

Demonstration Descriptions List

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1) Audiovisual Equipment

a) Film loops (8mm)

i) Mechanics

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b) 16mm Films

- Introduction to Holography
- Stirling Colgate on Supernovas
- The Solar System
- Light Control through Radiation
- Crystals: An Introduction
- Brattain on Semiconductor physics
- Radio Waves
- Time Dilation
- Violent Universe (5)
- Planetary Motion and Kepler's Law
- The Doppler Effect
- Planetary Circulation
- Cold Front
- The Invisible Universe

Fenynam Lectures

- #1 the Law of Gravitation
- #2 The Relation of Mathematics to Physics; Part 1&2
- #3 The Great Conservation Principles; Part 1&2
- #4 Symmetry in Physical Law Part 1&2
- #5 The Distinction of Past and Future Part 1&2
- #6 Probability and Uncertainty – The Quantum Mechanical View of Nature Part 1&2
- #7 Seeking New Laws Part 1&2

c) Videotapes

Physics of Space Flight Series

Part 1: Accelerations machines: Launching a Space Vehicle

Contents:

- The Rocket Engine Principle
- Launch Trajectories and the Earth's Rotation
- Space Shuttle Launch
- Saturn V Launch
- Lift-Off of the Lunar Module from the Moon's surface

Part 2: Physics in Space: Orbital motion and Re-entry

Contents:

- Dynamics of Orbiting (Opening Segment)
- Satellite Deployment
- Motion Studies in Orbit
- Atmospheric Re-entry

Part 3: Gravity: A Broadened View

Contents:

- Newton's Law of Universal Gravitation (Opening Segment)
- The Microgravity Environment
- Gravitational Acceleration on the Moon's Surface
- The Gravity Assist Principle

Physics Demonstrations in Mechanics

Part 1: (of Physics Demonstration in Mechanics)

Contents:

- Projectile Motion: Simultaneous Fall
- Projectile Motion: Monkey and Hunter
- Projectile Motion: Trajectory of a Projectile

- Circular Motion: Direction of Centripetal Forces
- Circular Motion: Centrifugal Effects on a Rotating Sphere
- Circular Motion: Motion in a Vertical Plane
- Conservation of Energy: Minimum Critical Velocity Loop
- Work and Conservation of Energy: Energy Transformations
- Newton's 1st Law: Rest Inertia of Massive Ball
- Newton's 2nd Law: Effect of a Varied Net Force on a Bodies motion
- Newton's 3rd Law: Reaction Chart/Projected Ball Bearings
- Terminal Velocity: Air Resistance Acting on a Free-Falling
- Conservation of momentum: Internal Explosion
- Conservation of Angular Momentum: System of Rotating Spheres
- Free-Fall Paradox: Falling Chimney
- Center of Percussion: Impulsive Forces Delivered to a Baseball Bat

Dr. Ballard on Holograms

Experiments in Space:

- Galileo's Experiment - Moon and Earth
- Skylab: Weight (less) - Lifting in Orbit
- Skylab: Conservation of Astronaut Angular Momentum
- Skylab: Darts and Paper Airplanes
- The Sun: Prominence and Flares
- Skylab: Water Drops and Water Columns
- Skylab: Characteristics of the Gyroscope
- Skylab: The Earth

The Mechanical Universe Series: Produced by PBS, Caltech and JPL. Each of these 52 films is 30 minutes long and they must be checked out from the Office of Instructional Resources in Turlington Hall. The website has links to detailed information about these films.

D) Laserdiscs

1) Encyclopedia of Physics Demonstrations (600 2-5 minute films of demonstrations). The website has links to detailed information about these films.

2) Tacoma Narrows Bridge Collapse

3) 250 Films of physics Cinema Classics: The website has links to detailed information about these films.

e) Audiovisual Equipment

- Laserdisc player
- Videotape Players with 4 Heads
- 20 inch Color TV and 32 inch Color TV's
- 45 inch Projection TV
- 16mm Film Projector
- 8mm Filmloop Projectors
- Slide Projectors
- Overhead Projectors
- Macintosh II cx (40 MB HDD, !6 MB Ram)
- Apple Iie with two disk Drives
- Sharp QA1000 LCD Overhead Projection Panel
- Lightning Scan Hand scanner for Mac
- Mac recorder Sound Analyzer
- Pasco Smart Pulley Photogate

F) Software

- Interactive Physics
- Broderbund Physics
- Essence of Physics
- UF Projectile Motion
- UF Electric Fields
- Think Pascal
- MacPaint
- MacDraw II
- MacWrite II
- HyperCard

2) Mechanics

a) Basic mechanics

i) General Things

- Non-SI Measurement Standards
- Roll A Ball Down an Incline
Shows uniform acceleration, velocity and distance
- Atwoods Pulley
Shows constant acceleration
- 3 Meter Air track with Carts
Shows constant velocity, frictionless surface, uniform acceleration when inclined, use lightgates or stopwatches to time motion, shows center of gravity, shows momentum Collisions.
- Human Air puck:
Shows frictionless motion where students can ride basically a small hovercraft
- Relative Velocity
Roll a small cart on top of a larger cart to discuss the relative velocity between carts
- Assorted Friction Blocks
Pull across table with force scale to show static/kinetic friction
- Inclined Plane:
Shows mass on an incline and friction coefficient.
- Static Force Car on Inclined Plane
Shows vector components of forces on a mass
- Large Reaction Cars:
Shows Newton's third law, can be pulled with force scale for Newton's second law
- Fan Cart with Sail (Demonstrate Newton's Third Law)
The cart has a fan to push it forward and a sail that can be added that prevents it from moving.
- Tension in a Rope
- Reaction Cart with a Rope
Shows $F=MA$ by pulling a person (or weight) across the floor or set up a tug of war
- Bird on a Wire (with Spring Scales)
Shows the tension in a tightly stretched wire that has a mass hanging in the middle.
- Portable 1.5m Airtrack
- Little Toy Wagon
- Sun-Earth-Moon Model
- 4 Foot Blow up Earth Globe
- Black Globe on Stand
- Shearforce Cube:
Shows shear strain on a foam cube.

ii) Simple Machines

- Wheel and Axle
- Wedge
- Screw Jack: large and small

- Pulley Demonstration Set
- Inclined Plane
- Lever planks to lift Person

iii) Center of Gravity and Center of Mass

- Green Door:
Shows Forces in Equilibrium with a door suspended without hinges. (I need an hour's notice)
- Leaning Tower of Pisa
Shows a stable and unstable tower when the center of gravity is no longer over the base.
- State of Florida
Finds center of mass for a nonuniform shape (Also can show Torque Arm).
- Foam Tossing Map:
Shows parabolic motion of the center of mass as a Florida shaped object is tossed.
- Shaped Ellipsoid Toy:
Toy that spins preferentially in one direction. Uses its shape to direct a component of its weight to cause the spinning.
- Two Body Demonstration (variable)
- Three Body Demonstration (variable)
- Center of Gravity of a Meterstick:
Find the center of gravity by sliding your fingers underneath it until they meet.
- Balancing Toy Horse:
Hangs oddly over the edge of a table.
- Spindle Weight Off Center:
Disc that wobbles when rotated about its center. But it is stable when rotated off axis.
- 12 Nails Demo:
Balance 12 nails on one standing nail.
- Balancing Hammer:
Hangs oddly off edge of table.
- Balancing Trapeze
- Pipe Walking Robot:
- Air Track Pendulum Cart:
Cart and pendulum masses oscillate around center of mass.
- Human Rolling Balance:
Wooden plank and cylinder to stand on for balancing.
- Double Cone Inclined Track (rolls uphill)
Cone appears to roll uphill but the center of mass is actually falling,

iv) Projectile Motion

- Dual Ball launcher
Drops one ball vertically and projects one horizontally at the same time.
- Ball and Cart (Pop up Car):
Cart rolls across table and shoots a ball vertically and then catches it.
- Monkey and Gun
Blowgun dart shoots a falling target. This is a great demo but I need an hours notice to do it.
- Blow gun
Measures muzzle velocity for a projectile problem.
- Toy Dart Gun
Simple, safe, way to show range equation by shooting darts at various angles.

v) Gravity Experiments

- Penny and Feather
Drop the penny and feather in a vacuum and in air.

- Elevator Cup
Water streams out small holes in the side of the cup until it is dropped. Simulates weightlessness in a free falling object.
- 1-4-9-16 Ball Drop
Shows square ratio of distances for falling objects. The ball strikes the ground in equal time separations.
- Light gates for 2 Meter Ball Drop
Calculates gravity by measuring the time for a ball to drop 2 meters.
- Faster than Gravity Drop
Inclined board where the end of the board moves faster than gravity to catch a ball.
- Drop a Ball
- Terminal Velocity Tube:
Drops balls of different densities into water to show terminal velocities as they sink.
- Gravity Well Jar (Yellow Can)

vi) Inertia

- Inertia Ball:
Heavy lead ball suspended by string. If you pull fast the bottom string breaks, pull slow and the top string breaks.
- Magician Table Cloth
Pull cloth from underneath dishes.
- Inertia Balance
Shows how to measure mass in a weightless environment.
- Bed of Nails:
Lay between two nail beds and have concrete block broken on your chest. It's very impressive and not as dangerous as it might seem. Shows inertia and force per unit area.

b) Rotational Motion and Torque

- Moment of Inertia with large Incline;
Spheres, Solid and Ping disks, etc... for comparing Moment of inertia from bodies of different shapes.
- Inertia Batons:
Two equal mass batons where the mass is distributed differently. The batons are held in the middle and pivoted back and forth to feel difference in inertia.
- Angular Momentum Chair and Spindle (See the momentum section):
- Obedience Spool:
Disk that either rolls forward or backwards depending on the angle of that pulls it.
- Angular Measure Disk:
Shows comparison between linear and angular measure.
- Ball and String:
Tennis ball or foam ball on a string for circular motion and centripetal force.
- Centripetal Force Apparatus;
Can be used to measure centripetal force using a weight hanging down from the handle.
- Centripetal Force Water Bottles:
Two water bottles on a turntable with a floating ball and a sinking ball suspended within each bottle. As it's turned the floating balls lean inwards and the sinking balls lean outwards.
- Water Bucket:
Water stays in bucket as you rotate in a vertical circle.
- Penny and Coat Hanger
Balance a penny on the end of a coat hanger and rotate in a vertical circle.
- Bicycle Wheel Gyroscope:
Shows precession when used as a large gyroscope or with the rotating chair.
- Rotating Turntable:
Shows angular velocity on a solid disk. Chalk erasers are placed on it at different radii and fly off at different rotation speeds.

- Torque Meterstick:
Meterstick with masses suspended from it to demonstrate torque.
- New York Balance
Small torque metersticks on stands.
- Torque Arm of the State of Florida:
- Coriolis Effect Disk:
Shows the Coriolis effect in the curve of a ball's path or a chalk line.
- Hula-Hoop:
Shows wheel friction with backspin across the floor (rolls back to you).
- Rotational Energy Can:
Can rolls across the ground and then rolls back to you on stored energy.
- Tippy-Top
- Spinning Top
- Gyroscopes and Motorized Class Room Vector gyroscope

c) Energy and Simple Harmonic Motion

- Bowling Ball Pendulum
Heavy Ball suspended by rope from the ceiling for gravity measurement, SHM and Conservation of energy.
- Torsional Pendulum:
Shows simple harmonic motion in rotation.
- Ring Pendulum:
Shows a comparison between a ring oscillating and a ball on a string.
- Sand Pendulum
- Chaotic Pendulum
- Assorted Pendulums of Various Lengths
- Roller coaster Track:
Either a W or U shaped track to show conservation of a potential well.
- Loop to Loop Track:
Shows energy conservation, minimum velocity to complete loop and vertical circle.
- High / Low Road Track:
A race between two balls as they move between the same change in potential energy.
One follows a straight track and the other follows a longer curved track.
The curved track ball finishes first due to higher kinetic energy.
- Hooke's Law Springs:
Shows $F=kX$ and simple harmonic motion.
- Mass on Spring
- Shadow Graph
Projects the shadow of a rotating peg and a mass on a spring.
Compares linear to circular motion.
- Surprising Energy Springs:
Two springs tied together with a mass on the bottom.
When the middle string is cut leaving only a string from the support to the top of the bottom spring and a string from the bottom of the top string to the mass the total length gets surprisingly shorter.
- Drop a Ball (Free-Fall, PE to KE)
Drop a superball and a dud ball that doesn't bounce.
- Coefficient of Restitution Tube:
Provides a measurement system to check balls bounce and conservation of PE.
- Lead Shot Tube:
Used a thermometer to measure the temperature change of the lead shot as you turn the tube upside down repeatedly.
- Shearforce Cube:
Shows shear strain on a foam cube.
- Metronome

d) Momentum

- Air track Frictionless Elastic and Inelastic Collisions
Collide carts of various masses to see linear momentum in action.
- Air table
2 X 3 Air table to show 2D collisions similar to the linear collisions on the 3 m air track.
- Fire Crackers and Coke Cans:
Shows recoil of a gun when a firecracker is exploded between cans.
- Newton's Balls, large and Small
Shows conservation of momentum using five balls colliding.
- Klacker Toys
Basically a fun Newton's ball toy.
- Basketball Cannon (Minski's Cannon)
Drop a basketball with a foam ball placed on the top.
The foam ball shoots off quickly when they hit the ground.
- Elastic and Inelastic Wood Block:
A block is hit by a blow dart and tips over in an elastic collision but not in inelastic.
- Ballistic Pendulum
Shotgun shell is fired to project a bullet into a catcher.
A spark recorder measures the height of the recoiling catcher and muzzle velocity can be calculated.
- Angular Momentum and Velocity Spindle:
Shows relation of mass position to moment of inertia and resulting angular velocity when a constant force is applied.
- Angular Momentum Chair with Weights
Students can sit in chair and experience conservation of angular momentum.
It can also be used with the bicycle wheel gyroscope.
- 2D Collision:
Shows a 2D collision, but the apparatus is small and not well suited for lecture.
- Collision Ball Track
Show collisions between rolling balls on a straight track. (air track does a better job)

3) Pressure, Fluids, and Gas Law

a) Pressure and Gas Law

- Two Fire Syringes (also listed under Thermodynamics)
A Piston that uses high pressure to ignite tissuepaper much like a diesel engine works.
Shows $dU=dW$, if $dQ=0$
- Ice Cutting Regelation:
The pressure of a thin wire on an ice cube cuts the ice.
The ice refreezes after the wire passes.
- 3D P,V,T Curves for Water and Carbon Dioxide
Shows triple point, phases, etc.....
- Magdeburg Spheres
Two evacuated sphere halves, which are almost impossible to separate.
- Vapor Pressure Explosion Can
A one-gallon can that has a handle inside a fuel of dust (cork, flour, etc..) that explodes when it fills the chamber. The explosion blows the can lids off.
- Boiling While Cooling Bottle
A flask of water is boiled and the sealed off with a valve.
When the flask is cooled with water the steam condenses and drops the pressure to a Point where boiling can occur.
- Portable Vacuum Pump:
- Crush Can with Vacuum
The vacuum pump or cooling steam can be used.
- Balloon in Flask
The balloon gets pulled into the flask as cooling steam reduces the pressure

- Vacuum Bell Jar:
Vacuum chamber for all kinds of experiments such as balloons, marshmallows, shaving cream, boiling water at room temperature, Etc...
- Vacuum Jar Creation Model (Dewar Bottle Model)
- Absolute Pressure Gauge:
Can be used to estimate absolute zero temperature graphically.
Temperature Vs Pressure
- Cartesian Diver:
A bottle with a test tube that barely floats inside.
When the bottle is squeezed the "diver" sinks.
- Bicycle Pump
- Simulated Lung
- 22.4 Liter Box
- Cloud Bottle
Under relaxation of pressure the dissolved methanol in a bottle crystals out and gives Visible clouds.
- Air Pop Gun
- Bicycle Pump Pop Gun
- Large Barometers
- Mercury Barometer
- Large Celsius and Fahrenheit Thermometers
- Celsius, Kelvin and Fahrenheit Comparison Chart
- Simple Colored Water Flask Thermometer
Shows the Basic idea of how to construct a thermometer and create a scale.
- Windspeed Gauges
- Celsius Sling Psychrometer for relative humidity
- Fahrenheit Sling Psychrometer for relative humidity

b) Fluids

- Density samples
Wood, Aluminum, Lead Cylinders
- Surface Tension Experiments
Soap bubbles, Floating razor blades, etc....
- Buoyancy Masses
Two clay masses of equal size, one floats and one sinks.
- Archimedes Flow Fluid Can
A mass lowered into the can and the fluid displaced is measured for buoyancy force.
- Archimedes Graduated cylinder
A mass displaces fluid and the change in volume is measured using the cylinder.
- Glass Fluid Level Indicator
A glass tube of different shapes to show fluid level is the same regardless of the shape of the container.
- Bernoulli's Pressure Air Speed Experiment
A glass tube that narrows and with fluid shows the relationship between pressure and fluid velocity.
- Capillary Tubes
- Frisbee
To show a shaped surface that provides lift.
- Bernoulli's Funnel
A funnel that picks up a Ping-Pong ball even though air is blowing out of the funnel.
- Floating Bernoulli Beachball, Golf Ball, and Ping-Pong Ball
- Styrofoam Curve Thrower
A sandpaper lined handle that gives a thrown Styrofoam ball a strong spin and causes it to curve.
- Bernoulli's Floating Disk
A pair of flat disks where air pressure via Bernoulli's law holds them together.

- Fluid Pressure with Depth Bottle (and Tank)
Water squirting out drilled holes in a bottle at different depth shows pressure.
- Large and Small Vortex Generators
Smoke rings show fluid motion across a room and can blow out a candle at a long Long distance.
- Laminar Flow (overhead)
A very difficult, messy setup for the overhead projector that demonstrates laminar flow.
- Hydraulic Pump
Uses fluid pressure on a cross-sectional area to crush 2" by 2" wood block

4) Thermal Properties

a) Heat Capacity, Specific Heat and Latent Heat

- Calorimeter Cup:
An Example of an insulated container for heat experiments.
- Heat Capacity/ Specific Heat Balls
Five equal mass balls of different metals are heated to 100 C and placed on a wax strip.
The balls that contain enough heat melt through the wax while the rest only partially melt the wax.
- Re-Heater for Latent Heat of Crystals
A supersaturated solution that releases heat when it becomes a crystal.
I need one-hour prior to prepare the solution.
- Heat Capacity of Water Vs Steel
Heat water and a steel plate over the same flame to show how much higher in temperature the steel is over the water.
- Phase Change of Ice to Water
Shows the constant temperature during the time of phase transition.
The computer samples the temperature and plots a graph of temperature Vs time.
I need a day notice to prepare the ice and this runs about fifteen minutes in the back of your lecture.
- Moe's Burning Rag or dollar Bill
Shows latent heat of water as it changes to steam.
The rag is soaked in a 50/50 solution of water and alcohol so it burns but does not harm the rag.

b) Liquid Nitrogen

- Hofler tube
An acoustic heat engine with no moving parts.
A strong temperature gradient across closely spaced plates in the middle of the tube creates a thermodynamic cycle of oscillating air.
Produces sound.
- Nitrogen and copper tube or brass cannon
A small glass cannon the fires a rubber stopper when a small amount of Liquid Nitrogen is poured inside.
- Light and Frozen Battery
A small light bulb is turned on until the battery chemical reaction slows down as it freezes in liquid nitrogen.
- Flask with Liquid Nitrogen and Soapy Water or balloon
Expanding gas fills the balloon (or bubbles) through a nozzle in the neck of the flask.
- Light and Copper Wire
A light bulb connected to a coil of copper wire and a battery does not glow due to resistance in the wire. When the copper wire is coiled in the liquid nitrogen the light bulb shines.
- Fountain Tube
A rubber tube is placed inside liquid nitrogen that spouts nitrogen as boiling occurs inside the tube.

- Superconductor
Small kit of an YBaCO Superconductor which lifts off a magnet.
- Rubber Nails and Balloons
Drive frozen nails with a frozen banana (you supply the banana) or show gas laws with balloons cooled in liquid nitrogen.
Compare helium balloons to one blown by a person.

c) Thermodynamics

- Fire Syringe (2): for Adiabatic Compression
Ignites tissue paper with high pressure via adiabatic compression shows $dU=dW$ if $dQ=0$
- Fire Extinguisher for Adiabatic Expansion
Shows adiabatic cooling of gas as it rapidly expands.
- Second Law Paradox
A fluorescent dye is seemingly dispersed in a fluid filled container but then it opposes entropy and forms back into a drop.
The fluid is glycerine so the dye actually just spreads out in layers.

d) Conduction, Convection, and Radiation

- Five Metal Conduction Spider
Five different metal rods are equally heated and wax indicators melt off their ends depending on the heat conductivity of the metal.
- Burning Paper Conduction Rod
Paper is wrapped around a wood/metal joint and is then placed in a flame.
The paper over the metal does not burn due to conduction but the paper over the wood burns quickly.
- Liquid Crystal Conduction Bar
A flat panel of liquid crystals that can visually show heat conduction down the panel.
- Heat Transfer Cups
Two cups connected by a metal bar to conduct heat between them.
Thermometers show changes in heat (too small for lecture hall)
- Glass Fluids Convection tube
A drop of dye is placed in a fluid filled glass tube.
As the tube is gently heated in one corner the dye indicates fluid flow and heat transfer by convection.
- Smoke Convection Box
A box that has two openings and contains a candle.
Heat from the candle causes a convection current of air that can be seen with smoke.
- Assorted Hand Boilers
Closed glass bulbs shaped in odd ways and filled with a volatile fluid.
The fluid boils and rises quickly with the latent from your hand.
- Drinking Birds
A comical bird that operates by evaporative cooling to make it tip over and repeat the cycle.
- Radiometer
A light bulb-like device where black and white panels absorb radiation at different rates thereby heating air molecules to different amounts.
The difference in heating causes the panels to rotate on a spindle.
- Black Box Radiation Detection
A Cube filled with hot water the radiates energy at a different colored sides.
A thermocouple and a digital voltmeter provides readings.
- Thermocouple Radiation Detection
A sensitive thermocouple that produces voltage when heated.
It can be used with the radiation cube or with a heat lamp and colored filters to indicate spectrum.

e) Thermocouples

- Thermocouple Thermometer
Shows voltage generated between two different metals as they are heated.
The voltage displayed on a digital voltmeter
- Peltier effect
Shows cooling using electrical current.

f) Thermal Expansion

- Ball and Ring
Shows thermal expansion as a ball slides through a ring.
If the ball is heated it will not pass through the ring but if both are heated it will pass.
- Bimetallic Strip
Shows the difference in the linear thermal expansion of two different metals. The strip bends when heated.
- Bimetallic Disk
Disk Jumps when it cools and snaps into position.
- Bimetallic Disk thermometers
- Shape Memory Wire
- Metal Contraction Cooling Bar
Lower temperature leads to contraction of a solid metal bar.
Shows length change with temperature change
- Linear Expansion of a Copper Tube with Steam
Steam Passes through a copper tube and the linear expansion is shown on a dial.

g) Engines

- Overhead Projection Models
Plastic models of various kinds of engines.
- 2 Cycle Engine Model
- Steam Engine Model
- Hero's Engine model
- Stirling Engine
Shows working hot air engine that operates close to the Carnot cycle.
- Rube Goldberg Heat Engine
A Heat Lamp and Large hand boiler combined to create a useless heat engine.

5) Waves

a) Mechanical

- Long Spring Attached to the Wall
Shows basic wave properties such as wave length, amplitude, pulses, Standing waves and speed as related to tension for transverse waves.
- Rope to the Wall
Similar to long spring (some just prefer the rope but I don't think it works as well)
- Long Slinky Across Desktop
Shows longitudinal waves and their characteristics.
- Fixed and free End Wave Demonstrator (torsion wave model)
Shows wave reflections from fixed and free ends using a metal grill that looks like a barbecue grill.
- Longitudinal Wave Demonstrator with Magnets
Shows longitudinal waves with magnets repelling each other to transmit the wave.
- Superposition Principle Demonstrator
Very clearly shows wave addition with waves forms moved back and forth in the model.
- Hoag Wave Machine
Shows transverse, longitudinal, and combination (transverse + longitudinal) water waves side by side as they move.

b) Electromagnetic

- Microwave Transmitter and Receiver
Shows energy transmission through space by electromagnetic waves.
Reflection of electromagnetic waves from the surfaces can be also shown.
- Radiowave Transmitter and Receiver
Shows energy transmission through space of electromagnetic waves and reception by an antenna.
Signal strength is indicated by a light bulb on the antenna.
Antenna position and angle can be shown to effect reception.

6) Sound

a) Doppler Effect

- Overhead Projection Disks
Set of four round plastic disks that can be overlaid to show Doppler-effect.
- Whistle for rotator
Rotating whistle to hear the change in pitch.
- Humming Bee on String
Simple child's toy that can be used to hear the change in pitch.
- Plastic singing tube:
Toy resonant tube.
Also shows change in pitch.

b) Interference

- Two Speaker Interference
Two speakers mounted on a stand the produces the same sound, they can be rotated so that students can hear the interference pattern.
- Beat Frequency Tuning Forks (2 sets)
Tuning forks mounted on resonant boxes of slightly different frequencies.
- Beat frequency Resonant Bars
Similar to above but more like Xylophone like
- Radio Speaker with Cardboard
Portable radio attached to a small speaker.
The card has a hole the size of the speaker, which blends out he interference of the sound
Waves from the back of the speaker, dramatically increasing the quality of the sound output.

c) Resonance and Standing Waves

- Chladni's Plate (with violin bow)
A metal plate that is played with a violin bow and shows interesting pattern of nodal/
Antinodal points on the plate.
- Crystal Singing Glass
A Fine crystal glass that sings when rubbed with your finger. Sets up resonant wave pattern
in glass.
- Plastic Singing Tube
A corrugated toy tube that sings when spun in circles. Five harmonics can be heard.
- Hot Air Singing Tubes
Tubes that have a small mesh screens at the base.
If the mesh is heated it causes hot air to oscillate in the tube as it rises and produces sound.
- Flaming Tube with Speaker
A six Foot tube that has gas jets along the top and a speaker mounted on one end.
It shows standing waves created in sound by a flaming wave on top of the tube.
(high gas pressure=peak time)

- Adjustable Water Column Resonant Tube
A vertical tube filled with water where the water level can be adjusted to change the length of the resonant chamber.
A tuning fork is held at the open end of the tube and its wavelength can be measured by listening for its resonance.
- Kundt's Resonance Tube
Tube filled with a fine powder and has a speaker attached at one end.
The sound waves causes the powder to collect at the nodal points.
- Open and Closed Tubes Pipes with Speaker
Pipes of different length can be used with a tuning fork to show resonance with open or closed tubes.
- Sounding Resonance Tube and Bell on Wooden Stand.
A metal chalice mounted next to an adjustable closed tube.
The size of the resonant chamber can be changed to tune in resonance.
- Amplitude and Frequency Piston
Shows a red ball bouncing of a piston attached to the rotator.
The resonant frequency of the ball's bounce is found by changing the speed of the rotator.

d) Instruments

- Alto Recorder
- Soprano Recorder
- Bamboo Recorder
- Wooden Pipe Whistle (2 sizes)
- Glass Pipe Whistle (open or closed end)
- Adjustable Pipe Whistle (length of chamber is adjustable)
- Metal Bar Chime
- Four Coke Bottles
Bottles filled with water that can be blown on to produce sound.
- Construction Cone Trumpet

e) Others

- MacRecorder
A computer sound digitizer and analyzer.
A large screen can be display the computer output to show the shape of sound waves and a spectrum analysis of complicated sound.
- Assorted Whistles and Sound Toys
- Engineering Frequencies Tuning Fork Set
- Musical Chromatic Frequencies Tuning Fork Set
- Music Spectrum Range Chart
A chart that shows the frequency range of various instruments.
- Assorted Tuning Forks
- Sound Level Meters
- Audio Oscillator with Speaker for Hearing Sensitivity Tests
- Ringing Bell And Light in Vacuum
A bell producing sound waves and light producing electromagnetic waves are contained in a vacuum jar
The light transmits through the vacuum but he sound cannot be heard.
- Sonometer
A guitar-like stringed sounding board used to discuss length and the frequency of the sound produced.
- Helium Donald Duck Voice
Breathe helium to show how your voice changes with a different speed of sound.

7) Light

a) General

- Rotating Mirrors for Determination of C:
Four mirrors mounted on a rotator to simulate the first experiment to determine the speed of light.
- Large and Small Prisms
Shows dispersion of white light into the rainbow colors.
- Light Meter (Measures in foot candles)
- Solar Cell
- Magnifying Glass (concave lens)
- Diverging lens
- Eye Ball Model
- Fresnel Lens
- Old Polaroid Camera
- Pinhole Cameras
- Strobe Light
- Assorted Kaleidoscopes
- Liquid Prism
A prism shaped chamber that can be filled with different fluids.
- WW II Bomb and Gunsights
- WW I Naval Artillery Rangefinder (from 1918)
- Navy Quartermaster's Telescope

b) Geometric Optics

- Real Image Light Bulb Box (Mirror)
A large wood box with a mirror mounted inside to produce a real image of a light bulb.
- Real Image Mirage box (Mirror)
A matched set of parabolic mirrors that form a real image of a needle that seems to float above the box.
- Giant Glass lens
A 15 inch Converging lens that Can project a 3 foot real image on a wall 40 feet away.
- Giant Convex and Concave Mirrors
A matched set of 22 inch mirrors
- Optical Bench
Mirrors or lenses can be set up on the bench to show the different cases of object position and the image produced.(Real Virtual Reduced Inverted Erect)
- Microscope Optical Bench
A simple microscope set up on an optical bench using two lenses.
- Telescope Optical Bench
A simple lower power telescope set up on an optical bench using two lenses.
- Concave and Convex Air Lenses in Water Tank
The properties of lenses made from air can be studied by inserting them in this tank of water (they act opposite of glass lenses of the same shape).
- Liquid Lenses
A convex lens that can be filled with different liquids to change its focal length.
- Flexible Metal Mirror
A flat mirror that can be bent into a fun house type shape.
- Large flat Mirror
- Candle Reflection Trick
Shows the reflection of light from a candle on a glass sheet.
Two candles appear to be burning but one of them is not lit.
A good example of how Disney World does a lot of their tricks.
- Two Large Angled Mirrors
Show how multiple images are produced in mirrors and kaleidoscopes.
Also shows an image that is not reversed left/right if the angle between the mirrors is 90.

- Light Table with Mirrors and Lenses
Shows light rays as they interact with lenses and mirrors of different shapes.
The individual rays are projected on a 2' X 3' backboard so students can see easily the reflection and refraction.
- Binocular Prism
Shows a real application of internal reflection with a prism set from binocular lenses.
- Internal Reflection Water Tank
Shows internal reflection of a laser beam off water/air interface (shows critical angle)
- Internal Reflection Curved light Pipe
A Plastic Pipe wrapped in a coil to show transmission of light through light pipe.
- Fiber Optics
- Refraction of Wooden Stick in Water
- Astigmatic Cylindrical Lenses
Shows Astigmatism as an image spread out by one cylindrical lens and then corrected by a second cylindrical lens.
- Axial Symmetry Glass Rod
Place glass rod over words written in different colors (red and blue ink).
Some letters will flip upside down and others will not based on whether they have axial symmetry.
Write letters that flip over in red and letters that don't in blue and ask students if the cause is due to refraction indexes or something else.
Great puzzle for students to figure out.

c) Interference and Diffraction

- Michelson Interferometer
Shows light wave interference and how it can be used to measure minute distances
(this is tricky to set up give me an hours notice)
- Newton's rings
Shows thin film interference created by the air gap between two glass plates.
It can be projected on a screen.
- Soap Bubble Thin Film
Shows thin film interference in a soap bubble.
The colorful image can be projected on a screen and it has a speaker behind it to cause standing waves in the film.
- Soap Bubble Trumpet
Toy bubble maker for the fun thin film
- Giant soap bubble maker
Toy for thin film
- Evaporated Metal Interference Filters
High quality thin film interference filters.
- Space Fidgets
A simple toy to show thin film interference.
- Single and Double Slit Glass Plate on Stand (this is very good and easy to use)
- Two Speaker Interference
Two speakers mounted on a stand that produce the same sound, they can be rotated so students can hear the interference pattern.
- Two Source Interference model
Shows nodal/antinodal pattern created by two sources using overlaid transparencies of Concentric rings.
- Replica Grating 300 and 600 Lines/mm
Can be used with the mercury, sodium, or laser light sources to project a line spectrum or an interference pattern.
- Replica Grating Slides 13400 lines/mm
Small slides students can look through to see line spectrums

- Double Grating Rainbow Glasses
Funny looking laser light glasses that re actually creates using a diffraction grating cut Horizontally and vertically.
A good challenge for students to explain.
- Adjustable Single Slit
- Poisson's Bright Spot
Interference creates a bright spot in the center of a shadow when a laser passes a pinhead.
- Acoustic Double Slit
Shows the same thing as above demo but is larger and dominates one corner of the stage.
- Diffraction of Laser over Razor's Edge
Shows diffraction of light across a straight edge but it is very sensitive and sometimes Difficult to see.
- Double Slit Microscope Slides
Shows a simple diffraction grating made from candle smoke on a glass slide with slits Created by a razors edge.
Look through the slit at a straight filament for the diffraction pattern.

d) Holography and Lasers

- 20 mW Metrologic HeNe Laser on a Stand
Shows an example of a laser and chalk dust can be used to view the beam.
- 0.5 mW Spectrophysics HeNe Laser
- Solid State Metrologic Laser
- 15 mW and 35 mW Spectrophysics HeNe Lasers
- Broken 15 mW Spectro HeNe Laser for Take apart Demo
Shows the inside of a laser as the tube is working (this will not produce a beam but Glows nicely)
- Laser Tube parts
Examples of laser tubes and related power supplies
- Laser Goggles
A pair of safety goggles that are designed to absorb HeNe laser light
- Blowing Kiss Hologram (white Light Hologram = WLH)
Leslie smiles and winks as you walk past
- Telephone and Lens hologram (transmission Type)
- Train Engine WLH
- Microscope WLH
- Clown WLH
- Shakespeare Embossed WLH
- 360 Degree Rotating WLH
- Assorted (about 100) Hologram of various types from phy3400 Lab
- Two Speakers Lissajous Figure Maker
Shows Lissajous Figures produced by a mirror mounted to two speakers.
- Assorted Ground Glass Diffusion
Different types of bathroom glass produce interesting pattern when a laser is shone Through it.

e) Light Sources

- White Light
- Mercury light
- Sodium Light
- Ultraviolet Light
- Black Light
- See Atomic models for Spectrum Tubes

f) Colors

- Newton's Color Disk
A rotating disk of colors that blend to white if the speed is fast enough
- Color Mixing Box
Shows the mixture of red, green, and blue lights produce white light.
Cyan magenta and yellow can also be seen
- Assorted Color Filters
Shows subtractive mixing of colors
- Green Color Reflective Cloth
Two clothes that look exactly the same under sunlight but look different under fluorescent
Or incandescent light.
- Rainbow Angles 2-Liter Bottle
Shows 1st, 2nd and sometimes 3rd degree reflections in a spherical water drop to produce
Rainbows.
A laser is reflected through the bottle
- Light, Color, and Holography Transparencies from the book
Color Xerox copies of the plates from the textbook.
Shows primary color mixing, line spectra, reflectance graphs color image printing
And the CIE diagram
- Infrared Absorption
Using a heating coil (or lamp) thermocouple and digital meter this demo shows IR
Absorption and visible transmission of radiation through glass and plastic filters of
Various colors.
- After images using Colored Filters and Overhead projector
Shows afterimages and complimentary colors when students stare at colors shapes and
Then switch to seeing a white screen.
- Color Sensations
Shine a slide projector through the gaps created by rotating a triangular wheel through the
White light
- Thin Gold Film Shield
Shows reflection of red and transmission of green light.
- Light Bulb with Variac
Show the relationship between temperature and color as the variac slowly increases the
Intensity of the clear light bulb
- Polaroid Sheets on Overhead
Shows polarization of light using some optical active substances like scotch tape, mica
Sugar solution, Plexiglas, under stress and calcite crystals with birefringence properties
- Chemical Sunset
Shows how blue skies and red sunset occur by scattering light rays.
A solution of HCl and Sodium thiosulfate reacts creating a fine particulate that scatters
Blue light and passes red
- Use Large TV as a Color Mixer
The red, green, blue light of the TV can be blocked to show color mixing or shadows.
- Three Slide projectors with Masks
DR Detweiller devised this system to show light intensity and afterimages using cardboard
Masks in slide projectors.
This requires you practice for about an hour before you use it.
- Laser Wavelength Comparison with Full Spectrum
A slide projector's white light, HeNe laser and a solid-state laser are all shown through
Gratings to diffract the light.
The wavelength of the two lasers can easily be seen to be different because they appear
At different spots in the full spectrum from white light.
- Laser Absorption by Liquid Vanish Cleaner
He Ne laser light at -632nm and solid-state red laser light at -670nm are directed into a
Glass of liquid vanish and one is absorbed while the other passes right through
- Appearances of objects (Opaque, Metallic, ETC..)

- Spectrum Charts
Large Charts of the visible and total EM spectrum
- Fluorescent Chalk
- UV-samples Masses
- Fluorescent Dyes and Powder
- Fluorescent Minerals
- Infrared Filter (Passes Infrared Blocks Invisible)

8) Electrostatics

a) Electric Generators

- Van der Graaff:
Shows high voltage static charge, electric field, hair standing on end, and the discharging effect of point.
- Van der Graaff Toys
- Wimshurst Static Generator
Shows high voltage static discharge spark and is used to power many experiments.
- White Plastic Golf Rods with Wool for Negative Charge
Used to charge electroscopes, capacitors, plates, etc... and when used with rotating spindle to show attraction/repulsion of charges.
- Clear Plastic Rod with Silk for Positive Charge
Used to charge electroscopes, capacitors, plates, etc... and when used with rotating spindle to show attraction/repulsion of charges.
- Flat Acrylic Plate with Wool and Metal Disk for Induction
Used to charge electroscopes, capacitors, plates, etc... and when used with rotating spindle to show attraction/repulsion of charges.
- Conducting Rod (Also for use with spindle)

b) General

- Spindle Stand
- Faraday Cup with Charge Transfer Ball on Non-Conducting Handle
Shows that charge resides on the outside surface of a conductor using the electroscope
- Electroscope
Used to indicate sign and strength of charge. It is projected on the wall for students to see.
- Overhead Projection Electroscope
- Take Apart Capacitor (Leyden Jar)
Charged by Wimshurst generator and can be taken apart to show where charged is stored.
- Capacitor Plates on a Stand
Shows a dipole in an electric field (between capacitor plates). Acts as an electrostatic motor
- Dipole on Pivot Stand
- Electrostatic Field Demonstrator for Overhead projector
Shows five different cases of electric fields.
Examples are point charge, two point charges, electrostatic shielding, point charge with plate, and two plates.
- Two Ping-Pong Balls Between Capacitor Plates
Shows repulsion of two like charged balls.
- Ping-Pong Ball between Capacitor Plates
The ball bounces quickly back and forth transferring charge between the plates
- Lucifer's Tube
Shows a fluorescent tube being excited when a static charge from an acrylic induction plate is discharged through the tube.
- Adjustable Square Capacitor with Scale and Dielectric plates
- Faraday Shielding cages
- Conducting Chimney Experiment

9) Electrical Devices

a) AC-Devices

- Flickering Neon Bulb on Wire or Two Colored LED's
Shows AC current flickering on and off at 60 Hz as the bulb is swung in a circle
- Beer Can Motor
Uses four AC solenoids to produce eddy currents in a beer can causing it to spin.
- Take-Apart Transformer with Iron Kernel
Shows the effect how the numbers of wire turns effect a step up or step down transformer.
It can also be taken apart to show parts.
- Mutual Induction Coils (Solenoids)
Shows Faraday's law as current is passed through one coil and current is induced in a second coil. An iron core can be inserted to increase the effect.
- Self Inductance with Neon Bulb
A small neon bulb flashes when a battery is disconnected from the inductor causing the field to collapse
- Popping Capacitor
Shows energy stored in a capacitor that pops loudly when discharged.
- LR Circuit with Lamps & Coil
A light bulb and inductor are connected in series. A second light bulb is connected in parallel to them. When an iron core is inserted in the inductor it changes the inductance and the bulb in series with it dims, while the bulb in parallel is unchanged.
- LRC Resonance Circuit with red Light
An Inductor, resistor (red light bulb), and capacitor are connected in series.
As an iron core changes the inductance the circuit is tuned until the light bulb glows.
- Oscilloscope Traces
Shows a trace by audio frequency AC generator or an oscilloscope.
The scope is a standard size 3"x4" screen so it is suited for large classes.

b) DC-Devices

- Series Vs. Parallel Demonstration Box
Three light bulbs can be connected in series, in parallel, or in combination for students to see the results.
- Earth Magnetic Field Generators
A very large coil of wires is hand-cranked in the earth's magnetic field to generate AC and DC current.
- Large Scale DC-Motor
A lecture hall sized example of a motor.
It uses electromagnets instead of permanent magnets.
- Saint Louis Motor
An example of a simple DC motor using two bar magnets.
This is too small for large classes to easily see.
- Hand-Cranked Generator with Magnets
Example of power generation and transformation of energy.
- DC Discharging Capacitor with Pasco Science Workshop
The decay of a capacitor discharging through a resistor that can be displayed by the Computer.
- Ohm's Law Resistor with Pasco Science Workshop
Shows a plot of voltage Vs current on the screen.
The instructor must slowly change the voltage and press a key to measure the data.
This experiment will take about 10 min to perform and I need 1 hour to get it ready.
- Electro-Chemical Batteries
Simple take-apart electrolytic cell.

c) Meters

- Digital Multimeter
- Galvanometer (big) can be used as Ammeter or Voltmeter
- Ballistic Galvanometer
- Thompson Clock Face timer

d) Other

- Jacobs Ladder (Climbing Spark)
The classic Frankenstein high voltage climbing spark
- Hand-Held Tesla Coil
High voltage, high frequency coil used to excite gas spectrum tubes.
- 300,000 Volt Tesla Coil
Shows how high voltage, high frequency electricity can be transmitted through air without using wires.
A fluorescent tube held near the coil will glow nicely.
It also creates dramatic sparks and a lot of noise.
- Alternating Copper / Steel Resistivity Wire
120 Volt AC current runs through a wire made of copper and steel pieces.
The steel glows red hot while the copper remains cold.
- Wooden Board for Demonstration of Electronic Drift
Shows the idea of electronic drift in a wire carrying current using a marble bouncing down
A board of atoms (nails) or rolling down a superconductor (No nails in its path). The idea of Potential gradient can also be discussed based on relating voltage potential to gravitational Potential.
- Solution Conduction Tester
A light bulb with two electrodes that are inserted in a solution if the solution conducts Electricity the light will glow.
- 1 Farad Capacitor
A high-tech 5 volt 1 farad capacitor that is the size of a half-dollar
- Sample Capacitors, resistors, and Inductors

10) Magnetism

a) General Magnets

- Very Large Radar Magnets
Horseshoe shaped +/- 3000 Gauss magnets.
- Round Bar Magnet Set
Can be used with the spindle to demonstrate north/south polarity and attraction.
- Rectangular Bar Magnet Set
- Assorted Compasses
Can be used on overhead projector to show B-Field
- Neodymium Magnets
Extremely strong yet small sized magnets.
- Spindle Stand
- Electromagnet
Shows the property of an electromagnet where two students can try to pull it apart
- Liquid Magnetic Field Model for Overhead Projector
Shows the same thing as sprinkling iron filings around a bar magnet.
It is just contained so it is cleaner.
- B Field around a Wire
Iron filling sprinkled around a current carrying wire to show the magnetic field.
This is set up on the overhead projector for students to see.
- Magnetic Domain Model with Pivoting Magnets for Overhead Projector
Small dipole magnets are mounted on spindles to show magnetic domains.

- 3-D Magnetic Field Model
Clearly and cleanly shows a magnetic field in 3-D using a magnet inserted in a liquid /iron fillings chamber.
This is not very large.
- Toroid Model
A long solenoid made from a garden hose and wire that can be wrapped into a toroid.
- Magnetic Dip Needle Demonstration
Shows dip angle, but can also be used as a very large compass.
- Iron fillings

b) Magnetic Forces

- Force on Wire Stand
Shows the force on a current carrying wire in a magnetic field.
The wire is mounted on a swinging pivot so it can eject itself from the magnet.
The wire can also be manually moved through the field to produce current on a Ballistic Galvanometer.
- Two Wire Repulsion Stand
Shows the repulsion between two current carrying wires.
A laser beam bounces off a mirror on the stand, which makes the effect obvious
- Cathode Ray Tube (Crooke's tube)
Shows the effect of a b-field on an electron beam.

c) Lenz's Law and Eddy Currents

- Current Direction Indicator with LED Lights
Shows the direction of the voltage/current flow created when a magnet is pushed into a coil.
- Copper Tube for Neodymium Magnet
Dramatically shows eddy currents when an aluminum slug and a magnet are dropped down a copper tube. The aluminum slug falls freely while the magnet produces eddy currents and Therefore the forces dramatically slow its fall.
- Solid and Slit Copper Plate Pendulum (Eddy Current Brake)
Shows how eddy currents build to large values in a solid copper plate and don't in a plate full of slits. The tow plates are swung like a pendulum through the poles of a magnet.
The solid plate stops immediately between the poles while the slit plate is not effected.
- Floating Eddy Current Disk
Eddy currents float a 10 inch disk about 1 inch above a power supply
- Jumping Rings
Eddy currents cause aluminum rings to jump off an iron core solenoid.
- Hall Probe (Hall Effect)
Detects and measures B-field perpendicular to the probe using hall effect
- Hall Generator
Set of rotating disks that produce DC current.
This one is tricky to explain how it works and has to be seen to fully explain it.
- Y-Ba-Cu-O High TC Superconductor Kit

11) Nuclear Physics

a) Radioactivity

- Digital Geiger Counter
Counts in 7sec or 60sec intervals and then pauses the count before starting over.
Values are displayed in LED's and an audible click is heard for each particle detected
I need a day's warning so I can get the source
- Aluminum, Cardboard, and Lead Absorbers with Track
Used with Geiger counter and Radioactive Source.
- Tracerlab Density Absorber Kit
High quality absorber set that varies the density.

- Sample Fuel Pellets and Waste
Non-radioactive samples that give information about size, energy, and storage problems
Involving nuclear energy.
- Gainesville Radon Map
Shows an area of Gainesville likely to have high Radon levels.
- Cloud Chamber
Shows alpha particle trails in a cloud chamber.
It's very nice but I need two hours to set it up.

b) Gas Tubes

- Cathode Ray Tube
Shows an electron beam that can be deflected with a magnetic field
- Spectrum Tubes (H, He, Ne, Ar, others)
Shows the distinctive color of each gas and when viewed through a diffraction grating
Show the spectral lines.
- Electron Beam Tube with a Cross
Shows the shadow created when a cross X is placed in an electron beam and is charged
+/- or neutral. I need an hour to set this up.
- Electric Field/Electron Beam Deflection Tube
Shows the deflection of an electron beam as it passes through an electric field created by
Parallel plates. I need an hour to set this up.

c) Atomic Models

- Photoelectric Effect Magnetism Plate for Electroscopes and UV-Lamp
Shows the photoelectric effect by placing a charge on a magnesium plate attached to an
electroscope. The electroscopes show the charge decreasing as the UV lamp is placed next
to the Magnesium.
- Periodic Table (Auditorium sized)
A basic periodic table that has color pictures of the elements.
Big enough for the students to see.
- Size of Molecule Experiment
Oleic acid forms a one molecule thick layer on the surface of the water and the area can
be used to find the size of the molecule and Avogadro's constant.
- Cesium-chloride Model
- Tetragonal Model (Diamond)
- Trilinic Model
- Wurtzite Lattice
- Sodium-Chloride Lattice
- Face-Centered Model
- Cubic-Centered model
- Copper Lattice
- Magnesium Lattice
- Assorted Balls and Sticks for Assembling Models