CHINO VALLEY UNIFIED SCHOOL DISTRICT
INSTRUCTIONAL GUIDE
PHYSICS HONORS

Course Number	5421
Department	Science
Suggested guidelines for enrollment	"B" or better in Algebra II
Length of Course	Two (2) semesters/One (1) Year
Grade Level	10-12
Credit	5 units per semester/10 total credits-physical science
Repeatable	Not repeatable for credit
UC/CSU	Meets "d" laboratory science requirement
Board Approved	April 3, 2008

Description of Course - Physics is the study of the physical world and deals with the behavior and structure of matter. The study of physics is divided into the areas of motion, fluids, heat, sound, light, electricity and magnetism, relativity, atomic structure, nuclear physics, and elementary particles. Students will use basic concepts, equations, and assumptions to describe the physical world and develop an understanding of the tools of physics.

Rationale for Course - Physics is an elaborately integrated body of knowledge. The principles of physics come into play repeatedly in everyday life, from simple applications to understanding the laws of nature and relativity. Problem solving skills developed through the study of physics help students to improve critical thinking skills.

Standard 1 - Students will know that the motion of objects is ordinarily predictable using Newton's Laws.

1.1 Objective: Understand how to solve problems involving constant speed and average speed.

1.1.1 Performance Indicator: Students will be able to predict the location of an object moving with a measured average speed.

1.2 Objective: Know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's First Law).

1.2.1 Performance Indicator: Students will be able to state Newton's First Law and site everyday examples.

1.3 Objective: Apply Newton's Second Law in solving motion problems in one dimension.

1.3.1 Performance Indicator: Students will be able to calculate the net force acting on an object when multiple forces are applied to the object.

1.3.2 Performance Indicator: Students will calculate the acceleration experienced by an object when the net force and mass are known.

1.4 Objective: Recognize that forces between any two interacting objects always exist in pairs of equal magnitude and opposite direction (Newton's third law).

1.4.1 Performance Indicator: Students will be able to distinguish between action-reaction forces that are applied to different objects versus the net force acting on a single object.

1.5 Objective: Recognize the relationship between the universal law of gravitation and the force of gravity on an object at the Earth's surface.

1.5.1 Performance Indicator: Students will demonstrate the equivalence of the gravitational force between the Earth and an object on the earth's surface and the weight of an object on the Earth's surface through calculation.

1.6 Objective: Know applying a force to an object perpendicular to the direction of motion causes the object to change direction but not speed.

1.6.1 Performance Indicator: Students will describe a situation in which acceleration changes the direction of an object's motion but not its speed.

1.7 Objective: Recognize that an object in uniform circular motion requires a constant force directed toward the center of the circle.

1.7.1 Performance Indicator: Students will measure the force applied to an object required to maintain a state of uniform circular motion.

1.7.2 Performance Indicator: Students will be able to explain a demonstrated discrepant event in terms of center-directed forces (e.g. rotating candles).

1.8 Objective: Recognize that Newton's Laws of Motion are not exact but are good approximations for objects traveling at speeds well below the speed of light and for objects large enough to make quantum effects irrelevant.

1.8.1 Performance Indicator: Students will recognize that the relative velocity of any two objects may not exceed the speed of light.

1.9 Objective: Be able to solve two-dimensional trajectory problems.

1.9.1 Performance Indicator: Students will recognize that projectiles moving near the Earth's surface follow parabolic trajectories.

1.9.2 Performance Indicator: Students will be able to determine the velocity and position of a projectile at all points in its trajectory.

1.10 Objective: Be able to resolve two-dimensional vectors into their perpendicular components. Be able to determine the resultant vector from its perpendicular components.

1.10.1 Performance Indicator: Students will use the sine and cosine functions of a scientific calculator to resolve a vector into its perpendicular components.

1.10.2 Performance Indicator: Students will use the tangent function of a scientific calculator to find the resultant vector from its perpendicular components.

1.10.3 Performance Indicator: Students will be able to graphically determine component or resultant vectors.

1.11 Objective: Know how to solve two-dimensional problems involving balanced forces (statics).

1.11.1 Performance Indicator: Students will recognize that static equilibrium of forces results in a net force of zero.

1.11.2 Performance Indicator: Students will calculate the force necessary to establish a state of equilibrium when unbalanced forces are acting upon the system.

1.12 Objective: Be able to solve circular motion problems using the formula for centripetal acceleration, $a = v^2/r$.

1.12.1 Performance Indicator: Students will determine the value of an unknown variable given two known variables of centripetal acceleration, tangential velocity, or radius.

1.13 Objective: Be able to solve problems involving the forces between two electric charges.

1.13.1 Performance Indicator: Students will be able to state and explain Coulomb's Law.

1.13.2 Performance Indicator: Students will be able to determine electric force, electric charge, or the distance between the charges when given two of the other variables.

1.14 Objective: Be able to solve problems involving the gravitational force between two objects.

1.14.1 Performance Indicator: Students will be able to state and explain Newton's Law of Universal Gravitation.

1.14.2 Performance Indicator: Students will be able to determine gravitational force, mass, or the distance between the objects when given all but one of the variables.

Standard 2 - Students will know that the motion of objects can be predicted from the laws of conservation of energy and momentum.

2.1 Objective: Understand how to solve problems involving kinetic energy and gravitational potential energy near the Earth's surface.

2.1.1 Performance Indicator: Students will be able to determine kinetic energy, mass or the velocity of an object utilizing the formula $KE=1/2mv^2$

2.1.2 Performance Indicator: Students will be able to determine gravitational potential energy, mass, or the height of an object relative to the Earth's surface using PE=mgh.

2.2 Objective: Understand how to solve problems involving the conservation of energy principle.

2.2.1 Performance Indicator: Students will be able to state and explain the law of conservation of energy.

2.2.2 Performance Indicator: Students will understand that mechanical energy is the sum of the kinetic and potential energy in a closed and isolated system

2.2.3 Performance Indicator: Students will be able to determine the velocity of an object at the instant it hits the ground when it falls from a given height.

2.3 Objective: Understand how to solve momentum problems and recognize that momentum is a conserved quantity that is distinctly different from energy.

2.3.1 Performance Indicator: Students will be able to state and explain the law of conservation of momentum.

2.3.2 Performance Indicator: Students will be able to compare and contrast the law of conservation of momentum and the law of conservation of energy.

2.3.3 Performance Indicator: Students will be able to determine momentum, mass, or the velocity of an object using p=mv.

2.4 Objective: Understand that the momentum of an object will change when a net force is exerted on the object for a given time interval.

2.4.1 Performance Indicator: Students will be able to determine the force required to cause a momentum change in a given time interval.

2.5 Objective: Understand how to use the principles of conservation of momentum and energy to solve problems involving elastic and inelastic collisions in one dimension.

2.5.1 Performance Indicator: Students will be able to distinguish between elastic and inelastic collisions.

2.5.2 Performance Indicator: Students will be able to determine the final velocity of an object involved in a two-body collision.

2.6 Objective: Understand how to solve conversation of energy problems in simple systems involving various sources of potential energy.

2.6.1 Performance Indicator: Students will be able to solve problems involving elastic potential energy and the spring constant.

2.6.2 Performance Indicator: Students will be able to solve problems involving electric potential energy for a pair of electric charges.

2.6.3 Performance Indicator: Students will be able to solve problems involving capacitors in an electric circuit.

Standard 3 - Students will know that energy cannot be created nor destroyed, although in many processes energy is transferred to the environment as heat.

3.1 Objective: Understand that heat flow and work are two forms of energy transfer.

3.1.1. Performance Indicator: Students will define heat and work and be able to distinguish between the two forms of energy transfer.

3.2 Objective: Know that the work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature (first law of thermodynamics) and that this is an example of the law of conservation of energy.

3.2.1 Performance Indicator: Students will be able to define the first law of thermodynamics.

3.2.2 Performance Indicator: Students will be able to provide an example of a cyclic process.

3.2.3 Performance Indicator: Students will be able to calculate the work down by a heat engine operating in a cycle.

3.3 Objective: Know the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as thermal energy. The greater the temperature of an object is, the greater the energy of motion of the atoms and molecules that make up the object.

3.3.1 Performance Indicator: Students will be able to define temperature and explain the causes of temperature change.

3.4 Objective: Know that most processes tend to decrease the order of a system over time and that energy levels are eventually distributed uniformly.

3.4.1 Performance Indicator: Students will be able to provide an example of a system in which organization decreases.

3.5 Objective: Recognize that entropy is a measure of a system's disorder and that this quantity is larger for a more disordered system.

3.5.1 Performance Indicator: Students will be able to describe the second law of thermodynamics.

3.6 Objective: Understand that increasing entropy is a statistical fact governing all closed systems (second law of thermodynamics).

3.6.1 Performance Indicator: Students will be able to demonstrate entropy increase using a deck of playing cards or other ordered systems.

3.7 Objective: Know how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.

3.7.1 Performance Indicator: Students will be able to explain why a heat engine cannot be 100% efficient.

3.7.2 Performance Indicator: Students will be able to calculate a system's thermal energy when energy is transferred by heat or work.

3.7.3 Performance Indicator: Students will be able to determine the efficiency of a heat engine when given the net work done by the engine and the energy added to the engine by heat.

Standard 4 - Students will be familiar with the characteristic properties of waves and recognize that these apply to all wave types.

4.1 Objective: Understand that waves transfer energy from one place to another.

4.1.1. Performance Indicator: Students will be able to demonstrate with springs or ropes that waves transfer energy without a net displacement of matter.

4.2 Objective: Be able to distinguish between longitudinal and transverse waves.

4.2.1 Performance Indicator: Students will be able to contrast the particle displacements in longitudinal waves with those in transverse waves.

4.2.2 Performance Indicator: Students will be able to classify commonly occurring waveforms (i.e. seismic) as either longitudinal, transverse, or a combination of the two.

4.3 Objective: Be able to solve problems involving wavelength, frequency and wave speed.

4.3.1 Performance Indicator: Students will be able to determine wavelength, frequency and wave speed when given two of the variables.

4.4 Objective: Understand that sound is a longitudinal wave the speed of which depends on the properties of the medium through which it propagates.

4.4.1 Performance Indicator: Students will be able to make generalizations about the relative velocities of sound waves in solids, liquids, and gasses.

4.4.2 Performance Indicator: Students will be able to experimentally determine the speed of sound in air.

4.5 Objective: Recognize the different parts of the electromagnetic spectrum and know that the velocity of electromagnetic waves in a vacuum is the speed of light (approximately 3.00×10^8 m/s).

4.5.1 Performance Indicator: Students will be able to organize the various types of electromagnetic waves by increasing frequency, wavelength or energy.

4.5.2 Performance Indicator: Students will know the speed of light in a vacuum and know the relationship between the frequency, wavelength and speed of light.

4.6 Objective: Know how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.

4.6.1 Performance Indicator: Students will be able to explain the Doppler effect using common observations.

4.6.2 Performance Indicator: Students will be able to explain how and why resonance occurs.

4.6.3 Performance Indicator: Students will be able to explain how interference in sound waves produce beats and how beat frequency relates to the frequencies of the two interfering waves.

4.6.4 Performance Indicator: Students will be able to describe reflection of light and describe the images formed from various types of mirrors.

4.6.5 Performance Indicator: Students will be able to describe polarization and the ways in which light may be polarized.

4.6.6 Performance Indicator: Students will be able to describe why wave refraction occurs.

4.6.7 Performance Indicator: Students will be able to define index of refraction and use Snell's law to determine angle of refraction.

4.6.8 Performance Indicator: Students will be able to describe the characteristics of various types of thin lenses and the images they produce.

4.6.9 Performance Indicator: Students will be able explain the formation of a diffraction pattern.

Standard 5 - Students will know that electric and magnetic phenomena are related and that many electromagnetic phenomena have practical applications.

5.1 Objective: Be able to determine current or voltage in simple direct current circuits constructed from batteries, wires, resistors, and capacitors.

5.1.1 Performance Indicator: Students will be able to identify and diagram series and parallel circuits.

5.1.2 Performance Indicator: Students will be able to calculate equivalent resistance in series and parallel circuits.

5.1.3 Performance Indicator: Students will be able to apply the equations relating current, potential difference, resistance, and capacitance to simple circuits.

5.2 Objective: Be able to solve problems involving Ohm's law.

5.2.1 Performance Indicator: Students will be able to determine all terms in the equation V=IR.

5.3 Objective: Know that all resistive elements in a DC circuit dissipate energy in the form of heat. Students will know that the rate of energy dissipation is defined as power.

5.3.1 Performance Indicator: Students will be able to determine power, current, or the resistance in a circuit using $P=I^2R$.

5.4 Objective: Know the properties of general types of circuit elements and their function in electric circuits.

5.4.1 Performance Indicator: Students will be able to identify standard circuit elements and explain their basic function.

5.5 Objective: Recognize that an electric field exists around all charged particles and that an electric force exists between any two charged particles.

5.5.1 Performance Indicator: Students will recognize that the electric field is a vector quantity and will be able to diagram the electric field around a charged particle.

5.5.2 Performance Indicator: Students will be able to describe the relative magnitude and direction of the electric force acting on a charged particle due to its interaction with another charged particle.

5.6 Objective: Know that an electric current in a conductor will produce a magnetic field which can experience forces due to interaction with other magnetic fields.

5.6.1 Performance Indicator: Students will be able to predict the direction and relative magnitudes of forces produced by interacting magnetic fields.

5.7 Objective: Know how to determine the direction of the magnetic field produced by an electric current in a straight wire or in a coil.

5.7.1 Performance Indicator: Students will use the right-hand rule to indicate the direction of the magnetic field produced by a current carrying wire.

5.8 Objective: Know that a changing magnetic field will produce an electric field which can induce a current in a nearby conductor.

5.8.1 Performance Indicator: Students will be able to use a DC power source, a length of wire, and a permanent magnet to demonstrate the interaction of

the magnetic fields of the wire and the magnet (build a simple electromagnet and generator).

5.9 Objective: Know that plasmas contain ions and/or free electrons and can conduct an electric current.

5.9.1 Performance Indicator: Students will be able describe the effects of charged particles on the atmosphere (e.g. lightning strikes and auroras).

5.10 Objective: Know that electric and magnetic fields contain energy and are vector field forces.

5.10.1 Performance Indicator: Students will be able to describe the direction of electric force and calculate the magnitude of the electric force between two charged particles.

5.10.2 Performance Indicator: Students will be able to calculate the electric field vector due to a point charge.

5.10.3 Performance Indicator: Students will be able to determine electrical potential energy of an electric charge located within an electric field.

5.11 Objective: Know how to determine the force on a charged particle in an electric field.

5.11.1 Performance Indicator: Students will calculate the electric force on a charged particle when given the electric field strength and the magnitude of the charge.

5.12 Objective: Be able to determine the magnitude of an electric field due to a point charge and will recognize that electric fields are the result of electric charges.

5.12.1 Performance Indicator: Students will be able to calculate the magnitude of the electric field at a certain distance from a given point charge.

5.13 Objective: Be able to determine the force acting on a charged particle moving through a magnetic field.

5.13.1 Performance Indicator: Students will be able to calculate the electric force acting on a charged particle moving through a magnetic field at a specified angle.

5.14 Objective: Apply the law of conservation of energy in problems involving electrical potential energy in a manner similar to that used with gravitational potential energy.

5.14.1 Performance Indicator: Students will provide an example of the conservation of energy utilizing electrical potential energy as one of the forms.

Investigation and Experimentation
Objective: Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations.

1.a Performance Indicator: Students will be able to select and use appropriate tools and technology (such as computer linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships and display data.

1.b Performance Indicator: Students will be able to identify and communicate sources of unavoidable experimental error.

1.c Performance Indicator: Students will be able to identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.

1.d Performance Indicator: Students will be able to formulate explanations by using logic and evidence.

1.e Performance Indicator: Students will be able to solve scientific problems by using equations and simple trigonometric, exponential, logarithmic functions.

1.f Performance Indicator: Students will be able to distinguish between hypothesis and theory as scientific terms.

1.g Performance Indicator: Students will be able to recognize the usefulness and limitations of models and theories as scientific representations of reality.\

1.h Performance Indicator: Students will be able to read and interpret topographic and geologic maps.

1.i Performance Indicator: Students will be able to analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).

1.j Performance Indicator: Students will be able to recognize the issues of statistical variability and the need for controlled tests.

1.k Performance Indicator: Students will be able to recognize the cumulative nature of scientific evidence.

1.l Performance Indicator: Students will be able to analyze situations and solve problems that require combining and applying concepts from more than one area of science.

1.m Performance Indicator: Students will be able to investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include, but are not limited to, irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.

1.n Performance Indicator: Students will be able to determine when an observation does not agree with an accepted scientific theory, if the observation is mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects), and if the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).