Use of the
Video Encyclopedia of Physics Demonstrations
within the
California Science Standards
(Complete Video Encyclopedia Set)

Sixth Grade

Standard: Heat (Thermal Energy) (Physical Sciences)

3. Heat moves in a predictable flow from warmer objects to cooler objects until all of the objects are at the same temperature. As a basis for understanding this concept:

a. *Students know* energy can be carried from one place to another by heat flow or by waves, including water, light and sound waves, or by moving objects.
b. *Students know* that when fuel is consumed, most of the energy released becomes heat energy.
c. *Students know* heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and by convection (which involves flow of matter).
d. *Students know* heat energy is also transferred between objects by radiation (radiation can travel through space).

Applicable Video Encyclopedia Demonstrations:

Chapter 33: Heat Transfer

Disc 14 Demo 21:	*Thermal Conductivity*
Disc 14 Demo 22:	*Leidenfrost Phenomenon*
Disc 14 Demo 23:	*Radiometer*
Disc 14 Demo 24:	*Two Can Radiation*
Disc 14 Demo 25:	*Radiation Cube*
Disc 14 Demo 26:	*Insulation (Dewar Flask)*
Disc 14 Demo 27:	*Convection Currents*

Comments:

These demonstrations directly illustrate the concepts listed in the standards, such as conduction, convection, and radiation. In addition, they present important applications of these ideas to use in the modern world as well as the explanation of an interesting physics device, the radiometer, which many of the students have previously observed.

Seventh Grade

Standard: Physical Principles in Living Systems (Physical Sciences)

6. Physical principles underlie biological structures and functions. As a basis for understanding this concept:

a. *Students know* visible light is a small band within a very broad electromagnetic spectrum.
b. *Students know* that for an object to be seen, light emitted by or scattered from it must be detected by the eye.

c. *Students know* light travels in straight lines if the medium it travels through does not change.
d. *Students know* how simple lenses are used in a mgegnifying glass, the eye, a camera, a telescope, and a microscope.
e. *Students know* that white light is a mixture of many wavelengths (colors) and that retinal cells react differently to different wavelengths.
f. *Students know* light can be reflected, refracted, transmitted, and absorbed by matter.
g. *Students know* the angle of reflection of a light beam is equal to the angle of incidence.
h. *Students know* how to compare joints in the body (wrist, shoulder, thigh) with structures used in machines and simple devices (hinge, ball-and-socket, and sliding joints).
i. *Students know* how levers confer mechanical advantage and how the application of this principle applies to the musculoskeletal system.
j. *Students know* that contractions of the heart generate blood pressure and that heart valves prevent backflow of blood in the circulatory system.

Applicable Video Encyclopedia Demonstrations:

Chapter 56: Electromagnetic Waves

Disc 21 Demo 7: Light in a Vacuum
Disc 21 Demo 8: Straight Line Propagation
Disc 21 Demo 9: Pinhole Camera
Disc 21 Demo 10: Inverse Square Law
Disc 21 Demo 11: Radio Waves
Disc 21 Demo 12: Impossible Triangle
Disc 21 Demo 13: Lecher Wires
Disc 21 Demo 14: Microwave Unit
Disc 21 Demo 15: Microwave Standing Waves
Disc 21 Demo 16: Microwave Absorption
Disc 21 Demo 17: Radio in Faraday Cage

Chapter 57: Plane Mirrors

Disc 21 Demo 18: Microwave Reflection
Disc 21 Demo 19: Diffuse/Specular Reflection
Disc 21 Demo 20: Angles of Incidence and Reflection
Disc 21 Demo 21: Location of Image
Disc 21 Demo 22: Parity Reversal in a Mirror
Disc 21 Demo 23: Hinged Mirrors
Disc 21 Demo 24: Corner Reflector
Disc 21 Demo 25: Barbershop Mirrors
Disc 21 Demo 26: Mirror Box

Chapter 60: Lenses

Disc 22 Demo 16: Real Image Formation
Disc 22 Demo 17: Lens Magnification
Disc 22 Demo 18: Ray Tracing with Lenses
Disc 22 Demo 19: Fresnel Lenses
Disc 22 Demo 20: Fillable Air Lenses
Disc 22 Demo 21: Spherical Aberration

Disc 22 Demo 22: Chromatic Aberration
Disc 22 Demo 23: Astigmatism
Disc 22 Demo 24: Off Axis Distortion

Chapter 63: Spectra and Color

Disc 23 Demo 22: Infrared in Spectrum
Disc 23 Demo 23: Colors in Spectral Light
Disc 23 Demo 24: Rainbow Disc
Disc 23 Demo 25: Newton's Color disc
Disc 23 Demo 26: Additive Color Mixing

Chapter 10: Statics

Disc 4 Demo 1: Force Board
Disc 4 Demo 2: Clothesline
Disc 4 Demo 3: Load on Removable Incline
Disc 4 Demo 4: Pulley Advantage
Disc 4 Demo 5: Pulley and Scales
Disc 4 Demo 6: Simple Machines
Disc 4 Demo 7: Levers
Disc 4 Demo 8: Horizontal Boom
Disc 4 Demo 9: Arm Model
Disc 4 Demo 10: Torque Bar
Disc 4 Demo 11: Hinge Board
Disc 4 Demo 12: Torque Wrench
Disc 4 Demo 13: Torque Wheel
Disc 4 Demo 14: Balancing Meter Stick
Disc 4 Demo 15: Meter Stick on Fingers
Disc 4 Demo 16: Bridge and Truck
Disc 4 Demo 17: Roberval Balance
Disc 4 Demo 18: Ladder Forces
Disc 4 Demo 19: Broom Stand
Disc 4 Demo 20: Bed of Nails
Disc 4 Demo 21: Egg Crusher

Comments:

Demonstrations in Chapter 56 illustrate a variety of properties of electromagnetic waves and light, showing that light has common features with general electromagnetic waves and illustrating these properties as presented in standards 6a, b, and c. Chapter 57 illustrates properties of light reflection as applied to mirrors as listed in standards 6f and g, and presents a number of very interesting applications. Chapter 60 thoroughly reviews image formation by a convex lens, such as the eye lens as listed in standard 6d, gives some neat applications of simple lenses, and describes some important problems with simple lenses often found in the eye lens, which can be corrected by eyeglasses. Chapter 63 deals with the spectrum of light and its relation to our perception of color, and demonstrates the important concept of color mixing of lights. Chapter 10 discusses a wide range of statics problems, many of which are applicable to the human body as described in Standards sections 6h and 6i.

Eighth Grade

Standard: Motion

1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept:
   a. *Students know* position is defined in relation to some choice of a standard reference point and a set of reference directions.
   b. *Students know* that the average speed is the total distance traveled divided by the total time elapsed and that the speed of an object along the path traveled can vary.
   c. *Students know* how to solve problems involving distance, time and average speed.
   d. *Students know* the velocity of an object must be described by specifying both the direction and the speed of an object.
   e. *Students know* changes in velocity may be due to changes in speed, direction, or both.
   f. *Students know* how to interpret graphs of position versus time and graphs of speed versus time for motion in a single direction.

Applicable Video Encyclopedia Demonstrations:

Chapter 2: Linear Kinematics

Disc 1	*Demo 8:*	*Constant Velocity*
Disc 1	*Demo 9:*	*Bulldozer on Moving Sheet*
Disc 1	*Demo 10:*	*Rolling Ball Incline*
Disc 1	*Demo 11:*	*Constant Acceleration*
Disc 1	*Demo 12:*	*String and Weights Drop*
Disc 1	*Demo 13:*	*Reaction Time Falling Meter Stick*
Disc 1	*Demo 14:*	*Guinea and Feather*

Chapter 4: Motion in a Plane

Disc 2	*Demo 1:*	*Shooter/Dropper*
Disc 2	*Demo 2:*	*Monkey Gun*
Disc 2	*Demo 3:*	*Vertical Gun on Car*
Disc 2	*Demo 4:*	*Vertical Gun on Accelerated Car*
Disc 2	*Demo 5:*	*Air Table Parabolas*
Disc 2	*Demo 6:*	*Range Gun*
Disc 2	*Demo 7:*	*Velocity Vector Addition*
Disc 2	*Demo 8:*	*Bulldozer on Moving Sheet*
Disc 2	*Demo 9:*	*Sliding Weights with Triangle*
Disc 2	*Demo 10*	*Sailing Upwind*
Disc 2	*Demo 11*	*Local Vertical with Acceleration*

Comments:

These demonstrations illustrate a number of important features of motion in one and two dimensions, including position, velocity, and acceleration, and how to make and interpret graphs of position, velocity, and acceleration versus time. Definitions of important terms are provided in context.

Standard: Forces

2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept:

a. *Students know* a force has both magnitude and direction.
b. *Students know* when an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.
c. *Students know* when the forces on an object are balanced, the motion of the object does not change.
e. *Students know* how to identify separately the tow or more forces that are acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.
f. *Students know* the greater the mass of an object, the more force is needed to achieve the same rate of change of motion.
g. *Students know* the role of gravity in forming and maintaining the shapes of planets, stars, and the solar system.

Applicable Video Encyclopedia Demonstrations:

Chapter 3: Linear Dynamics

Disc 1	*Demo 15:*	*String and Weight Acceleration*
Disc 1	*Demo 16:*	*Atwood's Machine*
Disc 1	*Demo 17:*	*Acceleration with Spring*
Disc 1	*Demo 18:*	*Dropped Slinky*
Disc 1	*Demo 19:*	*Candle in Dropped Jar*

Chapter 5: Inertia

Disc 2	*Demo 12:*	*Shifted Air Track Inertia*
Disc 2	*Demo 13:*	*Inertia Ball*
Disc 2	*Demo 14:*	*Foam Rock*
Disc 2	*Demo 15:*	*Tablecloth Jerk*
Disc 2	*Demo 16:*	*Eggs and Pizza Pan*
Disc 2	*Demo 17:*	*Pencil and Plywood*

Chapter 6: Action and Reaction

Disc 2	*Demo 18:*	*Reaction Gliders*
Disc 2	*Demo 19:*	*Reaction Gliders Momentum Conservation*
Disc 2	*Demo 20:*	*Car on Rolling Board*
Disc 2	*Demo 21:*	*Fan Car with Sail*
Disc 2	*Demo 22:*	*CO_2 Rocket*
Disc 2	*Demo 23:*	*Water Rocket*
Disc 2	*Demo 24:*	*Fire Extinguisher Rocket*
Disc 2	*Demo 25:*	*Helicopter Rotor*
Disc 2	*Demo 26:*	*See-Saw Reaction Carts*

Chapter 7: Friction

Disc 3	*Demo 1:*	*Air Track Friction*
Disc 3	*Demo 2:*	*Static vs. Sliding Friction*
Disc 3	*Demo 3:*	*Area Dependence of Friction*
Disc 3	*Demo 4:*	*Weight Dependence of Friction*
Disc 3	*Demo 5:*	*Surface Dependence of Friction*
Disc 3	*Demo 6:*	*Stability of Rolling Car*

Comments:

These demonstrations illustrate the three Newton's laws of motion, and discuss the effect of friction on motion. Several demonstrations are included to illustrate the concepts as

applied to very compelling experiments, such as rocketry, the table cloth trick, and blasting a pencil through a piece of plywood. In some videos arrows superposed on the objects involved, so that the student can more readily visualize the relation between force and motion (Newton's second law) indicate forces.

Standard: Structure of Matter

3. Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:

a. *Students know* the structure of the atom and know it is composed of protons, neutrons, and electrons.
b. *Students know* that compounds are formed by combining two or more different elements and that compounds have properties that are different from their constituent elements.
c. *Students know* atoms and molecules form solids by building up repeating patterns, such as crystal structure of NaCl or long-chain polymers.
d. *Students know* the states of matter (solid, liquid, gas) depend on molecular motion.
e. *Students know* that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.
f. *Students know* how to use the periodic table to identify elements in simple compounds.

Applicable Video Encyclopedia Demonstrations:

Chapter 35: Phase Changes

Disc 15 Demo 9: Liquid Nitrogen in Balloon
Disc 15 Demo 10: Boil Water Under Reduced Pressure
Disc 15 Demo 11: CO_2 Critical Point
Disc 15 Demo 12: Drinking Bird
Disc 15 Demo 13: Freezing by Boiling
Disc 15 Demo 14: Cryophorus
Disc 15 Demo 15: Ice Bomb
Disc 15 Demo 16: Regelation
Disc 15 Demo 17: Helium and CO_2 Balloons in Liquid Nitrogen
Disc 15 Demo 18: Sublimation of CO_2
Disc 15 Demo 19: Slime Ball

Chapter 36: Kinetic Theory

Disc 16 Demo 1: Pressure vs. Volume
Disc 16 Demo 2: Pressure vs. Temperature
Disc 16 Demo 3: Temperature Increase Simulation
Disc 16 Demo 4: Pressure vs. Volume Simulation
Disc 16 Demo 5: Equipartition of Energy Simulation
Disc 16 Demo 6: Mercury Kinetic Energy
Disc 16 Demo 7: Brownian Motion
Disc 16 Demo 8: Brownian Motion Simulation
Disc 16 Demo 9: Diffusion

Disc 16 Demo 10: Diffusion Simulation
Disc 16 Demo 11: Bromine Diffusion
Disc 16 Demo 12: Gaussian Curve
Disc 16 Demo 13: Free Expansion Simulation

Chapter 37: Crystals and Low Temperatures

Disc 16 Demo 14: Superconductors
Disc 16 Demo 15: Crystal Models
Disc 16 Demo 16: Faults in Crystals

Comments:

These demonstrations describe the three states of matter and illustrate changes of state using several important examples. Phase changes are thoroughly illustrated in Chapter 35. The demonstrations on kinetic theory of Chapter 36 illustrate important aspects of how molecular activity leads to the particular properties of each state. Crystals are illustrated in Chapter 37, along with the semiconductor, perhaps the most important application of crystals. Levitation of a small magnet over a superconducting crystal, one of the most exciting experimental developments of the past ten years, is also illustrated.

Standard: Density and Buoyancy

8. All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept:

a. *Students know* density is mass per unit volume.
b. *Students know* how to calculate the density of substances (regular and irregular solids and liquids) from measurements of mass and volume.
c. *Students know* the buoyant force on an object in a fluid is an upward force eual to the weight of the fluid displaced.
d. *Students know* how to predict whether an object will float or sink.

Applicable Video Encyclopedia Demonstrations:

Chapter 27: Fluid Pressure

Disc 12 Demo 1: Same Level Tubes
Disc 12 Demo 2: Pressure vs. Depth
Disc 12 Demo 3: Pressure vs. Depth in Water and Alcohol
Disc 12 Demo 4: Pressure Independent of Direction
Disc 12 Demo 5: Water/Air Compression
Disc 12 Demo 6: Water and Mercury U-tube
Disc 12 Demo 7: Hydraulic Press
Disc 12 Demo 8: Hydrostatic Paradox

Chapter 28: Buoyancy

Disc 12 Demo 9: Hydrometer
Disc 12 Demo 10: Weight of Air
Disc 12 Demo 11: Buoyant Force
Disc 12 Demo 12: Archimedes' Principle
Disc 12 Demo 13: Board and Weights Float
Disc 12 Demo 14: Different Density Wood
Disc 12 Demo 15: Density Ball
Disc 12 Demo 16: Density Balls in Beans
Disc 12 Demo 17: Battleship in Bathtub

Disc 12 Demo 18: *Buoyancy in Various Liquids*
Disc 12 Demo 19: *Floating Square Bar*
Disc 12 Demo 20: *Helium Balloon in Glass Jar*
Disc 12 Demo 21: *Helium Balloon in Liquid Nitrogen*
Disc 12 Demo 22: *Cartesian Diver*

Comments:

These demonstrations thoroughly illustrate aspects of the density (standards 8a and 8b) and buoyancy (standards 8c and 8d). The fundamentals of fluid pressure (Pascal's law) and density (Archimedes' law) are also reviewed, and important applications of the principles of fluid pressure and buoyancy are presented. Interesting devices such as the cartesian diver, the "battleship in bathtub," and the variation of buoyancy in different liquids are included as centerpieces for discussion of the concepts, and the weight of air and the floating square bar explore unexpected buoyant behavior.