Physics 1

Course Competencies/Objectives with Activities and Labs

Course Code: 3241

Course Description

Physics, the most fundamental of the natural sciences, is quantitative in nature and uses the language of mathematics to describe natural phenomena. This course is designed to prepare students for the demands of a two- or four-year college degree program. The following topics are considered essential in a basic physics curriculum:

- Mechanics
- Electricity and magnetism
- Waves

Topics from modern physics (quantum physics, nuclear physics, etc.) should be included as time permits or could be included in an advanced physics course.

Percentages following the topic headings in the charts below indicate the amount of instructional time that should be devoted to that topic.

Minimum Course Requirements: Successful completion of Algebra 1 or equivalent, with a B or better, and geometry; or, successful completion of Algebra 1 or equivalent, geometry, and Algebra 2.

Teacher Resources

Books:

McDermott, Lillian C. and the Physics Education Group at the University of Washington. *Physics By Inquiry.* Vols. 1, 2, and 3. John Wiley and Sons, New York, 1996.[1]

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Internet:

The Frontier High School Web site at Red Rock, Oklahoma, is an excellent source with templates and rubrics for graphing, reports, projects, and essays. <http://pc65.frontier.osrhe.edu/hs/science/hsci.htm>

Frank Potter's Science Gems: Great Links to Great Science Resources. For students, parents, teachers, scientists, engineers and mathematicians. More than fourteen thousand science resources sorted by category, subcategory, and grade level. <http://www.sciencegems.com>

Special note to teachers: The standards notation in this document is based on the notation in the Science Curriculum Standaards 2000 document for grades 9-12, physical science section. The Science Curriculum Standards 2000 document represents scientific literacy for all students. Therefore standards have been expanded to include more advanced topics that should be included in a Physics course.

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Topic: Motion and Forces (25%)

S.C. Standards	Performance Objectives (Competencies)	Suggested Activities
	• Distinguish between vector quantities (displacement, velocity, acceleration, and force) and scalar quantities (distance, speed, and mass).	
	• Illustrate how to represent vectors graphically and be able to add them both graphically and analytically.	• Force table lab: Graphical analysis of forces; finding the equilibrant force.
IV.A.1.c. Solve uniformly accelerated, linear motion problems quantitatively and graphically.	• Distinguish between and solve problems involving velocity, speed, and constant acceleration for one and two dimensional motion.	
	• Create and interpret graphs of one-dimensional and two-dimensional motion (position vs. time, speed vs. time, velocity vs. time, constant acceleration vs. time).	• Motion lab (students generate and interpret position-time and velocity-time graphs). ▪ Constant velocity vehicle ▪ Analysis of constant velocity or accelerated motion, including falling bodies, using appropriate equipment (tape timer, photogate timer, CBL, etc.). ▪ Motion in two-dimension lab ▪ Projectile motion

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IV.A.1.b. Predict the motion of an object in terms of Newton's three laws of motion.	• Explain the relationship between mass and inertia.	
	• Interpret and apply Newton's first law of motion.	
	• Assess, measure, and calculate the relationship among the force acting on a body, the mass of the body, and the nature of the acceleration produced (Newton's second law of motion).	• Newton's second law of motion lab: Using dynamics cart with air track, smart pulleys, tape-timers, photogate timers, CBL, or other technology.
	• Construct a free body diagram to show forces acting on an object and generate the appropriate equations to solve for the force on it.	
	• Qualitatively and quantitatively distinguish between static and kinetic friction, what they depend on, and their effects on the motion of objects.	• Friction lab ▪ Investigation of variables affecting frictional forces. ▪ Determination of the coefficient of friction on horizontal and inclined surfaces.

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	• Interpret and apply Newton's third law of motion.	• Newton's third law of motion lab: Action/reaction labs.
IV.A.2.a. Describe quantitative changes in gravitational attraction in terms of distances between masses. **IV.A.2.b.** Describe quantitative changes in gravitational attraction in terms of changes in the masses.	• Assess, and calculate the nature and magnitude of gravitational forces (Newton's Law of Universal Gravitation). Apply concepts to analyze the motion of satellites.	▪ Kepler's Laws Lab
	• Analyze and evaluate the nature of uniform circular motion.	• Circular motion lab.
	• Analyze, evaluate, and apply the principle of torque.	

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Topic: Conservation of Energy and Momentum (25%)

S.C. Standard	Performance Objectives (Competencies)	Suggested Activities
IV.B.1.b. State and apply quantitative relationships among energy, work, power, and efficiency.	• Describe and apply the relationships between energy, work, power, and efficiency both conceptually and quantitatively.	• Use simple machines to calculate work, power, and efficiency.
IV.B.1.a. Evaluate transformations between potential and kinetic energies and other forms of energy.	• Analyze energy of position and energy of motion.	• Pendulum lab: Strobe photography to analyze the motion of a pendulum.
	• Analyze, evaluate, and apply the principle of conservation of mechanical energy.	• Conservation of energy lab ▪ Expanded pendulum lab. ▪ Inclined plane. ▪ Playground or amusement park physics. ▪ Interface lab (CBL, Smart Pulley)
	• Analyze and measure the transfer of mechanical energy through work.	• Hooke's Law lab.

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	• Assess the vector nature of momentum and its dependency on mass and velocity of an object.	
	• Compare and contrast impulse and the change in momentum.	
	• Analyze the factors required to produce a change in momentum.	
	• Apply the conservative laws to inelastic and elastic collisions.	• Conservation of momentum lab (using ballistic pendulum, air track, dynamics carts, etc.).

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Topic: Heat and Heat Transfer (5%)

S.C. Standard	Performance Objectives (Competencies)	Suggested Activities
IV.B.3.c. Assess particle motion and distance as they relate to temperature and phase changes.	• Relate thermal energy to molecular motion.	
	• Differentiate between specific heat and heat capacity, temperature, and heat.	
	• Explain the relationship between temperature change in a substance for a given amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.	• Specific heat lab: Calorimetry experiment.
	• Calculate the heat associated with phase changes.	• Latent heat lab: Calorimetry experiment.

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Topic: Electromagnetism (25%)

S.C. Standard	Performance Objectives (Competencies)	Suggested Activities
IV.A.1.a. Trace the historical development of the understanding of forces, including the contributions of Galileo, Newton, and Coulomb.	• Explain the contributions Charles-Augustin de Coulomb to the understanding of electrical phenomena.	
IV.A.3.a. Demonstrate the interactions of like and unlike charges.	• Recognize the characteristics of static charge, and explain how a static charge is generated.	
IV.A.3.a. Examine changes in electrostatic attraction in terms of changes in distances between two point charges. **IV.A.3.b.** Examine changes in electrostatic attraction in terms of changes in the quantities of the charges.	• Interpret and apply Coulomb's Law.	▪ Coulomb's law lab.

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	• Explain the difference in concept between electric forces and electric fields. • Relate electric potential to work per charge and use the work-energy theorem to calculate the kinetic energy and speed of a test charge.	▪ Field mapping
IV.A.5.d. Perform calculations using Ohm's Law.	• Develop a qualitative and quantitative understanding of current, voltage, and resistance and the relationship between them. • Develop a qualitative and quantitative understanding of current, voltage, and resistance and their relationship to each other.	• Ohm's Law lab.
	• Identify appropriate units of measurement for current, voltage, and resistance and explain how they are measured.	

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IV.A.5.a. Construct and schematically diagram simple series circuits and parallel circuits. **IV.A.5.b.** Use an electric meter to measure the voltage and resistance in a circuit. **IV.A.5.c.** Compare and contrast series and parallel circuits.	• Analyze and measure the relationship among current, voltage, and resistance in electrical circuits.	• Resistors in series and parallel lab.
	• Calculate the electric power and electric energy for DC circuits. • Predict the cost of operating a given electrical device.	• Joule heat lab.
IV.A.5.e. Explain how fuses, surge protectors, and breakers function.	• Explain how fuses, surge protectors, and breakers function.	
IV.A.4.a. Describe how moving electrical charges produce magnetic fields. **IV.A.4.b.** Describe how moving magnets produce electrical fields.	• Analyze magnetic forces on current carrying wires and moving charges and the production of electrical fields by moving magnets.	

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IV.A.4.c. Compare and contrast electrical motors and electrical generators in terms of energy transfers.	• Compare and contrast electric motors and generators.	▪ Electric motor lab.
	• Explain the production of electricity using Faraday's Law.	• Genco lab.

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Topic: Waves (20%)

S.C. Standard	Performance Objectives (Competencies)	Suggested Activities
IV.C.1.a. Identify and show relationships among wave characteristics such as velocity, period, frequency, amplitude, phase, and wavelength.	• Analyze the relationship among the characteristics of waves (velocity, wavelength, frequency, period, phase, amplitude).	• Wave experiments (using equipment such as ripple tanks, springs, oscilloscopes, etc.).
IV.C.1.c. Give examples of reflection, refraction, diffraction, interference, polarization, and Doppler Effect.	• Describe the behavior of waves in various media.	
	• Analyze the behavior of waves at boundaries between media (reflection, refraction).	• Snell's Law. • Plane mirrors.
	• Analyze the characteristics of lenses and mirrors.	• Concave and convex mirror lab. • Concave and convex lenses lab.
	• Analyze the diffraction of waves.	

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	• Analyze the relationship between phenomena of interference and the principle of superposition.	• Standing wave lab. • Measurement of the speed of sound using a resonance tube.
	• Analyze the frequency and wavelength of sound produced by a moving source (the Doppler Effect).	
IV.C.3.a. Describe how absorbing and releasing of energy by electrons produces light. **IV.C.3.b**. Explain that each element has its own configuration of electrons and has a unique line spectrum that can be used to identify that element. **IV.C.3.c.** Discuss the application of emitted colors by certain substances in such areas as fireworks and light sources.	• Analyze the emission of light from various sources and explain the emission process.	• Measuring the wavelength of light using a diffraction grating. • Gas discharge tubes.

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