Water Molecule (Set 6)
A model of H_2O with 12 small connectors. Packed loose, assembly instructions.

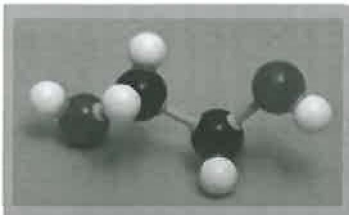


671-2113
Hydrochloric Acid Molecule (Set 6)
A model of hydrochloric acid - HCL in a set of 6. Includes 6 small connectors. Packed loose in a bag with assembly instructions.

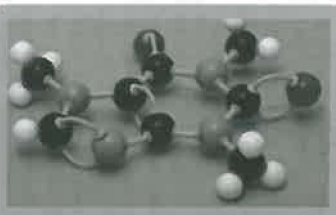


671-2107
Carbon Dioxide Molecule (Set 6)
A model of carbon dioxide - CO_2. Sold as a set of 6. Includes 24 long connectors. Packed loose in a bag with assembly instructions.

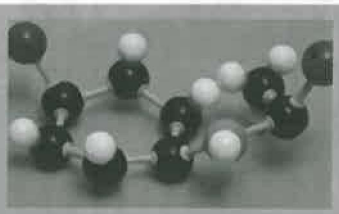
671-2100
Ammonia Molecule (Set 4)
A model of ammonia, NH_3 in a set of 4. Includes 12 small connectors. Packed loose in a bag with assembly instructions.



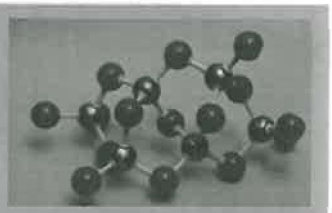
671-2101
Antifreeze Molecule
A model of the antifreeze molecule - C_3O_2. Includes 6 small and 3 medium connectors. Packed loose in a bag with assembly instructions.



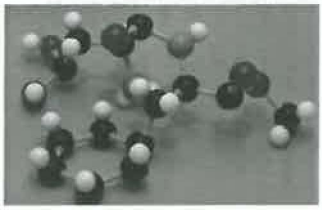
671-2105
Caffeine Molecule
A model of $C_8H_{10}N_4O_2$. Includes 10 small, 11 medium and 8 long connectors. Packed loose with assembly instructions.



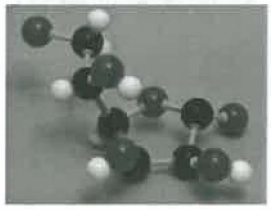
671-2120
Acetominophen Molecule
A model of acetominophen, $C_8H_9NO_2$. Includes 9 small and 11 medium connectors. Packed loose in a bag with assembly instructions.



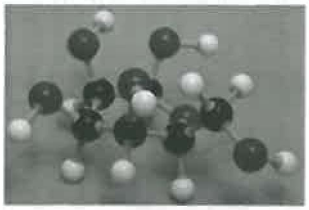
671-2117
Quartz Molecule
A model quartz molecule - SiO_4. Sold as a chrystal of 4 subassemblies (Si_6O_{16}) Includes 25 medium connectors. Packed in a bag with assembly instructions.



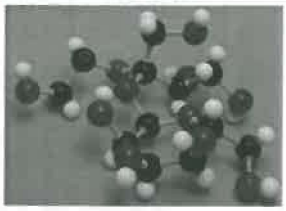
671-2102
Aspartame Molecule
A model of the aspartame molecule - $C_{14}H_{18}N_2O_5$. Includes 18 small and 20 medium connectors. Packed in a bag with assembly instructions.



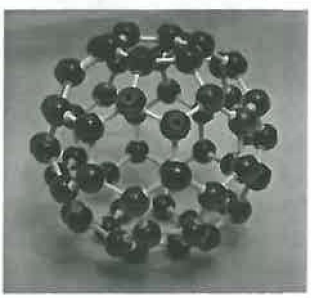
671-2122
Vitamin C Molecule
A model of the Vitamin C molecule, $C_{26}H_8O_6$. Includes 8 small, and 11 medium connectors. Packed loose in a bag with assembly instructions.



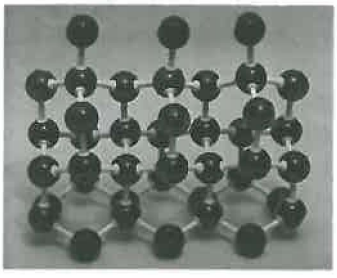
671-2112
Glucose Molecule
A model of the ethanol molecule - $C_6H_{12}O_6$. Includes 23 medium connector. Packed loose in a bag with assembly instructions.



671-2119
Sucrose Molecule
A model of sucrose - $C_{12}H_{22}O_{11}$. Includes 22 small and 23 medium connectors. Packed loose in a bag with assembly instructions.



671-2104
BuckyBall Allotrope
A model of the BuckyBall allotrope, C_{60}. Includes 70 medium connectors. Packed loose in a bag with assembly instructions.



671-2108
Diamond Allotrope
A model of the diamond allotrope - C_{40}. Includes 24 long connectors. Packed loose in a bag with assembly instructions.

Astronomy

654-0000 Single
654-0010 Bulk Pack/10

Refracting Telescope Kit (Project STAR PS-04B)

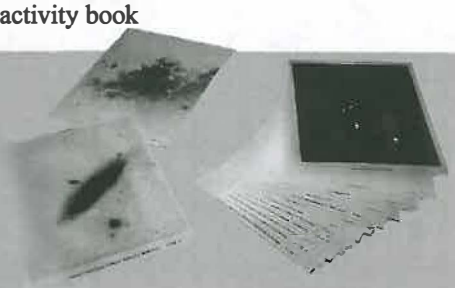
Galileo made astonishing discoveries with instruments just like this. Build a 16-power refracting telescope to show how lenses work without an optical bench. **Includes**: inner/ outer cardboard tube; plastic lens (43mm diameter, 400mm focal length); plastic lens (17.5mm diameter, 25mm focal length); foam holder; cardboard spacer; red plastic cap for end (2 per telescope); activity book (one with single kit or bulk kit).

654-0050

College Astronomy Kit (Project STAR PS-13)

This kit offers 3 of our most popular activities and is designed to supplement the college lab or lecture. At its core is our 18-page manual with assembly, operation and questions. **Includes:**

- Celestial Sphere Kit; Refracting telescope kit
- Cardboard Spectrometer Kit
- Instruction/ activity book



654-0140

14-Plate Set with Key (Project STAR PS-21)

Fascinating high-quality reproductions of photos from the Harvard College Observatory, Lick Observatory and Palomar Sky Survey (1950) show stars, nebulae and galaxies with a complete key for identification. Study the effect of a telescope's focal length or estimate the distances to two galaxies. Good companion to our booklet, "Where We Are in Space and Time," right.

Science First®

654-0130

DIY Star Finder Kit (Set of 10) Project STAR PS-19

Make your own adjustable star chart with tape and a pair of scissors! Our chart can be set for any time of night and any day of the year. Compare the evening sky in all seasons. Determine which constellations are signs of the zodiac. Images are black on white and depict 41 constellations with lines indicating their shapes. **Includes**: 10 sets of 2 printed cardboard sheets. Each set makes one 8.5" (21.5cm) diameter star finder.

654-0125

Teacher's Guide (Project STAR - PS-12)

48-page Answer Key has suggestions on conducting activities. With pages for copying.

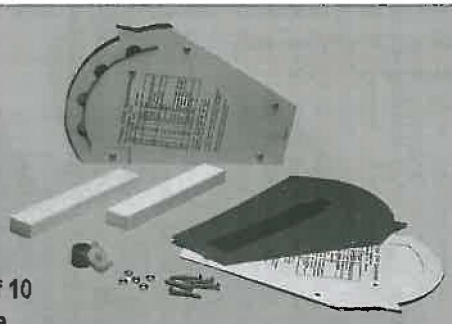
654-0005

Where We Are in Space and Time

Project STAR - **PS-01 (Materials available from this catalog)**

Our 176-page spiral-bound Student Workbook has 21 activities to help develop skills in scientific observation. The labs emphasize observing cycles and calculating sizes and distances to stars, planets and galaxies. Students can perform calculations right in the book. Also **includes** a glossary.

Astronomy



654-0020 Set of 10
654-0025 Single

Cardboard Spectrometer Kit (10-Pack or Single)

Project STAR PS-14/ Cardboard

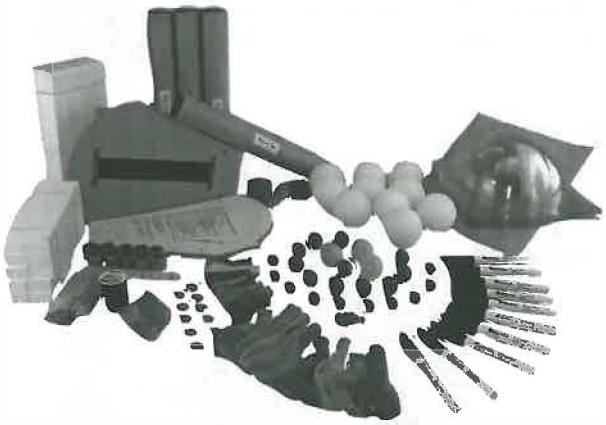
Grades 9 - college. Explore the mysteries of light in all its wonder and complexity. Our ready-to-assemble unit **includes** a film strip and a scale for identifying a color by wavelength in nanometers or photon energy in electron volts. Kit **includes:**

- Plastic disk, 1" diameter, with diffraction grating, 10
- Top and bottom set, cardboard, 10 sets
- Styrofoam set, long and short pieces, 10
- Support tube, cardboard, 10
- Nut and bolt set, 5 sets
- Film (35mm) - slits & wavelength/ photon scale, 10
- Instruction and activity booklet, 1 each

614-0210

Plastic Spectrometer (Project STAR PS-14/ Plastic)

Made with a high-dispersion, high-efficiency diffraction grating producing an easy-to-read bright spectrum, this high-impact plastic spectrometer is fully assembled. With 10-page activity booklet and scale labeled in both electron volts and nanometers. Identifying light sources. Study elements in flame spectra, solar spectra, street lights



654-0105

Project STAR Class Set (For 10 students)

Project STAR - PS-10

At home or school, year in, year out, this set has activities to keep 10 students enthralled with exploring astronomy.

- DIY Star Finder Kit & Celestial Sphere Kit (10 each)
- Sun Tracking Hemisphere Kit (10)
- 3-D Constellation Kit and Refracting Telescope (10 each)
- Solar System Scale Model Kit and Spectometer (10 each)
- Light Measurement and Stellar Distance Kit (10)
- Detailed activity book (10), Teacher Guide

654-0110 Cardboard
654-0120 Plastic

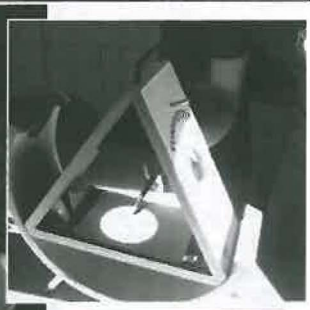
Project STAR Teacher's Sampler

(Project STAR - PS-11)

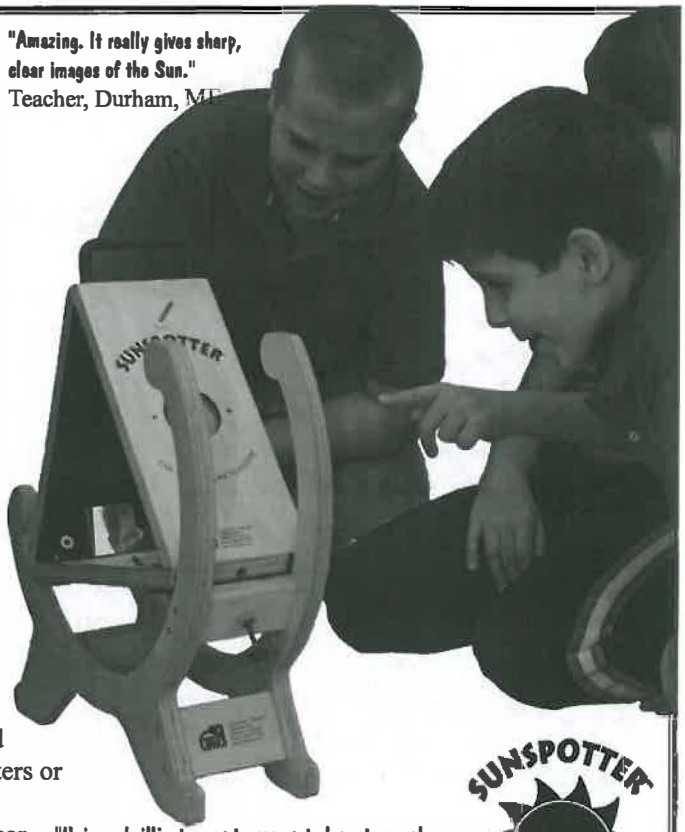
8 popular activities. This kit has a little of everything.

- DIY Star Finder, Celestial Sphere Kit
- Sun Tracking Hemisphere Kit, 3-D Constellation Kit
- Spectrometer Kit (choose cardboard or plastic)
- Refracting Telescope Kit
- Light Measurement and Stellar Distance Kit
- Holographic Diffraction Grating - mounted, 35mm
- Detailed activity book

Astronomy - Sunspotter®



"Amazing. It really gives sharp, clear images of the Sun."
Teacher, Durham, ME



654-0145
Sunspotter® Telescope

A telescope for viewing the sun? Our attractive hardwood device is precisely that. The folded-path Keplerian design provides a safe, convenient way to view the brilliant light on which all life on earth depends. A series of mirrors project a bright solar image (3.25") onto a white screen (5") through a powerful objective lens, 62mm in diameter. The perfectly curved wood cradle lets you align the sun in seconds - no telescopes, filters or tripods. Use the Sunspotter® to:

- View sunspots, eclipses and transits as they appear and disappear
- Allow students to view the sun simultaneously - great for groups
- Trace and compare sunspots

"Unique, brilliant, easy to use, yet elegant enough to put on the coffee table" Lawrence Hall of Science Planetarium, Berkley CA

BE READY FOR THE TOTAL ECLIPSE!
Get you Sunspotter® Now!
On August 21, 2017, the United States will be treated to the first total eclipse of the Sun visible in the country in almost 40 years.

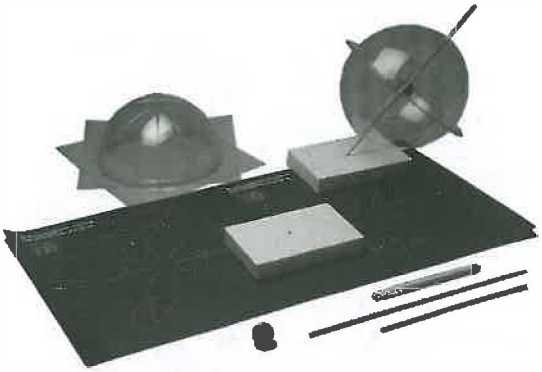
10230
Solar Motion Kit

What is the path of the sun where you live on Dec 31 or June 15? This elegant, easy to use, and hands-on model clearly shows the path of the sun at any latitude during any month of the year. It clearly demonstrates the seasons, comes with one model fully assembled and 23 more that are easy to finish.

10240
Solar Motion Model

Wooden desk top model, beautifully finished, fully operational, stands 13.5" high. What is the path of the sun where you live on Dec. 31 or June 15? This elegant, easy to use, and hands-on model clearly shows the path of the sun at any latitude during any month of the year. It clearly demonstrates any season.

Astronomy



654-0035 **Single**
654-0030 **Set of 10**

Celestial Sphere Kit (Single/Set 10) Project STAR PS-02
The sky's the limit! Experiment at home or lab with the apparent daily motions of stars and sun. Learn to use the sky for navigation and grasp what causes the seasons. **Includes**:

- Clear plastic hemispheres, 20
- Star chart, 10 (500 brightest stars)
- Pen to mark stars inside sphere, 10; pin for sun, 10
- Earth space globe, 1" diameter, 10
- Wood dowel for axis, 10
- Plastic straw for support,10; styrofoam base, 10
- Instruction/activity book

654-0045 **Single**
654-0040 **Set 10**

Sun Tracker Kit (10-Pack or Single) Project STAR PS-03
For grades 9 - college. Do your students believe the sun is at its zenith every day of the year? Free them of this notion with this unique kit. By constructing our model and comparing the daily path of the sun over different seasons, your students can engage in long-duration observations. Kit **includes**: hemispheres, 7" diameter, 10; pens, 10; activity book.

654-0060

Solar System Scale Model Kit
(Project STAR PS-05) (1- 4 students)
Hold the solar system in the palm of your hand. This colorful kit shows the relative locations and size of the planets, sun and moon. **Includes**: Marbles and balloons in small and large sizes, 10 each; Styrofoam balls and beads, 10 each; Plastic spheres, 3 each of different sizes, Map pins; earth globe; activity book

PROJECT STAR

654-0100

Light Measurement/ Stellar Distance Kit
(Project STAR PS-07A)
Determine the luminosity of (distance to) the sun with an ordinary light bulb. With a null photometer, compare 2 light sources to find the distance to one of them. The photometer then compares a 200-watt light bulb with the sun to estimate the sun's luminosity. Great for grades 9 - college, it **includes** 10 labs (1 lamp). **Includes**:

- 200-watt lamp & lamp holder (110/ 60 voltage only)
- Paraffin blocks, 10
- Piece of optical fiber, 1' long, 10
- Rubber bands, 20
- Flashlight with batteries
- Roll aluminum foil, 25'
- Instruction/ activity book

15170

Anti-Entropy Kit
Columns of dye in a viscous medium appear to mix and colors seem to add - and then the unthinkable happens: the dyes unmix. The situation seems to be reversible a large number of times. A clever demonstration becomes a springboard into discussions about energy and the ultimate fate of the universe. With detailed manual.

Astronomy

About Project STAR

- Science Teaching through Astronomical Roots
- National Science Foundation-funded program developed by scientists at Harvard Smithsonian Center for Astrophysics
- Stresses scientific skills suitable for all science classes
- Contains all or most materials needed, including curriculum materials

614-0080

Demo Diffraction Grating

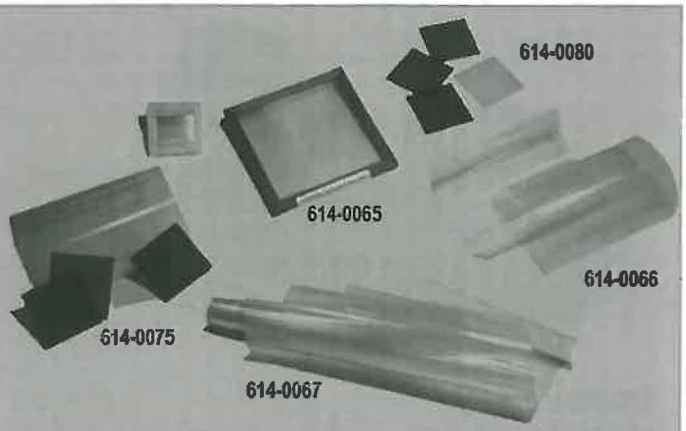
This functional, budget-friendly slide has three 20 x 10mm gratings mounted between glass plates. 100, 300, 600 lines per mm.

614-0072

Spectrum Projector (Project STAR PS-20)

Two lab set-ups in one: this device produces a diffracted light beam in 2 directions. Study how the spectrum changes with temperature and brightness. Display a graph of the projected spectrum with our paraffin spectrum analyzer. Experiment with objects in different colors of light. 110/ 60 volt only. **Includes**:

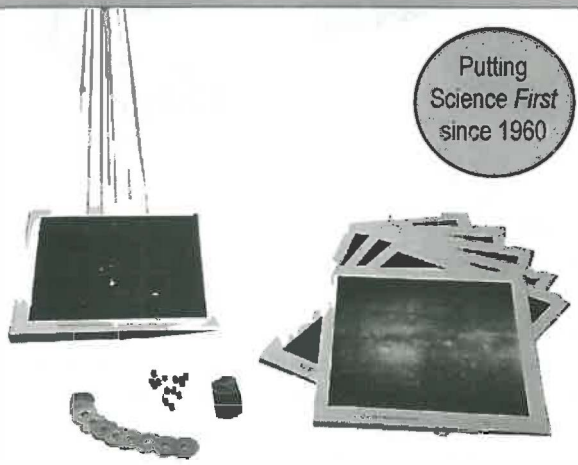
- Lamp with dimmer, 200W; diffraction grating square, 2
- Cardboard tube, 2; bottle, 6
- Collimated lens (53mm), 2
- Paraffin blocks and small mirrors; one set each
- Filter sheet (6 x 6"), 4; red, blue, green felt (2 each)
- Instruction/ activity book



Holographic Diffraction Grating (Project STAR)

For use with spectrum projector or overhead projector
Make a spectrometer. Show how light is affected by color. High-energy grating,100x more efficient than acetate, produces a spectrum bright enough to see in class. Polyester plastic sinusoidal shape places most light in the first order image and produces a 23.5° dispersion angle and groove separation of 19,050 lines/inch (750 lines/mm) - wavelength of 550nm.

614-0065	**1 mounted sheet & filters (4.75 x 4.75")**
614-0066	**2 sheets, 5.5 x 5.5"**
614-0067	**1 roll, 6' x 5.5 (13 squares - 5.5 x 5.5")**
614-0068	**10 slides, 35mm glass slide mount**
614-0070	**Single slide, 35mm glass slide mount**
614-0075	**1 sheet, 5.5 x 5.5" with 4 color filters**



654-0095

3-D Constellation Kit (Project STAR PS-06)

When you view our photo plates from 22" away, the stars look as if they were overhead. String beads to the plates to show not all stars are the same distance away. **Includes**: 4 photo plates (Ursa Major, Cassiopeia, Gemini, Orion; 250 orange beads (3mm diameter); spool of thread; 10 washers; instructions.

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

Astronomy

654-0150

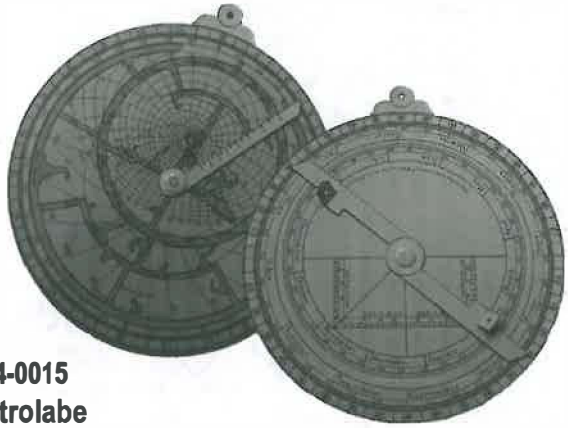
Heifetz Planisphere

Our innovative, pre-assembled planisphere shows undistorted images of the constellations along its periphery. Simple and understandable drawings make the constellations easy to recognize. Made of durable plastic with a clear window, this is a reusable way to show all the stars for a specific time and latitude. 8-3/4" diameter, 30° N.

654-0160

Precession of Equinoxes

Determine the past, present and future as told by the position of the stars, specifically for the Southern Hemisphere. Our unique device reveals which stars are visible at any hour and day. Durable plastic, 10" diameter, 30° S.

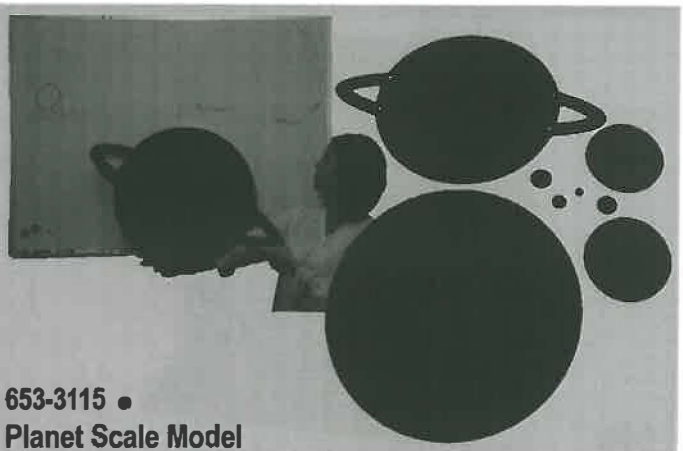


654-0015

Astrolabe

Study the sky the way the sailors did!

Duplicate the discoveries of yesteryear with our economical device. Make scientific measurements of declination, altitude, and azimuth of celestial bodies to determine latitudinal position or observe the motion of the earth. Also measure the slope, strike and dip of the geologic features around us. 15 x 18cm with instructions on product.



653-3115 ●

Planet Scale Model

The planets have long puzzled the ancients; were they gods or omens? Today we know they are remnants of the formation of the solar system varying from small rocks to Jupiter. While your students may have seen pictures, it can be difficult to "put it in perspective." Which is where our model can help! Using Mercury as the benchmark, we have cut each planet "to scale" out of lightweight, durable ABS plastic. Reusable pieces range from 1" to 29" in diameter; each planet is labeled. With holes to hang as a mobile. Instructions. ● *Ships oversize.*

10250

Moon Phase Demonstrator

Where and when does the Moon appear in the sky when it has a particular phase? When does the Moon rise and set in relation to sunrise and sunset? This device helps students answer these questions by showing how the Moon's appearance changes over a period of one month. A phase of the Moon is selected by turning the front disk, which correctly places the relative position of the Sun. The Earth's rotation is simulated by rotating the disks together from sunrise to sunset, illustrating the relative paths of the Sun and Moon. The rear disk is screened with a visualization of the perceived shape of the Moon throughout the cycle of its phases.

Astronomy - Navigation

U020

Season Modeling Globe

A smoked acrylic box houses this mechanical simulation of the solar illumination of the Earth. With a tilted 6" globe and a built-in calendar protractor, it is easy to set the hourly situation throughout the year. Study seasonal changes, positions of sunrise and sunset, Solstices and Equinoxes.

U010

Blue Planet Globe

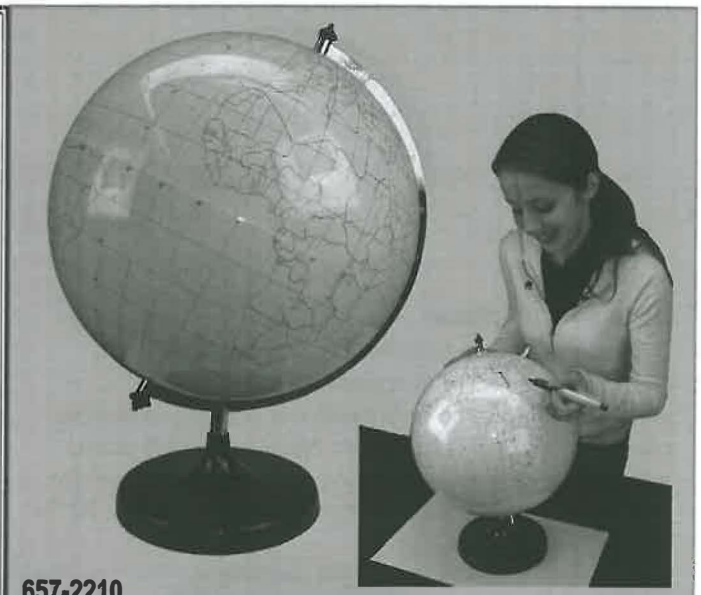
This 16" globe, with its internal illumination, simulates the Earth's daily rotation and seasonal changes within a 6-minute cycle. Between daylight and darkness there is emphasizes on the Polar regions, the current position of the sun and significance of the Arctic and Antarctic Circles. Smoked acrylic housing shields against distracting illumination.

653-8020

Milky Way

You are here - find the spot!

Clarify the relationship of the earth and our galaxy with this beautiful, intricate transparent model. Accurately locates and names the spiral arms, our sun, our solar system, and major star clusters. Illustrated booklet.



657-2210

Write-On Globe

Color code the ancient empires of extinct civilizations. Trace the trail of Lewis and Clark. Chart the discovery of the Nile. Our write-on globe has many uses. **Includes**:

- 35.5cm diameter bright white globe
- Major political boundaries in black
- Major rivers in blue
- Dry-erase marker (wipes with cloth), stable plastic stand, instructions

653-8012

Celestial Globe

Our transparent, four color globe is perfect for identifying stars and constellations. A 75mm earth globe is mounted within the center of the 300mm sky globe and can be rotated to align a position on the ground with a position in the sky. The 3D format lets you conceptualize your position from the outside in, helping you understand the movements of the earth relative to the starfield.

Radioactivity

612-1055
Accent Science™
Energy Transfer Kit
Explore the secrets of heat transfer by filling one container with warm and the other with boiling water. Place thermometers in each to study heat lost and gained. **Includes:** 3 containers with insulated lids; U-shaped copper bar, instructions with worksheets and teacher pages. *Needs 2 thermometers.*

612-1265
Accent Science™
Radiation Cans
How can color influence the rate of absorbing and radiating energy? Fill these two metal cans with cold water for absorption, hot water for emission. **Includes:** black & silver (or white) cans with one-hole cap for thermometer; instructions. Color can vary. *You need thermometer, heat.*

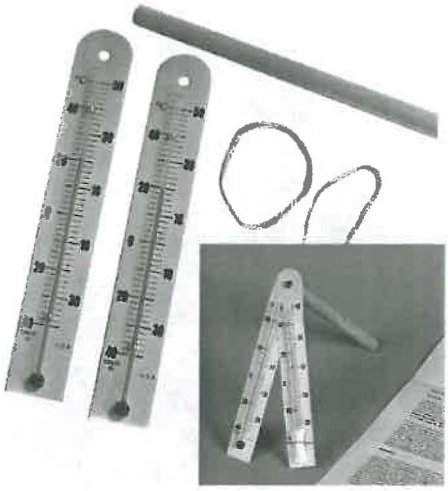
611-1125
Accent Science™ Air Pressure Kit
Everything needed to study air pressure!
- Magdeburg Hemispheres
- Weight of Air Cylinder
- Vacuum Lifter; Hand Vacuum Pump
- Force Pressure Cups
- Breaking Board Paradox
- Instructions tied to National Standards

16215
Heat Transfer
Observe and measure the transfer of heat by an aluminum bar between two water samples of different temperatures. Two insulated containers have foam lids and mounted thermometers.

16225 Single
16226 Class Set
Thermal Radiation
Investigate reflection and absorption, using a 100 W incandescent lamp as energy source. Two metal cans, one black one shiny, have a thermometer mounted in an insulating cap. When placed an equal distance from the lamp, what do you observe? Class set has enough for 8 students.

32840
Radiation Can
Investigate the absorption and radiation of energy on different surfaces. Fill both cans with water and place a thermometer in each. Observe how temperatures respond differently in the black and silver cans when exposed to light. Also investigate rates of cooling.

Meteorology



16220 Single
16221 Pack 15

Psychrometer (Singly or Pack 15)

Determine dew point and relative humidity with this easy to use kit. Correlate with other instruments to study weather. **Includes**: two thermometers, a handle, wet bulb wick and psychrometric chart.

652-1110

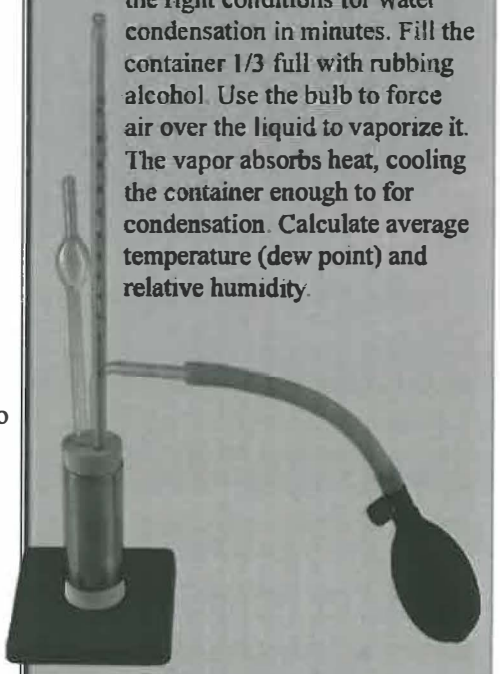
Hygrometer

This stationary hygrometer is a 19th century device that uses evaporation to determine relative humidity. Included are two thermometer bulbs: one wet, one dry. When the wet bulb cools due to evaporation, the difference in temperature between the two bulbs is used to calculate relative humidity. **Includes** instructions.

652-1000

Dewpoint Apparatus

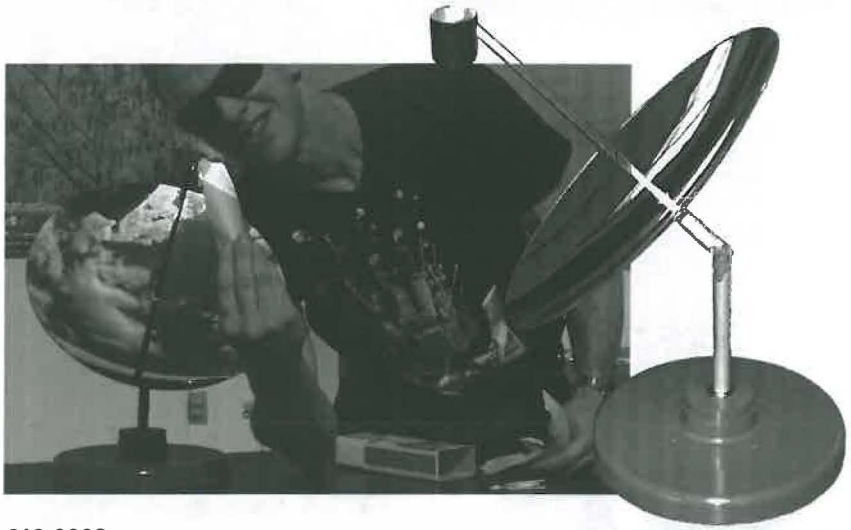
Don't wait all day for the weather to change. Create the right conditions for water condensation in minutes. Fill the container 1/3 full with rubbing alcohol. Use the bulb to force air over the liquid to vaporize it. The vapor absorbs heat, cooling the container enough to for condensation. Calculate average temperature (dew point) and relative humidity.



612-0015

Solar Hot Water Demo

Show how the sun can heat water cheaply and effectively. Our black ABS plastic sheet absorbs heat from the sun. Tubing runs through a carefully cut groove, zig-zagging to increase the total amount of water it can hold. As the panel heats up, the water inside does likewise - up to 90° in direct sunlight! **Includes**: valve to prevent leaking, kickstand, syringe for filling tubing, instructions. Generous 10 x 16" panel.



612-0003

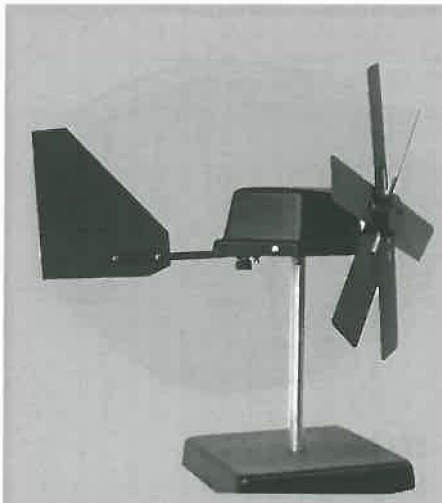
Solar Furnace

Did you know temperatures can reach over 150° C in sunlight? Try it with our 31cm diameter parabolic reflector. It concentrates sunlight on a black-colored copper cup. Try using it to pop popcorn!

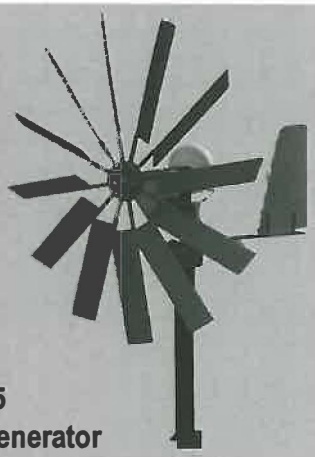
Meteorology

652-1015
Weather Station Box
Protect your instruments from the elements. Our triple painted weather instrument box holds thermometers, hydrometers and more. Excellent for GLOBE program. 23 by 11 by 9". **Includes** 2 keys.

Putting Science *First* since 1960



800
Wind Generator
Study the interrelationship of aerodynamics, motion, and electrical power production. Six fully adjustable vanes make a 36-cm diameter circle and are coupled to the generator through a 4:1 drive train DC output is monitored with a variable intensity bulb or with a voltmeter connected to the binding posts provided.



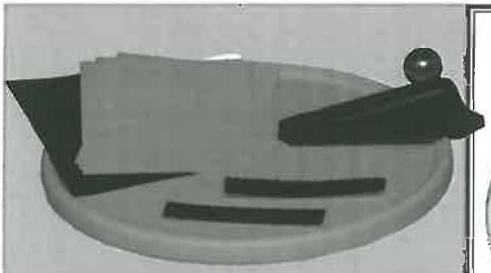
652-1025
Wind Generator
Study aerodynamic transfer with this "new" old favorite. Connect to a DC generator and light bulb to show electrical output. Clamps to a lab bench. **Includes** 12 colorful plastic vanes, balanced tail, clip leads, instructions.

652-1010
Anemometer
Colorful working model is sensitive to breezes as slight as 2 mph (3 kph). Since it rotates at speeds 1/6 that of the wind velocity, wind speeds can be determined quantitatively by counting rotations. **Includes**: four plastic molded cups, 3 black, 1 red; low friction axle; sturdy plastic base; instructions.

652-1020
Wind Vane
The wind may not always be at your back - but you'll know its direction. Plastic base and sturdy post support a cone bearing sensitive to the slightest wind. Place "N" at north and read the direction.

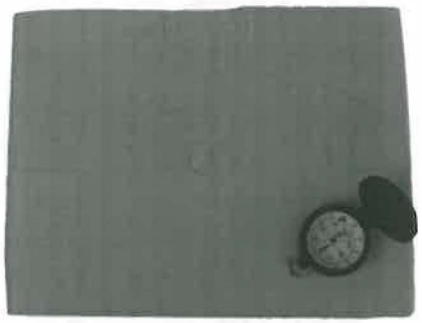
673-0090
Accent Science™ **Water Cycle Kit**
Find out why clothes dry on the line and a can of cold soda is wet. Create dew and measure the dew points of air. Study frost and learn how humidity affects dew points. **Includes**: 16 thermometers; 8 aluminum cans; 16 sample containers with slotted caps; sponge; spoon; 8 plastic plates; instructions & Journal Pages.

Geology



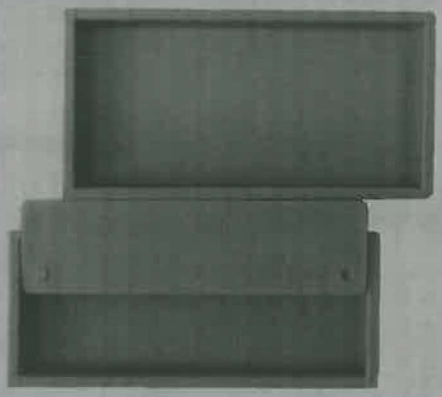
32290 Single unit
32290-C Set of 10
Coriolis Effect
(Singly or Set 10)
This demonstrates that the Earth's rotation causes linear motion to be perceived as curvilinear motion, and is different in the Northern and Southern hemispheres. A ball can be launched from the center or from the edge of the rotating disk, leaving a carbon track on white paper. Meets ESCP standards.

653-9015
Magnetic Earth
This is a great demo of the earth's magnetic field. Use as is or place on an overhead projector to show the whole class. Iron filings are suspended in oil to align to the field of the included magnet.

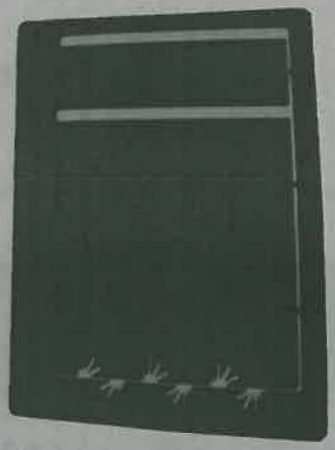


615-0400
Polar Reversal Model
Geomagnetic reversal - the switching of magnetic north and south poles - is a mysterious phenomenon. With our board and a compass (not included) you can demonstrate the sudden reversal in polarity in earth's magnetic field!

653-3045
Economical Coriolis Effect
Demonstrate the apparent tendency of a moving object to deflect as viewed against a rotating surface, such as an airplane moving across the globe. Drop a ball while spinning the platform and watch how it deflects. **Includes:** turntable, launching mechanism, steel ball, carbon paper. Instructions.



651-6350
Fault Simulator
Need a tactile way to feel the motion of transverse faults and earthquakes? Who could "fault" that? This unusual lab consists of two durable plastic plates with sliding tab connections. Show how two tectonic plates slide against each other, generating friction. Simulate the mechanism that causes an earthquake. At the first hint of lateral motion, they slide past one another rapidly. Instructions



651-6330
Fracking Model
Natural gas is essential for our current electrical grid. The most effective new extraction technique, "fracking", is controversial. It involves drilling a horizontal hole at great depth, injecting sand and fluids at high pressure, and shattering rocks to allow gas to escape. Our plastic model shows the basic structure of a modern natural gas well with the relative position of the surface, gas layer and aquifers. Unique way to start a discussion on energy. Use as a stencil to draw your own pictures.

Geology - Stream Table

Stream Table features:
- ABS plastic construction
- Clear acrylic sides
- Integrated reservoir with sediment trap contains pump
- Five water jets produce five fully adjustable streams
- Integrated prop holds table at different angles
- Folds for storage. 48 x 20"

Putting Science *First* since 1960

651-6215 ●

Stream Table

Stream tables are an essential part of the earth science class for the study of erosion, sediment deposition, and the behavior or rivers and lakes. Use them to unfold these processes inside the classroom at an accelerated rate - easier than observing a real river over the course of decades.

Until now, however, there's been little choice in features or affordability in a stream table. That's why we're proud to introduce the most advanced system to be found anywhere, at a price you won't believe! With our integrated design, set-up is a breeze - simply add water, turn on the pump, and teach!

A generous 48 x 20" in size, our rugged ABS device features five water jets, not the usual one. One water jet yields one piddly stream, while many jets form tributaries that make rivers, just like the landscape around you. The reservoir contains a sediment trap to prevent particulates from clogging the pump. The integrated prop holds the table at several angles, and the clear acrylic sides allow views of sediment layers. A removable dam creates a lake to illustrate how sediments form deltas. Fully watertight. Folds for storage.

● *Ships oversize.*

32200 Single
32210 Class Pack (15)

Contour Model Kit

Learn to draw contour lines and how to indicate elevations on a chart or map. By immersion in water, the model of Mount Capulin allows the shape of earth surface features to be displayed in two dimensions using hand drawn contour lines.

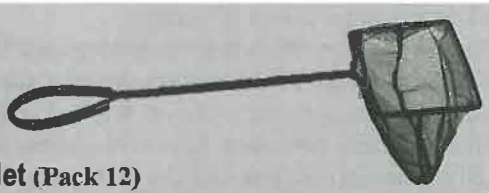
651-6300

Volcano Model

Simulate a volcanic eruption with vinegar and baking soda without the mess. Our sturdy plastic tray catches "lava" runoff and washes clean in the sink. A small tube (not included) fits snugly inside the "volcano" to hold the materials that "explode". *You need disposable tube.*

Water Sampling - Air Sampling

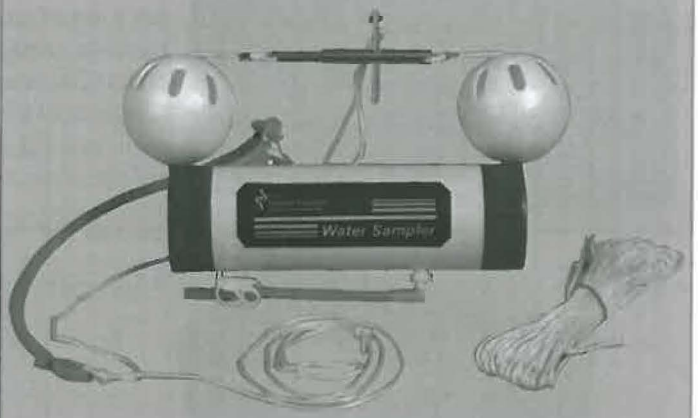
3-190-E25
Wash Bucket
For sorting samples taken with Mighty Grab™ and other samplers. This heavy-duty plastic bucket has a stainless steel wire cloth bottom in 500 micron mesh, reinforced with hardware cloth and welded to a stainless steel ring.



3-122-N30
Aquarium Net (Pack 12)
It's cheaper by the dozen. These fine-mesh nets are great for student field studies or your personal fish tank, they feature an extra-strong, three-ply, vinyl-covered handle. 3 x 4" in size.

3-168-A10
Sludge & Tank Sampler
Ideal for sampling settled solids in liquids. A float valve open when the sampler is lowered and closes when pulled up. Made of 3/4" diameter plastic pipe with screw-type fittings, it comes in three 5' sections for a total of 15". Holds 3 oz per foot.

15000
Air Sampler
What's in the air you breathe? A high efficiency filter draws air at a calibrated rate so you can determine its total mass in milligram for chemical and radioactive tests. 40cm tall, 115 VAC 60 Hz indoor-outdoor operation. **Includes:** filters, manometer.



15010
Economy Water Sampler
No tangled lines with this efficient, economical sampler. A single line deploys and triggers the sampler from any depth in lakes, rivers, or ponds. The flow-through design allows a valid sampling for measuring temperature and water quality. A 14 meter line is supplied. 1.5 liter capacity.

See pg. 16 for
Fieldmaster® Water Samplers

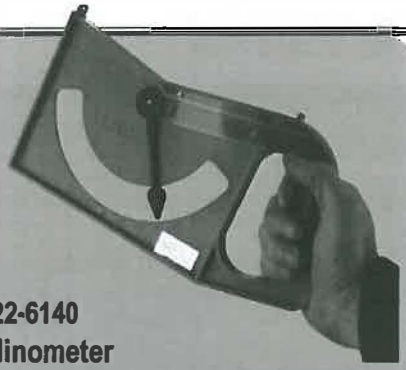
Soil Testing - Field Equipment

3-181-A10
Invertebrate Lab Starter Kit
Everything you need to start out right.
- "Critter Pickin™" pan
- Clear glass vials, set of 12
- Hand lens
- Lab scoop and probe
- Entomological forceps
- Basic instructions

Everything is reusable!

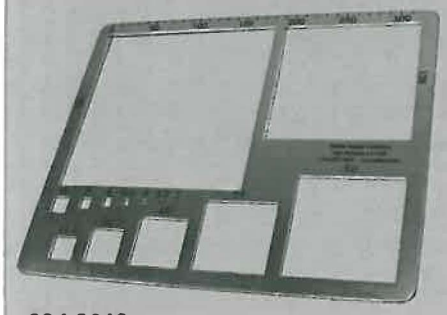
32910
Screen Sieves
Separate and grade dry soil samples into five different size ranges. **Includes**: cover, solid bottom, 4 stacking sieves with #6, #20, #40, & #100 wire mesh screens.

See pg. 21 for **Fieldmaster® Screen Sieves**

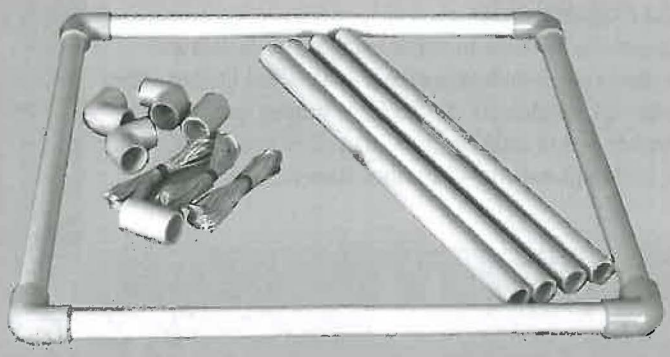


622-6140
Clinometer
Easily calculate the height of any tall tree or building. Simply aim, squeeze the trigger and view the angle of inclination. Instructions on product.

623-1050
Colony Counter
Microorganisms are far too small to count with the naked eye. However, many join to form visible colonies, which can be counted with a dedicated device such as ours. **Includes**: backlit counting surface, ergonomically angled; counting grid with 1cm grid distribution in "x" pattern; instructions.



624-3010
Gravelometer (Size Analyzer)
This can grade or measure gravel and small cobble more accurately than a ruler with 14 square holes of common sieve sizes. Scale in 10mm increments along one side can measure up to 310mm. 13.5 x 11" (34 x 28cm). Lightweight, portable.



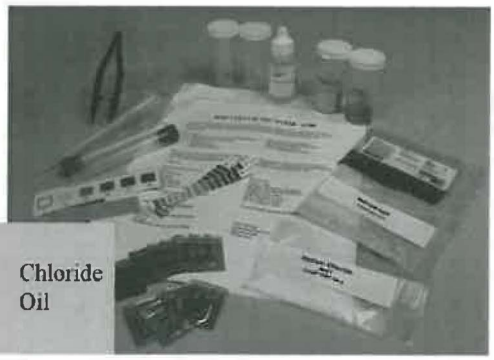
32805
Quadrat Kit
Two calibrated transect lines and a quadrat make this classic field-sampling device. Used to ensure uniform sampling per square meter, it can be assembled into one square (1m on a side), or two (0.5m on a side). Disassembles easily for storage. With 20m calibrated line.

Water Testing Kits

15030

Groundwater Demonstration Kit (5 groups)

The study of ground water is an important national subject. Visually demonstrate the relationships between ground water, water tables, ponds, wells, salt marshes, & estuaries. Graphically track the distribution of pollutants. Describes a raindrop's journey from the clouds to the ocean and life in and around an estuary. Five student groups can use the various kit components simultaneously.

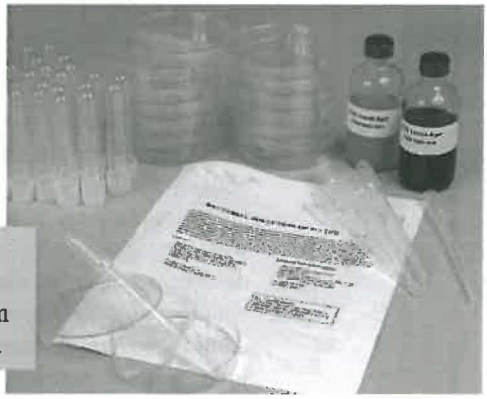


Test for:
- Phosphate
- Chloride
- Lead
- Oil
- Bacteria

5700

How Clean is the Water

Water pollution is a major public issue today. This kit allows students to test local water samples for pH, available phosphate, chloride and lead concentration, oil determination and bacterial contamination. Use in a demonstration, or in small groups, or in three repetitions. Requires two 45-minute class periods and 3-4 days of observation.



Test for:
- e-coli
- Coliform
- Bacteria

1400

Bacterial Pollution Kit

Test for coliform bacteria in water using a sterile culture medium that is ready to heat and sterile Bi-Petri Dishes. The kit provides for the detection of E.Coli (human and animal enteric bacteria) and total bacteria in up to 20 natural water samples, and requires one 45-minute class period.

1500

Chemical Pollution of Water (For 4 groups)

Trace chemicals in water are a serious problem to human health and are routinely monitored. This kit allows students to perform tests for pH, copper, sulfates, nitrogen compounds and oil. Three unknown solution mixtures are supplied for use in independent student determinations. Enough materials are provided for four groups of students over a minimum of two 45-minute class periods.

5500

Enviromental Test Lab

Our kit **includes** extensive tests for evaluating both water and air quality. Test for dissolved oxygen, water hardness, pH, phosphates, chlorides, lead, hydrogen sulfide, air particulates, gaseous pollutants and rain water chemistry. The kit allows for three repetitions of the testing of local environmental conditions. Use for demos, small groups and individuals.

Microorganism and Soil Testing Kits

5800

How Clean is the Soil

Investigate, observe and characterize the nature of soils. Study chemical composition and the microbial community. Although this kit makes a great demonstration, it is also good for small groups, or for several repetitions for an individual. investigator. Needs two 45-minute class periods.

1900

Intro to Microbiology (12 pairs)

Twelve pairs of students will spend one 45 minute class period and then four or five days of observation of cultures of microorganisms using sterile techniques with the prepackaged media and growth containers in a close examination of mold yeast, bacteria, algae and protozoa.

2000

Chemical Composition of Soil

Permits students to perform chemical determinations on locally derived soils to determine percentage of water, organic content, pH, and the presence of calcium, carbonates, magnesium, phosphates, sulfates, potassium, nitrate, ammonium and iron. Provides an accurate profile of the chemical nature of the soil.

2100

Microorganisms in Soil (12 pairs)

Culture soil samples from local sources to observe the nature of soil microbes; investigate nutritive and non-nutritive components in soil samples. Enough for 12 pairs of students for one 45-minute class, to be followed by observations over 3-4 days.

2500

Thermal & Chemical Pollution (For 12 groups)

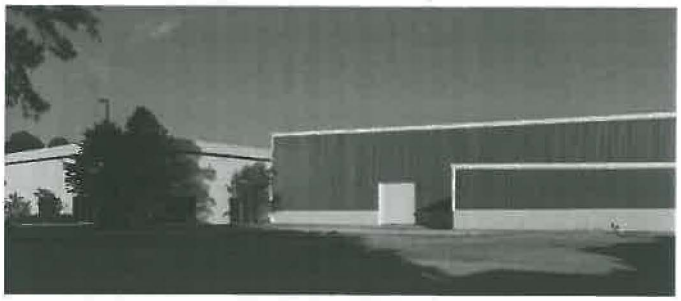
Use yeast to represent oxygen consuming microorganisms or animals and study the effect of temperature on biological oxygen demand and dissolved oxygen, as relates to the organism's metabolism. Also investigate chemical pollution by direct poisons (lead ions) and indirect (phosphate ions) on water organisms. Requires two 45 minute class periods, and 2-3 days of observing results.

Dialysis Tubing - General

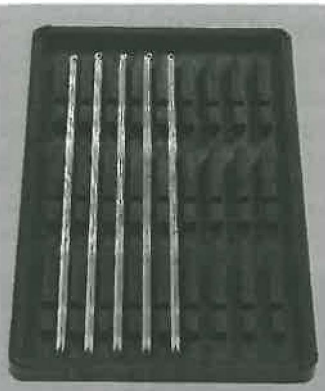
663-0661 pH Meter
3-4105-A55 Calibration solution

pH Meter

0-14, 0.1 pH resolution. +/-0.1 pH unit accuracy.
0-50° C. 2 point calibration



Science First® has 44,000 square feet of manufacturing and machining capacity located off the first exit off I-95 in beautiful Northeast Florida



663-0670

Thermometer Rack

Use this nifty rack to protect your thermometers or magnets. Handy slots of 3 sizes hold a variety of equipment. Unbreakable 1-piece construction.

Thermometers not included

663-0666

Probe Caps™ (Pack 4)

4 colorful, different-size plastic caps fit most 100 - 1,000mL beakers. Holes in caps hold probes upright

Beakers, probes & thermometers not included

Our proprietary customized machine allows us to make small rolls of dialysis tubing in the configurations you need.

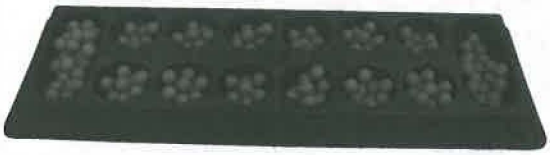
Dialysis Tubing

The semi-permeable membrane, created from a natural source of cellulose, allows passage of particles up to 14,000 molecular weight standards. Each length is packed in heat-sealed plastic bags to prevent contamination.

In biochemistry, dialysis is the process of separating molecules in solution by the difference in their rates of diffusion through a semipermeable membrane, such as dialysis tubing. Dialysis is a common laboratory technique that operates on the same principle as medical dialysis. In the life sciences, the most common application of dialysis is for the removal of unwanted small molecules such as salts, reducing agents, or dyes from larger macromolecules such as proteins, DNA, or polysaccharides. Also for buffer exchange and drug binding studies.

	Width	Length
2842	3/8 inch	10 feet
2844	3/8 inch	50 feet
2846	3/8 inch	100 feet
2852	1 inch	10 feet
2854	1 inch	50 feet
2856	1 inch	100 feet
2862	1 5/16 inch	10 feet
2863	1 5/16 inch	15 feet
2864	1 5/16 inch	50 feet
2866	1 5/16 inch	100 feet
2872	1 3/4 inch	10 feet
2874	1 3/4 inch	50 feet
2876	1 3/4 inch	100 feet
2882	3 inch	10 feet
2884	3 inch	50 feet
2886	3 inch	100 feet

General



Putting Science *First* since 1960

679-0150

Kalah Board

Here's the western version of the ancient game of mancala, played in Ethiopia since the 7th century! You win by capturing more "seeds" than your opponent. Start with 3 seeds in each compartment and work your way up to 4 and 5. Strategy is key - you will need to plan 2 to 3 moves ahead. There is absolutely no element of chance involved, making it different from many board games. We include plastic board with molded pits and numerous small blue plastic "seeds". With instructions.

679-0100

Tower of Hanoi

Bring the classic puzzle to life. Moving only one disc at a time, transfer the entire tower from one pole to another. No disc can be placed on a smaller disc. Compete to see who can solve the puzzle in the fewest moves.

16250

Elasticity of Gases

This is ideal for gathering data to support Boyle's Law. **Includes**: cap to seal the calibrated syringe; packet of lubricant. Add series of uniform masses (such as books) to the top platform, read the corresponding volume on the way down and back up to determine an average value, then then plot pressure versus the reciprocal of volume in search of a straight line.

611-2300

Boyle's & Charles' Law

The discovery of the Gas Laws dates to 1662, but it needn't take long to understand the concepts. Verify Boyle's and Charles' Law accurately with this clever design. **Includes**: syringe; 2 round wood blocks, one with slot for syringe; instructions. *You need weights; calipers; beaker; thermometer.*

671-1100

Function Generator

Learn about mathematical functions with instant feedback. Link facts and concepts in a meaningful way. Have students quiz each other to prepare for tests. Make guesses on sturdy whiteboard dry-erase cards and feed them through the in/out slots. **Includes**: two stands; cover that doubles as a base.

615-3165

Lightning Leaper™

Even electricity follows the path of least resistance. Connect our insulating plate, with incomplete metal path on its surface, to a Van de Graaff. Watch the electricity leap over each gap! 10 x 20 cm. 2 binding clips. Instructions.

Electrostatic - Van De Graaff

Create your own lightning! Science First® Van de Graaff Generators have delighted students for decades. Named after the inventor Van de Graaff, a physicist of German descent, this machine produces low-amperage static electricity that can be "shocking" but perfectly safe. Two different pulleys inside a plastic column create and carry a static charge up to the metal globe. You can draw out this static charge in a burst of lightning - or you can set each hair on your head on end! Our instruction booklet tells you how to raise hair, produce lightning and electric wind, experiment with St. Elmo's fire or electrostatic attraction and repulsion.

615-3130 ● 400 KV (negative collector) .
615-3132 ● 400 KV (positive collector) .
615-3145 ● 500 KV - our largest (negative)

Large Van de Graaff

- Spectacular 400 KV potential (500KV with supersized collector, available separately!)
- 90 cm high. No shock hazard
- Sparks up to 8" (20cm) in humidity up to 90%
- 10 microamp output - fast yet safe
- On/off switch with ground terminals
- Pairs with **615-3135** discharge wand (*page 146*)
- Fully assembled with spare neoprene belt
- Highly polished, seamless 32cm (12.5") globe
- Transparent butyrate column resists static
- 220 volt versions on special order (export only)

● *All ship oversize at additional freight charge.*

615-3145 includes giant collector (44cm/ 17.5" diameter)

615-3140 ● .

Hand-cranked Van de Graaff

- 300 KV potential (arcs to 5" - 12cm)
- Polished, seamless 25 cm (10") globe
- 40 cm (16") wand with plastic handle
- **Includes** electric whirl and electric plume
- Adapter for attaching accessories
- Hand cranked and safe for all ages.

● *Ships oversize at additional freight charge.*

615-3100

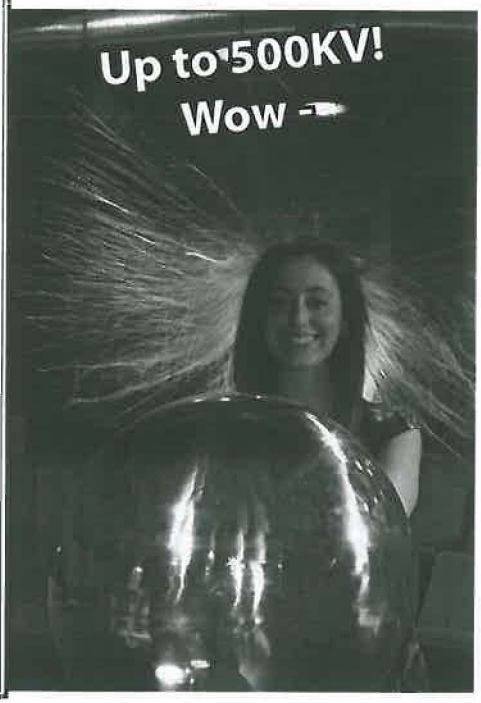
Small Van de Graaff

- 200 KV potential
- Arcs to 5" (12cm)
- 45 cm high, 18 cm (7") diameter globe
- Operates in humidity up to 90%
- Spare neoprene belt
- 4.5cm diameter transparent column
- Pairs with **615-3115** Discharge Wand *(page 146)*
- 220 volt versions on special order

Van de Graaff Parts

615-3220 Globe, large
For **615-3130** (31cm diameter)
615-3225 Globe, super
For **615-3145** (44cm diameter), page 14
615-3110 Belt, small
For **615-3100** (1.9 x 64cm)
615-3185 Belt, large
For **615-3130** (5 x 114cm)
615-3180 Belt, crank
For **615-3140** (5 x 96cm) - white belt to dome
615-3141 Belt, crank
For **615-3140** (5 x 96cm) - belt to crank
615-3235 Upper comb
Large, *For* **615-3130**

Good for science fairs!



Electrostatic

615-3125
Foot Switch
(110 volt only)
Start and stop your Van de Graaff with a press of your foot. Experiment at a comfortable distance - no static discharge.

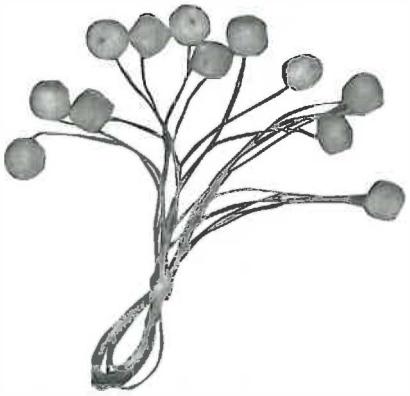
615-3115 For 615-3100
615-3135 For 615-3130
Discharge Wand
Stand-Alone Discharge Wand
Bring the power of a lightning bolt into your class. Here's an easy yet dramatic way to discharge Van de Graaffs in full view. **Includes**: heavy cast iron base, PVC support rod, 18cm diameter aluminum globe, and attached clip lead to connect to ground terminals on Van de Graaff bases. With instructions. Can also be hand held.

615-3150
Discharge Wand
Hand-held Mini Discharge Wand
10.5cm diameter stainless steel sphere mounted on a 40 cm insulated plastic rod. With banana plug and alligator clip.

615-3225 ●
Supersized Collector
(440mm - 17" diameter)
This giant globe packs a real wallop when placed atop your **615-3130** Van de Graaff. Because the voltage is dependent upon the globe's size, this upgrades your machine to a potential 500KV. One piece, seamless, highly polished sphere is made of stainless steel. Mirror-smooth surface has few flaws to drain the electric charge. ●
Ships oversize.

Good for science fairs!

615-3205
Leyden Jar
Charge it with your Van de Graaff!
Dissectible jar holds a charge for hours and proves that a charge is stored in the insulator, not metal. After charging, remove conductors to measure the charge. **Includes**: 2 aluminum cans, polystyrene dielectric, electrode with ball terminal, instructions.



Pith Balls
Use with electroscopes or Van de Graaffs to show electric charge. 7mm dia. Texture, color may vary.

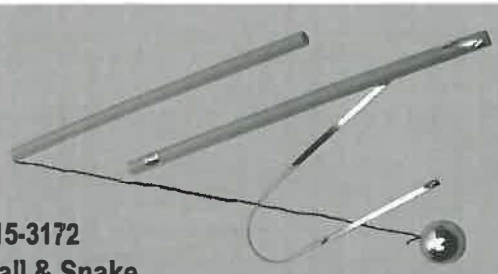
615-3045 Threaded (Pack of 6)

615-3050 Unthreaded (Pack of 12)

615-3055 Conductive, threaded (Pack of 6)

615-3120
Foot Stool
Stand on our plastic stool to insulate yourself while using Van de Graaff generators. *Style varies.*

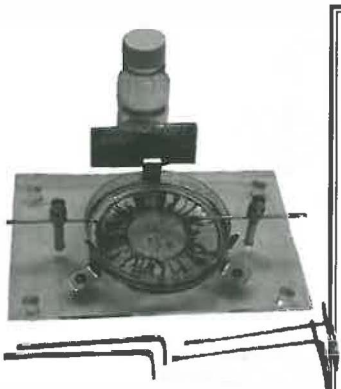
Electrostatic



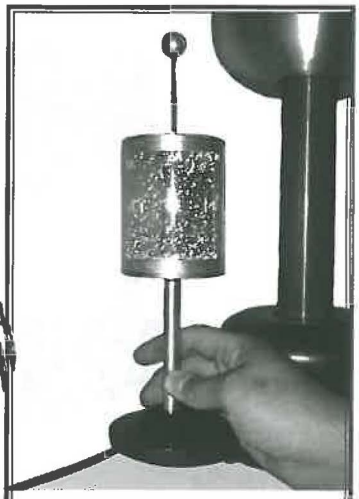
615-3172
Ball & Snake
Show the shape of an item affects its ability to hold an electric charge. The conductive ball hovers in the air near a Van de Graaff while the Mylar™ ribbon is attracted, touches, and then snaps back. With non-conductive handles and instructions.

615-3116
Mylar™ Foil
3 long strands repel each other when taped to a Van de Graaff generator globe.

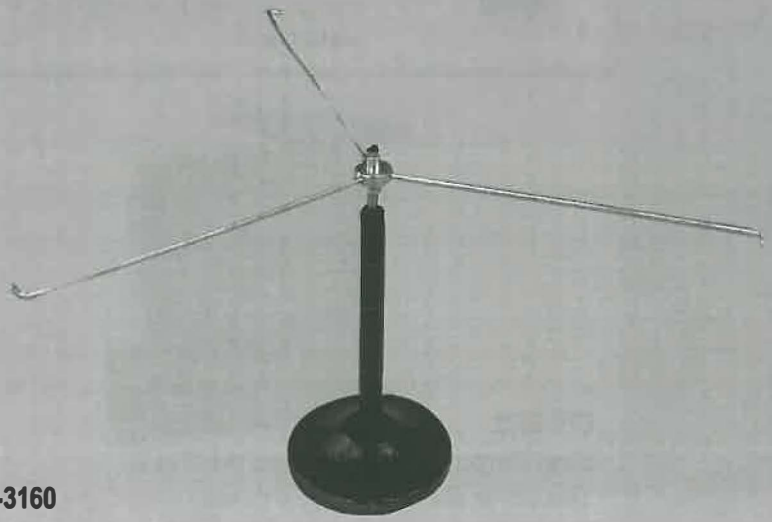
615-3175
Neon Wand
Glows bright red near a Van de Graaff. 24cm long.



615-3170
Electric Fields
Show the lines of an electric field produced by a Van de Graaff or Wimshurst Machine. Transparent for use with an overhead projector. Fill the dish with oil and mount electrodes just beneath the surface. Sprinkle iron filings and connect to show the patterns created. **Includes**: bottle of oil; 2 parallel charge electrodes; 2 point charges; 2 round field electrodes; iron filings.



615-3155
Volta's Hailstorm
The tiny balls inside our transparent cage bounce wildly near a Van de Graaff. Demo electrostatic charge, Coulomb's Law and a method of smoke control. **Includes**: ball terminal to attract electric charge; tiny polystyrene balls; transparent cage on a sturdy base, instructions.



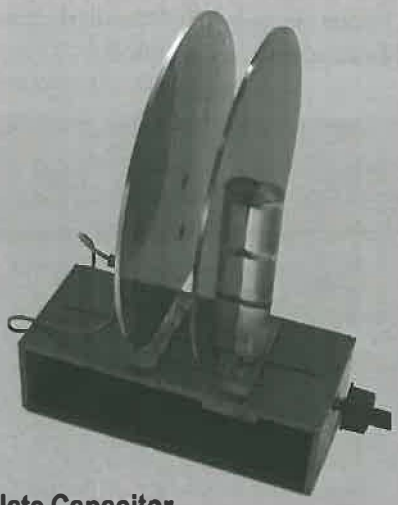
615-3160
Static Spinner™
Detect an invisible electric wind from a Van de Graaff! Since pointed objects carry more electric charges than spheres, the spinner rotates rapidly in its vicinity. **Includes** metal base, 9" (23cm) diameter spinner on cone bearings, and instructions.

Electrostatic

615-0185
Dip Needle
Our highly sensitive rotating compass mounts on a horizontal rod with low-friction bearings. Use horizontally as a normal compass or vertically to measure the declination of the earth on our 360° scale. We've even added a second scale to measure the exact angle at which the needle tilts. Ours is the only dip needle that includes banana jack connections on the gimbal. This allows you to electrify the gimbal, which will deflect the needle, providing another avenue of experimentation entirely.

615-3245
Hollow Cylinder
Show that an electric charge lies on the outer surface of a charged body. Our metal cylinder mounts on an insulating rod attached to a stable base. Lightweight balls hang by threads above and inside a short tube. When the tube is charged, the balls touching its outer surface are also charged, but those inside are not. With instructions.

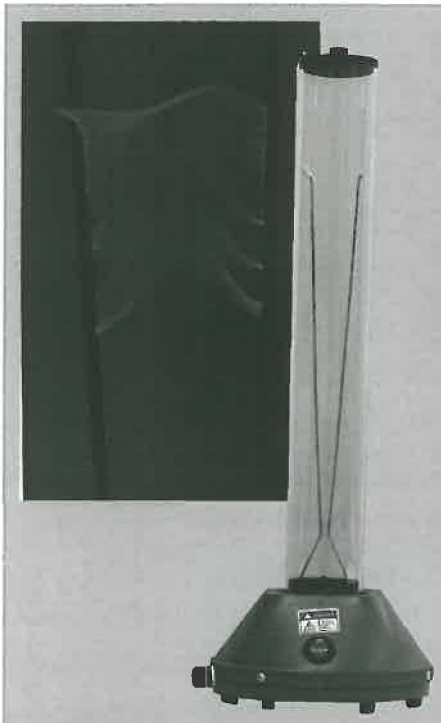
615-3162
Electric Plume
Need a way to demonstrate electrostatic repulsion without a model? This "head of hair" makes a good substitute. Attach the suction cup on the base of the plume to the globe of the Van de Graaff generator. Turn on the machine and watch each strand of "hair" stand away from each other. The reason, of course, is that each strand has the same electric charge and repels its neighbor. With instructions.



615-4125
Variable Plate Capacitor
Investigate the Q = CV relationship with our simple device, so named because the two plates can be moved closer or further away from each other. The farther the plates are from each other, the less electricity can be stored, as the capacitance increases when the distance between the plates decreases. Consists of two smooth plates mounted on insulated supports that slide along an extrusion. The distance between the plates can be controlled with an adjusting knob. We include leads for attaching to a multimeter. Instructions include experiments. *Needs multimeter, banana plug cables, power supply, calipers.*

615-3072
Dual Purpose Electroscope (Malvern)
This has an aluminum case with 4mm socket, ground terminal and gold leaf support insulated by PTFE. It includes a scale to measure the deflection of the gold leaf when static electricity is induced, making it a quantitative device. Design consists of two interchangeable electrodes, a disc top plate and a metal hook. Includes internal transparent scale divided 0 to 90° x 10° on the rear glass wall. With instructions and gold leaf.

Electrostatic

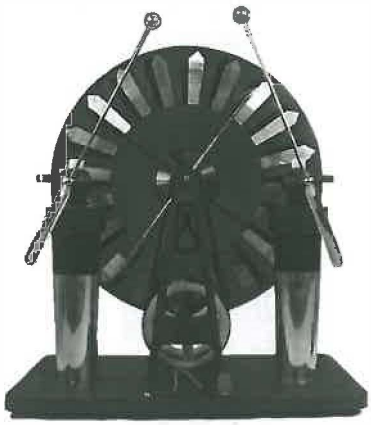


615-4670

Jacob's Ladder

The Jacob's Ladder, or climbing arc, is a fascinating depiction of the power of static electricty. A power supply creates a powerful voltage potential (15kV) between two brass electrodes, which ionizes air and turns it into a plasma. The plasma is conductive, allowing an electric arc to form and complete the circuit. The arc dances up the electrodes, carried by rising convection currents.

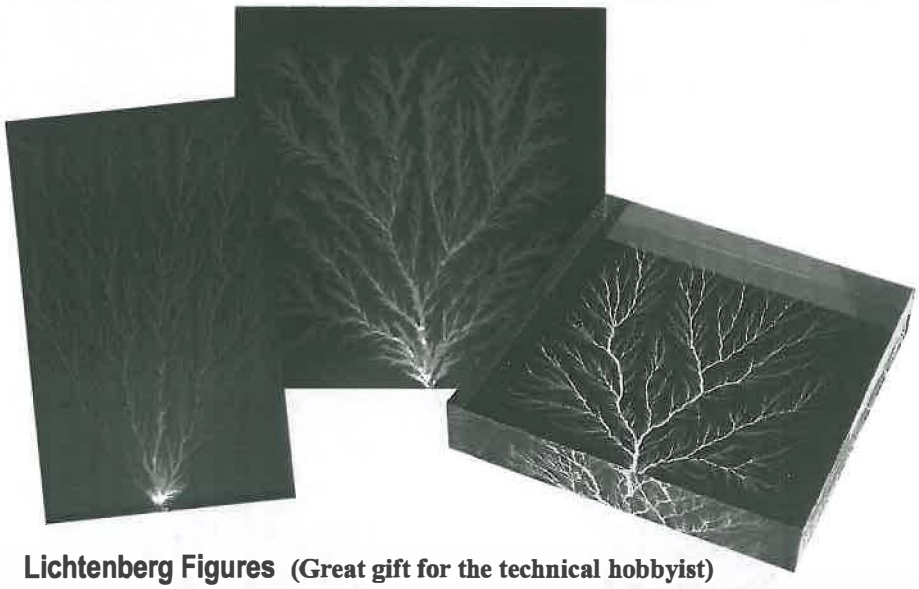
What makes our model so safe? Because the electrodes slant outwards, eventually the distance between them is too great to sustain the arc, which dies, only to form again at the bottom. The electrodes are shielded by a sturdy polycarbonate tube, which is extra long to prevent students from reaching into it. A lid allows hot air to escape but prevents objects from being inserted into the tube. Each electrode is capped with ceramic to ensure the arc is extinguished, while a built-in fuse prevents overloads. The maxiumum current is 3 microamperes, insufficient to cause injury.



615-3190

Wimshurst Machine

Generates static electric charge at higher current (lower voltage) than Van de Graaffs. Two high-resistance plastic discs with metal sections rotate in opposite directions with a hand crank, producing strong opposite charges. Adjust electrodes and Leyden jar capacitors for higher potential. Fully assembled. Plastic base.



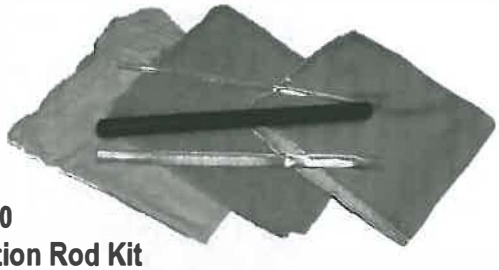
Lichtenberg Figures (Great gift for the technical hobbyist)

What happens when you bombard clear acrylic pieces with electrons from a linear particle accelerator? You create beautiful, one-of-a-kind sculptures we call "captured lightning." Each branching, tree-like or fern-like pattern, encased in crystal clear acrylic, is unique. Instructions describe how they are made.

- 2 x 2 x 3/4" - square polished edges and edge or interior dendritic pattern
- 4 x 4 x 3/4" - square polished edges and edge/interior dendritic/bushy discharge
- 4 x 6 x 1/2" - dense branching vertical tree with square polished edges

615-3264 2 x 2 x 3/4"
615-3260 4 x 4 x 3/4"
615-3262 4 x 6 x 1/2"

Electrostatic



32380
Friction Rod Kit
This collection of standard and modern materials is for investigating the properties of static electric charge by rubbing three choices of rods with three choices of fur and fabric.. **Includes:** one glass rod, two plastic rods (delrin or PVC), one plastic rod (acrylic, clear), one square of silk or nylon cloth, one square of cotton cloth, one fake rabbit fur.

615-3015
Friction Rod Kit
Study electric charges. **Includes:** 3 rods, 200mm long (glass, acrylic, hard rubber); 3 fabric pads about 30 x 30cm (cotton, faux fur, silk). Instructions.

Friction Rods

615-3020	**Acrylic Friction Rod (10 x 200mm)**
615-3025	**Polystyrene Friction Rod (10 x 200mm)**
615-3030	**PVC Friction Rod (10 x 200mm)**
615-3035	**Nylon Friction Rod (10 x 200mm)**
615-3040	**Faux Fur Friction Pad (15 x 15cm)**

615-3085
Electrostatic Demo Kit
Charge electroscopes, show electrostatic attraction, study Faraday's ice pail experiment and more! This kit contains everything needed for home or school fun. **Includes:** 2 electroscopes with flasks, 2 ball and disc terminals; Faraday cage; 6 friction rods, labeled; electrophorus with charge plate and handle; neon lamp, ice pail; acetate and polyethylene cloth; charge transfer ball; conductive ball; pack of pith balls; mounted point; instructions.

612-0002
Franklin's Bells
Benjamin Franklin famously used this to detect approaching thunderstorms. When near static electricity, the metallic ball will oscillate between the bells, producing a clear ringing.

615-3240
Electrophorus
Complete your electrostatic set! Demonstrate charge transfer with our electrophorus. **Includes** 15cm square charge plate, disk terminal with handle, faux fur and instructions.

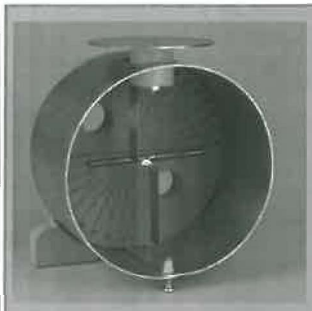
615-3095
Faraday Cage Kit
Demonstrate that a charge cannot exist inside a conductor cage. Study the lightning rod effect. **Includes**: cage with stand and cover; mounted point; instructions.

Electrostatic

615-3080
Pith Ball Electroscope
Charge a friction rod and bring it close to the hanging balls. Watch the balls diverge or collapse. **Includes**: plastic base, 3.5" (9cm) square, metal rod with hook; 2-pack conductive foam balls with strings; instructions.

615-3078 Electroscope
615-3065 Foil Leaf, pack 4
Metal Electroscope
Invented by British physician William Gilbert around 1600, this class version of the early electroscope detects the presence and magnitude of an electric charge and shows how two similarly charged objects repel. Features aluminum case with glass sides and sensitive aluminum leaves on hooks. **Includes**: die-cut leaves, 2; hanger; two glass panels; ball terminal; insulator; instructions.

Putting Science *First* since 1960



14435
Round Electroscope
Ideal for student experiments, this can make quantitative measurements of electric charge, study the photoelectric effect, and investigate the behavior of conductors and insulators. A sensitively balanced armature provides twice the deflection of simple leaf electroscopes.

615-3005
Positive/ Negative Electroscope
Determine the net charge on your statically charged objects. Works with friction rods. Red button is positive; green button is negative. ***Not*** for use with Van de Graaffs due to its extreme sensitivity. *Needs one 9V battery*

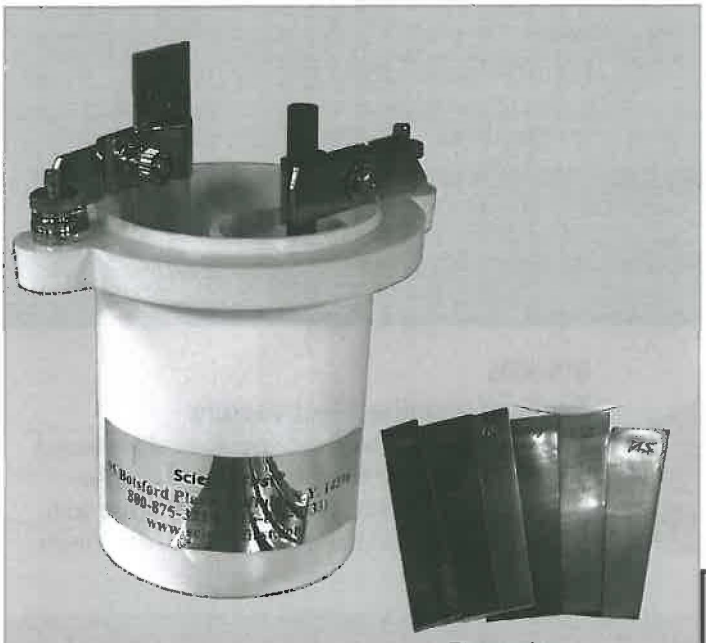
615-3070
Electroscope (Flask & Proof Plane)
This consists of a metal rod attached to a rubber stopper inside a 250mL flask. The foil leaves suspended from the rod separate when the terminal is electrically charged.

615-3075
Electroscope Kit
Detect and identify electrical charges and experiment with electrostatic induction. **Includes**: 2 electroscopes (250 mL flasks), 2 ball terminals; ice pail; 2 disc terminals; instructions.

615-3060
Electroscope (No flask)
Convert your 250mL Erlenmeyer Flask into an electroscope with this device. **Includes**: 2 foil leaves. Replacement aluminum foil leaves available (pack 4)

615-3065 Replacement Foil (Pack 4)

Electricity - Voltaic Cell



Electrodes

665-0300

Voltaic Cell (Complete Student Cell)

Build a safe, sturdy voltaic, coulometer, dry or Daniell cell. **Includes**: polypropylene 8-oz cell with low profile and wide base; porous cup; 8 labeled electrodes: iron, aluminum, nickel, carbon rod; 2 each, copper, zinc. Screw-on plastic rim has 2 brass brackets. Instructions.

665-0200

Daniell Cell

Add 8 ounce Mason jar & acids. **Includes**: screw-on plastic ring; brackets; 2 leads; zinc, copper electrodes; instructions.

Electrode Set and Electrode Pack (Set of 10 & Singly)

For for science fairs! **Includes**: carbon rod, nickel; 2 each, copper, iron, zinc, aluminum. 10 x 1.6 cm (except carbon). Large surface to mass ratio. Stamped chemical symbols.

665-0400 Electrode Set, 10: 6 materials
665-0205 Porous cup, each
615-4600 Iron electrode, each
615-4602 Carbon rod electrode, each
615-4603 Nickel electrode, each
615-4604 Aluminum electrode, each
615-4605 Copper electrode, each
615-4606 Zinc electrode, each

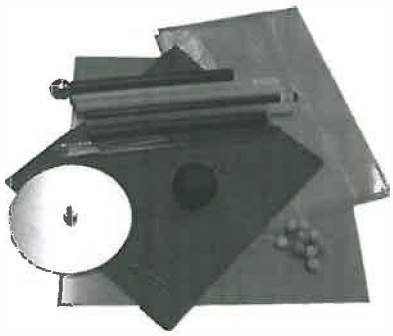
Short Electrodes (50 x 19mm)

615-4612 Copper
615-4613 Zinc

14450 Individual Set
14455 Class Set (for 24)

Electrostatic Material

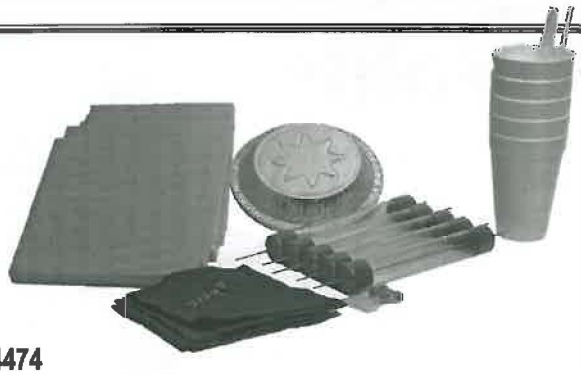
This kit contains two acetate strips, two vinyl strips, six conductive balls, two insulating strips with handles, two squares each of cotton and wool, two aluminum tubes and very fine monofilament. Singly or set of 24.



615-3090

Electrostatic Studies Kit

Make electricity by friction; store and transfer charge; study the electrophorus. **Includes**: electrophorus with charge plate & handle; 6 friction rods, labeled; acetate & polyethylene cloth; proof plane & transfer ball; neon lamp; conductive ball with hook; pith balls; instructions.



14474

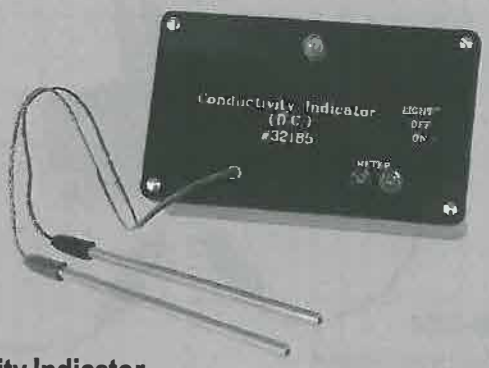
Static Electricity Kit

Determine the circumstance and limits for separating electric charge by experimenting with conductors. **Includes:** 5 each: styrofoam pads; aluminum plates; styrofoam cups with holes; plastic straws; threaded, conductive balls; wool cloth; neaon lamps; capped tubes with electrod and beads.
You need tape, needle, bags.

Electricity

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

665-0215
Copper Plating
Here's a simple way to show copper plating. **Includes:** glass battery jar, copper anode, 2 brass posts, 2 wire connectors with alligator clips, 500g copper sulfate, MSDS & paper clips.



32185
Conductivity Indicator
Powered by two internal C-cells power, this device provides switch selectable indications of the conductivity of materials in contact with the probes. One position allow a milliammeter to give a quantitative indication, the other allows the lamp to give a qualitative one. *Batteries, meter required.*

611-2263
Blinking LED Meter
When both electrodes are submerged in a fluid, our meter struts its stuff. The light stays off if the solution is non-conductive, glows dull red in a weak solution and blinks brightly in a strong conductor.

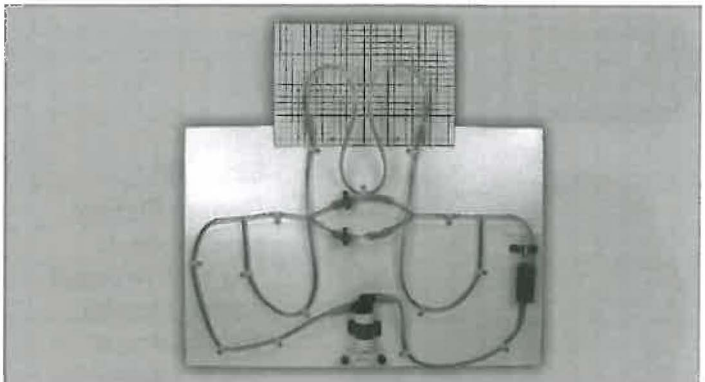
611-2261
Conductivity Meter
Visually compare conductivity of solutions. Green LED's (numbered 1-10) light up as you dip brass probes into solutions of salt or acid, each depicting a conductivity level.

611-2260 Tester
674-0035 15 Watt Bulb**Conductivity of Water Tester**
Determine the conductivity of different liquids qualitatively by causing a bulb to glow. No shock hazard due to built-in ALCI. Includes plastic body with recessed electrodes and instructions. Attaches to standard ring stand (not included). 110 volts AC only. *Needs 15 watt bulb, below.*

15080
Conductivity Tester
Test the conductivity of different liquids or the difference in concentration of the same solution with this device. The brightness of an AC powered lamp depends on the conductivity of solutions into which its electrodes are placed. Electrodes are shielded to prevent accidental contact.

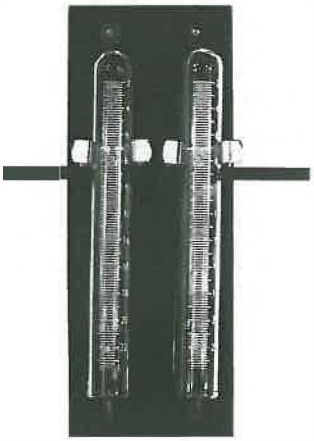
Electricity

665-0230
Electrode Stand
Perform electrolysis of water with our mini marvel with two stainless steel electrodes wired into a molded base. Place small glass tubes over the electrodes, insert in water and connect to a 6 or 9 volt battery (not included). In time, the water will electrolyze into hydrogen and oxygen gas.

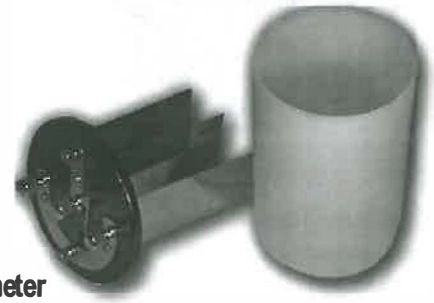


615-4720
Circuit Board Simulator
This new way to teach resistance uses water to make child's play of a difficult concept! Pump water through a circuit of tubes of various diameters to demonstrate how resistors work in electronic devices. With stand and instructions.

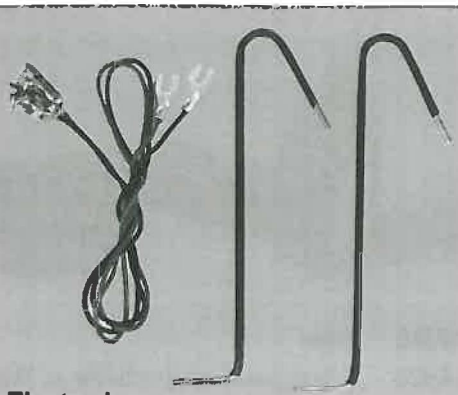
615-4098
Worcester Circuit Board Kit
Master electrical circuits at your own pace, without wires. Study series and parallel circuits; heating; rectification; resistance; more. Connections snap into place. Illustrated step-by-step instructions. Sturdy base for mounting components. **Includes**: 12 connectors, 3 battery holders, 10 lamp holders, 2 switches, rheostat, rectifier, resistor, 20 lamps, cables, nails, 3 wire coils, steel wool, copper foil, pencil leads, alligator clip. *You need batteries.*



615-4615
Brownlee Electrolysis
A non-conductive support holds 2 inverted test tubes and 2 large suspended platinum electrodes. With spring clips & black background to view water level. 140 x 203 x 38mm. Instructions. *Needs beaker, low voltage power supply.*



615-4620
Copper Voltameter
Experiment with electrolysis. Three thick copper plates with brass terminals are suspended from a plastic cover in an inert plastic jar. Weigh the central plate (cathode).

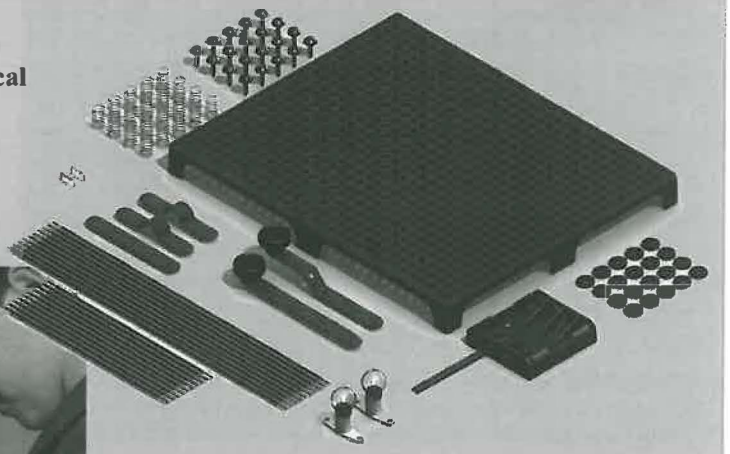


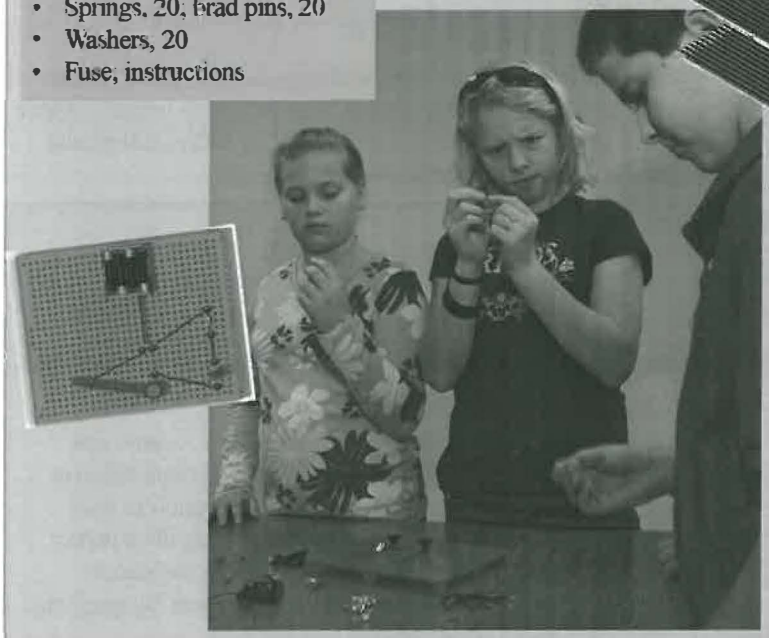
16240
Electrolysis Electrodes
13cm 'J' stainless steel electrodes with permanent insulation are great for decomposition of water and other experiments **Includes** two 55 cm leads with Fahnestock clips and spade lugs.

Electricity

Electricity Kit contains:
- Circuit board base, 5 x 7"
- Battery holder, 4-cell
- Brass strip
- Light bulbs/holders 7
- Clamps, 2; resistors, 2
- Morse code key & switch
- Long/short wires, 10 each
- Springs, 20; brad pins, 20
- Washers, 20
- Fuse; instructions

- Convert electrical energy into mechanical





615-4068

Electricity Kit

Build electrical circuits and learn how to harness the power of electrons for yourself. Investigate switches, series and parallel circuits, lights, short circuits, electrolysis, conductors and insulators, fuses, Morse code and resistance. 20-page instructions walk you through each experiment. Illustrated parts, circuit board layouts & diagrams. *Needs (4) AA batteries.*

615-4695

Energy Transformation

Mini battery-powered winch shows the relationship between gravitational potential energy and electrical. By measuring current and power source potential and lifting known masses through a known distance, you can calculate the mechanical work done and its efficiency. **Includes**: motor on plastic base; nylon thread; hook up wires; metal washers (15); paper clip hanger; instructions. *Needs: ammeter; stopwatch, battery.*

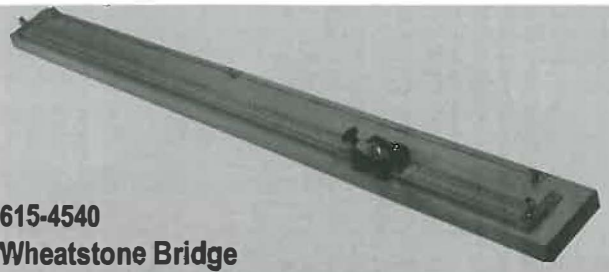
CE Certified

615-4130

Variable Inductance Kit

Inductance is the change in current flowing through a circuit which produces an electromotive force (emf). When it is variable, it has unique applications, such as RF transmitters. Our unit shows inductive reactance by imparting energy loss to a light bulb. **Includes**: copper coil, steel core, crank to slide core, inputs for a power supply, scale marked in centimeters and Henries, and sturdy acrylic housing. *Needs light bulb or multimeter, low voltage power supply, banana plug cables*

Electricity - Resistance



615-4540
Wheatstone Bridge
Use our traditional slide-wire device to measure resistance in a conductor by comparing a known resistance with an unknown. 7.5 x 110cm wood base; meter-long high resistance nichrome wire; terminals; corrosion-resistant nickel-plated parts; double-ended slider; low resistance connectors. 1000mm scale. *Needs DC power supply, galvanometer.*

- **Use with Wheatstone Bridge**

615-4545
Unknown Resistance Board
Expand upon the concepts taught by the Wheatstone Bridge. Assign each group different "unknowns" which are "disguised". The resistors are wired such that over 360,000 different values can be found. **Includes**: nine 1% resistors 1/4 watt (1-100 kilohm), randomly mounted on a printed circuit board, any two of which can be connected in series. Withstands up to 12 volts.

615-0340
Resistance Coils, Mounted
Show how resistance varies with diameter, length and type of wire. Five coils are permanently mounted on a sturdy base, their wire lengths in two to one ratios to simplify computations. 6 binding posts, instructions. *Needs batteries.* Wire coils include: # 22 copper wire (10m); # 28 copper (10m); # 22 copper (20m); # 28 copper (20m);# 22 German silver (10m). *For ohmeter or Wheatstone Bridge*

615-4500
Resistance Coils
Show how resistance varies with type, length, and diameter of wire used. The math is made simpler due to lengths of wire used. **Includes**: 8 labeled coils wound on individual plastic spools with 2 brass terminals.

615-4596
Mixed Materials Resistance
Not all metals conduct electricity well - silver, copper and aluminum have negligible resistance, making them efficient electrical conductors, while nichrome, iron, stainless steel and constantan show higher resistance, making them poorer conductors. Calculate the resistivity of higher resistance wires and compare them with theoretical values. By graphing resistivity, see its linear nature.

615-4590
Resistance Board Set
Show resistivity of different gauge wires with 8 different gauge Nichrome wires of equal length. Silkscreened scale on base for easy measurements of the length of wire.

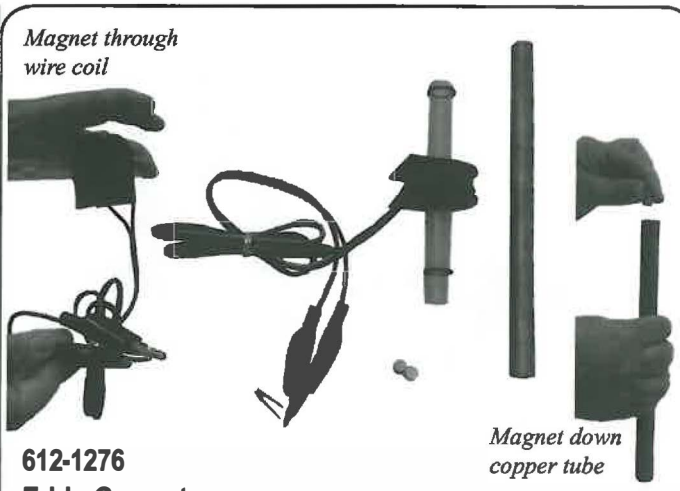
615-4090
Resistor Set
Our fixed resistance set allows you to set resistance to 5, 10, 20, 50, 100 or 200 ohms. Accuracy to 1%.

Electricity - Lenz's Law

32520
Lenz's Law
Drop a magnet and non-magnet through conducting and non-conducting tubes hanging from a spring balance. You'll see that the apparatus is heavier by the weight of the magnet as it falls in the conducting tube (due to the opposition to the eddy currents induced by the changing magnetic field). A novel way to treat the topic of terminal velocity. *Stand not included.*

615-0325
Lenz's Law Spinning Disk
Who says physics needs to be complicated? Here's a simple version of an experiment first described by **Leon Foucault** in 1855. Spin the aluminum disk on the included base. Watch it stop suddenly when the magnet is brought close. **Includes:** Neodymium magnet, aluminum disk, 4" (10cm) diameter with shaft plastic base to hold disk, instructions

615-0335
Lenz's Law Pendulum
Here's a graphic example of Lenz's Law. Our upright block is connected to a powerful neodymium magnet mounted perpendicularly on the base. Two aluminum plates act as pendulums - one solid, one slotted. Students time the pendulum until it stops.



612-1276
Eddy Current (Small)
'Conduct' two experiments in one
When slid down a copper tube, a magnet will generate eddy currents. When slid through a wire coil, the magnet induces electrical current that will make an LED glow. We include two identical-looking metal slugs (steel & neodymium); copper tube; wire coil with attached alligator clips and plastic tube; two LED's two O-rings; and instructions.

612-1275
Eddy Current Kit
An eddy current is an electrical phenomenon caused when a conductor is exposed to changing magnetic fields. Study magnetic braking, Lenz's Law, induced current and more. **Includes**: aluminum tube, neodymium magnet and spring scale. Instructions.

615-0330 Lenz's Law
615-7455 Magnet
Lenz's Law (open & closed loops)
This classic device teaches Faraday's Law of Induction and Lenz's Law. Show how passing a magnet through a complete loop causes the device to move. No movement at all occurs when using the split loop.

Electricity

615-4635

Ampere's Rule

Investigate the magnetic field around a wire. Our heavy brass wire has terminals on a clear plastic base, one 45mm and six 16mm compasses. Arrange the compasses around the rod and turn on a power supply. The change in the direction of the needles will intrigue your class. Instructions.

615-4585 Gilley Coil
615-4120 Power Supply

Electromagnet Kit (Gilley Coil)

Use the materials in this kit to experiment with magnetic induction in a coil, primary/secondary coils, magnetic lines of force and electromagnetism. Many unique experiments are possible. *Needs 6V power supply, galvanometer.* **Includes:**

- Coils vertical plastic saddle blocks, 2
- Alligator clip leads, 2
- Stiff card, iron filings in reusable vial
- Soft iron cores, 5

615-4630

Oersted's Law

Study the relationship between magnetism and electric current in a wire. Our 15cm long permanent magnetic needle rotates freely inside a metal frame that allows current to flow over or under the needle in either direction. With sturdy base, binding posts, and needle mounted on sensitive bearing. Instructions. *Needs DC power source under 15V.*

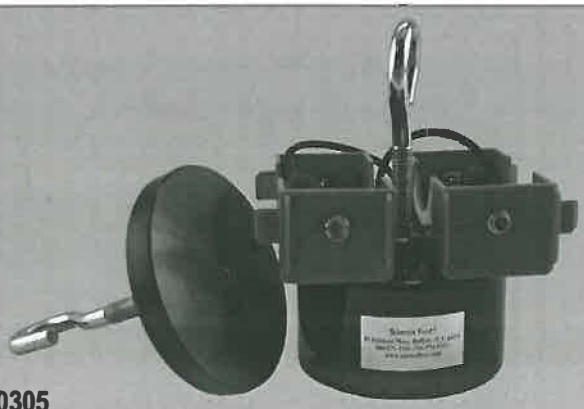
Did you know?
We are your source for dialysis tubing

Best Seller

615-0300

Small Lifting Magnet

This nifty little device weighs two pounds but lifts a whopping 200 pounds due to precision machining. Even more remarkably, it uses only one measly battery. Our 2.67" diameter cold rolled steel core and yoke are ground to within a fraction of 1/1000". The coil has 135 wire turns of 0.38mm wire. **Includes** alligator clip leads, battery holder on magnet, instructions. *Needs 1.5 volt D battery.*



615-0305

Large Lifting Magnet

Bigger can be better. This hefty magnet is a humdinger. Lift up to 500 pounds with only two batteries. 3.25" diameter coil has 180 turns of 0.8 mm wire. Clip leads, 2 battery holders, instructions. *Needs two 1-1/2 volt D batteries.*

Electricity

Toy Motor Kit

All you need to construct a working DC motor and learn its parts. Wind your own armature and field coil. Build the commutator with two snap-together pieces. **Includes**: 2 copper wire coils; plastic base; field poles; armature core; brushes; step by step instructions with theory. *Ages 10 up.* Also in bulk for an entire class, 2 students per instructions.

615-4685 Single kit
615-4686 Class Pack (12 kits)
615-4691 Bulk Pack (48 Kits)

Putting Science *First* since 1960

615-4710
Neodymium Motor

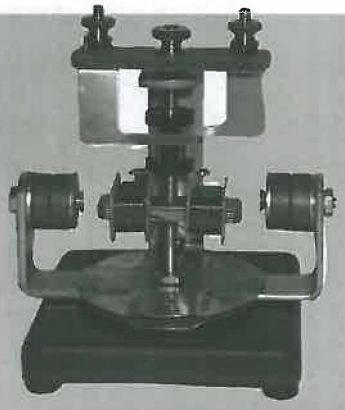
Two powerful neodymium magnets make a mean little motor in minutes. The U-shaped metal frame and strong magnets ensure a permanent magnetic field. Easy assembly, with few working parts. **Includes**: 2 magnets, 3/4" x 2" (19 x 50mm) with north painted red; metal frame; plastic forms for rotor and end plates which snap together; 2 wire coils; 2 elastic bands; three O-rings; alligator clips. Step-by-step illustrated instructions. *You need 1.5V battery.*

32590
Motor Kit (Set of 15)

15 small electric motors that operate on homemade or regular batteries.

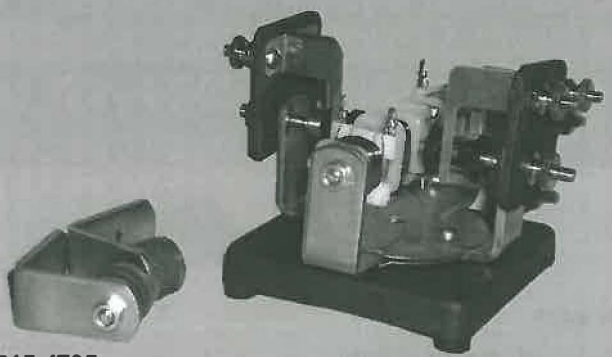
615-4120
Power Supply
(CE-certified)

Vital anytime you wish to use an electrical kit without batteries, this CE-certified unit will generate 2, 4, 6, 8, 10 or 12 volts AC or DC at up to 5 amps. With instructions.



615-4700
St. Louis Motor

Here's a classic way of converting energy from electrical to rotary. Demonstrate the fundamentals of motors and generators with this open design. Features powerful ceramic disc magnets on brackets and an armature with low-friction brass cone bearings. **Includes**: 2-pole DC armature; permanent magnets; armature with slip commutator; 2 bronze brushes; instructions. *Needs 3-6 volt DC power.*

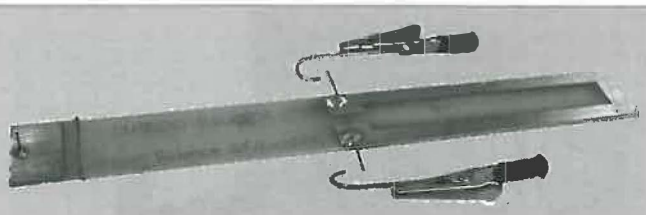


615-4705
Motor Generator

Experiment with AC and DC operation. Build a magneto, universal motor or series and shunt generator. Dissectible. **Includes**: 2-pole armature, field coil and permanent magnets on interchangeable brackets; 4 brushes; commutator and slip rings; instructions. *Needs 6 volt DC power source.*

Electricity

14480
Coulomb's Law
This ingeniously designed apparatus greatly simplifies the study of Coulomb's Law. One can explore the force between charged particles by varying the charge and the distance. A parallax-free scale aids in data collection.

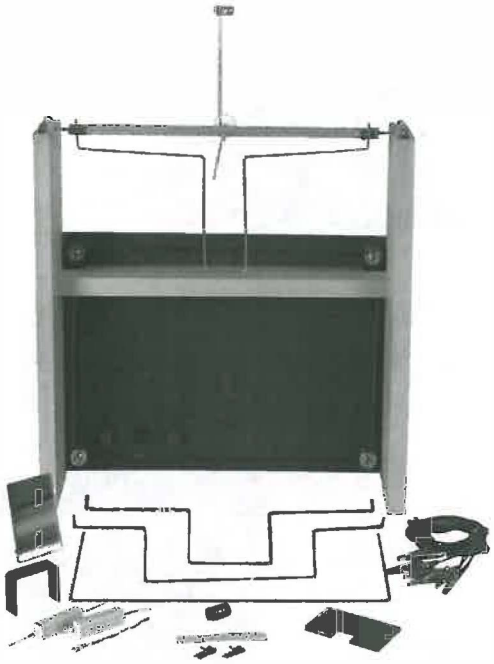


615-4645
Current Balance
Show the effect of magnetic force on a current-carrying wire; measure the strength of the magnetic field in a solenoid. Our printed conductive blade is attached to 2 axles. With alligator clips, instructions. *You need ammeter; rheostat; balance, leads, solenoid.*

- **Use 615-4640 & 615-4645 together**

615-4065
Battery Kit (To run small motors)
Build a 1.5 - 6 volt power source. Experiment with different voltage levels. **Includes** 4 holders; connecting snaps on end. *Needs 4 D batteries.*

14476
Voltage & Current Kit
Explore the effects of varying voltage on common materials. How does a light bulb vary in brightness, temperature and color? How do changes in voltage and circuit polarity affect an LED? **Includes** 5 each, battery holdes for 4 AA batteries; battery snap connectores; LED's, 6V bulbs, bulb holders; diffraction gratings. Also, 15 shunts, 20 leaders with alligator clips. Instructions with optional activities. *You need AA batteries, multimeter, potentiometer (optional)*



10-400
Classic Current Balance
Based on Ampere's design for measuring the force between two current-carrying conductors, this sensitive device shows how this force is affected by current, distance between wires, length of wire, and the interaction between magnetic fields and a current carrying wire. Particularly effective since the wires are arranged in parallel.

615-4595
Thermoelectricity Demo
Demystify the concept of a thermal electro-magnetic force (EMF). Our demo has aluminum and copper strips so formed that a compass can be placed inside it. Heat one end; watch the compass needle instantly deflect. Cool the end; the needle swings the other direction. **Includes**: magnetic compass; attached handle; aluminum and copper strips; instructions.

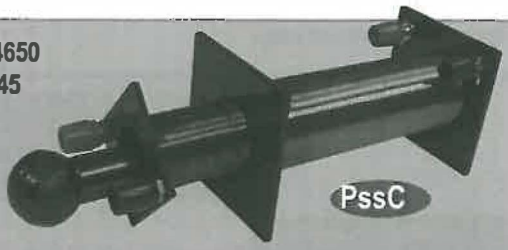
Electricity - Solenoid

615-4715
Hand Generator
Create up to 5 volts of DC with the turn of a crank. Light a bulb without batteries. Low-voltage power source **includes**: attachable electric cord, polarity coded, with alligator clips; plastic housing; instructions.

615-4740
Induction Kit
Everything you need to study electrical induction, magnetic fields, electromagnets, motors, AC/DC motors, basic transformers, series and parallel transformers and many more. Features snap-together frames for laminated or solid core transformer frames, motor mounts, field coils and Thompson ring experiments. Fitted case and instructions. *You need 12V power supply and multimeter.*

615-4730
Simple Capacitor
Explore the principle of capacitance. Simply charge the plates with a dielectric between. Show that the charge is contained on the dielectric and not the metal plates. **Includes:** 2 aluminum plates with binding posts, instructions.

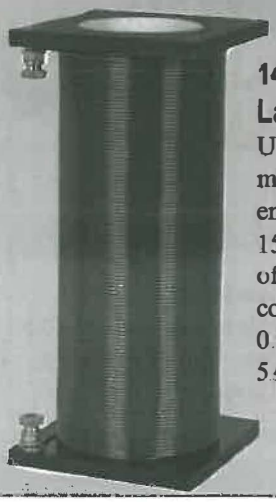
- Use 615-4650 & 615-4645 together



615-4650 Primary Secondary
615-4065 Battery Kit
Primary Secondary Coil
Used to study electromagnetic induction and transformers, this economical device also functions as a demo induction coil. **Includes:** coil, 250 turns #23 wire; coil, 1250 turns of #28 wire, iron core; binding posts on plastic mounts; instructions. *Needs galvanometer, switch and battery.*

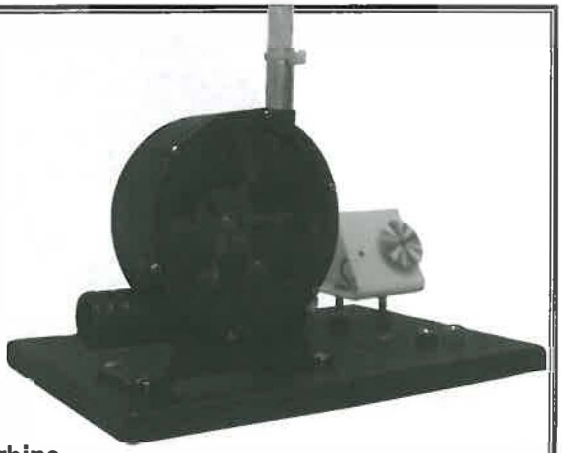
- Use 615-4640 & 615-4645 together

615-4640 Air Core Solenoid
615-4065 Battery Kit
Air Core Solenoid
Use this for experiments requiring an external magnetic field as well as for studying induction and the rate of magnetic flux change through a coil. **Includes** 4 layers of wire wound on a PVC core with two banana plug jacks on the base. Assembled. Instructions.



14835
Large Air Core Solenoid
Used for electromagnetic induction, mass of the electron, conservation of energy experiments. Approximately 15 cm in length, this has 550 turns of #16 wire wound on 3.8 cm I. D. core with a field to current ratio of 0.00461T/A. Max. 10A intermittent or 5A continuous current.

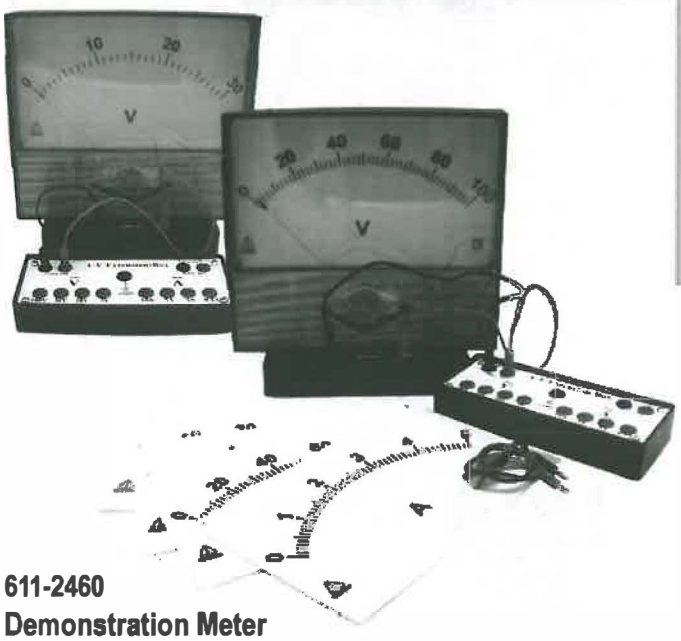
Electricity - Right Hand Rule



611-2235
Water Turbine
Explore the first way of generating electricity - falling water! Explore hydroelectric power right in your classroom. Use water from a faucet to spin a small wheel. This, in turn, drives a generator, which produces up to 6V DC. The turbine is made of plastic and brass and is resistant to water damage. **Includes:** all tubing, small color wheel (turns white when turbine reaches optimal speed) and instructions.

615-4750
Right Hand Rule Roller
Show magnetic repulsion and the "right hand rule". Two electrified rails generate a magnetic field, causing a small roller to shoot across. The device consists of a plastic base with battery holder and magnet, two rails, switch to change the direction of the electrical current and rod (roller). The magnet beneath the rails reacts with the magnetic field around the roller and produces enough force to propel the roller along the rails, even uphill. *You need 4 alkaline AA batteries.*

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com



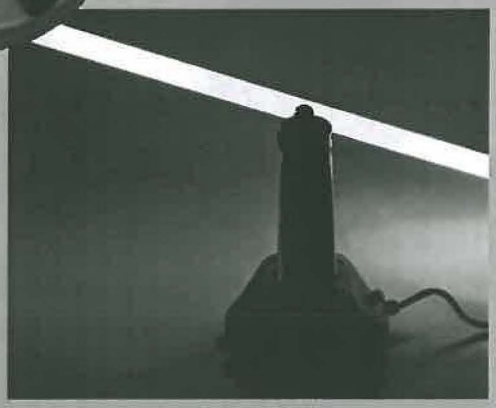
611-2460
Demonstration Meter
Our oversized demonstration meter can be viewed from across the room. The easy-to-read scale is a substantial 10.5 x 6" in size. Five reversible plates allow you to display the appropriate range of volts or amps. **Includes:** meter frame; 5 voltage scales; 6 amperage scales; input box; banana plug wires and instructions.

615-4725
Energy Ball
Having fun while learning! Our 1-1/2" diameter ball has two metal contacts. When you touch both at once, completing the circuit, the ball lights up and produces an eerie sound. Arrange your students in a circle, holding hands. Study conductivity by showing what sort of materials will activate the ball.

615-4040
Contact Key
Convenient banana plug connections!
Close an electrical circuit with a light touch. The circuit remains closed only as long as the key is depressed. Shows the action of a switch and is a good way to test equipment. **Includes:** plastic base, 2 color-coded binding posts.

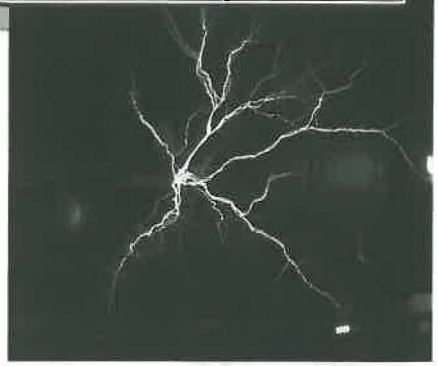
Electricity - Tesla Coil

615-4665
Tesla Coil
Transmit electricity without wires. Watch light bulbs glow in your hand. Study ionization of gases, insulators and conductors. Our powerful yet completely safe high frequency high voltage electricity source arcs to 1" (25mm), for maximum output of 50,000 volts. Assembled, with plastic housing for safety. 110 volt (220v on special order.) **Includes:** vibrator, 2 high voltage capacitors; primary coil, secondary coil (400 turns), high impact resistant plastic housing; lamp socket; 2 radiating plates; neon bulb; discharge electrode; plastic and copper wire; instructions.



Fluorescent bulb near Tesla Coil

615-3175
Neon Wand
24cm glass tube, filled with reduced pressure neon gas, glows vivid red near our Tesla Coil or Van de Graaff Generator.



615-4745
Plasma Globe
A safe way to explore potential and electron orbital jumping. A high voltage transformer produces a large potential difference between it and the glass of the globe. Inert gases inside complete the circuit and release harmless lightning bolts that respond to touch. 120v 60hz.

Free science video.
What is light? How do colors combine? Find out at **www.sciencefirst.com.**

Electricity

615-0190

Barlow's Wheel

How can four small batteries turn a big, heavy wheel? By harnessing the force of eddy currents! Eddy currents are attracted to powerful neodymium magnets on the gimbal. This causes the wheel to keep spinning. Use for studies in the right-hand rule, magnetism and eddy currents. **Includes**: hefty brass slotted wheel, neodymium magnets on gimbal ring, sturdy base, instructions. *Needs 4 AA batteries.*

615-4755

Ring Thrower

Dramatically demonstrate the power of induction by hurling a ring up to 12 feet! Our affordable coil gun uses line voltage to generate enough current to move objects while a special microprocessor keeps the current in check. **Includes** solid and split aluminum rings; acrylic ring; microprocessor; extendable shaft (prevents students from leaning over); rubber rim to absorb impact; insulated electrical components; instructions.

Electricity Meters

Our affordable meters combine high sensitivity with an astonishing range. Sturdy ABS housing and scale printed directly under the needle. Analog components need no additional power and are more stable than digital. With three connections.

615-4200

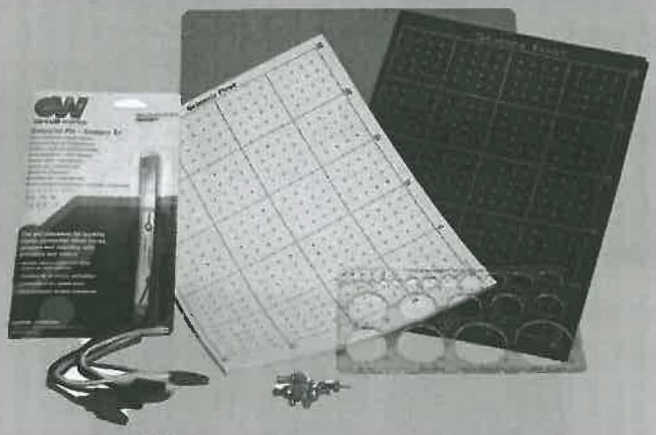
Voltmeter

- 0.1 to 300 volt range.
- 3 maximum readings of 3, 15, 300V
- Scale with all 3 maximum voltages

615-4220

Ammeter

- 0.1 to 5 amp range.
- 3 max readings of 50mA, 500mA & 5A
- Scale with all 3 maximum amperages

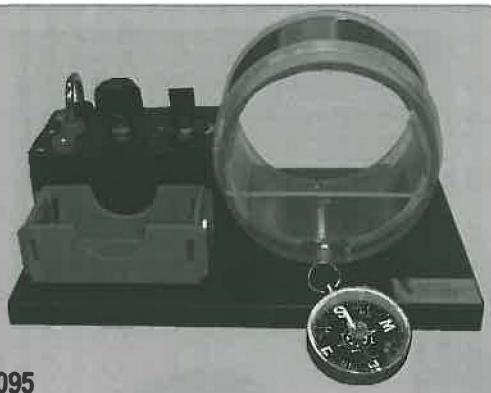


Electric Field Mapping

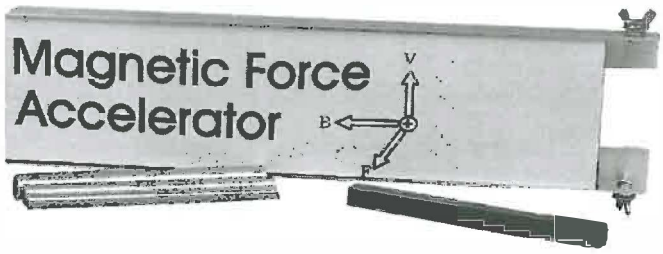
Plot an electric field around electrodes of various configurations. Draw electrodes in electrically conductive ink on semi-conducting paper and transcribe data to graph paper. **Includes**: cork board cover; 25 sheets black conductive paper with grid; 100 sheets white paper with grid; template; conductive ink pen; 4 alligator clip leads; instructions. Pen has a shelf life of 6 months. *You need 12 volt power supply or battery; digital volt meter.*

615-3195 Field Map Kit
615-3200 Replacement Pen
615-3196 Conductive Pad, 25

Electricity - Magnetic Force



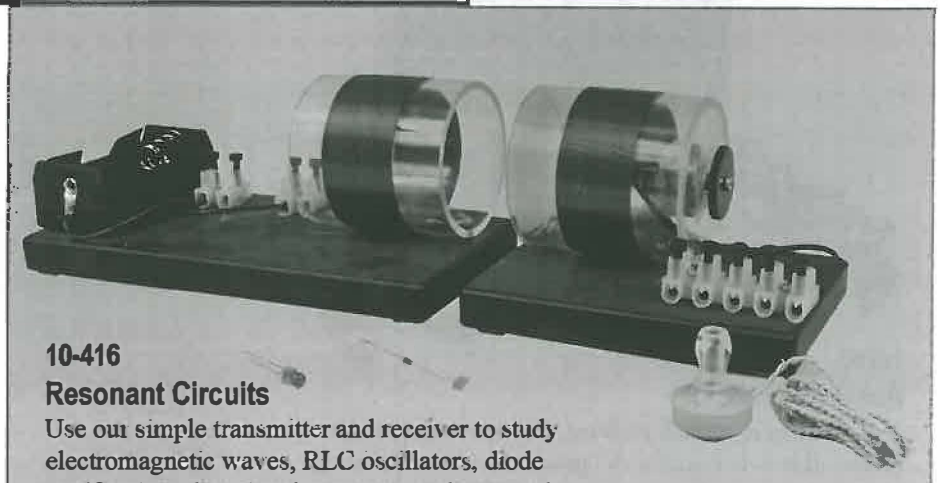
615-4095
Tangent Galvanometer
Measure an electric current by determining the magnitude and direction of the horizontal component of Earth's magnetic field. Set the compass needle parallel to the coil, pass an "unknown" current through and measure the angle of deflection. Features copper magnet wire, adjustable potentiometer, compass, non-magnetic stand; instructions. *Needs D-cell and galvanometer or voltmeter.*



32575
Magnetic Force Accelerator
The Right Hand Rule wins again with this dramatic demonstrator. A uniform and permanent magnetic field is provided between two conductors. When a 12VDC, 15 A, supply is connected, any of the three included tubes will be accelerated away from the connectors and off the end of the apparatus, even when that end is raised using the included one cm block.

615-0025
Levitating Vortex
Demonstrate magnetic levitation and frictional force with our two-tone device. Black and white sections let you measure rotation speed with a stroboscope. Instructions.

615-0180
Field Tracer Magnet Probe
This magnet, suspended in a gimbal, demonstrates forces between magnetic poles, induced magnetism, shapes and direction of magnetic fields and properties of a field produced by an electric current. *Color may vary.*

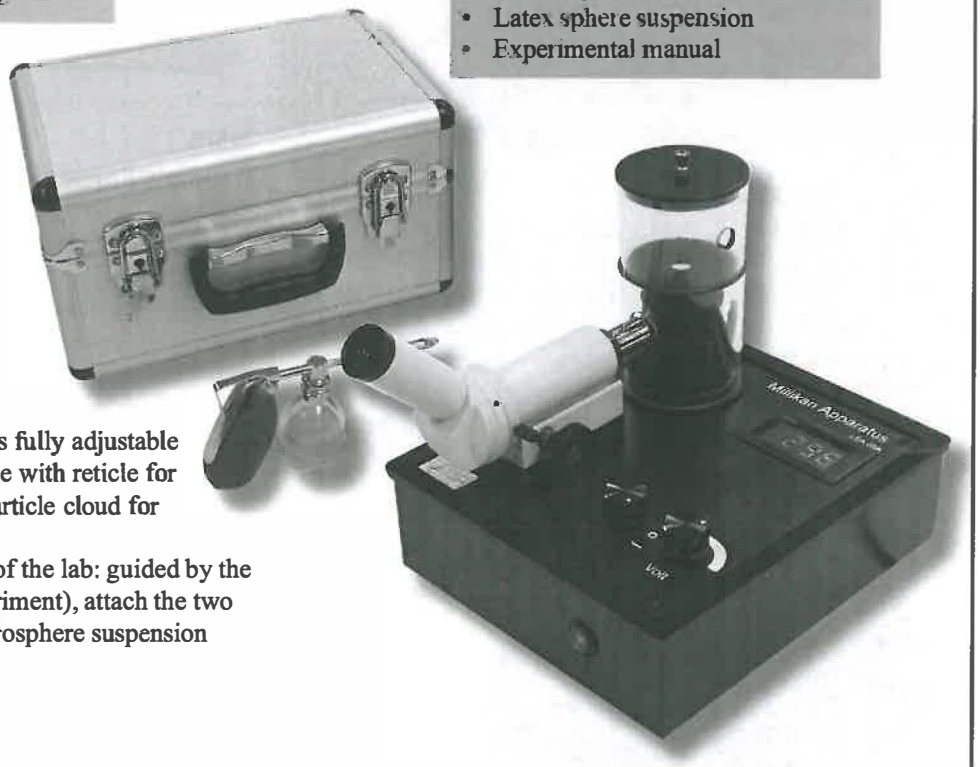


10-416
Resonant Circuits
Use our simple transmitter and receiver to study electromagnetic waves, RLC oscillators, diode rectification, directional antennas, and many other topics. Note: An appropriate signal generator (approx. 1MHz, 10V peak-to-peak), as well as a D-cell battery, is required. Some experiments need oscilloscope.

Electricity

16120 Specifications:
- Field voltage: 0-500V, reversible polarity
- Light source: 1A high intensity LED
- Particle: 1 um latex, in suspension (16110 replacement particle suspension)
- Supply input: 110VAC 50-60Hz

Includes:
- Base & integrated 500V supply
- High intensity LED light block
- Parallel whole-plate field chamber
- Viewing scope with reticle
- Focusing rod & atomizer
- Latex sphere suspension
- Experimental manual



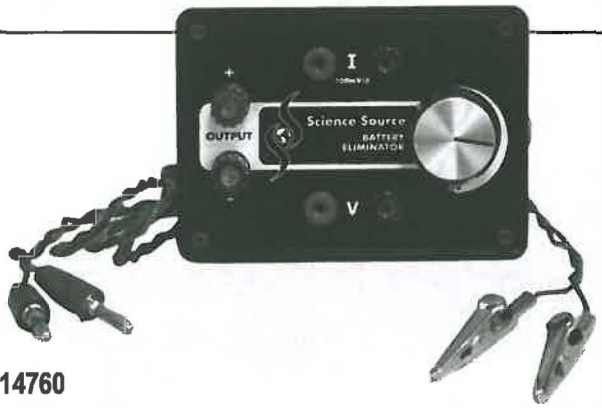
Millikan Apparatus & Accessories

Think this classic of modern physics is out of reach in your class? Think again! Accurately determine the elementary charge of the electron and demonstrate quantization.

- Whole-plate reversible polarity electrode chamber provides a completely uniform field
- High intensity LED light source is fully adjustable
- Short depth-of-field viewing scope with reticle for coarse and fine focus. Scan the particle cloud for individual particle selection

Assembly takes seconds and is part of the lab: guided by the case image (a schematic of the experiment), attach the two main components. We use latex microsphere suspension instead of oil for easy clean-up with distilled water.

16120 (no accessories)
16125 (with accessories)
16110 Latex particles



14760

Battery Eliminator

A good thing in a small package, this neat unit provides regulated low-voltage (0-3V) power. Its current limiting circuit prevents damage to internal components in case of overload. Output is through versatile terminal posts. Pin jacks for both voltage and current monitoring. Its shunt-type current monitoring means you don't need a meter or bridge.

615-4100

Speaker

This 100 ohm, 0.2W speaker has many uses. Frequency range: 460 to 4 KHz; impedance: 100 ohms. Sound pressure level is 2 dB, with a maximum power rating of 3W.

Electricity - Electronics

615-4555
Electroflash Electronics Kit
This patented kit, developed by a teacher, has been acclaimed by instructors of technology, general science and physics as the best they have ever seen. Our innovative magnetic connection system allows you to build circuits quickly. **Includes**: easy to follow Learning Guide with cartoon illustrations; storage box with separate wells for components. Kit **includes:** resistors, thermistor, light bulb, switches, speaker, buzzer, earpiece, LED's, power and signal diode, capacitors, transistors, radio, aerial coil, transformer, relay, motor, connector packs, connecting wires, magnets, copper tape, mounting boards, battery mount, base plate, circuits sheets, flashing LED.

615-4015
Electric Bell Kit
Saved by the bell! This device rings out when an electrical circuit is completed. **Includes**: stand, banana plug jacks, adjustable hammer, instructions. *Use* **615-4065**

Putting Science *First* since 1960

32500
Light Source
8" reflector, mounted on a socket with a 6' cord, has spring clamp and stand. Good for bench use or wall mounting. Rated for 150 watts. *Needs bulb.*

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

615-4575
LED Dice Game
14 LED's arranged like a real dice face. Push the buttons and watch LED's simulate a dice roll. With microcontroller. Detailed instructions. *Basic soldering skills required.*

Electrical Components

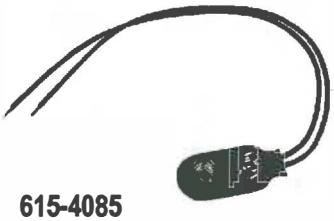
Battery Holder (D-Cell)
615-4105 Aluminum
With attachment tab for positive & negative leads.

615-4110 Plastic
Connectable & locking.

615-4005
Battery Holder (2 holder)
Select 1.5 or 3 volt DC power for experiments. With 3 banana plugs. *Needs 2 D-cell batteries.*

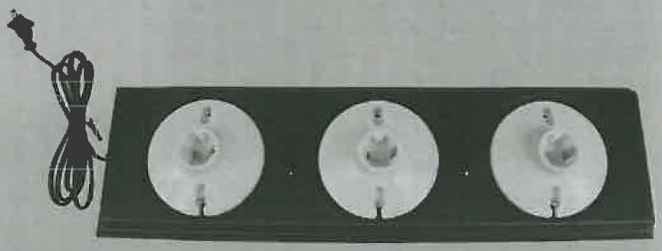
615-4010
Battery Holder (4 holder)
Provides DC, 1.5, 3, 4.5 and 6 volt DC power. 5 banana plugs for added safety. *Needs 4 D-cell batteries.*

615-4065
Battery Kit
Build a 1-1/2 to 6 volt power source. Batteries can be connected from 0 to 6 volts to experiment with different voltage levels. **Includes:** 4 plastic holders; end snaps for connecting cells. *You need: 4 D cells.*

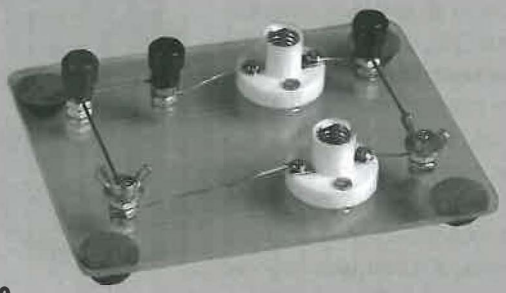


615-4085
Battery Button Clip
(Pack 10)
These 6" (15cm) long red and black leads contain an insulated snap-in connector. 9 volt.

615-4002
4-Slot Battery Holder
One-piece, 4-slot, AA battery holder has both black and red 15cm lead.



32495
Series & Parallel Lamps
Demonstrate series and parallel circuits with an easy-to-use device that can be seen from a distance. Three household lamps of different wattage are connected by using two 3-position rocker switches. Counterintuitive, provocative. **Includes** pre-wired connections on circuit diagram copy master. *You need 40, 60 and 100W bulbs.*



32930
Series Parallel Lampboard
Two lamp sockets with binding posts and switchable shunts let you measure series and parallel circuits with minimum set up time. *You need lamps.*

615-4115
Lampboard Rheostat
Learning the basics of electricity doesn't get much more basic than this. Experiment with series and parallel circuits by studying the brightness and intensity of light bulbs. Clear plastic base, 12 x 6". 5 lamp receptacles and 5 sets of binding posts. **Includes:** connecting leads, instructions. *Needs 3 7V DC clear bulbs, 6V lantern battery.*

Electrical Components

615-4030
Metal Lamp Socket
Our socket with 2 terminals fits all miniature screw base lamps. Why buy a whole new receptacle when you can just replace the socket?

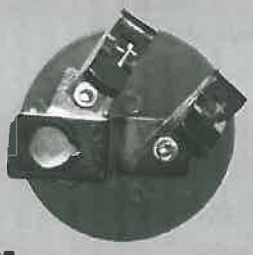
615-4028
Mini Bulb Holder
Tiny 5mm diameter, 25mm bulb holder has holes for screws. Works with mini bulbs.

615-4035
Lamp Holder
(With banana plugs)
Stand with red and black banana plugs fits miniature screw base bulbs.

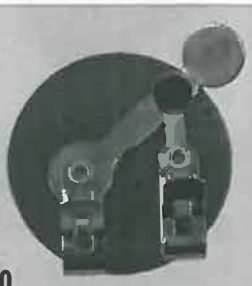
Banana Plug Socket (Pack 5)
615-4070 Black
615-4075 Red

615-4000
Banana Plug Switch
Power your low voltage experiments with the touch of a switch. You can attach alligator clips or use banana plugs for added safety. With plastic housing.

615-4080
Banana Plug Wires (Pack 3)
42cm long wire lead with two banana plugs. Set of three. red, black and green.

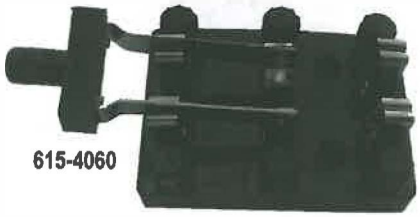


615-4025
Mini Bulb Holder (Single)
This miniature holder has metal parts, 45 mm plastic base, and two Fahnestock clips. Use with our mini switch to open and close a circuit. *You need bulb.*



615-4020
Mini Switch (Single)
This has a 45mm diameter plastic base with two Fahnestock clips for connecting wires. Because the switch pivots to complete the circuit, it can be used to build a doorbell.

615-4045



615-4060

Knife Switch

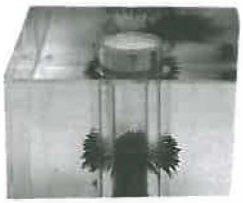
615-4045	**Single pole, single throw**
615-4050	**Single pole, double throw**
615-4055	**Double pole, single throw**
615-4060	**Double pole, double throw**

Putting Science *First* since 1960

612-0025 Thermostat
615-4065 Battery Kit

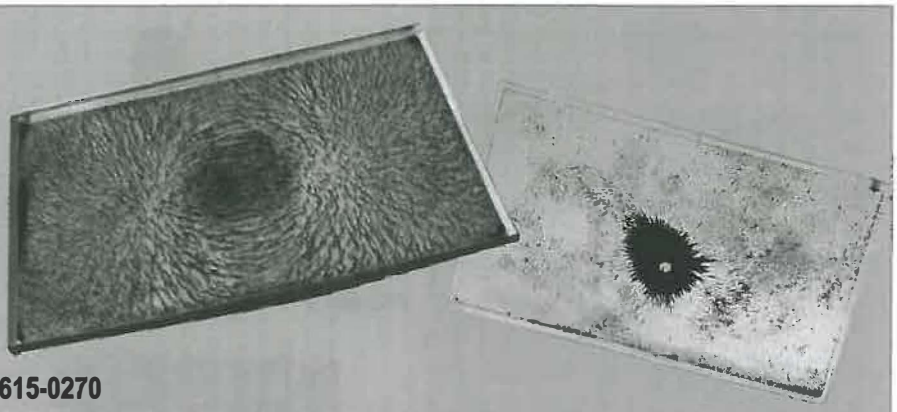
Thermostat Model
Demonstrate the action of a switch. When the bi-metal strip is heated, it will bend to open or close the circuit. Instructions. *You need DC power supply, bulb, socket.*

Magnetism

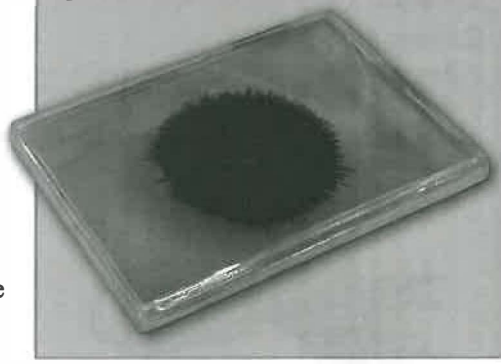


615-0250
3-D Magnetic Viewer
Explore the magnetic field in 3-D. Iron filings mixed with oil inside an acrylic plastic cube will react to a magnetic field or electric current.

615-0095
Magnetic Field (2 Halves)
Three-dimensional magnetic fields are an open and shut case with our new folding apparatus.



615-0270
2-D Large Magnetic Field Demonstrators
Study magnetic lines of force from afar. Visualize magnetic lines of force in two dimensions. Transparent case contains iron filings in transformer oil which point along lines of force when near a magnet. 16 x 9 x 1cm with reusable styrofoam pack. *You need magnet.*



615-0255
2-D Magnetic Field Demo Student Field Viewer
Smaller in size (and price) and ideal for the classroom. 3-1/2 x 2-1/2 x 1/4" (90 x 65 x 6mm). *You need magnet.*

615-0000
Magnetic Needle
Demonstrate the action of a compass and the Earth's magnetic field. Magnetic needle, 145mm long, has red North and pivots on a sensitive brass and nylon bearing. 9.9cm non-magnetic support has 5.9cm round base.

615-0090
Magnetic Viewing Paper
Observe the shape & patterns of various lines of force. Place paper over a magnet and watch how metal particles are attracted. **Includes**: metal dust & filings in oil in laminated green plastic. *Magnet not included*

615-0260
Levitating Top Set
Use the scientific method to determine which of the included weights (brass or plastic) line up and let the magnetic top to spin freely in the air.

Magnetism - Compass

615-0105
Alnico Magnet Set
4 powerful boxed alnico magnets
- 2 bar magnets (80 x 15 x 10mm)
- Small horseshoe (25 x 8mm)
- Large horseshoe (35 x 15mm)
- Keepers for all magnets

615-0010
Alnico Bar Magnet
Useful magnet is 3 x 0.5 x 0.25".

663-0670
Magnet Holder
Use this nifty rack to protect your magnets or thermometers! Handy slots of three sizes hold a variety of "stuff". Unbreakable one-piece.

615-0005
Plotting Compass (Pack of 12)
Use to trace the field of a bar magnet. 16mm diameter aluminum case with clear plastic top. Red North on 10mm steel needle mounted on brass bearing.

626-1020
Magnetic Compass
Nifty liquid-filled compass is good for basic studies in magnetism and electricity. Marked North, degree scale and cardinal compass points. 16mm x 45mm diameter.

Cylindrical Alnico Magnets
High magnetic force in a small package.

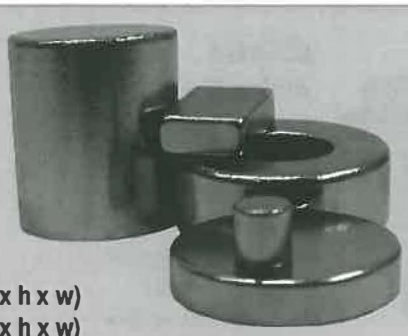
615-0200 **Small:** 6mm x 12mm
615-0205 **Large:** 8mm x 24mm

615-0015
Iron Rod (Pack of 10)
This soft iron rod (3.125 x 100mm) is great for demonstrations since it is readily magnetized and demagnetized.

615-0020
Cow Magnet
This strong magnet is so named because it's fed to cows to attract metal swallowed while grazing. Watch it float in a hollow steel cylinder. Take it apart to show separation of poles. 75mm (3") long, 20mm (1-3/4") diameter, 100 grams. Dissectible.

615-0035
Ring Magnets
(Ceramic, Pack of 10)
These little magnets are great for floating magnet demonstrations due to the multiple poles on their faces. 19mm diameter, 6mm thick, with a 6mm diameter hole.

Magnetism



Neodymium Magnets

What can be more fun than a mess of these amazingly strong magnets? You're sure to find as many uses as there are choices.

615-6077	Rectangular	10 x 5 x 3mm (l x h x w)
615-6808	Rectangular	25 x 9 x 3mm (l x h x w)
615-6809	Rectangular	25 x 11 x 5mm (l x h x w)
615-7050	Cylindrical	3 x 10mm (dia x h)
615-7160	Cylindrical	6 x 6mm (dia x h)
615-7270	Cylindrical	10 x 3mm (dia x h)
615-7275	Cylindrical	10 x 7mm (dia x h)
615-7285	Cylindrical	9.5 x 10mm (dia x h)
615-7330	Cylindrical	12 x 5mm (dia x h)
615-7335	Cylindrical	12 x 6.6mm (dia x h)
615-7455	Cylindrical	20 x 6mm (dia x h)
615-7465	Cylindrical	22 x 10mm (dia x h)
615-7485	Cylindrical	22 x 25mm (dia x h)
615-8500	Ring	20 x 10 x 8mm (OD x ID x thickness)

615-8510

Exploring Magnets Kit

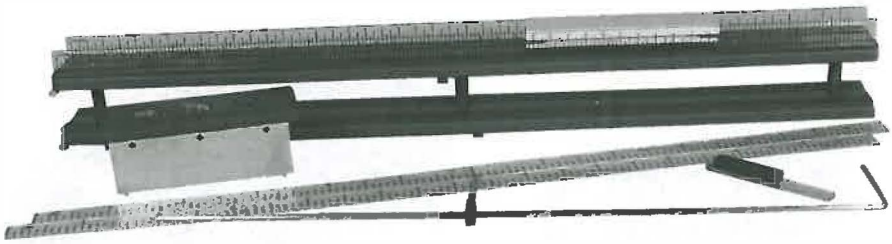
Odd magnets, odd magnetic fields! Show off your magnetic personality! 7 powerful neodymium rare earth magnets: bar, star, heart, disk, triangle, ball, ring. When near the included magnetic field viewer (2.5 x 3.5"), iron filings line up in amusing patterns. With 3/4 x 4" keeper and instructions.

615-7450

Neodymium Magnet Pair

Two powerful neodymium magnets hang out just about anywhere. With instructions.

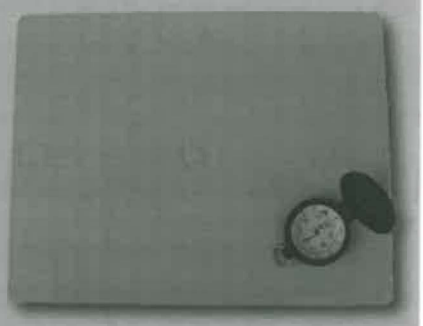
E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com



21486

Magnetic Levitation Set

Introduce your students to an exciting future mode of transportation based on magnetic levitation. Two 4' tracks demonstrate the attraction principle of levitation using an elevated track and a wrap-around model train. Investigate the repulsive principle of levitation by adding the enclosed guides: two tracks can be hinged at any convenient angle to study acceleration, or they can be connected end-to-end to make an 8-foot long track. A clamp is provided to hold the hinged tracks at desired angle. A magnetic wand is included to simulate methods of propulsion. Guide ways are screened with English and Metric scales to facilitate quantitative results. Magnets and Styrofoam vehicle blanks are included.



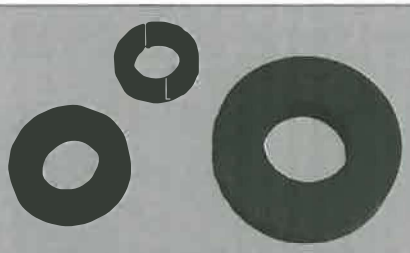
615-0400

Polar Reversal Model

Geomagnetic reversal, or the switching of the magnetic N/S poles, is a mysterious phenomenon. Use a compass (not included) and our board to demonstrate this in hands-on fashion. Place the compass on the board and slide it upward. Without warning, the needle will suddenly spin about 180°!

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

Magnetism



Iron Magnetic Rings

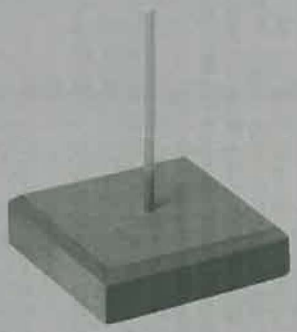
615-0040 18mm hole x 7mm thick
32mm diameter

615-0045 22mm hole x 9mm thick
45mm diameter

615-0050 32mm hole x 15mm thick
70mm diameter

10-302
Ring Magnet (Set of 16)
This ceramic magnets are approximately 0.6 cm thick with an inside diameter of 2.2 cm and an outside diameter of 4.4 cm. Use for collision and scattering experiments with #10-102 Plastic Beads

615-0030
Magnet Stand
This is a quick, easy setup to teach magnetism, electricity and magnetic fields. Our sturdy non-magnetic base holds a bar magnet up to 20mm thick (magnet not included).



20200
Magnet Block
Demonstrate that like poles attract and unlike poles repel. Four magnetized discs appear to "float" above each other. Use with magnetic rings.

615-0175
Floating Magnet
Demonstrate that like poles attract and unlike poles repel. 4 ceramic disc magnets seem to "float" above each other. **Includes:** base, 4 magnets, support, instructions.

615-0055
Stirrup
This support for bar magnets or friction rods lets them swing freely in a horizontal plane. Hooks are 3-1/2" (90mm) apart. 9 x 5 x 13mm.

615-0150 615-0155

Horseshoe Magnet
These magnets have many uses. With keeper. Color coded. Color may vary.

615-0150 Large Magnet:
11 cm, 2.5 kg.
615-0155 Mini Magnet:
27.5 x 25 x 6.2mm

Horseshoe Magnet
Steel, with keeper. Labeled poles. Color may vary.

615-0060	5.0cm
615-0065	7.5cm
615-0070	10.0cm
615-0075	12.5cm
615-0080	15.0cm

615-0160
Alnico "U" Magnet
55 x 50 x 22mm U-shaped magnet provides high magnetic power. **Includes:** keeper.

615-0100
Alnico Block Magnet
- High quality
- Use with viewing paper & 2D field demo
- 50 x 19 x 6mm

Radioactivity - Heat

Geiger Counters & Radioactivity Sets intended for educational & didactic use only

16760
Cloud Chamber with Needle
With this detector, the tracks of radioactive particles are made visible by the condensation of droplets in a thin layer of alcohol vapor. Includes a mail-away coupon for the source of alpha and beta particles. Requires liquid nitrogen or dry ice.
- Alpha and beta particles available by mail
- Just add liquid nitrogen or dry ice

10810
Digital Solar Hand Held Geiger Counter
Compact low-level radiation detector is sensitive to alpha, beta, gamma, & x-rays. Solar powered, charged capacitor. Wide LCD displays count, counts/minute, mR/hr, elapsed time, charge state. Shown visually & with mutable chirp. *Needs 2 AA batteries.*

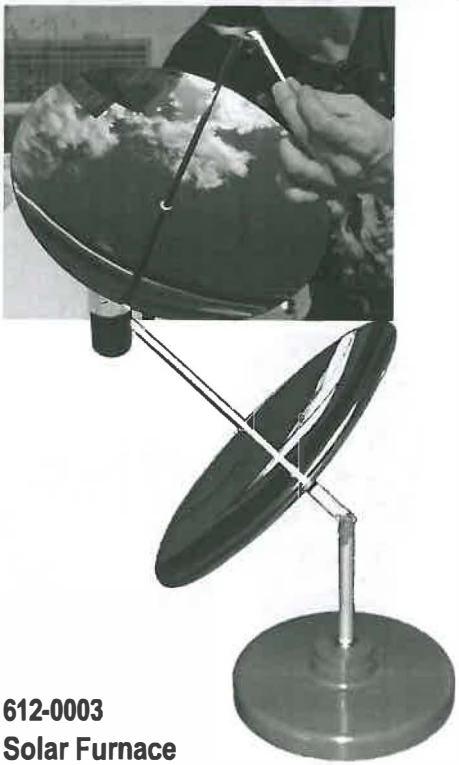
See pg. 7-8 for **Daedelon® Geiger Counters**

10-609
Geiger Counter
Our self-contained, AC powered detector and speaker produces a sharp click when exposed to alpha, beta, or gamma radiation. Useful for qualitative comparisons. Show the effects of distance, shielding, and activity of radioactivity.

612-0050
Heat Absorption Comparator
Compare heat absorption and radiation. Activate the light bulb and graph results. **Includes:** two pans (90mm diameter), one dark, one silver. 10 W/12 V lamp mounted between the pans shows different temperature increases. Binding posts, instructions on base. *Needs 2 thermometers.*

Putting Science *First* since 1960

612-0015
Solar Hot Water Demo
Show how the sun can heat water cheaply and effectively. We use a 10 x 16" black ABS plastic panel to absorb heat from the sun. Tubing runs through a carefully cut groove, doubling back on itself to increase capacity. The panel heats the water inside - up to 90° in just a few minutes in direct sunlight. **Includes** a valve to prevent water from leaking, kickstand, syringe for filling the tubing and instructions.



612-0003
Solar Furnace
Did you know temperatures can reach more than 150° C in sunlight? Study this with our 31cm diameter parabolic reflector. It concentrates sunlight on a black-colored copper cup.

Specific Heat - Calorimeter

612-1335
Joule's Calorimeter
Use our double-walled calorimeter to measure the specific heat of solids or the electrical equivalent of heat. **Includes:** 150mL aluminum can, styrofoam liner, plastic insulator ring, instructions. Clear lid holds the heating element, stirrer, and built-in thermometer cork. Removable heating element. *Needs 6V power source, thermometer.*

612-0055
Aluminum Temperature Probe
Prevent damage to your terminals from rapid heating by letting our probe do the dirty work. Let the probe conduct heat from your sample, then simply measure the temperature of the probe.

612-1330
Aneroid Calorimeter
Our "dry" calorimeter is five times more sensitive than traditional versions! Its one-pound core keeps heat loss to a minimum, allowing precise measurement of changes in temperature. **Includes:** die-cut styrofoam insulation; aluminum core; machined hole for inserting thermometer, instructions. *You need thermometer,* **612-1332** *specimens (right).*

612-1331
Calorimeter Resistor
Determine electrical equivalent of heat: pass a known current through a known resistance for a known time; measure the temperature change. Use with **612-1330** due to its low heat loss. **Includes:** power resistor on cover, terminals and instructions.

32140
Calorimeter
Determine the caloric content in solid foods by burning food and measuring the rise in temperature in water placed in a flask suspended over the burning food. With calorimeter chamber, flash and instructions.

612-1332
Specific Heat
Same volume, with hooks
Fits the core of **612-1330** calorimeter. Aluminum, zinc & copper, 4 cm x 2cm. Instructions. With hooks.

Specific Heat Values

Ice (0°C)	2.093
Iron	0.452
Nickel	0.440
Alcohol, ethyl	2.450
Mercury	0.138
Water	4.180
Air (50°C)	1.046
Hydrogen	14.300
Steam (100°C)	2.000

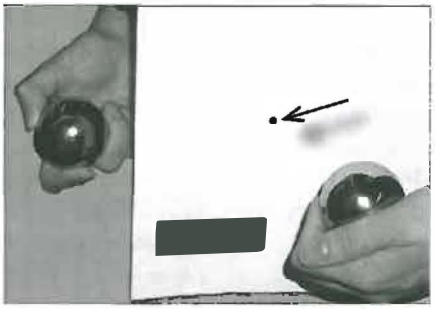
612-1345
Specific Heat
Same mass, with hooks
4 cylinders (aluminum, copper, zinc, steel) with machined hook for easy handling. Same mass (58g) and diameter (19mm) for calculations of specific heat. With instructions.

Heat - Energy Conversion

612-1240

Convection of Air Apparatus

Air heated by a candle moves up one chimney while cooler air moves down another to replace the lost air. These currents can be seen against a dark backdrop. **Includes:** metal box (100 x 215 x 50mm) with glass front; 2 plastic chimneys, instructions. *Needs smoke source.*



612-1315

Kinetic Energy Kit

Bet you never knew converting mechanical energy to heat energy could entertain. Striking our two precision machined balls together creates enough heat at point of contact to burn a hole in paper. *You need: safety glasses; paper.*

612-1310

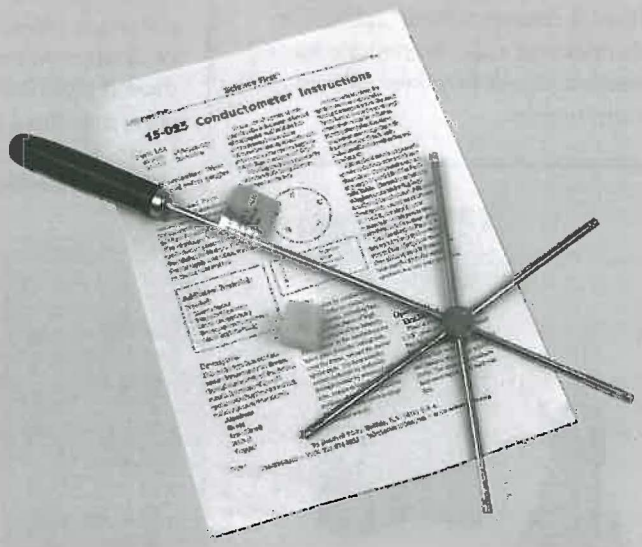
Fire Syringe

Here's an explosive demonstration of the Ideal Gas Law. As air compresses, the temperature increases, and combustible material bursts into flames. **Includes:** an aluminum piston, plastic piston chamber and two custom O-rings. Place paper in the bottom and the piston inside the tube. Plunge down to compress the air and create a burst of flames.

611-2305

Gay-Lussac's Law

Demonstrate the direct relationship of pressure and temperature of a gas by measuring pressure of a known amount of gas at several temperatures. Contains a sealed volume connected to an absolute-reading pressure gauge. Immersible parts are copper and brass. Bulb diameter is 100mm. *Needs pump and thermometer.*



612-1050

Conductometer

Demonstrate diverse thermal conductivity of five distinct metals. Place small strips of wax (included) over each metal spoke. Heat the central hub over a Bunsen burner and watch the rates at which the wax melts. **Includes** brass hub; five labeled metal spokes (aluminum, brass, iron, nickel, copper); wax; wood handle; instructions. *You need safety gloves, goggles.*

Heat - Energy Conversion

16225
Thermal Radiation
Explore reflection & absorption with our 100 W incandescent lamp. Place one black and one shiny metal can, each with a thermometer mounted in an insulating cap, equidistant from the lamp and observe temperature changes.

612-1065
Liquid Convection Apparatus
This rectangular glass frame (19 x 24cm) has an opening at the top for filling with water. When clamped and heated, you can visualize the circulation of water in a hot water system. *You need food coloring, heat source and stand.*

612-1325
Hero's Engine
This working model goes back to **Hero of Alexandria** in 100 AD. Heated water causes steam to jet from the nozzles and rotate the vessel. **Includes**: flask, 2 opposing nozzles, suspension chain, instructions.

16215 Each
16216 Pack 15
Heat Transfer
Observe & measure the transfer of heat by an aluminum bar between two water samples of different temperatures. The two insulated containers have foam lids and mounted thermometers.

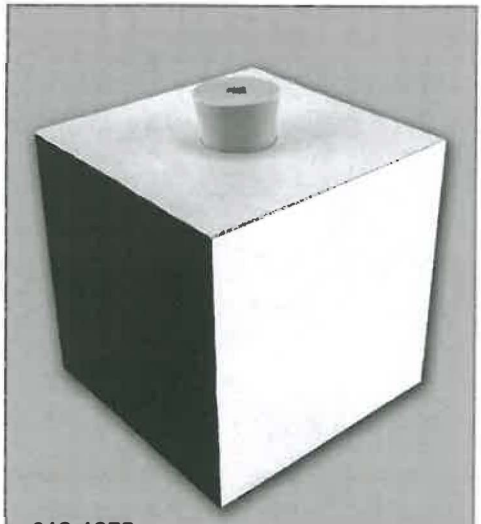
Meets National Science Education Standards & Benchmarks of Science Literacy

612-1055
Accent Science™ Investigating Energy Transfer Kit
Explore the physics of heat transfer by filling containers with water of different temperatures. Determine heat lost and gained with a thermometer. Includes: 3 containers with insulated lids; U copper transfer bar; detailed instructions with worksheets and teacher pages. *Needs 2 thermometers.*

612-1265
Accent Science™ Radiation Cans
Investigate how color can influence the rate of absorbing and radiating energy. Fill these two cans with cold or hot water and experiment. **Includes:** black and silver (or white) metal cans with one-hole cap for inserting a thermometer; instructions. Color can vary. *You need thermometer, heat source.*

Heat - Energy Conversion

612-1340
Ice Melting Set
Our blocks look alike, but do they act alike? Ever wondered why they don't use aluminum hockey pucks? This answers that "burning" question. Prove the difference in heat conductivity in different materials by placing an ice cube on two similar blocks at room temperature. Do they melt at the same rate? Why or why not? **Includes:** aluminum base and plastic foam base, both with ring to prevent spillage; instructions.



612-1255
Leslie's Cube
Each side of our 5-inch cube has a different finish (red, black, white and shiny silver) to demonstrate that heat absorption changes depend on surface color. *You need thermometer or digital probe, heat source.*

611-2280
Conductivity Bars
Although all metals conduct heat, they do so at different rates. Our cleverly designed set, aided by liquid crystal thermometers, will demonstrate this. Contains steel, brass, aluminum, and copper samples. **Includes:** instructions. *You need beaker, water and heat source.*

612-1270
Drinking Bird
This famous novelty shows how water cools as it evaporates. Dunk the bird's head into water to start it bobbing. The "drinking" never stops. Instructions. *MSDS available.*

611-2170
BB Board
Visualize how molecules of iron behave when heated! Two clear acrylic plates have BB's in a single layer, with just enough room for the BBs to move two dimensionally. Place the unit on your overhead projector and watch the BB's line up. Distinctive patterns show annealing, hardening and tempering of a metal. With experiments and illustrated instructions. *You need steel wire, Bunsen burner, water, tongs.*

*WARNING: These teaching aids are not toys. Products are not for children under 13. Products may contain lead or choking hazards such as small parts, small balls, marbles, and balloons. Adult supervision is required.

Heat - Thermal Expansion

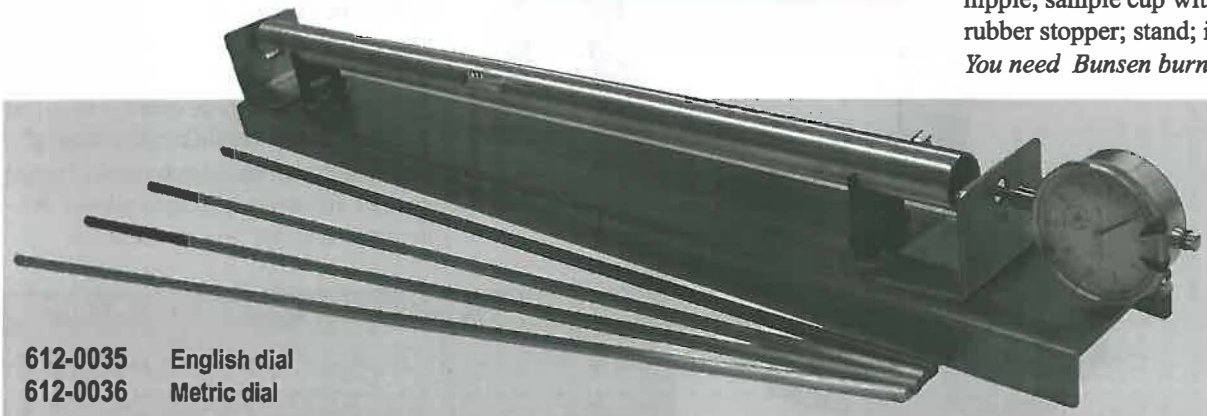
612-0045
Thermal Expansion Kit
Show both linear and spherical expansion! Both rod and gauge have handles for safety. At room temperature, the rod fits snugly inside the gauge's slot; both ends fit into either hole. When heated, the rod no longer fits the slot. It fits one - but not both - of the holes. With instructions.

612-0010
Ball & Ring
This popular demo of metal expansion and contraction has a brass ball and ring mounted on steel rods with wood handles. At room temperature the ball passes through the ring; when heated it will not. Instructions.

612-1300
Steam Generator
Here's a safe, reliable source of steam for linear expansion experiments - or anywhere else. New tripod base dissipates heat more evenly, making it safe with low and high Bunsen burners. **Includes:** boiler with cap; nipple; sample cup with wood handle; rubber stopper; stand; instructions. *You need Bunsen burner or hotplate.*

612-1360
Compound Bar
Demonstrate unequal expansion of metals. A bi-metal bar with wooden handle can be heated over a flame. The metal with the greater coefficient of expansion makes the bar curve.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com



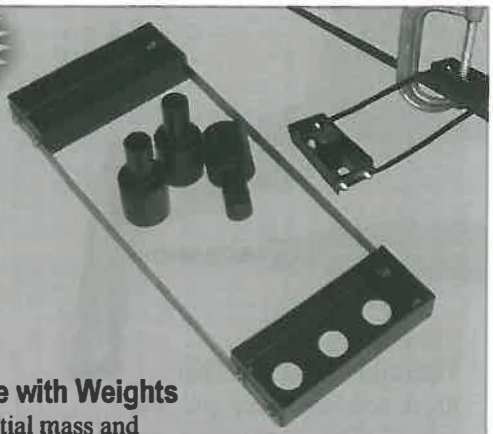
612-0035 English dial
612-0036 Metric dial
Linear Expansion Apparatus (Dial indicator)
Prove that metals expand when heated and measure their coefficient of expansion. This device is easy to set up, use and store. Because you can heat the rods with warm tap water, there is no danger of burns from steam. The high-contrast dial indicator (English-reading or metric) is sensitive to 1/100 mm. **Includes:** heavy duty stainless steel channel base; 3 water intake nipples, water outlet, thermometer; and four rods (steel, aluminum, brass, copper). Instructions.

Replacement rods
60 cm long and 6.3mm in diameter. For linear expansion apparatus.
612-0040 Aluminum
612-0041 Brass
612-0042 Copper
612-0043 Iron (steel)

Kinematics - Inertia

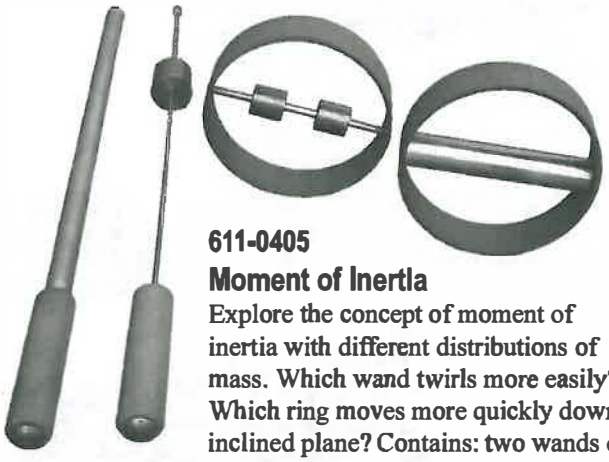
See pg. 13 for
Beck® Inertia Device

611-1210
Inertia Ball
Demonstrate Newton's counterintuitive First Law. Suspend the ball from the ceiling using one hook. Attach a string to the bottom hook. What happens when you pull the lower string? What if you jerk it quickly? **Includes**: chrome-plated steel ball with mass over 454 g; 3 eyebolts (one for safety), and instructions. *You need string.*



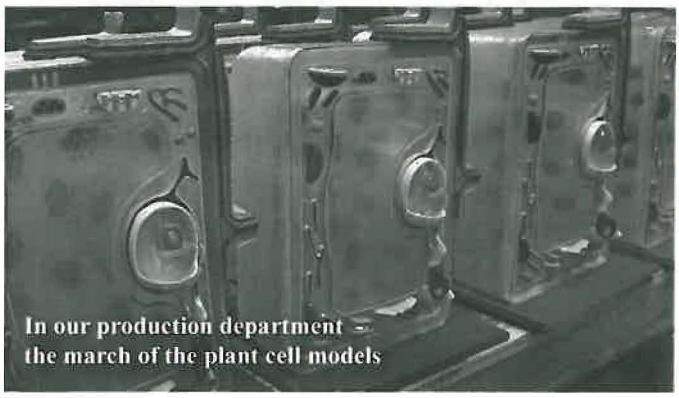
611-1200
Inertial Balance with Weights
Demonstrate inertial mass and Newton's Law. Quantitatively determine the inertial mass of an object and demonstrate Newton's First Law. Push the device sideways to calculate the periodic motion, proving that it is independent of gravity. **Includes:** frame with two platforms (one with holes) connected by firm, horizontal spring blades. A cylinder of unknown mass is suspended and rests in a hole in the platform. Detailed instructions. *Needs clamp.*

611-1220
Variable Inertia
Study rotational inertia. Quickly change the distribution of mass by loading balls inside 2 plastic discs. Which is faster - the disc with the mass toward the center or toward the rim? Why? **Includes:** two 4-1/2" (11cm) diameter discs with 8 compartments; 8 solid steel balls; hardware; instructions.

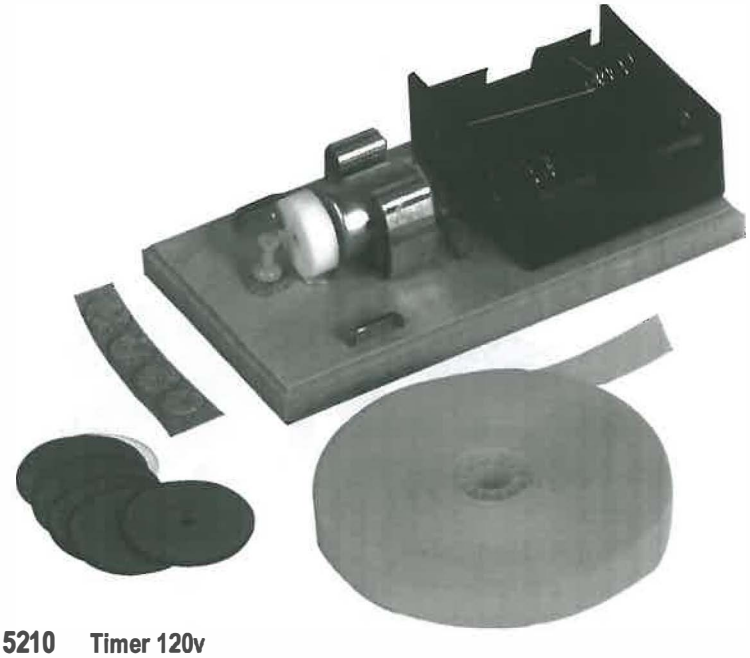


611-0405
Moment of Inertia
Explore the concept of moment of inertia with different distributions of mass. Which wand twirls more easily? Which ring moves more quickly down an inclined plane? Contains: two wands of equal length and mass; two rings of equal diameter and mass; movable masses of one wand and one ring; instructions.

611-1140
Inertia Demonstrator
What happens when a tablecloth is whisked from beneath a load of dishes? Demonstrate this intriguing scientific principle. Place the ball on the card and pull back the spring. The card shoots forward but the ball drops back. **Includes:** glass ball, card, plastic base, post, hardware, instructions.



Kinematics - Tape Timer



15210 Timer 120v
15215 Timer DC

Tape Timer

Every lab should have one of these low-cost timers! Synchronized to 60 Hz power, this is very accurate for gathering position and time data from which the speed and acceleration of moving objects can be calculated. It includes carbon disks, ticker tape, and a plastic feeder gauge.

15225

Tape Feeder

For recording timer 15210.

15230 (Pack 5)
15231 (Pack 10)

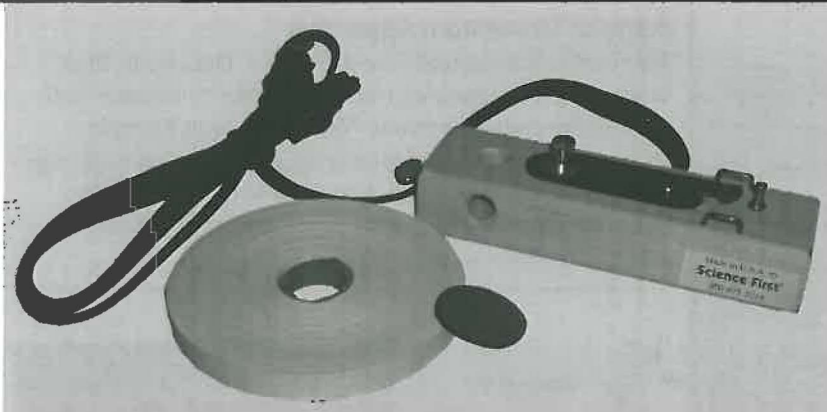
Replacement Tape Timer Paper

For recording timer 15210.

15220

Replacement Carbon Disks

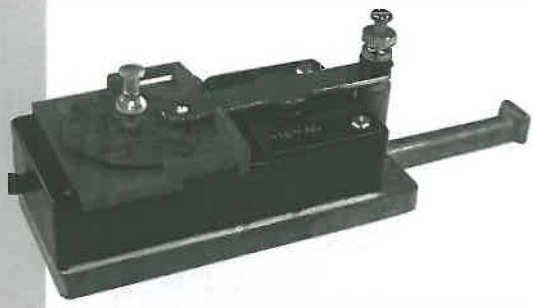
(Pack of 96)



Deluxe Tape Timer

This plugs directly into any 120 volt outlet. It places a carbon dot on moving paper precisely every 1/60 second. By measuring and comparing the space between dots, you can demonstrate velocity, acceleration and friction. The hardwood body is heavy enough to work without clamps but **includes** holes for a support rod. With shielded electric connections, adjustable tuning nut and brackets. **Includes** carbon discs (12), ticker paper (100') and instructions.

611-1230 Tape Timer
611-1231 Carbon Discs, 12
611-1232 Paper, 100'



611-1235

Economy Tape Timer

Our budget timer puts a dot on moving paper every 1/60 second. Operates on 110 volt electricity with a push button switch and power indicator. It features a cast iron base for stability. **Includes:** output terminals, 32 carbon discs and 17mm recording tape. *Needs AC 120 volt power supply.*

Kinematics

10-108

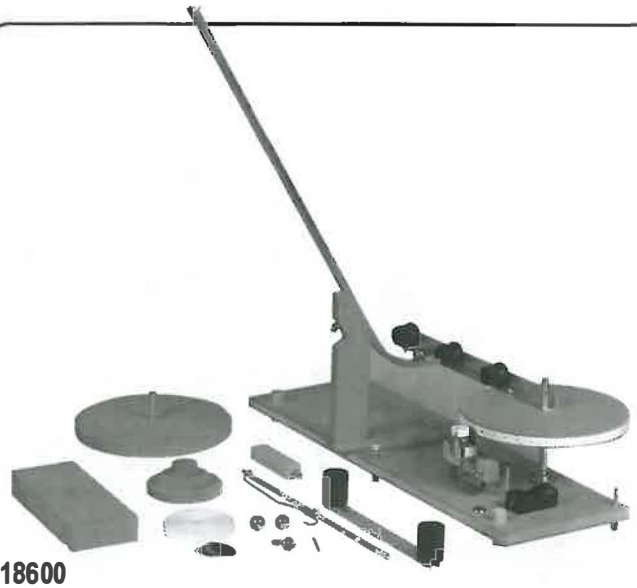
Trajectory Apparatus

Clearly visualize and quantify projectile motion with this compact, durable device. A steel ball is launched repeatedly from the same place on a ramp and strikes a recording paper on a target plate that is moved horizontally each time. As each of these marks is transferred to the background graph paper, the shape and properties of the trajectory emerge. Wonderful opportunity to study a body that is uniformly moving horizontally and accelerating vertically. Separate motion into components. **Includes:** steel ball, 5 sheets of graph paper & recording paper.

611-1415 Projectile Launcher
611-1416 Photogate

Student Projectile Launcher

Our low-cost unit combines safety, performance and quality. It is suitable for all grade levels and experiments. Accurate to within 4cm at 2m, it features sturdy aluminum construction, launching cable, 3 position settings, cocking lever and instructions. Photogates are available separately, allowing it to be used with our **611-0103** smart timer. *Shown with 611-1416 photogates.*



18600

Angular Momentum

Here's a reliable way to study angular momentum, rotational inertia, and the relationships between torque and angular acceleration.It consists of a massive base wheel rotating on a low friction bearing, timer for gathering rotation data, 3 cups on an arm for catching a ball from a long ramp, drop-on wheel, weighted bar, and dumbell. **Includes:** ticker tape, recording tape, and 3 steel balls. *Needs D- cell battery*

611-0735

Angular Momentum Apparatus

Removable masses make the difference. Use one to show center of gravity paradox (the rod is easier to balance with mass at the end). Use two to "feel" angular momentum (rotate the rod with masses near the center and on ends - the classic "ice skater's spin"). Use three to mathematically calculate the center of gravity at a given point and to visualize counterbalance.

611-1410

Projectile Launcher

Bring the precision of the ballistics pendulum into the classroom. This economical yet accurate device clamps to any table top and shoots from -15° to 90°. **Includes:** assembled spring-loaded gun; (2) 19mm diameter balls: steel, aluminum; protractor; plumb bob; brace; instructions.

Kinematics - Air Track

12500 & 12505 included accessories:
- 1.8m track & scale
- Integrated/ detachable air source
- Two 100g gliders; 4 spring bumpers; 2 coil springs, pulley assembly with string; 3 magnetic bumpers, inelastic bumper (banana plug), 4 connecting brackets for springs; 4- 25g masses; 2 thumbscresws; 3 leveling feet
- Experiment manual and guides

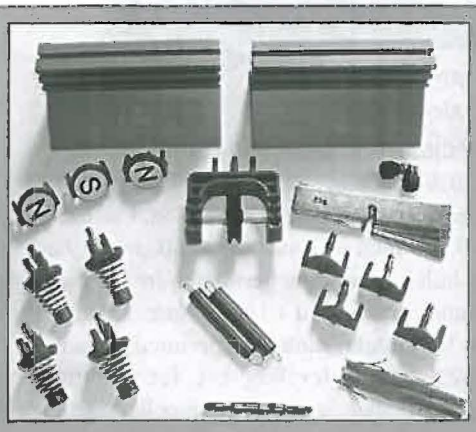
See pg. 9-10 for **Daedalon® Air Tracks**

12500 Specifications:
- Power 110V, 60Hz
- Motor Max Amps 6.8, Max Air Watts 190
- UL Recognized (E47185) CSA Certified

Science First® Basic Air Track
(With and Without Integral Air Supply)

The affordable cornerstone of mechanics experimentation. The anodized aluminum air track provides a near-frictionless surface that is indispensable for studying the mechanics of linear motion. Improve the clarity of your students' data by virtually eliminating error and fricton. With the included gliders and accessories, students can investigate acceleration, collisions, explosions, momentum, and simple harmonic motion. The large, easy-to-read screened scale makes front-bench demonstrations a breeze. Completely self-contained. Attachment of the noise-suppressed air source means that set-up takes only moments: simply plug in the motor, level the track with the three leveler feet, and start experimenting. With no hoses to wrangle or trip over, the 1.8m track is tidy and portable, making the most of storage space.

12500 ● **With Air Supply**
12505 ● **Without Air Supply**
611-1246 **Air Source**



12515
Glider & Accessories for 12500
- Anodized glider, 6", 15 cm, 210 g.
- Anodized glider, 3", 7.5 cm, 105 g
- Large & Small Bumpers, 2 each
- Mounted magnet set (for elastic collisions)
- Dashpot and coupler set (for inelastic collisions)
- Weak springs, 2; pulley; hook and loop tape set

Bumpers, magnets, & dashpot plug into gliders

611-0104
Air Track Smart Timer

Specifically for Air Tracks and other collision devices! Allows precise timing of motion experiments. Seven separate functions for counting time and measuring acceleration. Six digit LCD and rimter range up to 1,000 seconds with an accuracy of .0001 seconds. Displays its functions with large graphical user interface.

611-0103 functions:
- Single photogate
- Count
- Period (cycle)
- Collision
- Gravity
- Acceleration
- Dual photogate

611-0103
Smart Photogate Timer

Measure the time interval between two photogates, time it takes to pass through one photogate, acceleration of a released ball, acceleration due to gravity (with picket fence), elastic and inelastic collision times, cycles, the frequency of a rotating object, period of a pendulum, and count interruptions. Because up to 20 data points can be stored in memory for instant recall, you can watch the experiment as it happens and perform calculations after. Rechargeable - use with or without the adapter. *Use with Air Track*

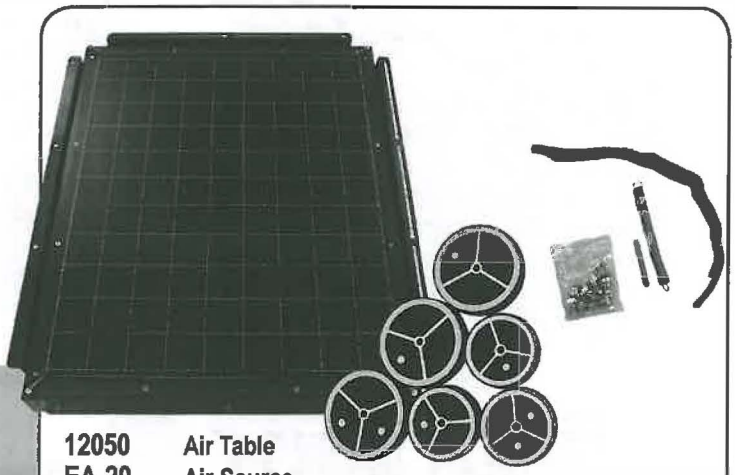
Kinematics - Air Table

10-004
Photographic Meterstick
Centimeter markings are white on black on one side, black on white on the other. Good for photographing objects in motion.

611-1600
Bee Spi Velocimeter
Our compact, battery powered double photogate has a built-in display. Measure free fall, dynamics car & projectile velocities. Two parallel photogates, 40mm apart in a U-shaped housing, detect, measure and display objects. Includes clock to measure lap times. Range: 0-99.99km/h; 60 x 60 x 50cm. *Needs two AAA batteries.*

32130
Brownian Scope
An amazing demonstration of kinetic molecular theory can be done with this 200-power dark field microscope. The motion of tiny but visible particles betrays the collisions of individual air molecules as they dance about in random (Brownian) motion.

10160
Force Stick
This spring and mass accelerometer, which is easily calibrated, can be used to measure both vertical and horizontal accelerations. A marker is carried and left behind to indicate the maximum acceleration.



12050 Air Table
EA-20 Air Source
Ealing Precision Student Air Table
Needs EA-20 Air Source
The honeycomb core provides exceptional stability, and flatness to 0.005 inch on a surface of 50 cm x 79 cm. Steel pins in peg holes around the perimeter are for the rubber bands to launch pucks, and a 1/4-20 threaded hole through its center is for circular motion experiments. Includes bumper wire assembly, leveling feet, Tee air fitting and hose, large and small pucks, hook and loop collars, and springs. Requires EA-20 air supply, which will run up to four tables.

See pg. 11 for
Daedalon® Air Table

12000
Science First® Air Table (Built-In Air Source)
With its air source built in, this provides a frictionless, two dimensional 60 cm x 90 cm surface for the study of velocity, acceleration, Newton's Laws, center of mass, elastic and inelastic collisions, linear and angular momentum, conservation of momentum, moment of inertia, centripetal force, simple and complex harmonic motion. The smooth, hard, black surface is ideal of photographic studies and has threaded inserts strategically positioned for use with accessories. Includes corner posts, bumper wire, tension adjustment bolts, levelers, pucks, springs, & hook & loop collars.

Kinematics - Air Table Accessories

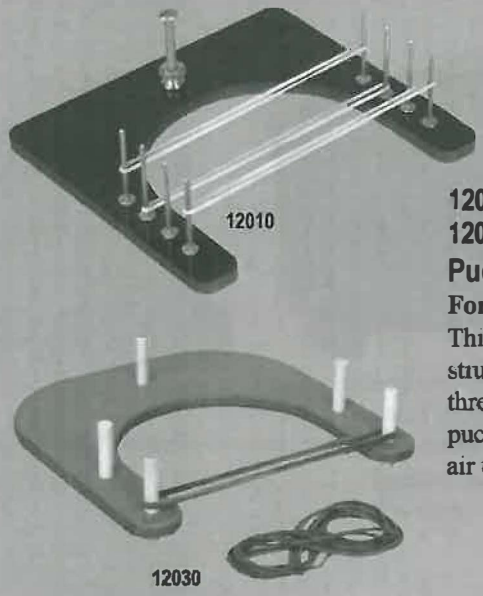
EA-55
Magnetic Puck (Set of 2)
Strong magnetic field enhances physical contact and makes for strong collisions. Photo-ready decals installed on a repelling pair.

EA-53
Aluminum Puck
7.5cm diameter, 210gm aluminum puck for collisions between unequal masses. A smaller effect than with EA-52 but with better energy conservation.

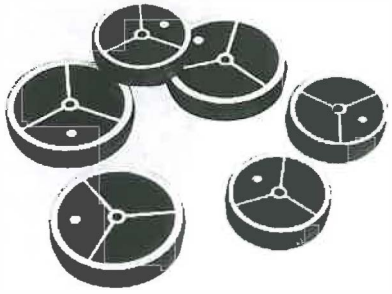
EA-52
Acrylic Puck
Very light (90gr) 7.5cm diameter acrylic puck for collisions between very unequal masses.

EA-58
Paper Guide
59cm long acrylic rod with internal spring. Compressed between inside edges of an Air Table, it acts as a guide in recording simple harmonic motion.

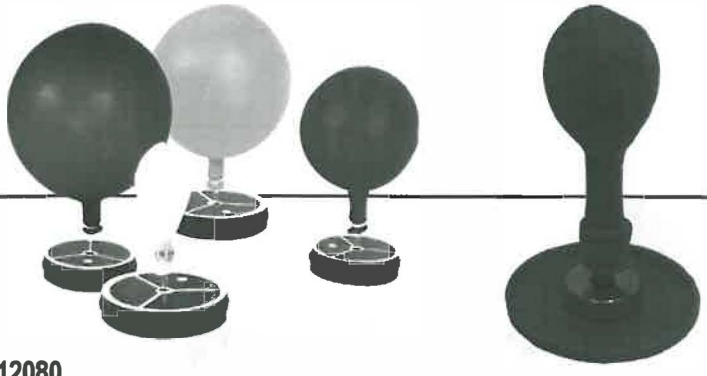
EA-51
Recording Paper Kit
4 sheets special carbon paper, 400 sheets newsprint, 56 x 56cm.



12010 Puck Launcher
12030 Large Launcher
Puck Glider Launcher
For use with all our Air Tracks
This single device can be mounted and strung with a rubber band in one of three places to reproducibly launch a puck on an air table or a glider on an air track.



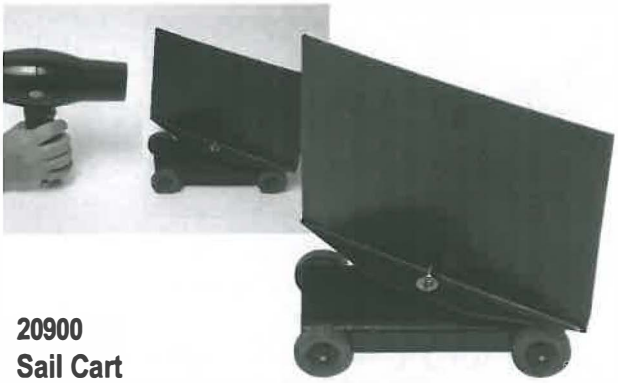
12070
Ealing Precision Air Table Pucks (Set of 6)
This marks a return to a proven style. The 3-part puck is bolted together and has a protruding bumper. Photo ready decals are affixed to three each of the 7 cm and 9 cm sizes.



12080
Balloon Puck Set (Set of 4)
These 7 & 9cm Ealing-style pucks need only a smooth surface for levitation. No tools are needed to assemble or stack. **Includes** two large and two small pucks and four sets each of balloons, stoppers, and connecting tubes.

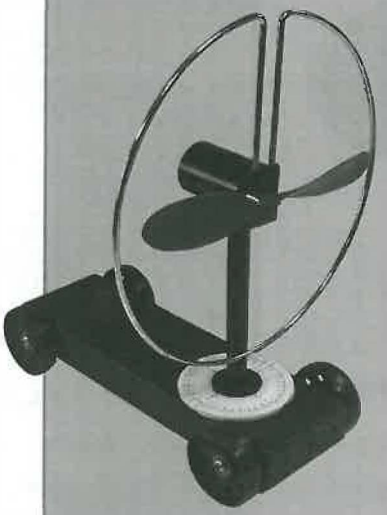
611-1605
Air Puck & Balloon (Pack 5)
Learn about collisions in two dimensions and uniform velocity and acceleration. Our pucks hover on a film of air created by inflated balloons. **Includes:** 3-55mm diameter pucks, 5 balloons and stoppers.

Kinematics - Motion Cars



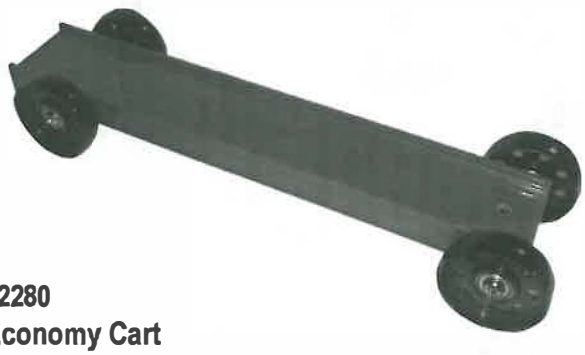
20900
Sail Cart
Conduct vector experiments with this sturdy cart, which features an easily adjustable rigid plastic sail. Sturdy wheels and a wide base provide stability. Attach weights and use with inclined plane (#32300) to measure the force of the wind. *You need: small fan.*

10-103
Constant Speed Vehicle
Long a favorite for introducing velocity and acceleration, our vehicle **includes:** three position switch (to power car in both directions), stable platform for carrying objects, hook for towing, and blunt ends for pushing. Also includes spacer to take the place of one battery for half speed operation. *Requires 2 C-size batteries.*

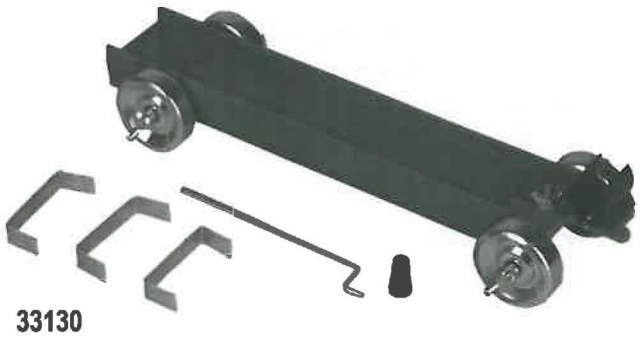


611-1290
Fan Cart
Study acceleration independent of gravity and Newton's Law of Action and Reaction. **Includes:** frame around fan blade for safety.

10-105
Fan Cart
Our low mass cart with sturdy colorful wheels has a large adjustable sail and a novel system of shunts to obtain several speeds. Use without the sail to study motion with a constant force. Replacement propeller is #21437. *Needs 4 AA batteries.*



32280
Economy Cart
This low cost, rugged cart, with durable I-beam body and low friction ball bearings, can be used for force and motion studies. This is our most fundamental four-wheel dynamics cart.



33130
Wheeled Cart
This simple cart with I-beam body and low friction ball bearings has clips to retain a load, and a bracket for attaching a small DC motor (not included). The motor converts the cart into a constant speed vehicle.

Kinematics - Dynamics Cars

611-1300

Mini Dynamics Cars

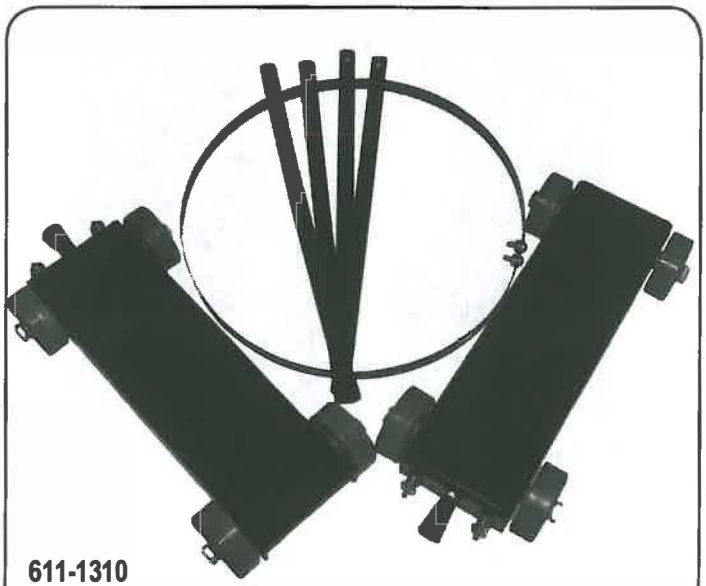
Each colorful car (13.5 x 5.5 x 3.8cm) has a 10" (25cm) spring steel bumper, deep well for weights (not included) and low-friction wheels that snap into place. **Includes:** 2 cars, 2 spring bumpers with 2 rubber bumpers, instructions.

Putting Science *First* since 1960

611-1320

Three-wheel Dynamics Cars

Expect quantitative data from the accurately aligned axles on large, high impact resistant cars. Features include Velcro™ attachment and an easily set firing mechanism with 2 positions. Can be towed with rubber bands to simulate constant forces. Non-slip vinyl surface for holding more weight and a locking safety catch. Stackable, each car can support over 132 lbs (60 kg), has a low profile and 3 widely spaced wheels. Instructions.



611-1310

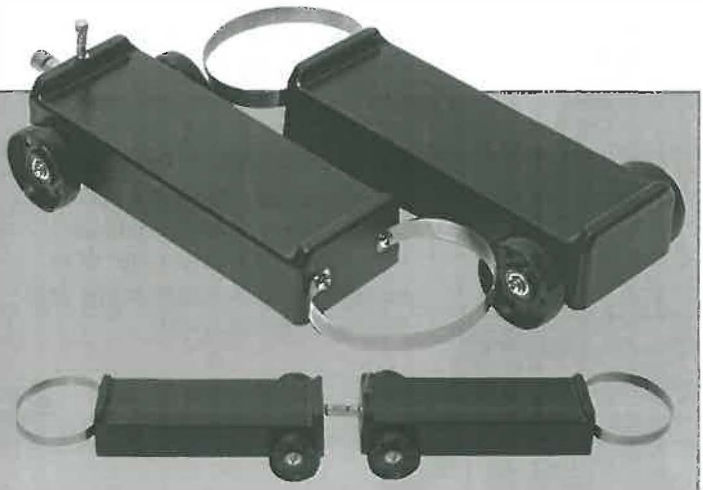
Deluxe Dynamics Cars

Show what an air track can do, at far less cost! Study momentum & elastic & inelastic collisions. Each car has 4 ball bearing wheels and holds over 100 pounds (45 kg). Wide base and low profile for carrying bulky loads. Bumpers screw on without tools. **Includes:** 2 high-strength plastic cars; 2 light, 2 heavy bumpers; large loop bumper; instructions.

14300

Dynamics Carts with Explorer

Two 3-wheel carts, one with an exploder with two levels of spring tension. Low friction ball bearings can carry additional masses on the 9 x 30.5 cm top. A trigger releases the exploder without applying horizontal force. **Includes** 10 towing bands for applying constant force.

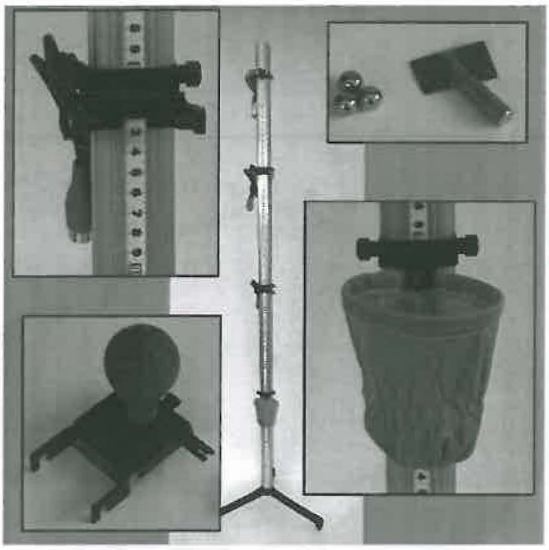


10-4300

Dynamics Carts with Hoops

Three-wheel carts have two easily attached large spring steel hoops to serve as bumpers. Use for many collision experiments.

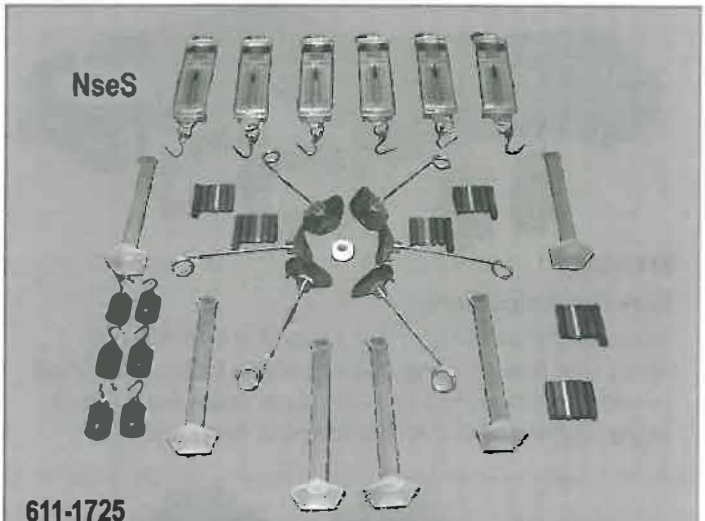
Force & Equilibrium



611-0105 • Gravity
611-0103 Timer

Gravity Drop Free Fall

Improve upon the classic free fall experiment with this updated device. 3 balls, electromagnet release, vacuum bulb release, 2 photogates and catch bag. 160cm high. *Needs Smart Timer (page 191).* • *Ships oversize*



611-1725

Accent Science™ Gravity Investigation

This complete kit **includes:** 6 each, hanging rods, bobs & string (acceleration), graduated cylinders, sets of aluminum, copper, brass, steel, PVC & carbon specimens (density); foam peanuts, spring scales ; copper cylinders with hook & string (weight); instructions with journal pages

- Determine acceleration due to gravity; calculate density; study relationship of gravity, density, buoyancy

611-0370

Center of Gravity Paradox

Things are not always what they seem: introduce the concepts of center of gravity, angular acceleration and moment of inertia. Our 4' rod is weighted at one end. Try to balance it with the heavier end down; intuition tells us this should work. Actually, the opposite is true - turn it over and balance it easily on a mere fingertip. With movable mass and instructions with theory. Truly hands-on!

611-0351

Bottle Balancer

Our precision-cut board is great for teaching the center of gravity in a way that wows your class. It contains a hole to hold the neck of a water-filled two liter plastic bottle. With the right amount of water, it balances, seemingly "defying gravity," because the center of gravity is directly above the base. Experiment with varying amounts of water. Instructions.

14555

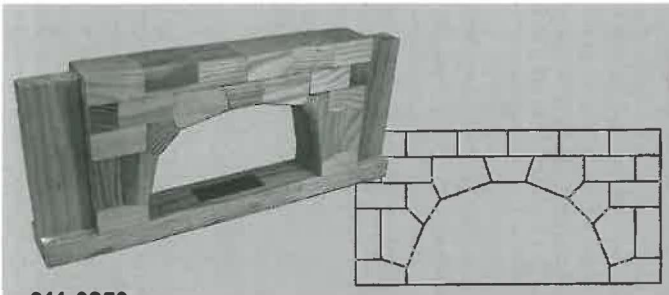
Overhang Blocks

Demonstrate equilibrium and center of mass when four stacked blocks are spaced at L/2n. Note the top block overhangs the edge of the bench. Spacings are marked.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

Force & Equilibrium

Putting Science *First* since 1960



611-0350

Roman Arch Set

Build a working model of the Roman Arch and learn why it's so strong. A puzzle in force and geometry. Try building it without the template - it's not as easy as it looks! (Build on a flat surface, then raise.) **Includes:** 23 pine blocks in 6 unique shapes, instructions. Blocks are about 2 x 2 x 3/4" (80 x 50 x 19mm). Base 16" (406mm).

611-0355

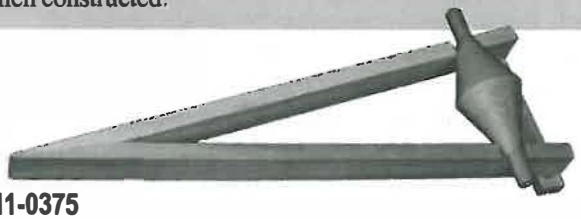
Catenary Arch Set

Here's a great hands-on lab for physical science, math or even art. Our streamlined block set helps explain the unique structural strength of a catenary arch. While the math is complex, the basic shape is not. **Includes:** 13 pine blocks, 2 x 1" (5 x 3.8cm), instructions with template. 8 x 5.5" (20 x 14cm) when constructed.

32050

Balance Support

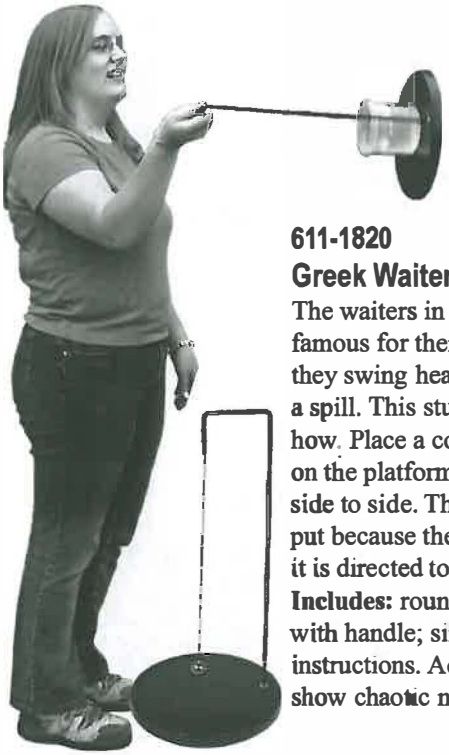
A meter stick and knife-edge clamp are required to use this support in fashioning a simple balance to investigate torque.



611-0375

Double Cone & Plane

Defy gravity as our cone appears to roll upward. This visual demonstrator of the center of gravity has a wooden frame with diverging rails and a double-ended cone. Although the cone appears to roll up, actually the center of mass is moving down.



611-1820

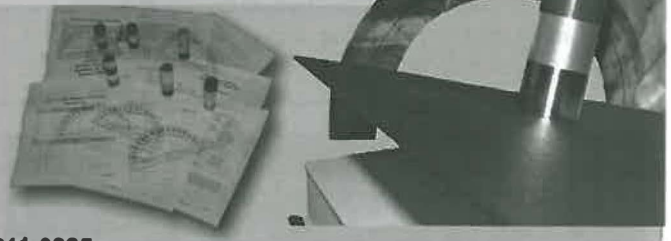
Greek Waiters Tray

The waiters in Greek cafes are famous for their dexterity as they swing heavy trays without a spill. This sturdy device shows how. Place a container of water on the platform and swing from side to side. The container stays put because the force acting on it is directed toward the center. **Includes:** round wood plate with handle; simple pendulum; instructions. Add magnets to show chaotic motion.

How to use:

1. Weigh and measure each cylinder.
2. Stack cylinders on center pin.
3. Calculate center of gravity. Record.
4. Place tower on incline. Slowly tilt until it topples. Find angle of topple with protractor.

Meets National Science Education Standards & Benchmarks of Science Literacy



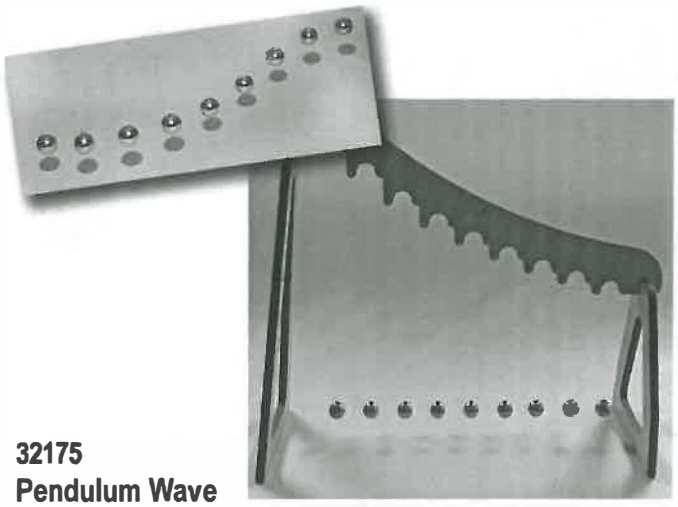
611-0395

Accent Science™

"Mystery of the Tower" Kit

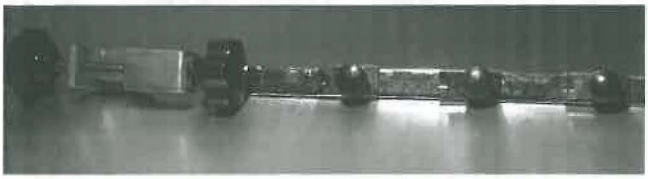
Make the center of gravity the center of attention with this intriguing class kit. Observe, move and measure the mathematical concept of "center of gravity" with enough materials for your entire class. Kit **includes:** 6 Learning Tower of Pisa™ sets, 6 protractors, Instructions with questions & pages.

Kinematics

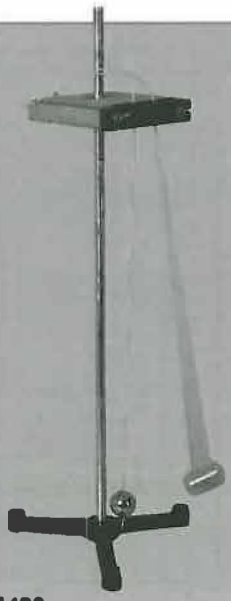


32175
Pendulum Wave
Nine pendula, each having a 2-line mount, vary from slightly less to slightly more than 20 swings in each 20 seconds. With a simultaneous start, the bobs make a very captivating wave-like parade that shows all the possible phase relationships before returning to unison and starting over again. The rigid interlocking frame is 55cm wide and 48cm high and provides offset sharp edges to support each pendulum.

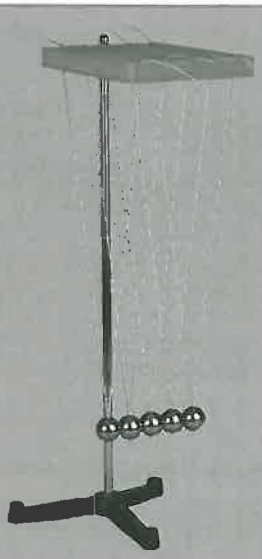
611-0065
Newtonian Demonstrator
Demonstrate Newton's Third Law of Motion and Principle of Conservation of Momentum. **Includes:** 5 chrome-plated steel balls on strings suspended from a plastic frame. 23 x 18 x 23cm.



611-1860
Pendulum Clamp
Suspend 3 pendulums at once and adjust each with this welded steel clamp. Connects to any 13-19mm diameter support rod. 27cm long. **Includes:** individual cord clamps.



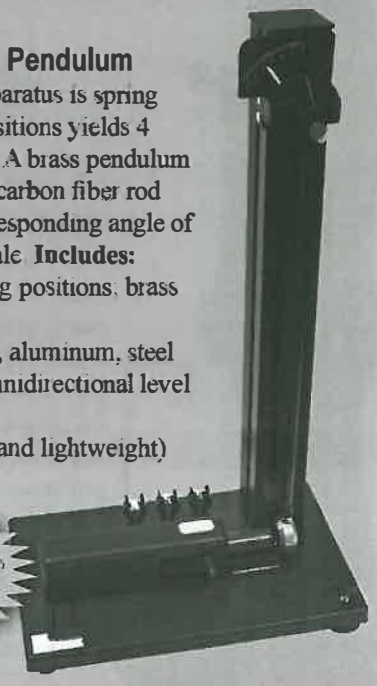
14490
Adjustable Pendulum
This compares the periods of two drilled steel balls with individual string lengths up to 80cm. The novel mount fastens to a ring stand and allows the length to be easily changed while the bob is swinging, allowing for qualitative studies of period, frequency and beats. *Need stop watch.*



32170
Collision Balls
These 5 balls, each in adjustable 2-line suspension, shows that both momentum and kinetic energy are conserved when several balls are swung back and released. The same number swing out at the opposite side following the collision. *Requires ring stand.*

611-1720
Economical Ballistics Pendulum
Our highly repeatable apparatus is spring fired. 4 different firing positions yields 4 different initial velocities. A brass pendulum connected to a scale by a carbon fiber rod catches the shot. The corresponding angle of rise is indicated on the scale. **Includes:**

- Spring gun with 4 firing positions, brass pendulum (35g)
- 3 different shots: brass, aluminum, steel
- Adjustable feet and omnidirectional level to set the unit
- Carbon fiber rod (stiff and lightweight)



See pg. 14 for
Daedelon® & Beck® Pendulums

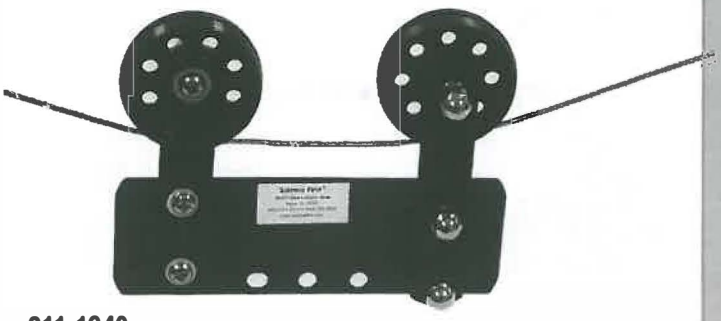
Force & Equilibrium

611-1135
Acceleration Paradox
It all happens in a flash, but the point it underscores will remain with your class for a long time. When a ball and board are released together, the end of the board outstrips its center of mass, leaving the ball behind. The ball is caught in the included cup, an acrobatic feat. **Includes:** two boards, 30" long, hinged together; cup; instructions.

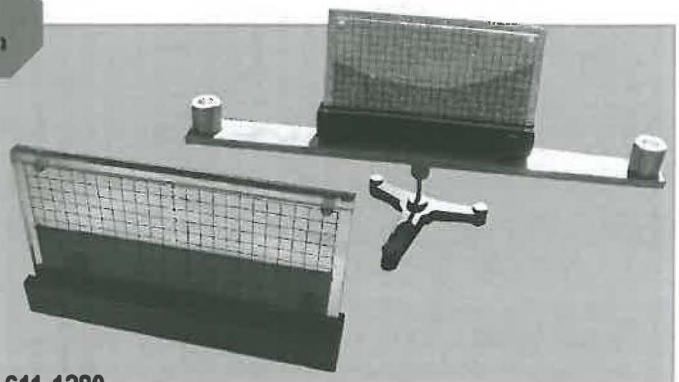
32005
Adding Momenta
Twin hammers are mounted at right angles so each imparts a component of momentum to the croquet ball. The included reinforcement ringsallow the precise positioning of the ball. **Includes:** mounting clamp. *Needs paper, lab stand.*

611-1282
Pocket Accelerometer
Measure acceleration without cumbersome calculations on a bike, in a car, even on a roller coaster! The plastic face is calibrated with an easy-to-read scale in "g" units. Freeze the reading with the lock bar. 4 x 4 x 1/4" (10 x 10 x 3cm). 1 lb (500g). Instructions tied to National Standards.

10-106
Galileo Lab Material
Galileo used similar materials to determine the acceleration of falling bodies. **Includes:** 175 cm inclined plane with adjustable stop, a steel ball, and materials to make a water clock from a funnel a stopper and a tube.

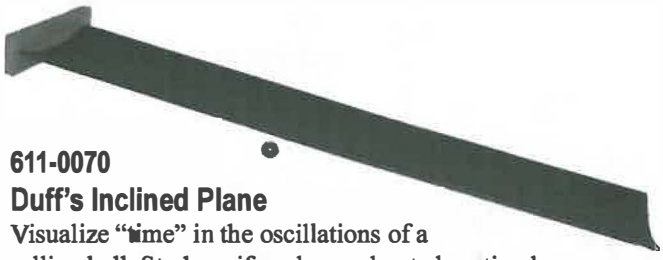


611-1340
Acceleration Trolley
Show how the rate of acceleration of an object depends upon the angle of incline. Our aluminum trolley has two low-friction pulleys to ride along wire cable fastened to a wall. There are three holes in the trolley for attaching weights and brackets for positioning along the cable. **Includes:** trolley with 50mm diameter pulleys; 1.5m wire cable; attachment kit; instructions for installation and calculations.

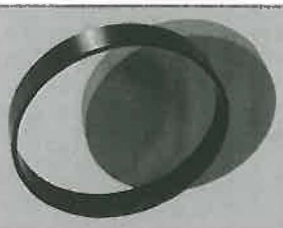


611-1280
Liquid Accelerometer
What flings you out when your car cuts a corner sharply? Visualize the effects of inertial movements. Horizontal acceleration creates characteristic wave patterns as the colored liquid inside our transparent housing moves in the direction opposite to the acceleration. Measure patterns with imprinted horizontal and vertical grid. **Includes:** hook and loop connector to attach to a dynamics car or rotating platform; grid lines; instructions. *Needs food coloring.*

Force & Equilibrium

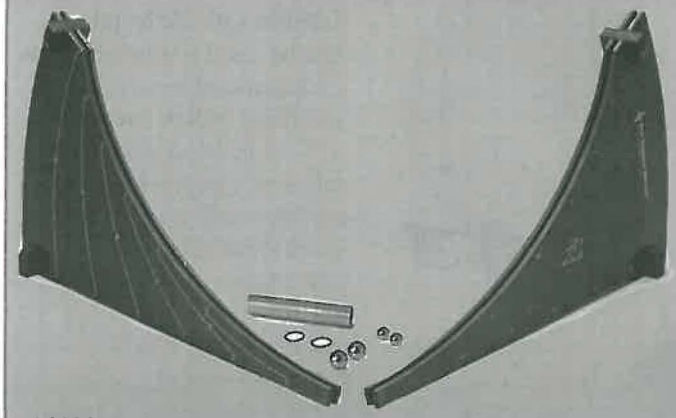


611-0070
Duff's Inclined Plane
Visualize "time" in the oscillations of a rolling ball. Study uniformly accelerated motion by rolling a ball down a curved track. The oscillating ball leaves a trail in powder. Measure the distances traveled between each half wavelength and subtract to show the differences are constant. The fact that a ball is rolling down the incline, not sliding, changes the mathematical workup performed in most physics labs. **Includes:** curved plastic track; wood support one end; 3/4" (19mm) diameter steel ball; instructions with theory. *You need fine powder or chalk dust.*



611-1215
Ring & Disc
Simple materials of the same mass and diameter - metal ring and wood disc, each 4-1/2" (11cm) across - demonstrate mass distribution in rolling bodies. Roll them together down an incline and time which is faster. With instructions.

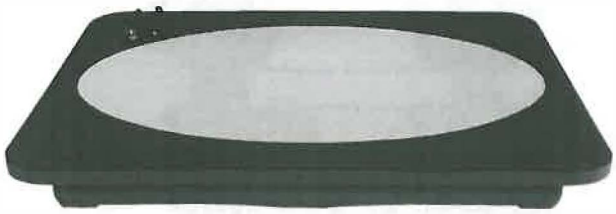
611-1815
Rattle Back
Rattle backs or "Celtic stones" are a curious study in mechanics. The top will rotate readily in one direction. Spin it the other way, however, and it will stop, "rattle" and reverse direction! Is it magic? A violation of physics? With instructions.



14180
Cycloidal Ramps
Harness the unique properties of the cycloid three ways! Each carefully machined curve has a full-length track for a descending ball. In their tautochrone configuration, you'll see that two balls released simultaneously from different points reach the end of the ramps at the same moment. When placed so that the balls' paths intersect, the ramps become excellent colliders. Position markers allow for repeatable experiments varying the gravitational potential energy of each ball. Vary collision angle and ball mass to explore vector diagrams on carbon paper. In their brachistochrone configuration, the ramps demonstrate that the shortest path for an object traveling between two points separated in X and Y axes is not a straight line but the cycloidal curve!

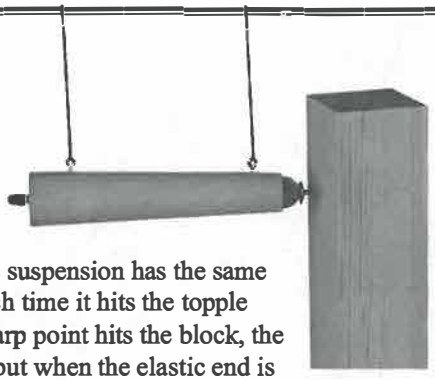
Includes:
- Ramps with feet, 2
- 11 & 19mm steel balls, 2 ea.
- Chime
- Carbon paper

611-1285
Stringless Pendulum
Don't tie yourself down when showing simple harmonic motion! Investigate the period of an oscillating body from a new perspective. When started at the maximum height, the included steel ball rolls back and forth on the curved track. Measure the period to predict pendulum length.



14900
Curvature of Space & Time
A framed oval of Spandex fabric, its shape distorted by positioned masses, simulates the gravitational behavior of objects. Two masses and two balls are provided to demonstrate plausible orbits around one-mass and two-mass systems in a very tactile way. Using the large and small steel balls, the mutual attraction of masses is easily demonstrated.

Force & Equilibrium

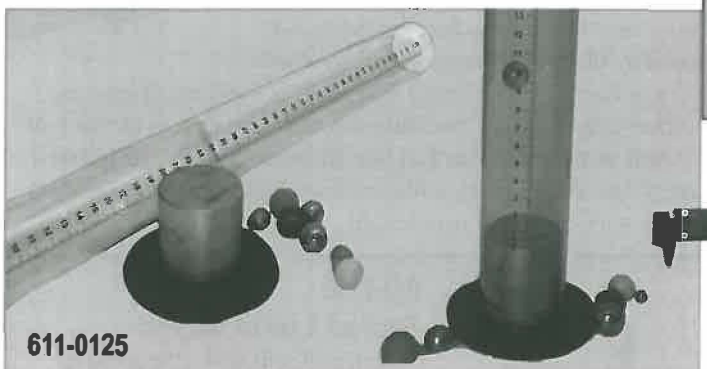


20700
Bouncing Dart
A dart on a two-line suspension has the same potential energy each time it hits the topple block. When the sharp point hits the block, the block will wobble, but when the elastic end is used, the block will topple. More momentum is transferred in the elastic collision than in the inelastic collision.

611-1700
Collision In One Dimension
It may be one-dimensional, but it's a good lab! Study elastic collisions by observing the effects of conservation of momentum and energy. Propel one or more balls down the track to hit balls grouped further down. Observe how far - and how many - in the second group move in response. **Includes:** 27" (68cm) aluminum channel track, 5 steel balls (3/4"/19mm diameter), 2 molded plastic supports, instructions.

611-0400
Wind Tunnel
Perform many intriguing experiments with our new wind tunnel. Study drag, lift and other aerodynamic features with models of your own design. Try different wings or shapes to see their effect on a digital balance. Instructions. *Needs digital scale, ring stand, power supply.*

14155
Collision in 2D
This low-cost, versatile device is ideal for studying conservation of momentum and kinetic energy in both elastic and inelastic collisions in two dimensions. The constant fall time is used to convert displacements to velocities, which become momentum vectors with the addition of masses. **Includes** heavy gauge platform, steel, glass & wood balls. *You need C-clamp for mounting.*



611-0125
Coefficient of Restitution
The Coefficient of Restitution is a ratio of the velocities of two objects before and after a collision. If the coefficient of restitution is zero, the collision is perfectly inelastic: all the energy is absorbed and no bounce occurs. If it is 1, the collision is perfectly elastic: all the energy is conserved. **Includes:** graduated acrylic tube, steel base, and a collection of balls. Instructions.

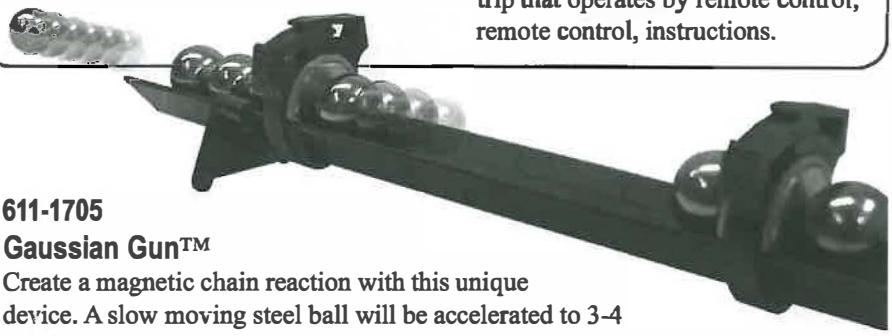
611-0100
Force Mechanism Trough
(Study rolling and sliding friction)
How does acceleration and gravity affect a moving body? Study acceleration, speed and distance under a variable force. Propel a ball or two down our track and observe how other balls react. **Includes:** 43" (110cm) one-piece metal track; plastic supports; trigger with 4 settings; 5 steel balls, 1" (25mm) diameter; wood block; and instructions.

Force & Equilibrium

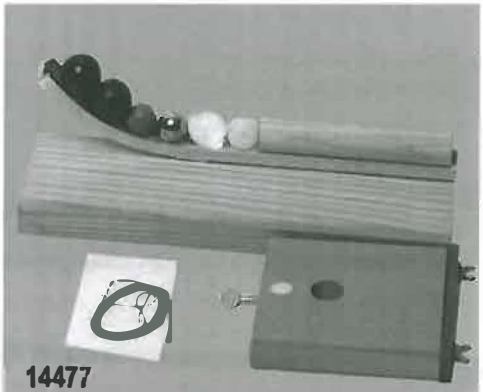
20750
Recoil Again
Study conservation of energy and momentum by showing that an elastic collision transfers more momentum than an inelastic one. When a "happy" ball topples the block, it recoils; the "sad" ball simply fell. *You need ring stand & clamp.*

611-1400
Magnetic Ballistics Car
How to show that the horizontal component of force is independent of the vertical? With this reliable device, a magnet on a string trips a mechanism which launches the ball. **Includes** car with barrel; 25mm steel ball; magnetic trip and instructions.

611-1405
Remote Ballistics Car
This has a trigger that can be operated with a remote control. As the car propels forward, shoot the ball out of the barrel with the remote. Marvel as the ball is caught again by the moving car! With a smoother run and less friction than our prior design, this unit includes a car with barrel; 25mm steel ball; trip that operates by remote control; remote control, instructions.



611-1705
Gaussian Gun™
Create a magnetic chain reaction with this unique device. A slow moving steel ball will be accelerated to 3-4 times its original speed by the pull of magnets and Newton's Third Law. As a ball approaches the powerful magnet, it is accelerated into that magnet, but on the other side, there are two balls in a row. The impact of that ball kicks off the farthest ball on the other side just like Newton's Cradle. **Includes:** 4 neodymium magnets; 4 movable magnet holders; 10 steel balls (19mm diameter); low-friction metal track with open end; instructions.



14477
Properties of Motion
Study motion from Galileo through vectors with our curved chute and 4 different balls. Study momentum in hitting, bouncing and recoiling in elastic and inelastic collisions. Also explore periodic motion with light & heavy pendulums. **Includes:** aluminum ramp, 4 balls (steel, glass, "happy" & "sad"), solid block, pendulum support with two bobs (plastic and lead; line. Instructions

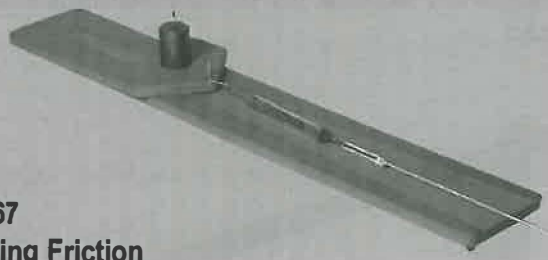
611-0110
Second Law of Motion
Which ball will strike the ground first, one dropped down or one shot outward? Because the horizontal component of force is independent of the vertical, the answer is - both! See it to believe it. **Includes:** aluminum base; spring plunger with 2 settings; 2 steel balls (1"/ 25mm diameter); instructions.

Force & Equilibrium - Friction

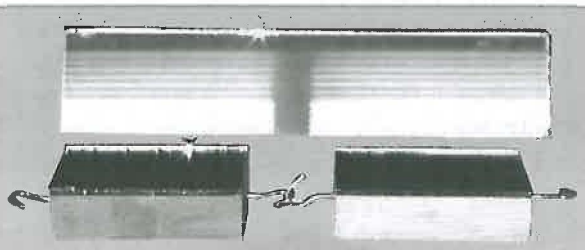
611-0082
Friction Cube (4 Surface)
Wood cube has 4 different surfaces (wood, sandpaper, paper, vinyl), attached hook. 5cm sides.

611-0080
Friction Box
Determine the Coefficient of Friction with loads. High quality wood box has an open top, ring at one end and non-slip bottom. 15 x 9 x 8cm.

32370
Friction Block
Equipped with a hook, this 4 cm x 8 cm x 15 cm pine block presents two different surface areas when used with a spring balance and additional weights to explore static and kinetic friction. The coefficient of friction can be found against various other surfaces.



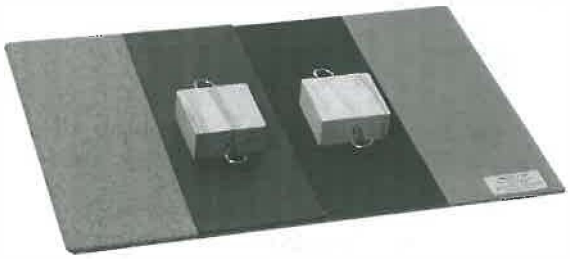
32967
Sliding Friction
The mass is not included nor is the spring balance, but the rest of this apparatus enables sliding friction with a changing contact area between the two pieces. The 6" by 40" base has non-skid feet and the sled has a towing pin, which make this apparatus very easy to use for lab demonstration.



611-0085
Friction Blocks & Surfaces
Show how different frictional characteristics affect the force that moves a stationary body. **Includes:** 3 wood blocks (7.5 x 10cm) with hooks - plain, mirrored surface and sandpaper surface; 7.5 x 35.5cm base; instructions.

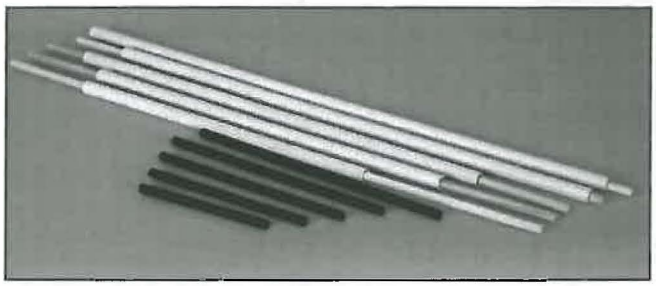
10-102
Plastic Beads
Creates a very low friction surface by spreading these in a confined area. For use with pucks and magnets in studies of energy and Newton's Laws.

13100
Friction Block Set
Study the effects of friction for a variety of surfaces. Distinguish between coefficients of static and sliding friction. **Includes:** two wooden blocks with hook and eye: one with a mirror on one surface; one with mirror and sandpaper surfaces.



33010
Surface Board - ISCS
This kit is designed to study the effect of different types of friction on the force required to move a stationary body. The four element multi-surface board (sandpaper, rubber, cork, cardboard), the friction block with 1 hook, and the friction block with 2 hooks provide support for the ISCS format or other traditional investigations of the topic.

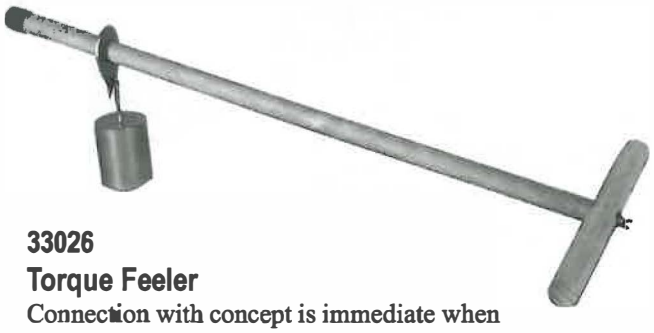
Force & Equilibrium - Friction - Torque



33024

Torque About It

Predict and then check the balance point of a system randomly assembled from one of 5 metal rods, one of 5 pieces of tubing, and one of 5 wooden dowels combined in a particular way. **Includes:** free software source and solution program.

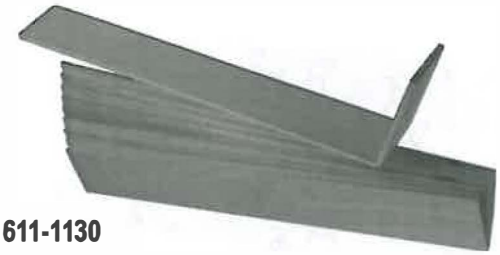


33026

Torque Feeler

Connection with concept is immediate when a fixed force operates at varying distances and angles to produce a torque, which must be resisted by grasping the smoothly sanded wooden handles. **Includes** 1000 gm hooked weight.

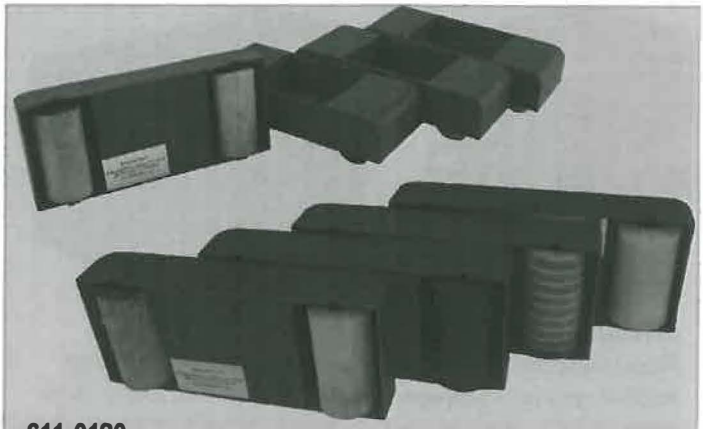
E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com



611-1130

Breaking Board Paradox

Don't know your own strength? It's entirely possible. Lay our thin slab of wood on a smooth surface with newsprint over half. When you strike the slab, what happens? Due to its large surface area, the weight of air holds the board in place. The board breaks instead of sliding. **Includes:** wood for 10 experiments; instructions. *You need newsprint.*



611-0120

Rolling Friction Cars (Set of 4)

Wheels seem to perform the impossible - to overcome the effects of friction. But any wheel will experience friction ("rolling resistance"). This set contains 4 cars with wheels of differing materials - wood, soft rubber, felt, extra-soft silicone. Each car is the same mass to simplify calculations. With instructions.

611-0045

Halls Car Metal-Wheel Halls Car

The one-piece aluminum wheels and axles mount in cone bearings for low friction. One piece plastic body.

611-0040

Halls Car Plastic-Wheel Halls Car

(0.15 Coefficient of Friction with no load)

Study the relationship between work and energy with this virtually frictionless car. Plastic-molded body has a deep well for weights. Covered plastic wheels snap into place if dropped. High-tech recessed sleeve bearings never need adjustment. Instructions.13 x 5 x 3.5cm.

Force & Equilibrium

19385 Set 2
19380 Set 10

Vector Board Set (Set of 2 & 10)

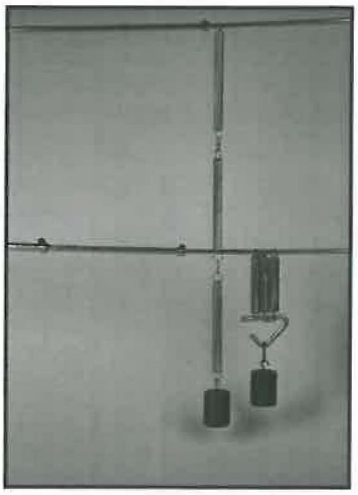
Two soft boards display three vectors each as outstretched precise springs on the paper, radiating from a common point. Subtracting the original length of each spring leaves three relative force vectors in equilibrium. **Includes** 6 pieces of paper; 6 long pushpins. Also in Class Set of 10.

Spring Scales (For Force Board)

For direct readings for force & measurement. Transparent tube. Color coded. Calibrated in grams & newtons.

- Read from 100g/1.0N to 5000g/50N
- Fusion-welded for durability. Top and bottom won't come off

611-0000	**Purple**	**100g/ 1N**
611-0005	**Blue**	**250g/ 2.5N**
611-0010	**Green**	**500g/ 5N**
611-0015	**Brown**	**1000g/ 10N**
611-0020	**Red**	**2000g/ 20N**
611-0025	**White**	**3000g/ 30N**
611-0030	**Yellow**	**5000g/ 50N**
611-0032	**Set of 7**	**one each**



32445

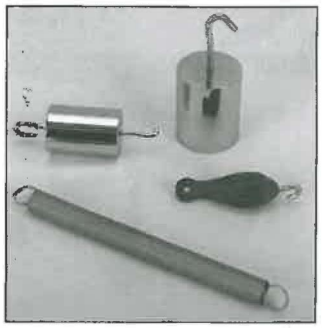
Linked Springs

Learn what happens to the spring constant when identical springs are connected in series and in parallel. Learn about summing reciprocals in the mechanics part of the course where the notions are real and the concepts concrete. With instructions.

611-1110 With weights
611-1112 Without weights

Hooke's Law Apparatus with Weights

Hookes' Law, named after physicist **Robert Hooke**, states that the stretch of a body is directly proportional to its load. This lightweight, precise apparatus is the perfect way to show this. It can also be used to show harmonic motion by counting the oscillations of a vibrating weight suspended from a spring. **Includes**: 15cm long adjustable, reflective scale, graduated in millimeters, mounted to a support rod and base; spring with very low spring rate for ease of measurement; weight holder with attached pan and pointer; illustrated instructions; slotted weights in a reusable case.



15105

Helical Spring Set

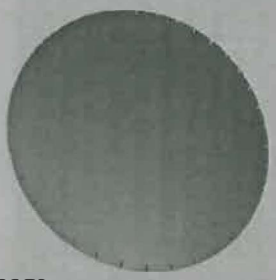
Investigate Hooke's Law and the important concept of energy conversion with this dependable set. Determine the spring constant of a helical spring using two different methods, by stretching of a spring and by oscillating a spring. **Includes**: 3 weights, spring.

611-0115

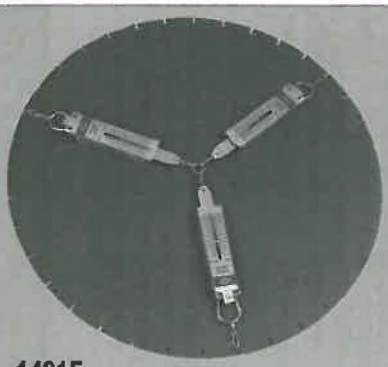
Weight Set

Here's a handy set of 10 brass weights with slots and holder. **Includes:** 10g , 20g (2), 50g, 100g (5), 500g.

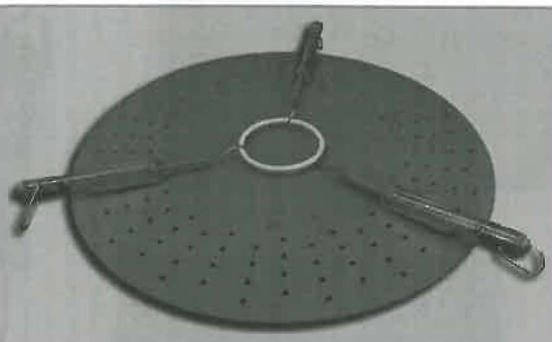
Force & Equilibrium - Force Boards



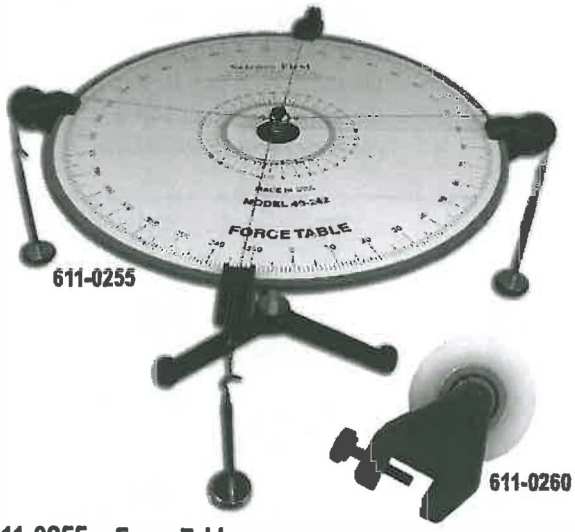
32350
Force Board
without Springs
Notched every 10°, the 56 cm dia board uses spring balances to show 3 vectors in equilibrium. Slide paper under balances for analysis. *Springs not included.*



14015
Force Board
Notched every 10°, the 56 cm diameter board has 3 spring balances to portray 3 vectors in equilibrium. Slide paper under the balances to graph and analyze results.

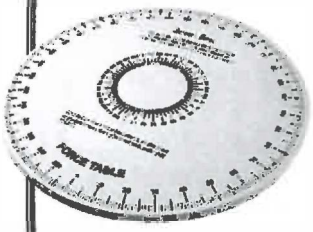


611-0250
Force Board with scales
Low-cost alternative to the Force Table. Graph the composition of forces & direction & magnitude of vectors. Link 3 spring scales together by a center harness and measure their corresponding angles and distances. Slide paper under the harness to mark the center, trace the position of the arms, and record each reading. **Includes:** tempered masonite disc with 117 precision-punched holes, 3 spring scales, 3 aluminum clips, instructions.



611-0255 Force Table
611-0260 Force Table Pulley (ball-bearing)

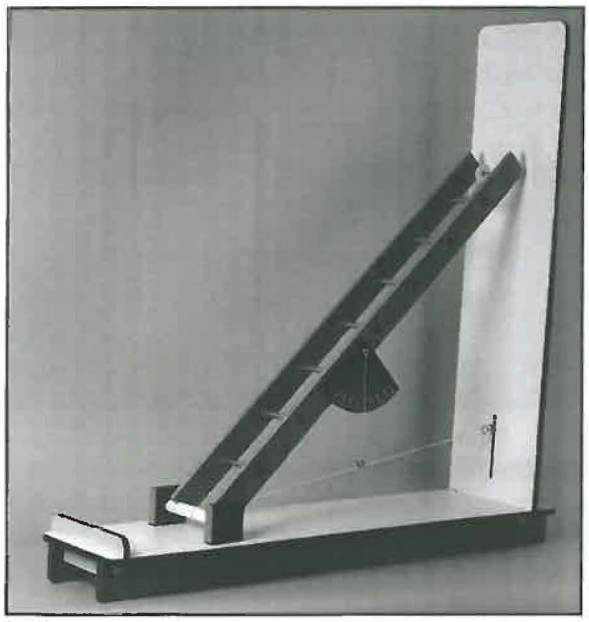
Deluxe Force Table
Here's the classic way to study force and vectors. Our lightweight, accurate device exceeds the degree of accuracy needed for most high school or college labs. Our 16" (40cm) diameter masonite disc balances on our sturdy cast-iron tripod base. The disc has a permanently printed decal with large, easy-to-read numerals graduated in two 360° scales to prevent parallax error. The weight harness snaps into place around a central ring. The base can be fine-tuned with leveling feet. Pulleys feature a low 0.04 Coefficient of Friction. **Includes**: 4 pulleys, 4 slotted "use anywhere" weight hangers; tripod base; force table with two scales; instructions with theory and sample problem. *You need slotted weights.*



611-0095
Force Table Paper™ (50 sheets)
Here's a new twist to your vector lab - do calculations right on the force table. Attach our paper circle with two 360° scales beneath the center pin. Discard when done or hand in with your lab.

14010
Force Table
Proved through years of classroom service and based on the principle that friction is easy to ignore in an earthquake, this 40 cm diameter table resolves angles to 0.5 degree. It uses glass quarter bends to display up to four vector quantities at a time using washers to represent their relative magnitudes. Gentle tapping on the table lets the center ring migrate unless the vectors represented are truly in equilibrium.

Simple Machines



14660
Learning Ladder
A four foot real ladder, made to a convenient scale, offers four choices of footing, an included clinometer and a base which provides a suitable vertical wall. The ladder can also be reversed to allow the upper wheels to ride on the base in order to study the relevant forces in more detail, with user provided instrumentation.

611-0031
Inclined Plane (With Pulley)
Use with ring stand or books. Our hardwood board (5 x 23-1/2") (12 x 60cm) has a low friction pulley at one end.

611-0260 Ball-bearing
611-0265 Plastic
Clamp Pulley
Turn a board into an inclined plane with this nearly frictionless pulley. 2" (50mm) diameter ball-bearing or plastic sheaves. ABS plastic. Adjusts to 3/4" (19mm).

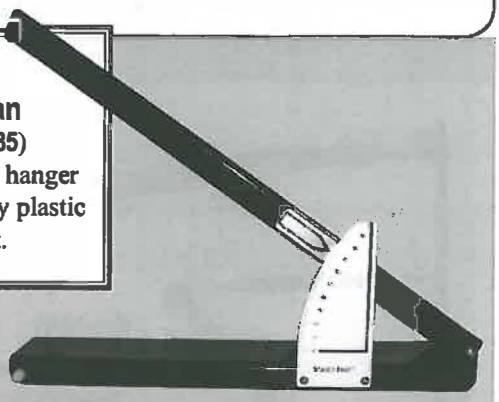
611-1030 Ball bearing
611-1035 Plastic
Pulley with Rod
Ideal for **inclined planes** that accept shaft diameters to 5mm thick and rods up to 10cm (4") long. Designed to fit our **611-0035** Inclined Plane (page xx), it features a low Coefficient of Friction of 0.04. **Includes:** aluminum rod; ABS plastic mount; ball bearing or plastic sheave 50mm (2") in diameter.

Accessories for Inclined Planes

611-1220	Variable Inertia
611-1215	Ring & Disk
611-0080	Friction Box
611-0082	Friction Cube
611-0085	Friction Blocks

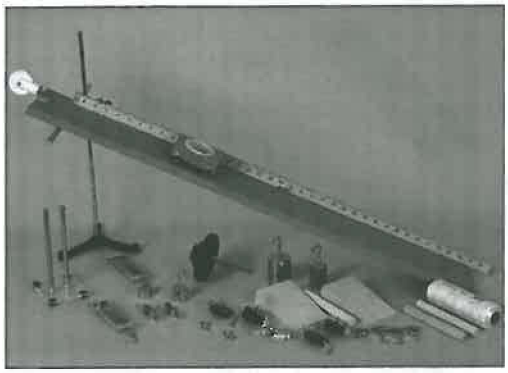
611-0050
Weight Pan
(For **611-0035**)
Strong wire hanger holds sturdy plastic cup upright.

611-0055
Economy Inclined Plane
Study friction at different angles. **Includes:** 60 x 10cm wood incline hinged to wood base, metal pulley, protractor, 3 friction boards (2 wood, 1 metal), weight pan, string, hooks. Instructions. 645 x 125 x 40mm



611-0035 Inclined Plane
611-1030 Pulley with rod, ball bearing
611-1035 Pulley with rod, plastic
Deluxe Inclined Plane
Here's the classic way to demonstrate the resolution of forces, uniform and accelerated motion and kinetic and potential energy. Our all- aluminum, accurate, easy to use device folds for storage and clamps to angles 0 to 45°. Rugged PVC protractor with high-resolution scale, special low-friction pulleys. Instructions. Accessories below.

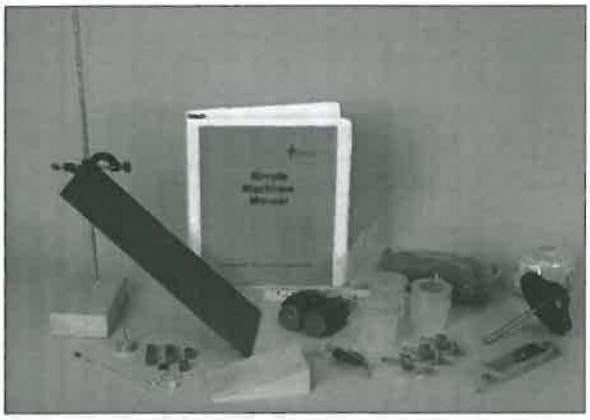
Simple Machines



32950

Simple Machines Deluxe

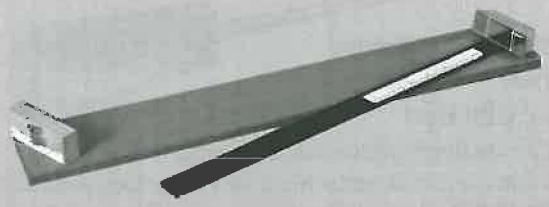
Standard size components in this assortment provide several levels of introductory experiences in the topic of mechanics. This durable collection emphasizes the basic principles of the six elementary classical mechanisms: lever, wheel and axle, pulley, inclined plane, screw, and wedge.



32955

Simple Machines Kit

Abbreviated components, selected for their simplicity and ease of operation, provide for 24 introductory mechanical experiences. Seventy-five pages of detail accompany the materials to support and encourage productive student inquiry and satisfying teacher demonstrations using the classical mechanisms: lever, wheel and axle, pulley, inclined plane, screw, and wedge. This kit includes specific experiments dealing with the effort arm with respect to levers of the first, second, and third class; reducing effort with a wheel and axle; fixed and movable pulleys to change the direction and amount of a force; inclined plane in the context of mechanical advantage; and the relationship between wedges and screw.



14200

Distance Measuring Apparatus

This one device demonstrates measuring very large distances (using techniques of parallax) and also very small distances (by applying the principles of an optical lever).

14650

Learning Levers

Four foot beam models three classes of the lever as a simple machine.

611-0410

Giant Lever

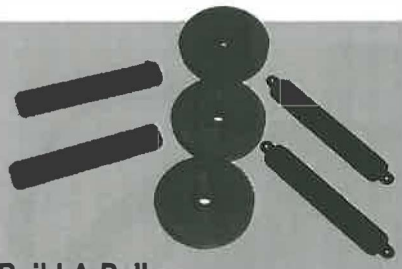
This brings the joy of the teeter totter to the mundane classroom. But it's not all fun and games: we've got work to do. Demonstrate a neat example of mechanical advantage. Place up to 100 pounds (or a student), show how mass can be lifted. 3 fulcrum positions.

611-0365

Simple Truss Kit

Quantify the effect of force on a basic mechanical derrick or truss. Introduce simple bridge building by exploring compressions, tensions, force and equilibrium. **Includes:** 0.5m knife edge with hooks on both ends; V-shaped clamp; instructions. *You need stand, hanger, spring scale, cord, slotted weight and protractor*

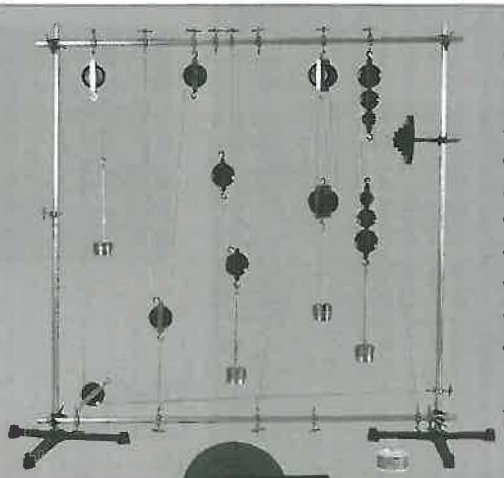
Simple Machines



Build-A-Pulley

Like building toys, these low friction modular pulleys snap together with interlocking brackets. Connect up to 6 for a lab in simple machines. Attach strings and hooks to bracket holes to create single, double or triple sheave pulleys. **Includes:** 3 sheaves (2"/ 50mm diameter); 2 end, 2 center brackets.

611-1050 Build-a-pulley
611-1051 Sheaves, pack 10
611-1052 Ends, pack 10
611-1053 Centers, pack 10



432720
Pulley Demonstration Kit

Everything you need to study block & tackle, wheel & axle, mechanical advantage! **Includes:**

- Stand, base/ rod units, 2
- Crossing rods, 5; pulley cord
- Wheel & axle; hook collars, 16
- Single pulley, 6; quad pulley, 2
- Slotted Masses: 10g, 2; 20g, 3; 50g, 5; 100g, 5
- Weight Hangers, 4

611-1040 Ball bearing
611-1045 Plastic

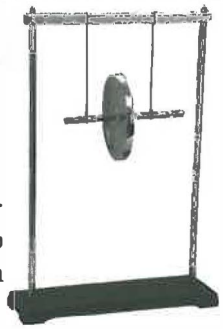
Tabletop Pulley

Ball bearing or plastic sheaves

This versatile pulley rotates 360°, adjusts up to 10cm, locks in place with a thumbscrew and fits surfaces 5cm thick. **Includes:** glass-filled nylon molded clamp and pulley; blue sheave 2" (50mm) diameter; stainless steel rod.

611-1065
Wheel & Axle

The mechanical advantages enjoyed by lever systems capable of continuous rotation can be shown by our Wheel and Axle. Our wheel has a ball bearing which turns on a single steel axle for the lowest possible friction. It is fitted with 4 coaxial pulleys in ascending sizes: 42, 58, 75 and 112mm diameter sheaves.



611-1890
Maxwell's Wheel

Investigate conservation of mechanical energy and momentum. Our wheel rolls to the top by a string wound on its axle, then turns potential energy into kinetic and rolls back. At the bottom, the wheel rolls up again. In an ideal world this continues forever; when friction sets in, the wheel will stop.

Economy Pulleys

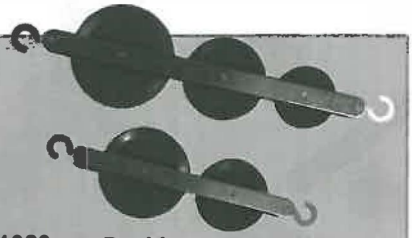
(Single to quadruple sheaves)

Good for experiments with pulley systems, these attach easily with included hooks. Determine mechanical advantage, velocity ratio and efficiency, "work" done by force over distance. **Includes**: metal frame with hooks, plastic sheaves.

611-1000 Single
611-1005 Double
611-1010 Triple
611-1015 Quadruple

611-1028
Atwood's Machine

Study linear and angular acceleration and force. Hang two masses of different weights over our pair of pulleys and observe the unequal gravitational forces that act on them. Based on a experiment by **George Atwood** in 1784, our device consists of two low-friction pulleys mounted on a metal rod. 1 lb (500g). 3 x 8" (7.5 x 20 cm). Instructions.



611-1020 Double
611-1025 Triple

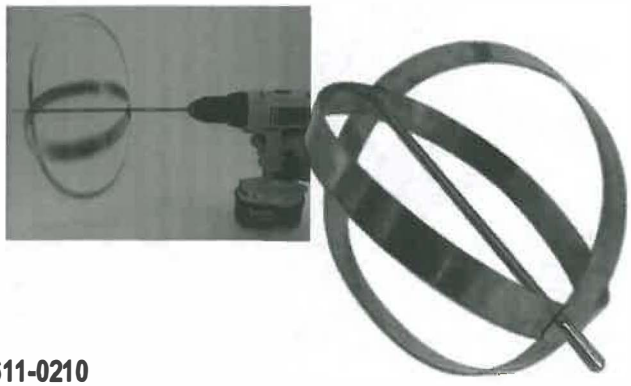
Inline Plastic Pulleys

These free-running tandem pulleys have 1, 2 or 3 rigid plastic sheaves and nickel-plated steel frames with hooks on either end. Single has 50mm sheave; double has 38 and 50mm sheaves; triple has 25, 38 and 50mm sheaves.

See pg. 12 for **Daedalon® Atwood Machine**

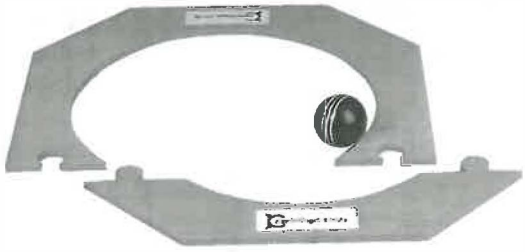
Rotation & Oscillation - Centripetal

611-1810
Centripetal Force Demo
Similar to the rotating candle, this shows centripetal force in a way that "goes against the grain". Two floats serve as pendulums inside clear water-filled jars. Since the floats are buoyant, they move opposite to the accelerating force when spun. **Includes:** tripod base with rod, 2 plastic jars with caps, bobber, cord, instructions.



611-0210
Centrifugal Hoops
These copper hoops are joined by a single shaft. Spin the shaft with your hands or drill and watch as the hoops change from a sphere to an oblate. A good way to show Earth's rotation.

611-1825
Rotating Candle Apparatus
A great way to understand centripetal force and centrifugal force. Why do the flames turn in instead of out when spun on the rotator?



14020
Centripetal Circle
Dispel a popular misconception! Our two part circular track causes the included large durable resin ball to move in a circle or tangent to that circle, but never radially.

See pg. 13 for
Beck® Centripetal Force

14004
Centripetal Demonstrator
How can loose links become a rigid wheel? Introduce a classroom "ring-a-round the rosie." Show that the sum of the forces on a link, or person, alway point to the center of the circle. *Needs variable drill.*

611-1800
Centripetal Force Kit
This PSSC kit can show the effect of mass, radius and velocity on the centripetal force of a rotating body. The experiment uses the weight of 1-20 one-gram masses from one end of a cord as a counterweight to the pull of a rubber weight swinging in a circle overhead. **Includes:** handle, sturdy cord, rubber weight, masses (20), instructions.

Rotation & Oscillation

611-0205
Rotating Platform
Turn your students into human gyroscopes. Now you can do the "skater's spin" without skates, rink or ice! Our stable 16" (40cm) wide bright blue wooden disc has a nonslip surface and safely holds up to 220 pounds (100kg). Used hands-on (or feet-on), it has very low friction with a weight of 100 lbs (50kg). Instructions with theory.

18750
Rotating Platform
Place this on a back-less lab stool or carefully stand on it, using outstretched masses or bicycle wheel gyroscope (#18700) to demonstrate torque and angular momentum. *Maximum 250 lbs*

32290
Coriolis Apparatus (ESCP) (The Science Source®)
This demonstrates that the Earth's rotation causes linear motion to be perceived as curvilinear motion, and is different in the Northern and Southern hemispheres. A ball can be launched from the center or from the edge of the rotating disk, leaving a carbon track on white paper.

611-0200
Bicycle Wheel Gyroscope
Spin this student-sized wheel, then try to tilt or deflect it. It turns freely on its axis and has large, comfortable handles. Because mass is concentrated at the rim, you feel the force of rotation. Instructions. (Stand on 611-0205, above, to begin to spin yourself!)

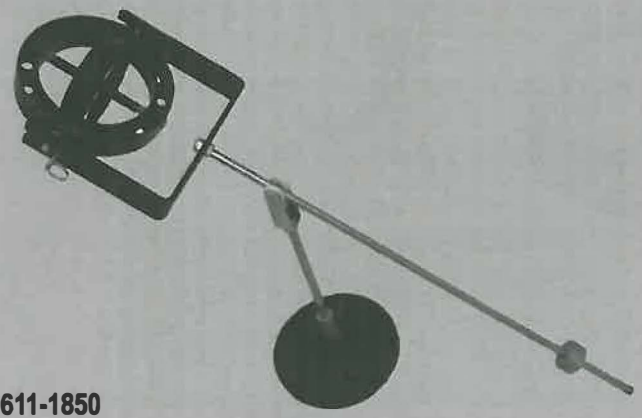
18705
Bicycle Wheel Gyroscope
Bring precession diagrams to life! This is easy to use by hand because of its smaller diameter, massive tire, and simple means of hanging and loading. Requires a rotating platform (#18750) and suspension line.

653-3045
Coriolis Effect
Named after the French mathematician, **Gaspard-Gustave Coriolis**, this shows the apparent tendency of moving objects to deflect when viewed against a rotating surface, such as an airplane across the globe. Drop a ball while spinning the platform and watch how it deflects. Contains turntable, launching mechanism, steel ball and sheet of carbon paper. Instructions.

18730
Gyro Studies
A rotational motion suite of products that includes a sturdy lab stool (#18725) with (#18750) turn table built in, a bicycle wheel gyroscope (#18700), two accelerometers (#611-1280), special rotary mounting arm, 2 bag-toss masses.

18725
Lab Stool
A rotational motion sturdy stool which has a turn table built in.

Rotation & Oscillation



611-1850

Counterpoise Gyroscope

A great tool for demonstrating precession and permutation under gravitational force. Our high quality gyroscope has a movable mass to balance the system. Placement of the mass will alter the direction of precession and allow the unit to rotate right or left.

611-1855

Loop-the-Loop

This high-quality apparatus easily demonstrates the transformation of potential to kinetic energy. Use the built-in ruler to measure the distance (in cm) the ball has dropped from its starting point at the top. We feature a two-sided plastic disc backdrop that allows for measurements in degrees or cm when the ball traverses the loop. **Includes:** steel balls (2), rubber-coated ball, sturdy wood base and instructions.

18650

Center of Mass

Roughly modeling an Earth - Moon system, two spheres can be adjusted on the connecting bar. A simple handle fits in a hole at the geometical center. The system balances and spins without wobble only about the geometrical center.

611-1831

Gyroscopic Stabilizer (With gyroscope)

Ever wondered what keeps today's enormous ships from rolling? Show a practical application of angular momentum. The sturdy ABS "ship" (8 x 8") has two runners that allow it to rock easily. The included gyroscope has a 3-1/2" plastic rim and 2" heavy metal wheel on a low-friction shaft. Spin the gyroscope and set it to enhance or dampen the ship's roll. Quantify by counting the number of rolls. **Includes** ship and gyroscope. Instructions.

611-1830

Deluxe Gyroscope (With gimbal cradle)

Explore the mysteries of precession, inertial guidance, gyroscopic compasses, stabilization. This hands-on, precision-machined demo runs up to 3 minutes. Dynamically balanced 6 cm diameter steel rotor has near-frictionless bearings. Gimbal cradle with cone bearings pivots to hold the spinning gyroscope. **Includes:** pull string and handle; plastic base; plastic rocker with gimbal cradle; washers; support hook; and instructions.

Properties of Solids

Metal Specimens (Singly or Set of 3)
Measure density by determining the mass and volume. 50mm x 13mm diameter. Instructions.

611-2060 Set of 3
611-2062 Steel
611-2063 Brass
611-2064 Copper

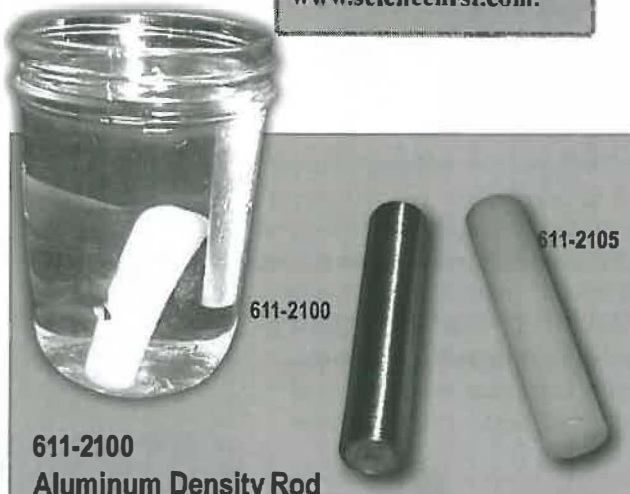
611-2010
Specific Gravity Blocks (Set of 4)
Rectangular blocks in four different metals are 13 x 13 x 50mm.

611-2055
Specific Gravity (Set of 9)
Large enough for younger children to handle. Densities 0.05 to 19g/mL. **Includes:** 7 cylinders, 32 x 5.5mm (carbon, aluminum, brass, PVC, copper, polyethylene, steel); glass sphere; styrofoam lump. Instructions. Each 1cc in volume.

Putting Science *First* since 1960

Free science video: How to appreciate Newton's Genius? Check out our science videos at **www.sciencefirst.com.**

611-2065
Specific Gravity Cubes (4)
25mm cubes with hooks on one face for easy handling. **Includes**: 1 each, aluminum, brass, plated steel and zinc; instructions.



611-2100
Aluminum Density Rod
Precisely calibrated cylinder floats in cold water and sinks in hot, proving water's differing density at different temperatures. 6.5 x 1.9cm. Fits most graduated cylinders. Instructions

611-2105
Reverse Density Rod
Why does high-density plastic *sink* in cold, yet *float* in hot water? It becomes less dense as it heats. 6.5 x 1.3cm, weighted & tested. Instructions.

Properties of Solids

611-2180
Density Ball Set (4, Mixed)
Polypropylene, acrylic, HDPE (high density polyethylene), steel. 3/4" (19mm) diameter

611-2175
Density Ball Set (4, Plastic)
4 different plastic balls are in our set, each 3/4" (19mm) in diameter (acrylic, acetal, nylon, polypropylene).

Wood Physics Ball
611-1915 25mm, hole
611-1920 38mm, hole

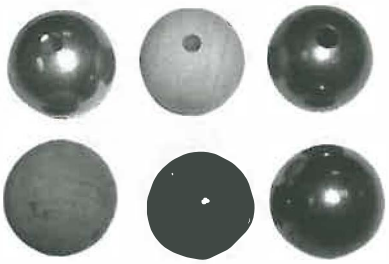
Aluminum Physics Ball
611-1925 19mm, hole
611-1930 25mm, hole

Glass Physics Ball
611-1935 19mm, solid
611-1940 25mm, solid

Steel Physics Ball
611-1945 13mm, solid
611-1950 19mm, solid
611-1955 25mm, solid, soft
611-1960 19mm, hole
611-1965 25mm, hole

Cork Physics Ball
611-1970 19mm, solid
611-1975 25mm, hole

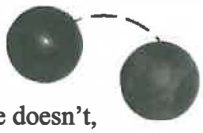
Polypropylene Physics Ball
611-1980 25mm, hole



611-1985
Small Ball Set (Set of 6, 19mm)
3 drilled - aluminum, steel, wood, 3 solid - glass, steel, cork.

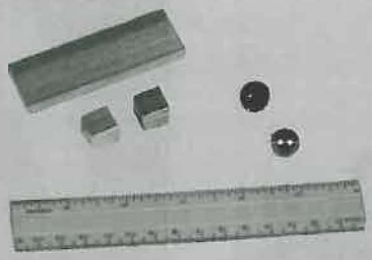
611-1990
Large Ball Set (Set of 5, 25mm)
3 drilled - aluminum, cork, wood, 2 solid - glass, steel.

611-0385
Leaning Tower of Pisa
Show that bodies in stable equilibrium cannot tip unless their center of gravity is raised. Stack cylinders so the heaviest is on the bottom. If placed on an incline, you'll have to raise it quite high until the "tower" falls. What if the lightest is on the bottom? **Includes:** 4 cylinders, 1 x 3/4" - aluminum, steel, PVC, and polyethylene; center pin; instructions.

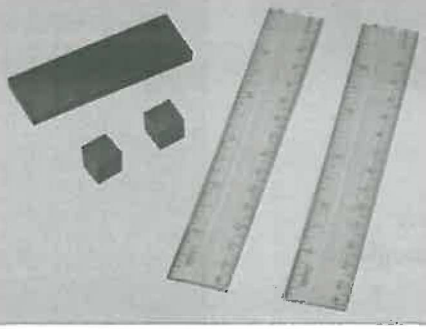


Happy-Sad Ball
One bounces and one doesn't, although they look identical. Why? One is made of "happy" rubber, the other of specially-formulated "sad." For studies in elastic and inelastic collisions. Instructions.
611-0380 Happy & Sad (1 each)
611-1900 Happy Ball
611-1905 Sad Ball

3-7900-A10
Polyester Line
Polyester braided line is durable and won't stretch. 65' (20m), 1/8" (3mm) diameter.



16210
Density of Solids Kit
Show that volume and mass relate to density. This simple kit gives your class tools to investigate D = M/V. Includes steel and glass balls (1.3cm), 2 aluminum cubes, aluminum bar, 15cm metric ruler. Class kit has 10 kits.



16243
Metal Cubes & Slab Set
Two cubes (steel, aluminum) and aluminum slab, all the same color, demonstrate the relationships of mass, volume, and density. The cubes have the same volume but different mass and density. **Includes:** two 15-cm rulers.

Properties of Solids

Aluminum	Brass
Copper	Acrylic
Pyrex™	Rubber
Tecaform™	PVC
PTFE	Nylon
Poplar	Oak

611-2000

Density Identification Set (Set of 12)

Twelve samples with different densities

It's a puzzle - it's a lab - it will separate the sheep from the goats. Ask your class to identify each of 12 different samples by determining their density. Each cylinder varies in size and density since it is constructed of a different material. All are 1.3cm (1/2") in diameter and range between 4 and 7cm in length. **Includes:** 12 samples, plastic storage rack, instructions.

Aluminum	Brass
Copper	Acrylic
Pyrex™	Rubber
Tecaform™	PVC
PTFE	Nylon
Poplar	Oak

611-2140

Mystery Density Set (Set of 12)

"What's the density?" may be hard to answer. Here's one way to do so, quickly and accurately. Twelve specimens look alike, but are two different plastics. When placed in water, some float and some sink. Graph mass over volume and analyze the results. **Includes:** 12 samples, 6 each of two plastics; wood holder with linseed oil coating; instructions.

611-2160

Pressure Paradox Kit

What weighs more, a large styrofoam ball or a small heavy steel ball? The light styrofoam ball,of course. or does it? Show how the sense of touch changes how we feel pressure. Great introduction to density.

Copper	Brass	PVC
Aluminum	Bronze	Delrin™
PTFE	Stainless steel	

611-2002

Density of Solids

Use this innovative set to determine the specific gravity of a material by graphical methods. It consists of four samples each, 8 different materials, arranged in a binary weighting sequence. Each weight is double its predecessor (10, 20, 40, 80 grams), for 15 individual determinations of specific gravity. These results are plotted on a graph. The slope is the specific gravity of the material. **Includes:** 8 sets of 4 masses; sturdy weight hanger; instructions with worksheets.

Aluminum
Brass
PVC
Tecaform™

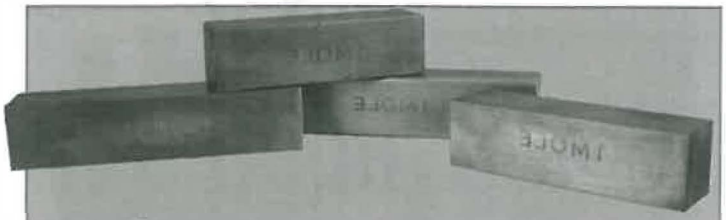
Density Sample Sets (Set of 12)

When is one lab four? When it contains samples in 4 different materials. Each set has 12 specimens of the same material, machined to different lengths. Determine the mass and volume of each sample and graph. The slope of the straight line that results is the material's density. **Includes:** 12 samples in your choice of four (4) materials, wood holder coated in linseed oil for protection, instructions.

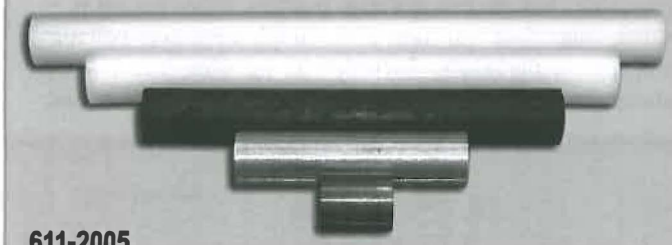
611-2030	Aluminum, 12
611-2035	Brass, 12
611-2040	PVC, 12
611-2045	Tecaform™, 12
611-2050	All 4 sets, 48

Properties of Solids

15435
Mystery Masses
This counter-intuitive "ice-breaker," at the beginning of any science course, draws sharp attention to the process of observation, and the role of the senses, in scientific inquiry. Includes five blocks of the same size and mass and five steel balls of the same size and mass. Requires participant voting.



673-0115
Mole Set
The same concept as the Mole Box but in solid form. **Includes** one mole (6.03×10^{23} particles) of four metals: aluminum, copper, iron and zinc with stamped symbol. Learn why a mole of iron atom weighs more than aluminum. Instructions.



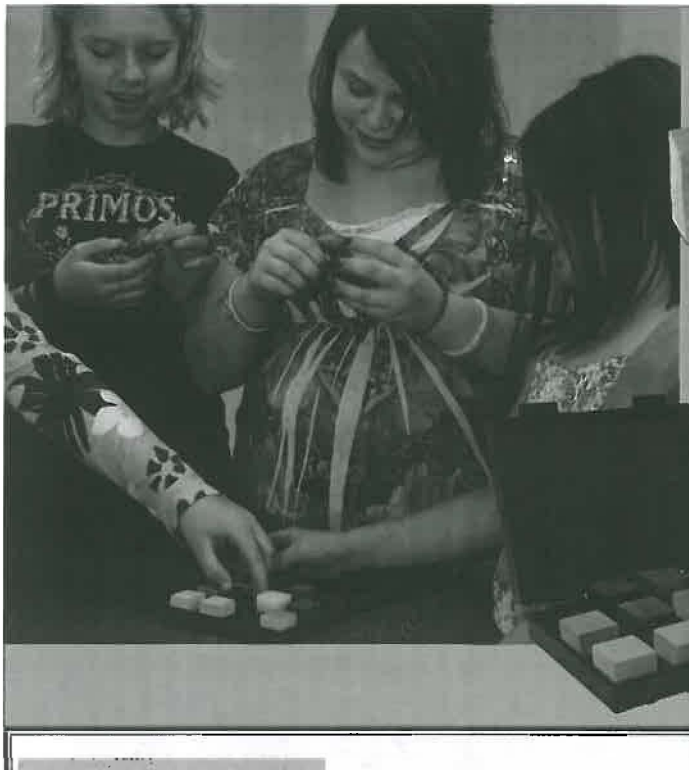
611-2005
Equal Mass Set (Set of 5)
Show the inverse relationship between density and length for the same mass and diameter. **Includes:** 5 specimens - brass, polyethylene, aluminum, nylon and PVC - each 12mm diameter but with different lengths, instructions.

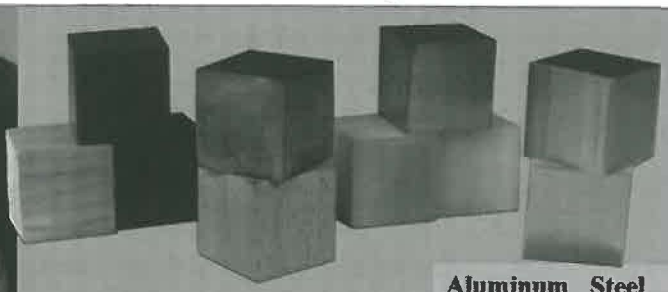
671-1000
1,000 Cubic Centimeter Cube
This doubles as a decimeter cube and is 10 x 10 x 10cm.
- Nine slices, each 10 x 10 x 1cm
- Nine pieces, each 1 x 1 x 10cm
- Ten cubes, each 1 x 1 x 1cm
- Handy storage case. *Wt: 750 grams*

611-2130
Volumetric Shapes
Make the abstract concrete. Our blocks help you visualize volumes and geometric shapes. Although they look different, several shapes may actually possess the same volume or capacity. **Includes:** 16 wood blocks in unique shapes (cone, sphere, cube, cylinders, pyramids, prisms, triangles, hexagons, pentagons) in included case. *Case may vary.*

611-2185
Geometry Blocks
Studying ideal geometric shapes, like these, can lead to an understanding of the imperfect shapes found in nature. Our colorful set **includes:** 3 cones, rectangular prism, square prism, cube, sphere, 2 nesting cylinders. Instructions.

Properties of Solids

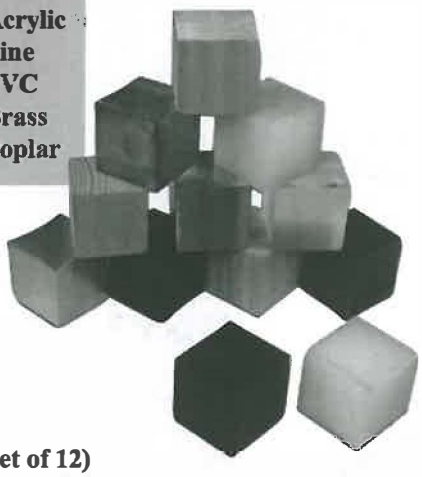




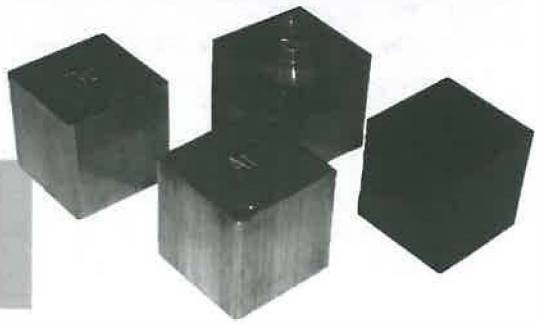
Aluminum	Steel
Brass	Oak
Copper	Acrylic
Nylon	Pine
PVC	Poplar

611-2025
Density Blocks (Set of 10)
These ten 1" (25mm) cubes can be used in many experiments. What makes them unusual? They represent materials we actually use today. Learn about density, mass, volume, buoyancy, specific gravity and flotation using real building materials. **Includes:** ten cubes in common metals, plastics and wood, with instructions and plastic case.

Aluminum	Steel
Copper	Acrylic
Polypropylene	Pine
Lignum Vitae	PVC
Nylon	Brass
Oak	Poplar



611-2026
Density Blocks (Set of 12)
Similar to the Set of 10, but with 2 extra cubes. Lignum Vitae (ironwood), one of the heaviest and hardest woods in the world, sinks in water, although your students may expect it to float. Dense plastic polypropylene floats in water, although your students may expect it to sink. 12 one-inch cubes, with instructions and handy storage case.



Aluminum
Copper
Steel
Brass

611-2020 Set 4, no hooks
611-2065 Set 4, with hooks
Density Blocks (Set of 4)
(4) 1" (25mm) cubes: copper, steel, brass, aluminum. Stamped with chemical symbol. With or without hooks

611-2075
Lignum Vitae Cube
Our 2.54cm (1") "ironwood" cube is ideal for density and buoyancy experiments since it sinks in water. It is one of the hardest and heaviest woods. Specific gravity is 1.28-1.37g/cc.

Brass
Steel
Aluminum
Zinc
Copper

611-2021
Mini Cubes (Set of 5)
Tiny cubes in 5 common materials have a mini price. Show the differences in different metals, each stamped with their chemical symbol. Perfect for graduated cylinders and small plastic beakers. Because each side is 10mm (3/8"), measurements are easy.

Properties of Solids

611-2095

611-2090

611-2085

Overflow Can

Does your cup (or can) runneth over? Fill our displacement cans with water just to the point of overflow. When you place an object such as a block or sample in the can, an amount of water equal to its volume gushes through the angled spout and can be caught in the catchbucket and later weighed.

611-2085
Classic Overflow Can

Our essential overflow can has 750mL capacity and is 13cm high, 10cm diameter. Can is aluminum with molded plastic angled spout.

611-2095
Clear Overflow Can

480mL capacity, 10cm high and 9cm diameter. One-piece clear plastic construction to prevent leakage.

611-2090
Catchbucket

All-aluminum. 300mL capacity, 7.5cm high and 7.5cm diameter. Use the attached handle for hanging from a balance. Weigh the water displaced from overflow cans.

611-2150
Density Experiment Kit

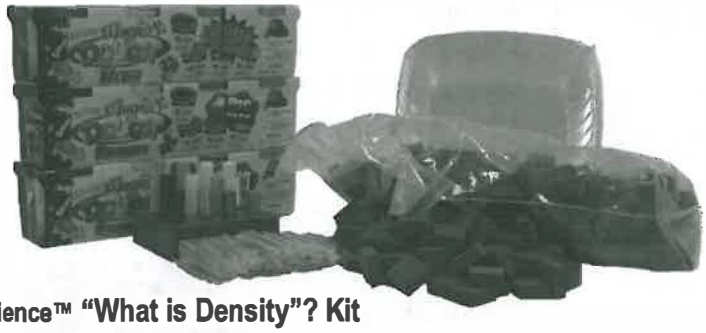
Budget-conscious density lab kit has three (3) density samples, overflow can, catchbucket, spring scale and instructions.

611-2070
Aluminum Sinker
(With hook)

Find the specific gravity of aluminum. Ours fits neatly in a graduated cylinder. 19mm diameter x 75mm.

611-2145
Density Specimen
(With hook)

Steel specimen has a thin coating of zinc to prevent rust. 20mm diameter x 45mm long. With hefty hook for easy handling.



611-2125
Accent Science™ "What is Density"? Kit

Density is a term often misused and misunderstood that describes how closely-packed the particles of a substance are. It is usually expressed in terms of comparison. Here, the comparisons are made to water, because the results are obvious: the less dense substance will rise to the top, or float. By modeling gases, liquids and solids (dough figures progressively more compact) and floating them in water, your class realizes that it is the volume, not weight, that matters. **Includes:** cans of colored Magic Dough; **611-2000** Density ID set (12 specimens); 12 plastic containers; 250 toothpicks; 300 blue foam squares; instructions with journal pages.

Meets National Science Education Standards & Benchmarks of Science Literacy

Glass
Aluminum
Nylon
Wood

611-2015
Equal Volume Mixed Material
(Set of 4)

Our four cylinders each have the same volume. 13mm x 7.5cm.

Properties of Gases

Science First®

NseS

611-2330

Force Cups™

No vacuum pump needed

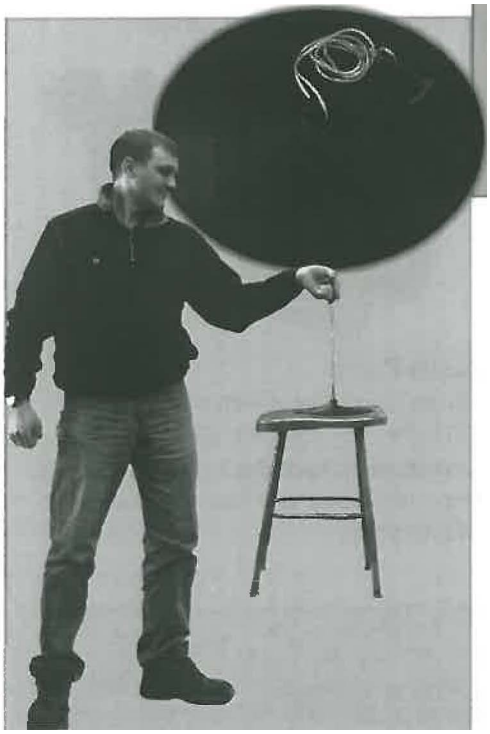
These student-friendly rubber cups can be placed together and squeezed to force out the air inside. They then prove surprisingly hard to pull apart. **Includes:** two cups, 7.5cm in diameter, attached plastic handle.

611-1125

Accent Science™ Air Pressure Kit

Everything you need to experiment with air pressure!

- **Magdeburg Hemispheres:** two plastic half-spheres, handles, high quality pushbutton valve. 1/4" diameter pressure tubing. Withstands 180 lbs of force
- **Weight of Air Cylinder** - 1000 mL can with plastic valve and tubing
- **Vacuum Lifter** - 10.5" diameter rubber disk with handle and rope
- **Force Pressure Cups** - Soft rubber suction cups
- **Breaking Board Paradox** - 10 thin slabs of wood
- **Hand Vacuum Pump** - Displaces 725 mL of air with 2-way pump. Plastic tubing, gauge in cm and inches Hg.
- Instructions tied to National Teaching Standards



611-2370

Vacuum Lifter

This doesn't look like much, but its effects are surprising. Demonstrate the impressive strength of air pressure! Place our mat on a flat surface and lift up with the handle. Why does it "stick" to the surface? 27cm diameter. **Includes:** mat, handle, instructions

Good for science fairs

611-2375

Water Hammer

The water hammer is a great demonstration of properties of a vacuum. Show how a liquid can act like a solid. With instructions.

611-2325 Magdeburg
611-2365 Student Pump

Magdeburg Hemispheres

Our plastic half-spheres withstand 180 pounds (80kg) of force when pumped free of air. Pass them around the class - try to pull them apart. **Includes:** two ABS plastic hemispheres, 4.75" (12cm) diameter; plastic exhaust valve; molded handles; brass pushbutton valve; illustrated instructions. *Needs vacuum pump.*

Properties of Gases

The "Bell in Vacuum" base plate can be used to show what happens in a vacuum. Balloons expand! Shaving cream explodes!

611-2340

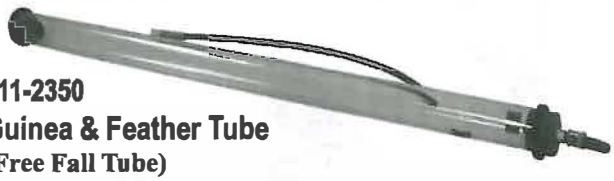
Bell in Vacuum

Nature, of course, abhors a vacuum - and sound waves won't travel through one. Prove it with a ringing bell inside a sealed glass jar. As air is pumped out, the bell becomes faint, then dies. **Includes:** jar, vacuum plate with valve, rubber seal, vacuum hose, bell system, instructions. Bell may be removed for other vacuum experiments. *You need vacuum pump, vacuum grease, and 2 AA batteries.*

32090

Buzzer in Vacuum

To demonstrate that sound requires a medium, the bell gets fainter as the air is pumped from the container. A safety mesh is included that completely covers the container.



611-2350

Guinea & Feather Tube

(Free Fall Tube)

This counterintuitive experiment must be seen to be believed. Galileo used the guinea (coin) and feather to show how items fall at the same rate in a vacuum despite their relative weights and sizes. **Includes:** 81cm clear plastic tube; 2 rubber caps, one with hose cock; hose to evacuate tube; weight set; instructions. *Needs vacuum pump.*

Best Seller

611-2365

Student Air Pump

Experiment with air pressure, vacuum filtering, and check for leaks. Displaces 725mL of air. Pump rate of 15mL with a gauge in cm and inches Hg. Clear tubing is 24" (60cm), 1/4" (6mm) inner diameter.

611-2355

Hand Vacuum Pump

This sturdy pump has two standard 9mm hose connectors, steel barrel and valve, wood handle, and molded rubber piston with triple O-ring seal. 35cm long, 2.5cm diameter barrel, stroke length 19cm, displaces 66mL/stroke.

611-2360

Motor Driven Vacuum Pump

Direct drive motor-driven pump comes with a built-in gauge. It works from 0 to -30 inches Hg. 1 micron ultimate pressure, 2-stage rotary vane construction. **Includes:** oil level indicator; vacuum pump oil. Use with Guinea and Feather (above) and Bell in a Vacuum. 14 x 14 x 6" (35 x 35 x 15cm).

611-2335

Collapsing Can

When evacuated by a hand pump, the can crumples right before your eyes. You can also boil water inside to drive out all the air, then cap it and let it cool. **Includes:** rubber stopper with hose nipple and screw cap. 21 x 13 x 9cm.

611-2345 Weight of Air
611-2365 Student Pump

Weight of Air

The air we breathe is not an abstraction. Prove it by weighing our can *before* and *after* pumping it out. The evacuated can weighs 1/2 gram less - why? **Includes:** 1000 mL seamless aluminum can with plastic valve and hose; instructions. *You need: scale/balance, vacuum pump*

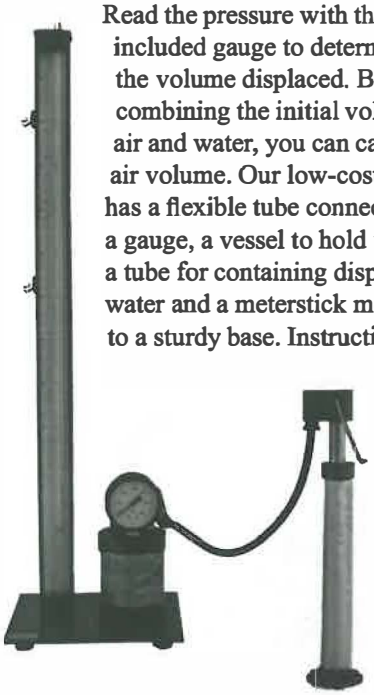
Properties of Gases

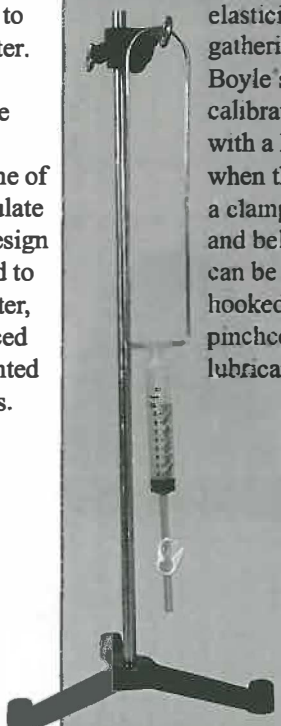
16250
Elasticity of Gases
This widely used and low cost apparatus is ideal for gathering data in support of Boyle's Law. It is supplied with a cap to seal the calibrated syringe and a packet of lubricant. A series of uniform masses (such as textbooks) are added to the top platform and the corresponding volume is read on the way down and again on the way back up to give useful average values. Students then plot pressure versus the reciprocal of the volume in search of a straight line.

611-2300
Boyle's & Charles' Law Demo
The discovery of the Gas Laws goes back to 1662. But it needn't take a few centuries to understand the concepts. Verify both Boyle's and Charles' Law accurately. **Includes:** syringe, 2 round wood blocks, one slotted; rectangular block with hole; instructions with sample data. *You need weights, calipers, beaker; thermometer.*

611-2308
Boyle's Law & Absolute Zero
Visualize the relationship between pressure, volume and temperature of gases. To show **Boyle's Law**, connect the calibrated syringe to the gauge. View pressure change and graph results as the volume of gas changes. To show **Absolute Zero**, connect a metal sphere to the gauge and immerse in water. Read pressure changes from the scale, graph temperature versus pressure and extrapolate to determine absolute zero. With instructions.

611-2302
Advanced Boyle's Law Apparatus
Leave nothing to chance. Add precision to your lectures on the gas laws. This unit works by pressurizing a vessel to displace a small amount of water. Read the pressure with the included gauge to determine the volume displaced. By combining the initial volume of air and water, you can calculate air volume. Our low-cost design has a flexible tube connected to a gauge, a vessel to hold water, a tube for containing displaced water and a meterstick mounted to a sturdy base. Instructions.





19350
Hanging Boyles Law
This low cost apparatus is ideal for demonstrating the elasticity of gases and for gathering data to validate Boyle's Law. A 10 ml calibrated syringe is fitted with a long bail so that when the body is held with a clamp, pressures above and below atmospheric can be explored using hooked hanging masses. A pinchcock and quantity of lubricant are included.

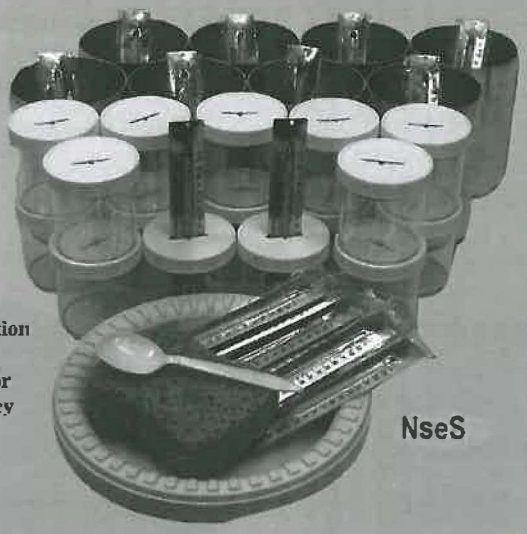
14775
Modeling States of Matter
Mechanically modeling liquids, solids and gases is easy with our device. Measure and graph the behavior of simulated gas under different temperature and pressure conditions. **Includes**: clear plastic tube; floating piston; electric motor; vial of breads; magnetic particles; pegboard stand base; hardware kit; student study aqnd alysis sheets. *You need low voltage power supply.*

Properties of Gases

611-2270
Diving Bell
The diving bell has allowed mankind to breathe underwater. Used by **Alexander the Great, Bernoulli** and **Pascal,** it is a submerged container with air pressure inside holding the water out. Our simple demo contains a bell, syringe and tube. Draw air out with the syringe; place the ball in water and watch it sink. When you inject air slowly back into the ball, it rises.

611-2305
Absolute Zero/ Gay Lussac's Law
Use this device to demonstrate the direct relationship of pressure and temperature of a constant volume of gas by measuring the pressure of a known amount of confined gas at several temperatures. It contains a sealed volume connected to a pressure gauge. Bulb diameter 100mm. *You need thermometer.*

32000
Absolute Zero
Demonstrate the relationship between the temperature and pressure of a gas, and illustrates the meaning and approximate value of absolute zero. A sealed volume connected to an absolute reading pressure gauge is immersed in liquid nitrogen, ice water, and boiling water to give three widely spread points on a temperature versus pressure graph which can be extrapolated to give an indication of absolute zero.

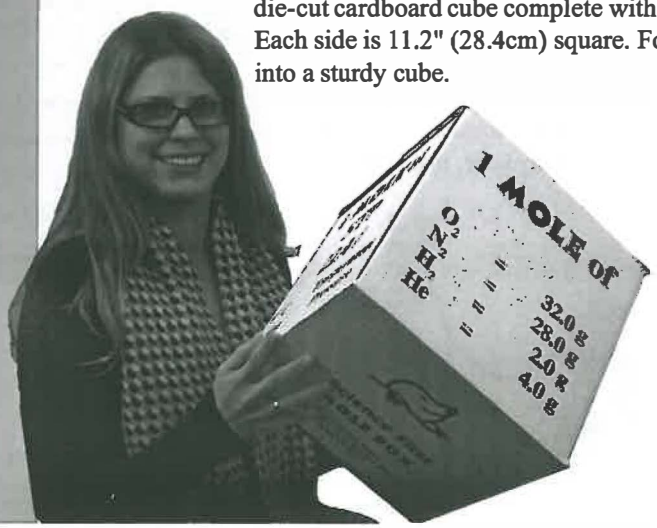


Meets National Science Education Standards & Benchmarks for Science Literacy

NseS

673-0090
Accent Science™ Water Cycle Lab (For 32 students)
Find out why clothes dry on the line and a can of cold soda pop is wet. Create dew and measure the dew points of air samples. Study the how and why of frost and learn how humidity affects dew points. Enough supplies for up to 32 students. Instructions, Journal Pages and worksheets tied to national standards. **Includes:**
- Thermometers, 16
- Aluminum cans, 8
- Containers & slotted caps, 16
- Sponge
- Tablespoon
- Plastic plates, 8

673-0110
Mole Box
How to visualize what a mole of air really looks like? Make it "hands-on" with our die-cut cardboard cube complete with mole! Each side is 11.2" (28.4cm) square. Folds into a sturdy cube.



Properties of Gases - Rocketry

17005

Launch Pad

Molded resin launch pad for use with our single Bottle Rocket Launcher #17000. This is good for use on playgrounds, parking lots, drive ways or anywhere else that you cannot secure the Bottle Launcher with soil.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

17007

Bottle Rocket Launcher & Pad

Investigate conservation of action and reaction with this solid, durable metal launcher equipped with a simple triggering mechanism! Turn almost any plastic soda bottle into a rocket with water as the propellant. Vary the fin size and placement; vary the water level and air pressure; and measure rocket altitude with the included paper astrolabe. You can even loft a full-size soccer ball! Launcher stakes must be pushed into the ground or supported by the Launch Pad. *You need bicycle pump*

17000

Bottle Rocket Launcher

Turn any plastic soda bottle into a rocket with this solid, durable metal launcher. Vary the fin size and placement, vary water level and air pressure, measure altitude with the included paper astrolabe - even loft a soccer ball! Investivate the conservation of action and reaction momenta. Launcher stakes must be pushed into the ground or supported by Launch Pad #17005 (shown - sold separately), and then aligned to the direction of launch. Featires simple trigger mechanism.

17010

Dual Bottle Rocket Launcher

Launch two bottles at the same time with a single lanyard! Good for competitive events or to compare rocket performance features. Launcher must be stuck into the ground and aligned to the intended direction of launch.

Properties of Gases - Rocketry

611-2430
Multi Stage Bottle
Use our modified 2-liter bottle with 1/2" diameter hole through its base for mounting the Multi-Stage Adapter.

611-2435
Thrust Restrictor
Study effects of varying thrust on performance. Our adaptor screws on a soda bottle. **Includes** 9 restricting holes ranging from 10% to 90% thrust in 10% increments. Instructions with experiments. *Bottle not included.*

611-2315
Aneroid Barometer
This wall mounting barometer is inexpensive but accurate. 12cm diameter case holds 10cm diameter dial. Includes thermometer and hygrometer.

611-2310
Bourdon Gauge
This method of measuring the pressure of liquids and gases is as useful today as when it was invented in 1849. Our unit contains a curved metal tube, closed on one end. When the air pressure inside the tube increases, it uncurls, turning a pointer to show pressure directly in psi. **Includes:** 100 mm dial; cast metal base; 3 mounting holes on frame; nozzle on post for connections (3/8" / 9mm O.D). Calibrated 0-30" Hg (0-750mm).

611-2410
Single Stage Kit
The basics for convenient, reliable launching of water rockets. **Includes:** launching mechanism on adjustable, foldable tripod base; fuel line to pressurize rocket; lanyard to trigger rocket's release; and an extensive, illustrated manual.

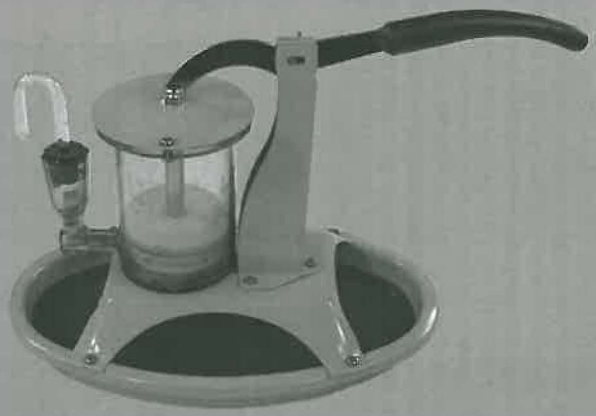
611-2415
Single Stage Launcher
The same launcher found in **611-2410**, right, but without the tripod base. Launch several rockets at once or make your own launch pad. **Includes** fuel line, lanyard, safety clip and assembly instructions. *Needs 1/2" diameter hole in your base.*

611-2420
Multi Stage Kit
Here's everything you need to start launching multi-stage water rockets. We include tripod base, pressurization hose, single stage coupler, modified first stage bottle and second stage coupler. *You need water and compressed air.*

611-2425
Multi Stage Launcher
Break the barrier! Launch multi-stage water rockets with this easy-to-use adapter. **Includes** second stage coupler, safety clip, lanyard, instructions. *First stage bottle not included.*

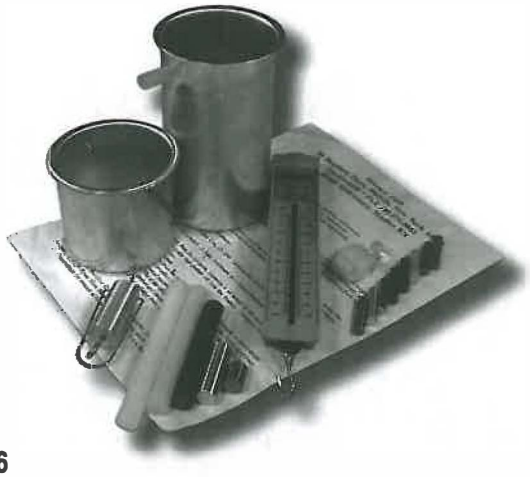
Properties of Liquid

611-2220
Lift Pump
Show how air pressure moves water
This well pump works like a siphon. **Includes:** 2 valves inside a clear cylinder with handle; spout; metal supports and basin; instructions. Color may vary.



611-2225
Force Pump
Demonstrate the operation of a force pump. When the plunger is pulled up, water fills the larger cylindrical chamber. When the plunger is pushed down, water returns to the reservoir. Color may vary.

611-2240
Pascal's Ball
Our hollow sphere connected to a hand pump shows that water pressure transmits in all directions equally through ten equidistant nozzles. 3" (7.5cm) diameter, 250mL. Instructions.

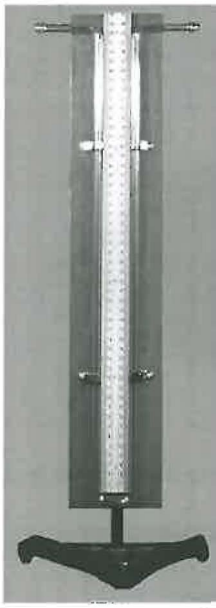


611-2266
Hydrostatic Studies Kit
This low-cost kit explores critical concepts. Experiment with immersion and liquid displacement, buoyancy and Archimedes's Principle. Instructions. **Includes:**
- Overflow can with angled spout
- Catchbucket for use with can
- Equal mass set
- Specific gravity set (9); spring scale

611-2115 Large
611-0005 Scale, 250g
Large Archimedes's Principle
Large and easy to handle, this is good for class demonstrations. Divisions on cylinder and cup allow repeat experiments with different volumes. Capacity 100mL. Instructions. *You need spring scale, overflow can, beaker.*

611-2110 Archimedes
611-0005 Scale. 250g
Archimedes's Principle
A solid cylinder with ring and a close bucket of equal volume suffer an apparent weight loss in water due to buoyancy. When taken apart and immersed again with the cylinder hooked on the bucket, water equivalent to the weight of the cylinder can be weighed. 5.5 x 2cm bucket, 4.5 x 1.5cm cylinder. Instructions, Dacron™ line.

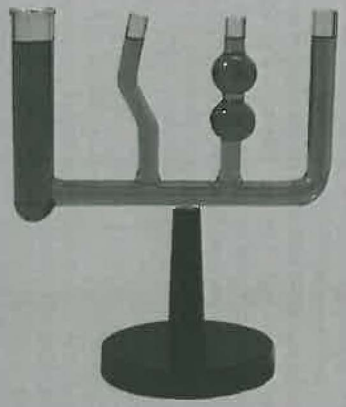
Properties of Liquid



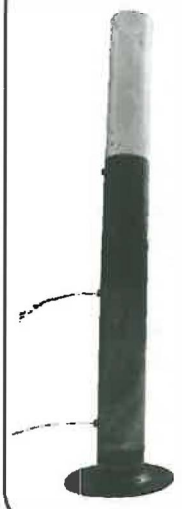
611-2245
Demonstration Manometer
Measure the pressure of gases and show how columns of liquid can oscillate. Our Borosilicate glass U-tube is large enough to be seen by the entire class. Contains riffled arm to connect to rubber tubing. Mounted on sturdy metal base with metric scale. 50cm high tube has both ends open. *You need colored water.*

611-2155
Density Ball
The density of water depends on several factors. Our ball sinks in warm water because its density is reduced, yet floats in salt water because its density is increased. **Includes:** metal ball, 4" (7.5cm) in diameter, with density less than that of water; instructions. *You need thermometer, hot water or heat source.*

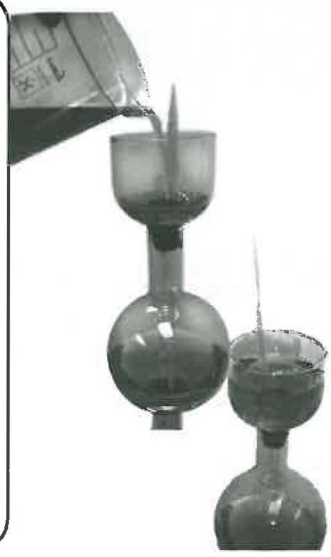
611-2232
Viscosity Tubes
Viscosity describes the flow resistance of a fluid under tensile or sheer stress. Compare the visocities of 4 different fluids. A rod with magnets holds 4 balls in place. Remove the rubber stoppers and suspend the rod and balls above each tube. Release the balls at the same time by pulling the rod. Time how long the balls take to fall through each liquid. Use the red marks for comparison.



611-2230
Equilibrium Tubes
Our solid base holds four (4) different-shaped tubes that show that liquid levels are independent of the shape of the containing vessel. Enlightening.



611-2380
Perforated Jar
Everything reacts differently to pressure, even fluids. Show how a fluid changes behavior even under its own weight. Fill our clear tube with water and watch the water shoot out at different rates of speed through 3 brass nipples. Water at the bottom will have the most water above it, increasing pressure and rate of speed at which it spouts. Water pressure decreases proportionately for the two upper nipples. Unbreakable polycarbonate tube, stand, 3 brass nipples, instructions.



611-2250
Hero's Fountain
Always fascinating! As water in the top enters the lower bulb, it forces the air upward, compressing more air in the upper bulb. The water has nowhere to go but out. 50cm high, with instructions.

Properties of Fluids – Conductivity

611-2260 Conductivity Tester
674-0035 15 watt bulb

Conductivity of Water Tester

Determine the conductivity of different liquids with this qualitative device which causes a bulb to glow when water conducts electricity. No shock hazard due to built-in ALCI. **Includes:** plastic body with recessed connections and electrodes; detailed instructions. Attaches to standard ring stand. 110 volts AC only. *Needs bulb, below.*

611-2261

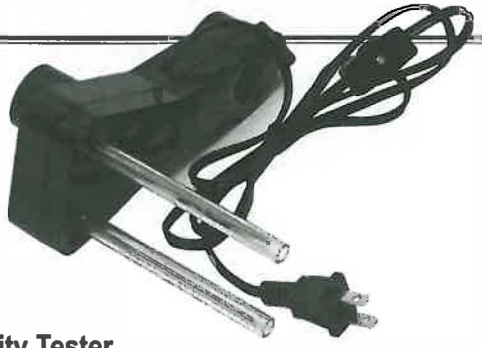
Conductivity Meter

Visually compare conductivity of solutions. Green LED (numbered 1-10) light up as the brass probes are dipped into solutions of salt or acid. Each light represents a level of conductivity.

611-2263

Blinking LED Meter

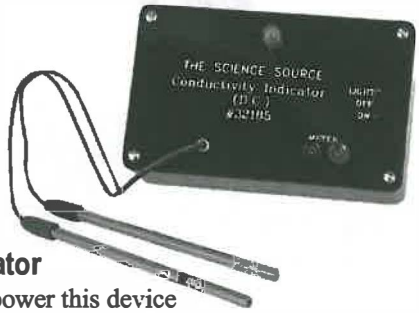
When both electrodes are submerged in a solution, our little meter struts its stuff. It remains off if the solution is non-conductive but glows dully in a weak one. When encountering a strong conductor, it blinks brightly.



15080

Conductivity Tester

Test the conductivity of different liquids or the difference in concentration of the same solution. The brightness of an AC powered lamp depends on the conductivity of solutions into which its electrodes are placed. Electrodes are shielded to prevent accidental contact.



32185

Conductivity Indicator

Two internal C-cells power this device that provides switch selectable indications of the conductivity of materials in contact with the probes. One position allow a milliammeter to give a quantitative indication, the other position allows the lamp to give a qualitative one. Batteries and meter are required.

611-1295

Soap Boat

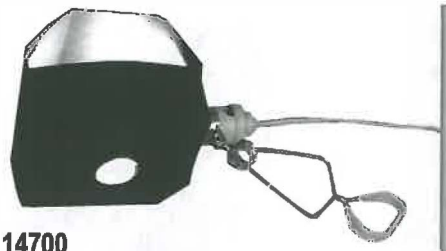
Use this to display a dramatic effect of surface tension. Put the light-weight plastic boat in water and fill the rear reservoir with hand soap. As the soap drips out over the stern, it coats the water and lowers the surface tension. This creates a force on the bow of the boat, making it creep forward. Experiment with different types of soap. With instructions.

611-2265

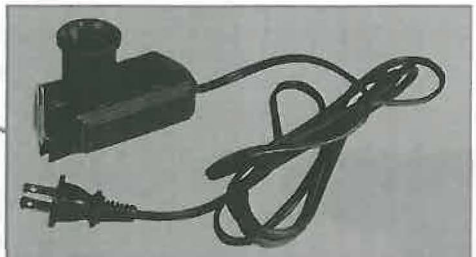
Glass Cartesian Diver

What a display of Archimedes' Principle and compressibility of gases! Fill a soda bottle with water, drop in the "diver", close and squeeze the bottle. As pressure increases, the diver descends, then rises when it decreases.

Optics



14700
Light Source
A specially made clear 150-w bulb is mounted inside a fully vented flat black shield. The bulb can be rotated to provide a straight-line source or an end-on point source. Complete with cord, socket, spring clamp, and Pole Cat®.



32490
Lamp Support
Our socket has a screen clip and slider clamp for attaching to a meter stick optical bench. Fits medium screw base lamp. **Includes:** supply cord and plug.

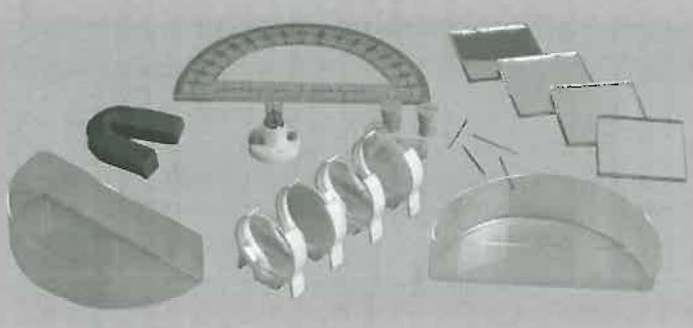
14200
Distance Measuring Apparatus
Demonstrates measuring very large distances using techniques of parallax and also very small distances by applying the principles of an optical lever, all with one apparatus.

See pg. 15 for
Daedalon® Optics System

16285
Floating Images
Explore real and non-real images in the context of focal length and image and object distance. Our two concave reflectors can be cradled to display the familiar floating image. **Includes** assorted stands and holders.

18605
Barbershop Mirror Set
Investigate the formation of multiple images! Our unique mount holds two thick, plastic mirrors vertically, one of which has a hole in the center. Multiple images seem to go on forever, sparking great discussions.

15050
Optical Materials
For investigations into reflection, refraction, Snell's Law, lens optics and image formation, this **includes:** 2 lenses and holders, 2 plane mirrors, semicircular dish, light source, protractor, pins, plasticene, and cork stoppers. *1.5 volt light source required.*



15055
Optical Materials Fifth Edition
Investigate reflection, refraction, Snell's Law, lens optics and image formation. We include 4 lenses & holders, 4 plane mirrors, 2 semicircular dishes, 2 light sources, protractor, pins, plasticene, and cork stoppers. *Needs 1.5V light source.*

Optics

See pg. 15 for Daedalon® Optics System

614-0122
Deluxe Optical Bench (With light source)
Demystify optics with our 1m illuminated optical bench. Components slide freely along the length of the extruded aluminum rail or can be fixed at any point. **Includes:**

- 2 pedestal ends, 5 sliders, graduated scale plate
- 40mm diameter and 30mm diameter convexo-convex lens
- 36mm diameter convexo-convex lens before light source with movable bulb
- 50mm diameter convexo-plane lens
- 80 x 120mm piece of frosted lens
- Candle support, I-shaped screen, white screen, card holder, supports. *Needs power supply*

614-0665
Laser Tank
We use a low power laser beam and a circular tank filled with water to show refraction and reflection. As the tight, bright beam bends, its angle can be read on the scale printed around the tank. The laser is permanently fixed to the tank and can be pointed at any angle. Fill the tank with mineral oil or other liquids to vary the effect. Laser meets US safety standards and tank is fully water-tight.

614-0160
Optical Bench Supports
Heavy duty, plated metal supports hold meter sticks 7mm thick.

614-0165
Meter Stick
Double sided hardwood. Centimeters on front; inches on reverse.

614-0155
Candle Holder
4-pronged metal holder supports candles up to 1.5cm diameter on your meter stick optical bench.

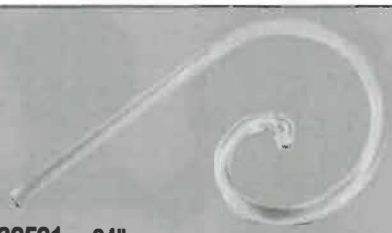
614-0135
Screen Support
This metal support holds a cardboard or metal screen where you need it on an optical bench.

614-0125 Lamp
674-0035 Bulb
Light Source
Medium 15 W lamp and receptacle mount on meter stick support. *Requires* **674-0035** *bulb.*

614-0145 Small
614-0146 Large
Lens/ Mirror Support
Special supports hold lenses and circular mirrors. Small (4-5cm) or large (7-8cm) diameter.

614-0140
Object Marker
Used as an image for lens and mirror experiments performed with an optical bench.

Optics - Refraction



32521 24"
32522 48"

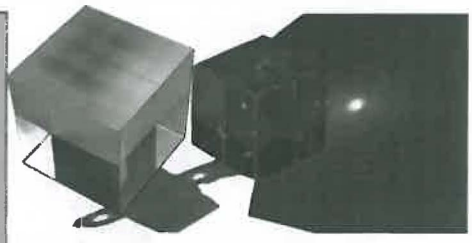
Light Pipe

Our long acrylic rod, although curved, conducts light by internal reflection. It transmits light along its length but also leaks light along the way, causing the entire length of rod to light up. Works with any lamp or flashlight. 24" rod has one circle, 48" rod has two.

611-1615

Acrylic Refraction Rod

Demonstrate the path of light through our unique rod - even through its elongated center loop! Place in sugar water or mineral oil and watch how light output dims at the other end. This is because the index of refraction of the rod matches that of the liquid and allows the light to escape.

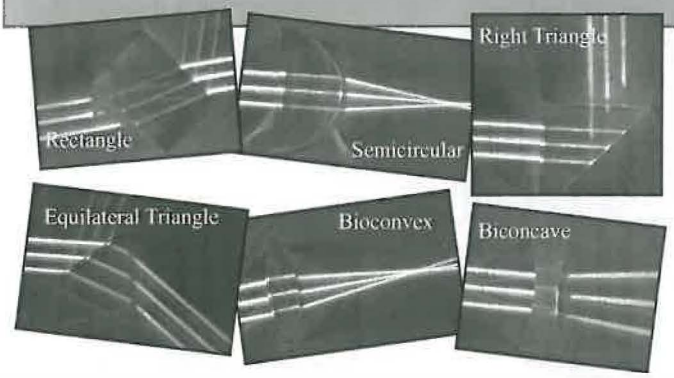


614-0290 25 x 25 x 25mm
614-0285 50 x 50 x 50mm

Refraction Cube

(1.5 Index of Refraction)

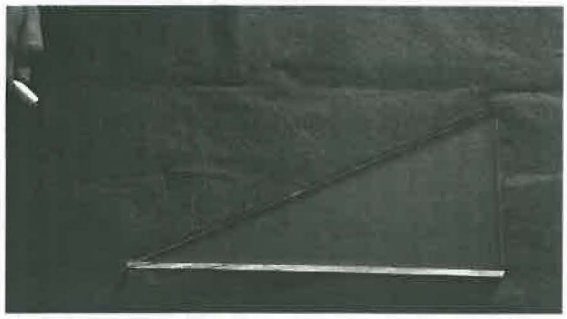
We call it the "disappearing cube" since it is invisible in sugar water. But it's also perfect for Index of Refraction and Total Internal Reflection experiments. Its 5cm square faces are of transparent and highly polished acrylic. With instructions.



Optics Blocks (1.5 Index of Refraction)

Each high quality, extremely clear acrylic block has polished edges and frosted bottom to minimize dispersion. Use with a ray box, laser or other light source. Available separately or as a set. Each block is 3/4" thick, ~ 2 to 3" high, ~ 2 to 3" long.

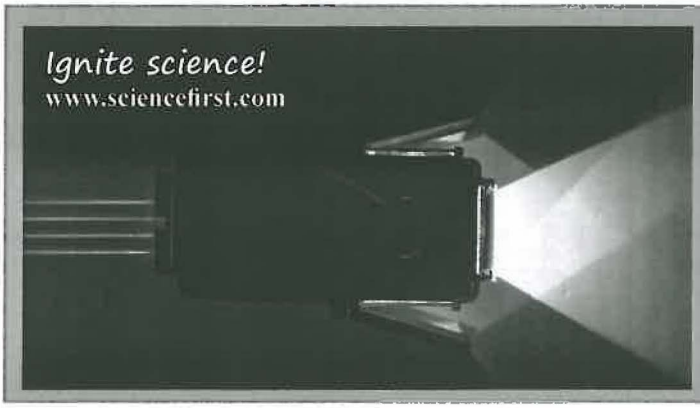
614-0591	**Rectangular**
614-0592	**Bi-convex**
614-0593	**Bi-concave**
614-0594	**Semicircular**
614-0595	**Right Triangle**
614-0596	**Equilateral Triangle**



Large Refraction Blocks

These huge optical blocks are larger than any others on the market. Use for refraction and reflection demonstrations that can be seen from across the room. Made from sturdy 0.5" thick acrylic, with polished edges. Instructions with experiments.

614-0295	**Square**	**12 x 12 x 0.5"**
614-0296	**Rectangle**	**12 x 6 x 0.5"**
614-0297	**Right Triangle**	**12 x 6 x 0.5"**
614-0298	**Equilateral Triangle**	**12 x 12 x 0.5"**
614-0299	**Circle**	**12" diameter, 0.5" thick.**



614-0670

Optics Box

A complete optics kit in one nifty package. Study color mixing, reflection, prisms, parallel and convergent rays and more - with better equipment than that used by the scientists of old! Molded plastic housing is durable and features magnets in the bottom to allow for use on the blackboard. Kit **includes**: color filters, mirrors, prisms, ray cards, color gels, replaceable bulb and instructions.

Optics - Prisms

614-0050

Acrylic Prisms (Set of 6)

Perform refraction experiments and study the behavior of light with this handy set of six prisms. All are made of 15mm thick acrylic with polished sides. **Includes:** rectangular (75 x 50 x 15mm); semicircular (90mm base); equilateral (75mm sides); double convex lens (90mm, 23mm at center); two double concave lenses (90mm, 10mm at center); wood box with storage.

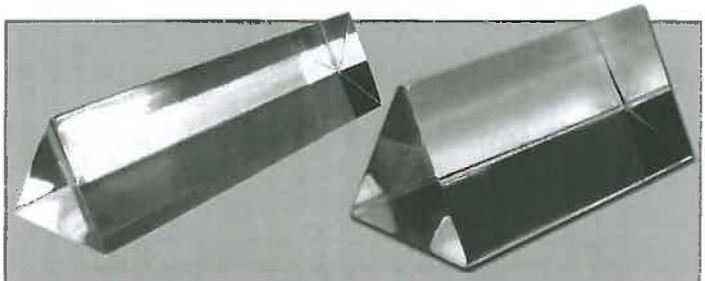
614-0265

Optical Glass Prisms (Set of 5)

Constructed of 20mm thick optical glass, this set of five (5) high-quality prisms has a refraction index of 1.62.

Glass Blocks

614-0600 Semicircular glass lens, 90mm base, 45mm radius.
614-0605 Rectangular glass block, 750 x 50 x 180mm.
614-0610 Large rectangular glass block, 114 x 62 x 180mm.



Acrylic Equilateral Prism

Experiment with diffraction, dispersion and spectrum formations with highly polished acrylic prisms.

614-0250 20 x 50mm
614-0255 25 x 75mm
614-0260 25 x 100mm

Glass Equilateral Prism

Highly polished glass prisms ideal for dispersion of white light into its spectrum colors, refraction of light studies, and prism spectrometer principles.

614-0422 25 x 50mm
614-0425 25 x 75mm
614-0450 25 x 100mm

Glass Precision Equilateral Prism

This glass prism has 3 -25mm sides

614-0455 60° x 60° x 60°,

15025

Half-Round Plastic Boxes (Set 12)

Refraction Cups - semicircular clear plastic boxes for optic experiment. Fill with different liquids to show refraction properties. Using Snell's law determine the index of refraction. 12 cm diameter. Package of 12

614-0470

Giant Water Prism

Produce a spectrum the whole class can see! Fill our 16" acrylic right angle prism with water or mineral oil. Integrated lid, 1/4" acrylic panels that resist rot and abuse. With spout and instructions.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

Optics - Strobescope - Hand Strobe

611-1625
Portable Stroboscope
The 5-digit LED digital readout on this economical stroboscope gives the exact number of flashes per second. Charge it & take it anywhere to clock rotational velocities. Features include: xenon flashlamp, solid-state design, 3 modes (RPM, Hz and mSec). Uses internal or external signal source.

611-1620
Variable Speed Stroboscope Rotator
This provides an adjustable rotation from 0-3200 RPM. View the digital readout in RPM or Hz. A central chuck supports your stroboscope disks (not included). 20 x 12 x 26cm. Uses 115V AC 60 Hz.

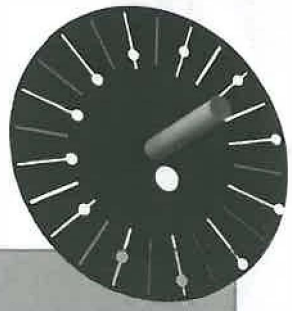
611-1610
Deluxe Stroboscope
Our 5-digit LED digital readout gives the exact number of flashes per second. Features **include:** xenon flashlamp, solid-state design, 3 modes (RPM, Hz and mSec). Can use internal or external signal source. Can be fine-tuned. Uses 120V AC, 60/50 Hz. **12-15,000 flashes/ minute**

614-0240
Color Wheel
Our 9" (23cm) diameter wheel has 4 distinct quadrants, each with *red, orange, yellow, green, blue, indigo, and violet wedges*. An attached handle can be set spinning with an included cord. At rest, the wheel's colors are separate. Is this true when it's in motion? **Includes** plastic handle, wheel with white wedges for maximum light reflection, cord on spool, Teachers Guide with questions.

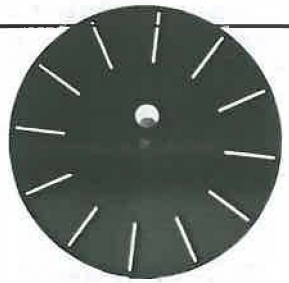
614-0800
Hand Driven Stroboscope
Our hand driven stroboscope is a low-cost way to view stroboscopic images in the class. Spin our plastic wheel and look through its slits to "freeze" action.

14502
Hand Strobe (Adjustable)
This 25 cm hardboard disk has 12 equally spaced radial slots and a second plastic disk with a scale marked to allow selecting 1, 2, 3, 4, 6, or 12 slots for changing the strobe frequency while maintaining a comfortable rotation.

14510
Hand Strobe
This device has three rows of equally spaced, precision machined slots. Change position of eye lets to view 3, 6 or 12 images per revolution. Good for repetitive motion & rudimentary timing.



14516
SHM on Hand Strobe
The phenakisticope printed on the back allows the user to view in a mirror the image of simple harmonic motion. Can also be used as a stroboscope.



14515
Hand Strobe
5th Edition

Optics - Spectrum Tubes

614-0200

Michelson Interferometer (Magnetic parts)

This new twist on the Michelson-Morley device measures the small differences in time needed for two separate light beams to travel two different paths. An interference pattern is produced by splitting a beam of light into two paths, bouncing the beams back and recombining them. The different paths may be of different lengths or composed of different materials to create alternating interference fringes on a screen. Positioning the magnetic optical components on our metal base is easy and accurate. The distance can be adjusted without a ruler as the base contains a permanent grid at a 45° angle. Unlike other models, we include all parts needed to measure the coefficient of linear expansion of a metal. **Includes:** red laser pointer; metal base with scale; optical components with magnets; 3 rods: brass, aluminum, steel; special diffraction grating separate light into two points.

Spectrum Tubes

We've found a unique source for high-quality tubes that produce bright, well-defined, unique spectra when the gas inside is excited before a spectroscope. Because they are 9 5", shorter than some other tubes, you need our **614-0796** power supply.

All spectrum tubes work with **614-0796** supply, which works with any size spectrum tube. However, our tubes may not work with all power supplies - they may be the wrong size.

614-0720	**Argon**
614-0730	**CO_2**
614-0745	**Helium**
614-0750	**Hydrogen**
614-0760	**Krypton**
614-0765	**Mercury**
614-0770	**Neon**
614-0775	**Nitrogen**
614-0780	**Oxygen**
614-0790	**Xenon**

614-0796

Spectrum Tube Power Supply

Specially designed to energize our shorter spectrum tubes, above, this safe and effective power supply adjusts to handle tubes of any length.

614-0072

Spectrum Projector

(Project STAR PS-20)

Two labs in one: our simple device produces a diffracted beam of light in two directions. Study spectrum changes as temperature and brightness of a light bulb vary. Graph the projected spectrum with our paraffin spectrum analyzer. Study colored objects in different light. Instructions. **Includes:**

- Lamp holder with dimmer
- Diffraction grating square, 2
- Cardboard tube, 2
- Collimated lens (53mm), 2
- 200-watt clear light bulb
- Paraffin block and small mirror sets
- Bottle, 6
- Filter sheet (6 x 6"), 4
- Red, blue and green felt (2 of each)

Optics - Spectroscope

Science First®

Refracting Telescope Kit (Project STAR PS-04B)
Galileo made astonishing discoveries with instruments just like this. Build a 16-power refracting telescope which shows how lenses work without an optical bench. **Includes:** inner/outer cardboard tube; plastic lens (43mm diameter, 400mm focal length); plastic lens (17.5mm diameter, 25mm focal length); foam holder; cardboard spacer; plastic cap (2); activity book.

654-0000 Single
654-0010 Bulk/ 10

614-0040
Spectra of the Elements Kit
Assemble a spectroscope and compare a variety of light sources. Demonstrate component colors of light and experiment with color filters. **Includes:**

- 24 spectroscopes, 15 handles, 4' wire
- Sodium hydrogen carbonate; chloride bottles
- Potassium chloride; potassium nitrate bottle
- Cupric chloride bottle

15605
Spectrum Analysis (Set of 24)
Ten different chemicals are included along with a standard means of introducing them into a burner flame. Materials are also provided to assemble twenty-four simple spectroscopes having a fixed slit with which students can individually view the bright line spectra of elements in the burner flame.

614-0701
Cylindrical Spectroscope
Produce great colors with superior optics and an accurate diffraction grating. View the spectral diffractions of light sources, flames, solutions, colored glass and excited gases. Separate white light; show the difference between incandescent and fluorescent light right in the classroom. **Includes:** metal spectroscope with focusing adjuster, instructions. 100mm x 25mm dia.

Spectroscope (Packs of 6, 15 or 24)
Once assembled with a fixed slit at one end, and a mounted diffraction grating at the other, these can be used to examine incandescent and fluorescent lights, flame tests and filters.

15610 24 Pack
15611 15 Pack
15612 6 Pack

Optics - Spectroscopy

614-0065
Project STAR Diffraction Gratings
Demonstration Grating
Nearly 100 times more efficient than acetate, our special grating produces a spectrum equivalent to 750 lines per millimeter. It can be seen in the classroom and is good for overhead projectors. 10cm x 12.5cm, mounted between glass to prevent scratching. 4 plastic filters (red, yellow, green and blue).

614-0070 Slide
614-0068 Slides, pack 10

Slide Mounted Grating (Single or 10 pack)
We mount a 24 x 36mm high resolution grating in a standard 5 x 5cm slide mount for affordability. **Includes:** 35mm standard glass slide mount.

Unmounted Grating Sheet
This low-cost 13cm square grating material can be used as a demonstration grating or cut into smaller pieces for individual use. Pack of two (one square with 4 colored filters), or as a bulk roll, 6' x 5.5" (13 - 5.5" squares)

614-0075 Unmounted
614-0066 2 sheets, 5.5 x 5.5"
614-0067 6'x 5.5" roll

614-0055
Night Spectra Quest
This is the same basic by which astronomers discovered the composition of distant stars. Identify the spectra of typical night lights in your community with our integrally-mounted holographic diffraction grating (spectroscope). 3 x 6-1/4" (7.5 x 16cm). Instructions & color pocket chart.

Putting Science *First* since 1960

614-0210
Plastic Spectrometer
(Project STAR PS-14/ Plastic)
Made with a high-dispersion, high-efficiency diffraction grating, this high-impact plastic spectrometer produces an easy-to-read spectrum. With 10-page activity booklet and scale labeled in both electron volts and nanometers. Activities **include:** Identify light sources, Identify elements in flame spectra, solar spectra, street lights

654-0020 Set of 10
654-0025 Single

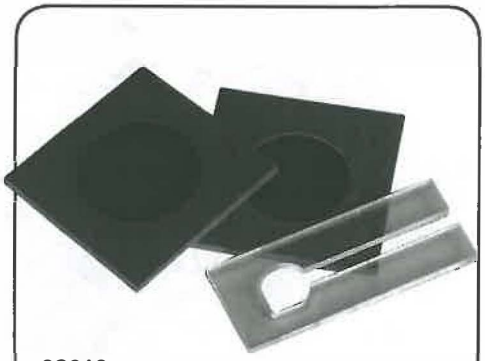
Cardboard Spectrometer Kit (10-Pack or Single)
Project STAR PS-14/ Cardboard (For grades 9 - college)
Explore the mysteries of light in all its wonder and complexity. Our ready-to-assemble spectrometer includes a 35mm film strip and scale in nanometers or electron volts. Instruction book. Kit **includes:**

- Plastic disk, 1" diameter, with diffraction grating, 10
- Top and bottom set, cardboard, 10 sets
- Styrofoam set, long and short pieces, 10
- Support tube & cardboard, 10; nut & bolt set, 10 sets
- Film strip w/ slits & wavelength/ photon energy scale, 10

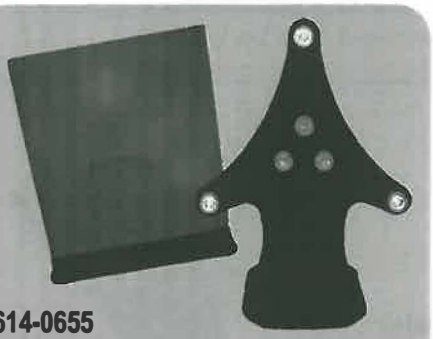
Optics

32530
Polarizer
To observe small optically active materials between crossed polarizers, a capped tube is arranged with polarizing film at both ends. The film can be rotated to suit the application.

614-0805
Polarization Slides
Polarized light has oscillations at a specific angle. To physically separate the ray, you need a polarizing filter or slide. Our low-cost kit makes experimentation fast and easy. **Includes:** 2 plastic filters (4 x 4"). When aligned correctly, they pass maximum light. When rotated 90°, they pass no light. With instructions.

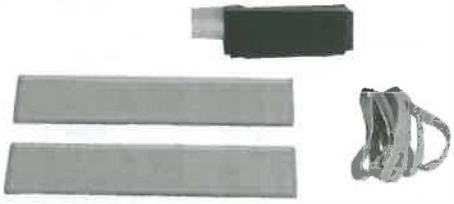


32613
Novel Crossed Polarizers
A change from typical square-cut polarized sheets - these polarizing materials were die-cut into a circle and mounted in a square frame.



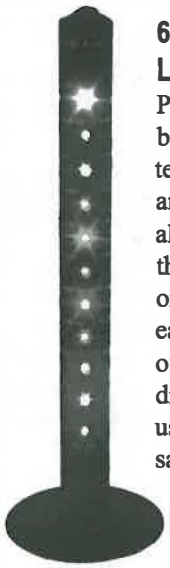
614-0655
Color Mixer
How do blue, red and green lights make white? Study primary/ secondary colors, color creation/ perception, additive/ subtractive color mixing, and reflective light. We include 6 super-bright, dimmable LED's (two each blue, red, green), 3 on rim and 3 in center (inner cluster creates most intense color). Three screens contain clear and blacked-out centers to expose or conceal white light. Substantial 1/8" steel frame with a carry handle. Instructions.

614-0657
Mini Color Mixer
Color science can be hard to understand because it seems counter-intuitive. That's why you need our battery-powered portable unit, which weighs mere ounces. Blue, red and green LED's shine onto a special screen. Each dimmable LED is bright enough to be seen in an ordinary room. With rugged ABS plastic housing;instructions. *You need three AA batteries.*



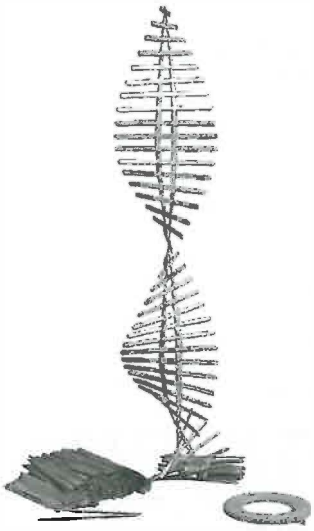
15040
Flat Glass Plates
Explore thin film interference and develop a way to measure the thickness of materials. Our plates are sandwiched such that the sample is on one side, forming an air wedge. Requires a monochromatic light source (#16880).

614-0660
Ray Box
Like a laser box but more economical! Show color mixing, generate parallel rays for refraction and reflection experiments, more! Simple enough for introductory optics, yet powerful enough for advanced studies. Includes fan. The best of both worlds!

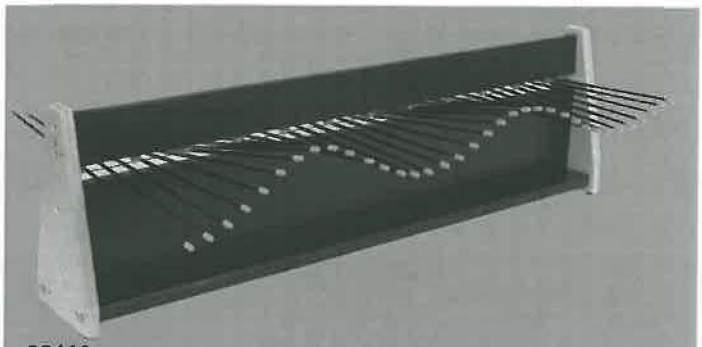


614-0650
LED Array
Produce a full spectrum of brilliant colors with LED technology. The lights are mounted on a sturdy aluminum stand for viewing through a spectrometer or diffraction grating. For easy reference, wavelength of each LED are printed directly on the stand, which uses low voltage DC for safety. Instructions.

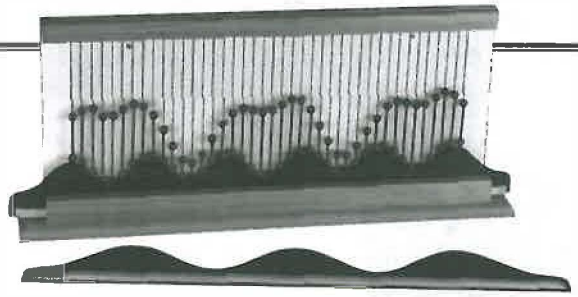
Waves & Sound - Wave Motion



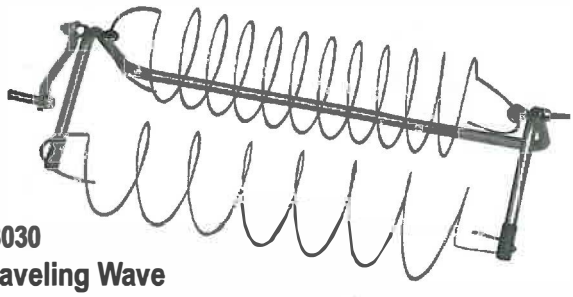
20500
Wave Sticks
Explore wave speed, reflection & refraction polarities, transformers & impedance matching with this novel torsional wave demonstration set. **Includes:** 400 sticks and special narrow tape. *Assembly required*



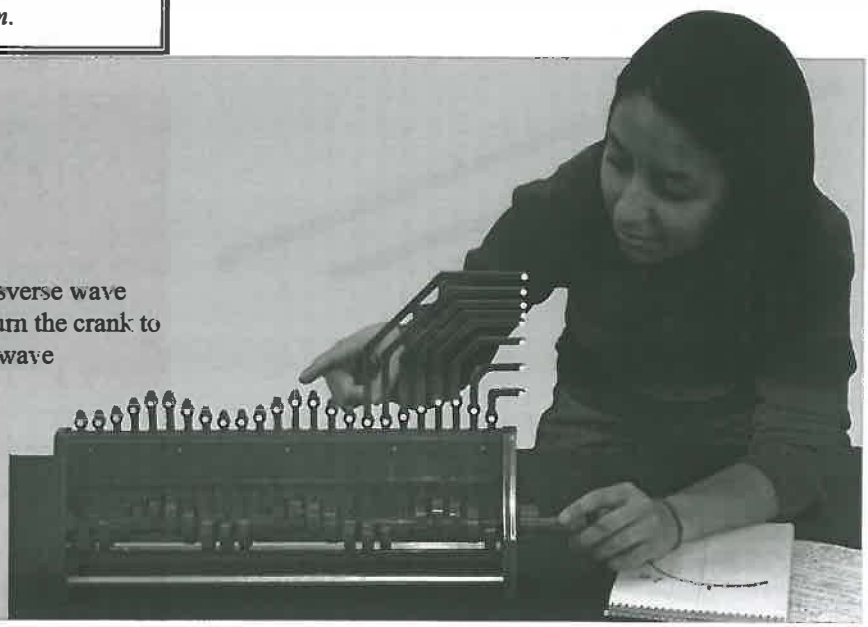
33110
Wave Motion
The inertia of massive rods creates slow, majestic displays of torsional waves that appear as transverse waves when seen from the ends. Show frequency, wavelength, amplitude, reflection, & phase. Works horizontally or vertically! *30 x 90 cm.*



22200
Wave Model - Sine Wave
A hands-on way to add sine waves! One wave is already stored on the apparatus. Use two templates to add another wave with (1) the same wavelength and amplitude *or* (2) half the wavelength and half the amplitude. Shows constructive and destructive interference as well as the basis for modes, harmonics and overtones. *32 x76 cm.*



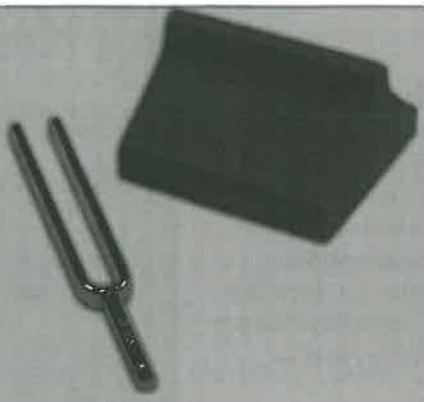
33030
Traveling Wave
Two different segments of a slinky® spring are stretched on an overhead projector to display sine waves of two different wavelengths. Turning the crank marches the wave along to demonstrate phase and phase angle by marking the projected image.



613-0075
Wave Model
Replicate the motion of a longitudinal and transverse wave with our economical, colorful plastic model. Turn the crank to put the waveform in motion. The compression wave demonstrator on the end combines the two wave principles.

Waves & Sound - Tuning Forks

Resonance Box (Tuning Fork)
Wood box (180 x 92 x 85mm) in 3 frequencies with tuning fork, mallet.
613-0040 256 Hz C
613-0045 323 Hz E
613-0050 384 Hz G



613-0070
Tuning Fork Activator
Use this solid rubber extrusion to activate tuning forks with one hand. 7.6 x 7.6 x 5cm. *You need tuning fork*

613-0035
Tuning Fork (Adjustable)
Recreate the C-major scale with just one fork. Markings show where to place weights for frequencies of 128 C, 144 D, 160 E, 170.7 F, 192 G. Aluminum, with weights. 210mm.

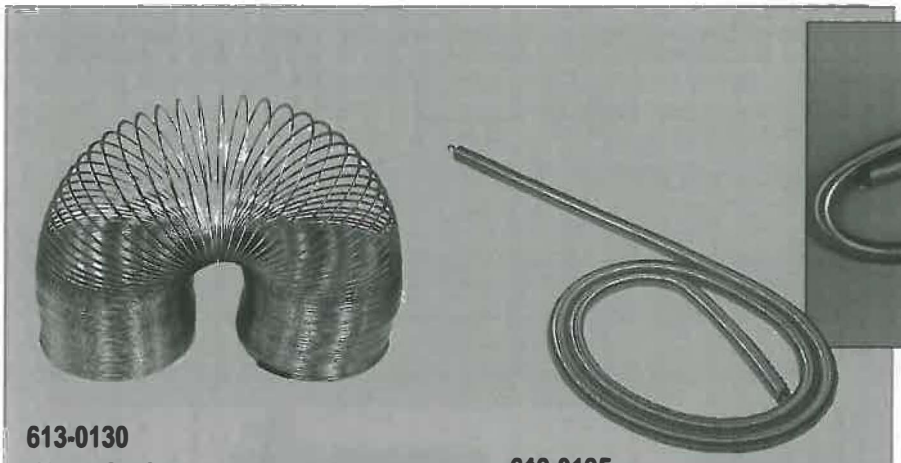
613-0115
Microphone
Unidirectional microphone features a 9' cord, 1/4" (6.3mm) adapter, 1/8" (3.5mm) adapter, on-off switch.

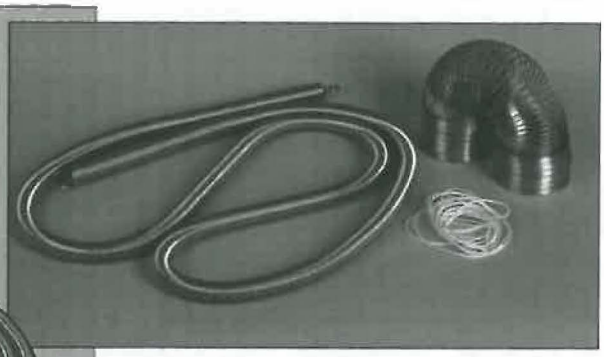
613-0030
Tuning Forks (Set of 8)
Eight accurate aluminum tuning forks in different frequencies. 256 C, 288 D, 320 E, 341 F, 384 G, 440 A, 480 B, and 512 C.

15845
Singing Rods
Striking or stroking the end of an aluminum rod while holding the center between fingertips excites a simple longitudinal standing wave. Measure the length of the rod and find the frequency to determine the speed of sound. A second rod creates 'beats' when sounded with the first. **Includes**: rosin for fingertips and earplugs.

15160
Open End Resonance Tube Set
Telesccoping tubes are used instead of a water column to find the wavelength in air for the included tuning fork. Calculations account for the end effect, and a styrene stopper explores harmonics (overtones) of the fork. **Includes** a fork-striking pad for bench top use.

Waves & Sound - Wavy Spring





613-0130
Wavy Spring
Who doesn't enjoy this little guy? Show transverse and longitudinal waves in an entertaining, old-fashioned way. Our flat metal spring (75mm diameter x 100mm) extends many times its length without distortion. Use either horizontally on floor or table or extend by cord from on high. 16 turns per cm.

613-0135
Wave Demo Spring
Our stainless steel helical spring is 20mm diameter and 1 8m long with a constant force of 29N/m. Use it to demonstrate wave motion. **Includes** line to hang from the ceiling.

613-0140
Wave Demo Set (Set of 2)
This set with two helical springs is highly versatile.

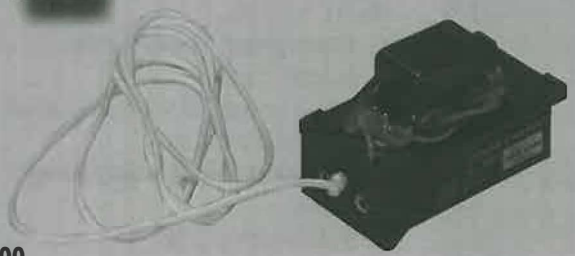
- Long spring: 19mm x 1.8m, extends 5m
- Large spring:7.6 x 10cm, extends without distortion
- 3m cotton cord to suspend large spring
- Ship weight 2.5 lb

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com

15815
Super Spring & Stand
This is sure to be the hit of the class! Our giant 20cm spring s-t-r-e-t-c-h-e-s so everyone can see. Teacher's guide covers: motion of waves through a medium, how waves interact, how energy transfers through a spring, the Law of Superposition. With stand, to prevent tangles and aid with storage.

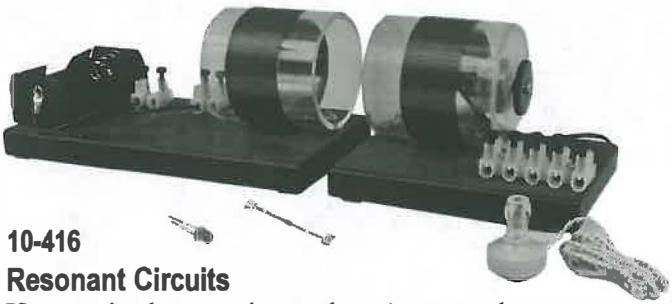
Waves & Sound

613-0008
Doppler Demo
Everyone's heard a car engine change in pitch when it roars by. Bring this effect into the classroom. Our buzzer on a string emits sounds of differing pitches depending upon whether the swinging pendulum is rising or falling.



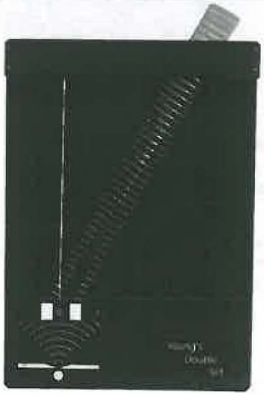
33000
Doppler Device
When swung on the included cord, this battery-operated sound source shows change in pitch as the source moves towards and away from you. *Requires a 9v battery.*

614-0685
Nanosecond Demo
How fast does light move? Our 30cm arrow shows how far light travels in exactly one nanosecond (one billionth of a second).



10-416
Resonant Circuits
Use our simple transmitter and receiver to study electromagnetic waves, RLC oscillators, diode rectification, directional antennas, more. You need a signal generator &D-cell battery. An oscilloscope is useful for some experiments.

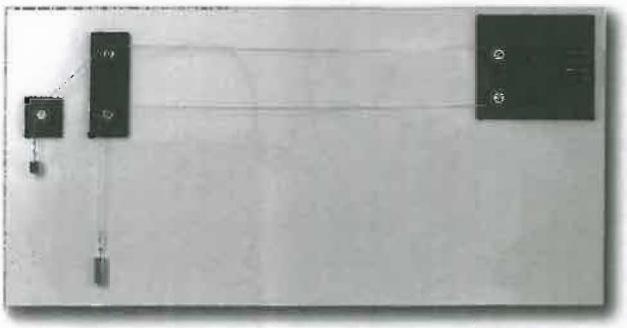
613-0110
Student Sonometer
This is a great introduction to the science of sound. Have your entire class find notes and hear the difference when the length and tension of a string is altered. **Includes:** sonometer base, 22cm long; two strings; tension adjusters, three bridges (one thick, 2 thin); 2 spring scales.



22300
Wave Model Young's Slit Apparatus
Built 20,000 time larger that the actual experimental conditions of a 600 nm HeNe laser illuminating a slit of 4.5 or 2.25 microns, this lets you perform the classic calculations. *40 x 57 cm.*

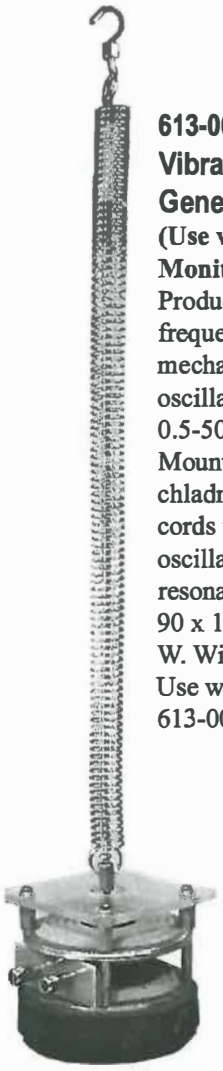
613-0005
Resonance Wave Demonstrator
Resonance is the tendency for materials to oscillate at maximum amplitude at certain frequencies. Our set provides a simple and fun demonstration of this concept. The device consists of an aluminum tube on a steel base. Attached are spring steel rods in 3 lengths, with an equal weight on the end of each. Swing one of the masses to start the oscillation and watch as its counterpart opposite receives the motion.

Waves & Sound - Vibration

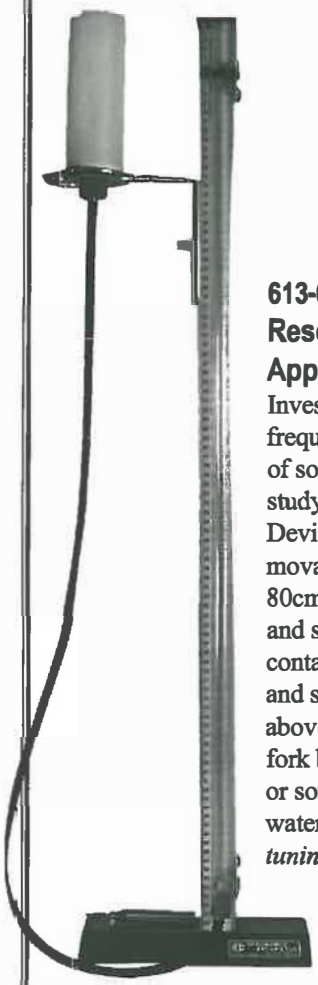


15240
DC String Vibrator
Two strings tuned to a common frequency display different standing wave patterns as the tension is adjusted with hanging weights. The motor, with power switch and frequency knob, uses two D-cells. **Includes** weights.

15250
AC String Vibrator
An intriguing novelty! Five hanks of fine line can be attached to our 60 Hz unit to form standing waves, which are controlled by the line's length and tension, yielding good qualitative and quantitative data.



613-0010
Vibration Generator
(Use with Wave Monitor)
Produces low frequency mechanical oscillation (range 0.5-5000Hz). Mount springs, chladni plates or cords to study oscillation & resonance. 90 x 90 x 100mm. 15 W. With spring. Use with 613-0012.



613-0000
Resonance Apparatus
Investigate length, frequency and velocity of sound waves by studying air resonance. Device contains a movable container. 80cm transparent tube, and stand. Fill the container with water and strike a tuning fork above the tube. The fork becomes louder or softer depending on water height. *You need tuning fork.*

See pg. 15 for
Daedalon® Chladni Plates

14420
Violin Shape
Make and view standing wave patterns on an aluminum sheet in the shape of a full size violin. A support stand is included. Do even more with an optional electromechanical driver and signal generator. *You need sand & bow.*

Waves & Sound - Ripple Tank

613-0015

Ripple Tank

(With projection screen)

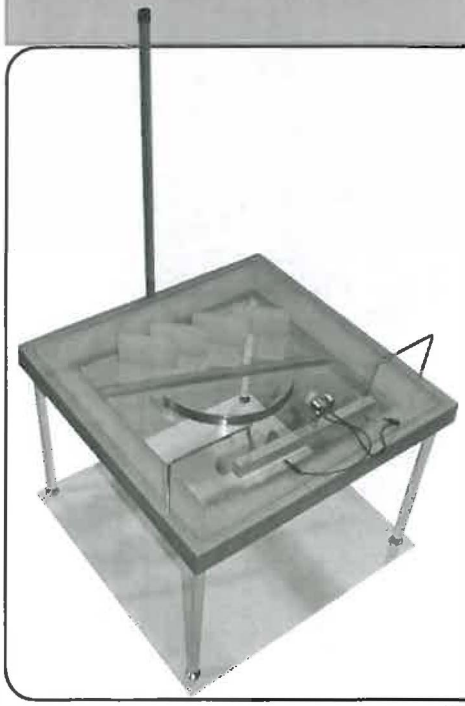
Project waves onto a 10 x 9" screen for viewing from a distance. Tune the wave generation of this self-contained, easy-to-use apparatus to match the stroboscopic light. **Includes:** light source with shutter, adjustable 2 and 3 prong wave generators, 2 baffles and removable 12 x 10" basin. 26" total height.

613-0016

Deluxe Ripple Tank

Couldn't your school use advanced equipment at a bargain price? Introducing our fully digital deluxe ripple tank for high school and college. Our 4-watt LED strobes at the same frequency as the agitator for complete synchronization. This results in highly distinct and visible ripples to project onto a translucent acrylic screen. Adjustable frequency & amplitude with LED display. Stores in ship box with foam inserts.

E-mail Justin Pascoe:
justin.pascoe@sciencefirst.com



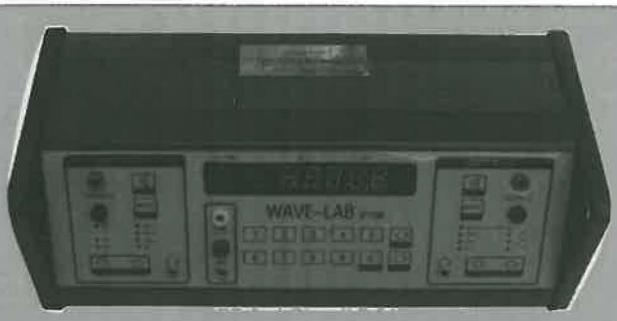
15415

Large Ripple Tank - PSSC

Here's an essential apparatus for both demonstration and lab work, ideal for studying reflection, refraction, diffraction and interference. The meaning of wavelength, velocity, frequency and phase become clear through the use of wave generators, reflectors, apertures and plates. Our design features heavy gauge molded parts with internal frames, hardwood legs for rigidity and durability, and a clear glass bottom panel, affording an unobstructed view of the included white screen. The 60x60cm tank has specially shaped foam beaches on the perimeter to damp reflections. Glass bottom is 43x43cm. **Includes:** 40cm motor driven rippler bar, a hand rippler bar, vertical light support, 4 paraffin blocks, 20x28cm glass plate, parabolic reflector, white plastic viewing screen. *Requires 1.5V power source & light source such as #14700.*

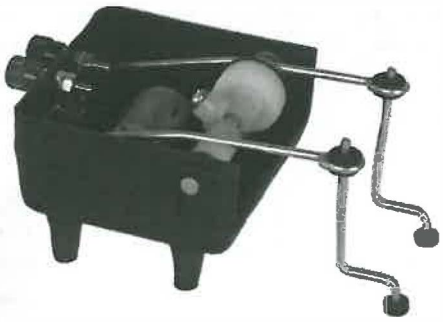
Waves & Sound - Wave Generator

613-0012
Wave Monitor
Use with Vibration Generator
Generate 1 to 100 Hz and use wherever you need it. Designed for use with a small speaker, this will also turn an LED into a stroboscope.



613-0007
Wave Lab
Equipped with dual amplifiers, this function generator is a versatile piece of equipment. Generate sine waves and square waves. Control volume and frequency. Select from 3 inputs and 6 outputs. Generate the waves simultaneously and compare them.

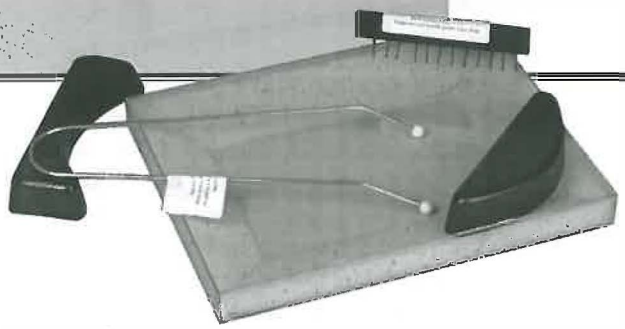
15456
Variable Wave Generator
Continuous variation of the phase between two point sources while the unit is running is the key feature of this generator. Mechanical cams move the rods so that even beat patterns become visible in the moving interference patterns.



15490
Wave Generator
A counterweight on the 1.5 V motor adjusts the amplitude for plane and one or two point sources. Applied voltage controls the frequency. **Includes** 75-cm leads and suspension bands.

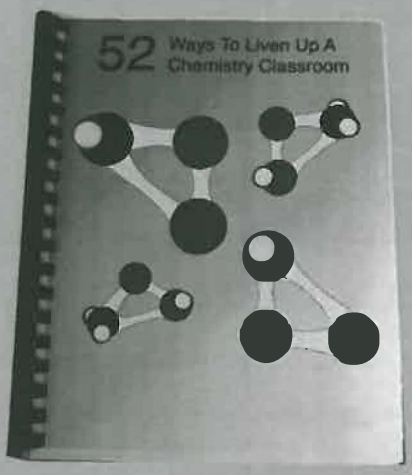
Adjustable Wave Generator
Shipped with a removable wave bar and two cam actuated rods, this device can generate circular or plane waves. Any phase angle can be set between the point sources before starting the motor. Sets in or mounts outside of ripple tank.

15445 Adjustable with bar
15455 With rippler bar, 1"
15456 With rippler bar, 12"



33105
Water Waves
Intended to be used by hand on an overhead projector to introduce the study of wave fronts, this demonstrator **includes**: wave tank, convex reflector, concave reflector, variable two point source, Huygens-type multi-point source, and sloping foam beaches.

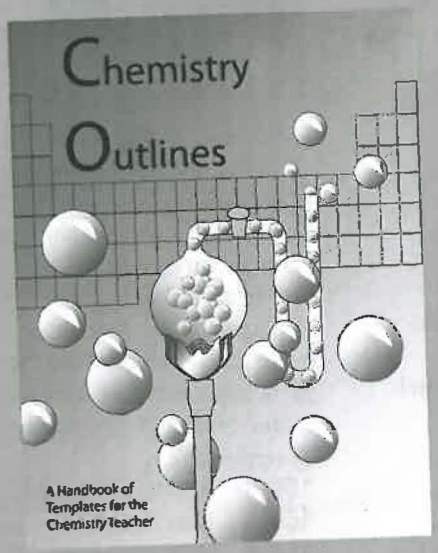
Books



2766

52 Ways to Liven up the Chemistry Classroom

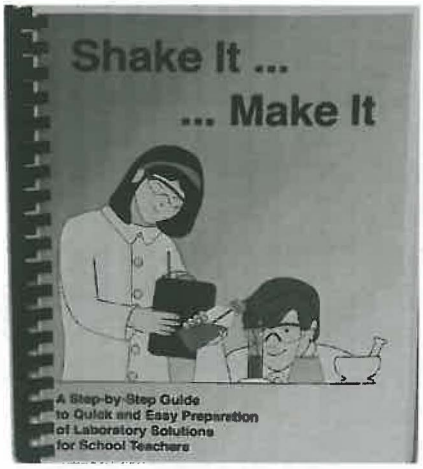
Are you playing with a full deck? If not, here are 52 ways to make your chemistry class fun! No elaborate materials needed - just cool stuff that will keep your students on the edge of their seats. Motivators, games, puzzles, tricks, and more. 38 pages, spiral bound



2792

Chemistry Outlines

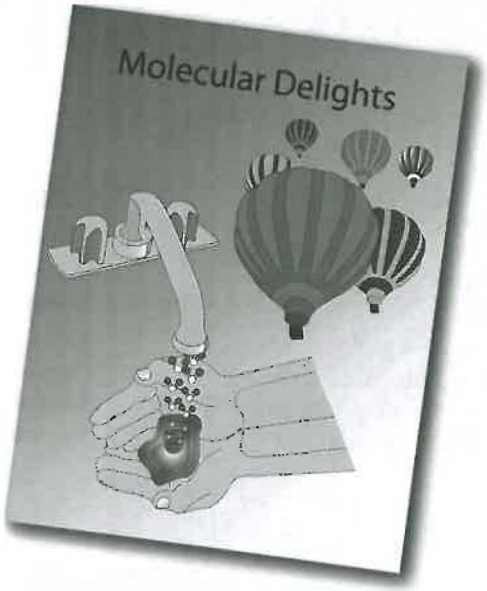
Book of line art images of scores of common lab equipment and molecules. Make a transparency of what you need and project on your board. Trace the image and create backdrops for your lectures. Cut and paste for tests, quizzes or lab sheets.



2760

Shake It - Make It (High School)

Prepare over 200 common solutions -- acids, bases, buffers, primary standards for titrations! We include formulations for biological stains and culture media. With tips on using molarity, molality, percents, normality, formality and mole fractions. Reproducible pages cover 40 critical topics. such as hydrolysis, molecular polarities, solubility equilibria, pH, buffer solutions, leveling effect, salt effect, colligative properties, conjugate pairs. 110 pages, spiral bound

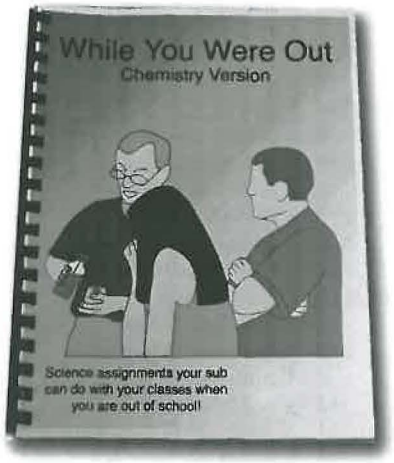


2768

Molecular Delights (Grades 7-12)

Teach atomic and molecular weights, moles, percentage composition, balancing equations, solutions, solids, nuclear chemistry, molecular geometries, multiple bonds and isomerism. We include 10 reproducible lessons students can do on their own. then work in group to construct models of each type of compound or structure with balloons (included.) *You need rubber cement.* 81 pp., loose-leaf

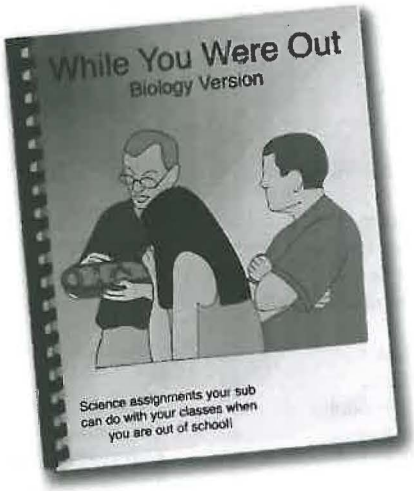
Books



2774

While You Were Out - Chemistry

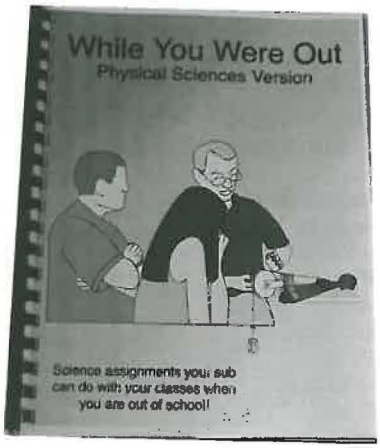
Let the While You Were Out series provide biology, chemistry or physical science assignments your sub can do with your class while you're out. No explanation is needed on the part of the sub other than telling students to hand in their work by the end of the period. Features concept crossword puzzles, formula word searches and challenging symbol games. Included answer sheetGr. 9 -- 12, 27 pages. spiral bound



2776

While You Were Out - Biology

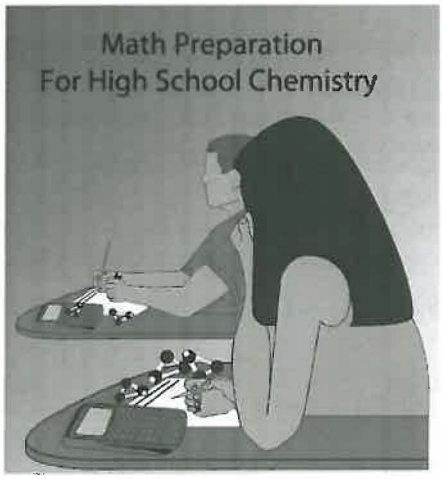
Imagine this: you left your substitute high and dry, your class with nothing to do! What to do? Here's a book to fill the time: concept crossword puzzles, formula word searches and symbol games. Included answer sheets.Gr. 9 -- 12, 27 pp., spiral bound. All the sub does is collect the work!



2778

While You Were Out - Physical Science

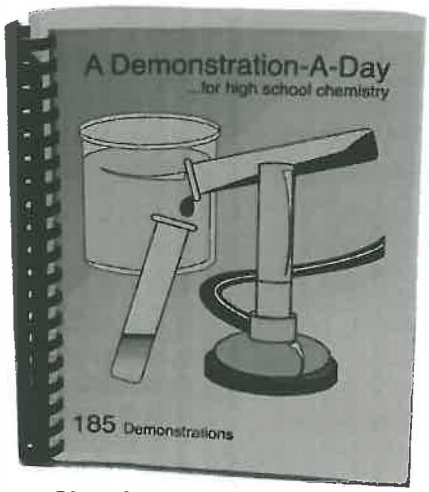
Here's the easy way to provide physical science assignments your sub can do with your class! **Includes** concept crossword puzzles, formula word searches, symbol games & answer sheets. 27 pages, spiral bound



2794

Math Prep for High School Chemistry

Tired of teaching math in your chemistry class? Most students who fail chemistry struggle with math. This reproducible book offers instructional pages and homework (with answers & quizzes) in 12 subjects, such as logs, proportions, graphing, ratios, exponents, etc.106 pages spiral bound.



2762

Demo a Day - Chemistry (Grades 9-12)

Star teacher Mike McMillan presents 185 of his best classroom demonstrations just right for your lesson plans. Daily demonstrations encourage students to ask "Why", " How come", and "What if" questions. Each **includes** background information, instructions and list of materials. Most have illustrations. All are easy to do and help explain a principle in chemistry. 157 pages, spiral-bound.

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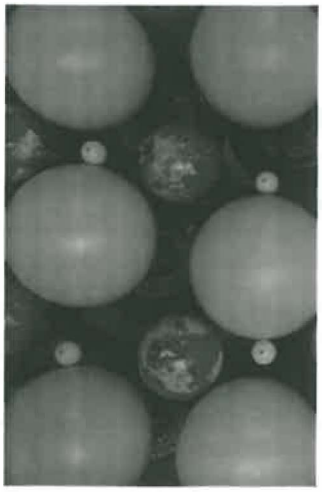

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