FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

Course Outline
Physics

Date: May 2006 **Subject Area: Science**

Proposed Grade Level(s): 11 & 12 **Course Length: 1 Year**

Grading: A-F **Number of Credits: 5 per Semester**

Prerequisites: Successful completion of Algebra 1 and Geometry with a 'C' or better, and completion of Algebra II with a 'C' or better, or enrolled in Algebra II

COURSE DESCRIPTION:

Physics is a lab science course covering mechanics, energy, waves, sound, light, electricity and magnetism, atomic structure, and quantum systems. Problem-solving homework assignments, written lab reports, and verbal presentations are required. This course meets university lab science entrance requirements, and is critical for any student who is intending to enter the field of math, science, or engineering.

GENERAL GOALS/PURPOSES:

- To Prepare the science-oriented student for college physics and engineering courses
- To learn the basic theories of mechanics, optics, wave theory, magnetism, and electricity
- To develop a logical step-wise method of problem solving
- Using a hands-on experience to devise a scientific model and to use that model to predict physical behavior
- Learning to think using critical thinking processes

STUDENT READING COMPONENT:

Students will read at the 11^{th} and 12^{th} grade levels from textbooks, laboratory assignments, and research from the Internet and library. The primary textbook used is *Glencoe Physics.* Other supplementary materials may also be used to further enhance student understanding of the curriculum such as, Modeling Physics High School curriculum from Arizona State University (http://modeling.asu.edu/Curriculum.html).

STUDENT WRITING COMPONENT:

Lab assignments will be assigned and completed on a regular basis along with detailed written reports.

STUDENT ORAL COMPONENT:

Students will:

- Work collaboratively during laboratory experiments
- Orally present their homework solutions and lab reports to the class

DETAILED UNITS OF INSTRUCTION:

Student expectations for each unit will be taken directly from the California State Content Standards.

Note: Units marked with an* are important aspects of physics however, they are an optional portion of high school curriculum. Teachers may elect not to address these areas if time does not permit. These items will not be tested by the state of California.

In addition to the units of instruction listed below, there will be at least two student based research projects required during the school year.

Semester One –

Motion and Forces (20% of test)

1. **Newton's laws predict the motion of most objects. As a basis for understanding this concept, students will:**

a. Know how to solve problems that involve constant speed and average speed.
b. 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).
c. Know how to apply the law F=ma to solve one-dimensional motion problems that involve constant forces (Newton's second law).
d. Know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).
e. Know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.
f. Know that applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g. Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).
g. Know that circular motion requires the application of a constant force directed toward the center of the circle.
h. *Know that Newton's laws are not exact but provide very good approximations unless an object is moving close to the speed of light or is small enough that quantum effects are important.
i. *Know how to solve two-dimensional trajectory problems.
j. *Know how to resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components.
k. *Know how to solve two-dimensional problems involving balanced forces (static's).
l. *Know how to solve problems in circular motion by using the formula for centripetal acceleration in the following form: $a = v^2 / r$.
m. *Know how to solve problems using Coulomb's Law and the law of Universal Gravitation.

Conservation of Energy and Momentum (20% of CST)

2. **The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept, students will:**

a. Know how to calculate kinetic energy by using the formula $E = (1/2)mv^2$.
b. Know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) $=mgh$ (h is the change in the elevation).
c. Know how to solve problems involving conservation of energy in simple systems, such as falling objects.

d. Know how to calculate momentum as the product of *mv*.
e. Know how momentum is a separately conserved quantity that is different from energy.
f. Know how an unbalanced force of an object produces a change in its momentum.
g. Know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.
h. *Know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.

Semester Two –

Heat and Thermodynamics (15% of CST)

3. Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. As a basis for understanding this concept, students will:

a. Know how heat flow and work are two forms of energy that transfer between systems.
b. Know how 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 is an example of the law of conservation of energy.
c. Know how 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 the object, the greater the energy of motion of the atoms and molecules that make up the object.
d. Know that most processes tend to decrease the order of a system over time and that energy levels are eventually distributed uniformly.
e. *Know how the statement "Entropy tends to increase" is a law of statistical probability that governs all closed systems (second law of thermodynamics).
f. *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.

Waves (16.7% of CST)

4. Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept, students will:

a. Know how waves carry energy from one place to another.
b. Know how to identify transverse and longitudinal waves in mechanical media, such as springs and ropes, and how to identify seismic waves.
c. Know how to solve problems involving wave length, frequency, and wave speed.
d. Know sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.
e. Know radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3×10^8 m/s (186,000 miles/second).
f. *Know how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler Effect, and polarization.

Electric and Magnetic Phenomena (18.3% of CST)

5. Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept, students will:

a. Know how to predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.

b. Know how to solve problems involving Ohm's law.
c. Know any resistive element in a DC circuit dissipates energy, which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula Power = IE (potential differences) x I (current) = I^2R.***)***
d. Know the properties of transistors and the role of transistors in electric circuits.
e. Know charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.
f. Know magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.
g. Know how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.
h. Know changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.
i. Know plasmas, the fourth state of matter, contain ions or free electrons, or both and conduct electricity.
j. *Know electric and magnetic fields contain energy and act as vector force fields.
k. *Know the force on a charged particle in an electric field is qE, where E is the electric field at the position of the particle and q is the charge of the particle.
l. *Know how to calculate the electric field resulting from a point charge.
m. *Know static electric fields have as their source some arrangement of electric charges.
n. *Know the magnitude of the force on a moving particle (with charge q) in a magnetic field is $qvB \sin(a)$, where a is the angle between v and B (v and B are the magnitudes of vectors v and B, respectively), and students use the right-hand rule to find the direction of this force.
o. *Know how to apply the concepts of electrical and gravitational potential energy to solve problems involving conservation of energy.

Investigation and Experimentation (10.0% of CST)

6. 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. Students will:

a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform test, collect data, analyze relationships, and display data.
b. Identify and communicate sources of unavoidable experimental error.
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
d. Formulate explanations by using logic and evidence.
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
f. Distinguish between hypothesis and theory as scientific terms
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
h. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena.
i. Recognize the issues of statistical variability and the need for controlled tests.
j. Recognize the cumulative nature of scientific evidence.
l Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
n. Know that when an observation does not agree with an accepted scientific theory, observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

THIS COURSE WILL PREPARE STUDENTS FOR THE CAHSEE AND/OR THE FCUSD EXIT EXAMS IN:

Math and Science

LAB FEE IF REQUIRED:

None

SUBJECT AREA CONTENT STANDARDS TO BE ADDRESSED:

All Physics standards for California High Schools

DISTRICT ESLR'S TO BE ADDRESSED:
Student will be:

- **Self-Directed Learners:** Who will be expected to take responsibility for their learning by participating in class activities, labs, and discussions. Students will be expected to keep up with homework and lab prep assignments.

- **Collaborative Workers:** Who will participate in cooperative groups for laboratory assignments and in class activities. They will be expected to collaborate with each other in developing class concepts.

- **Effective Communicators:** Who will actively participate in class discussions on a regular basis.

- **Quality Producers/ Performers:** Students will be guided to be quality performers and producers through ongoing assessment of their class work.

- **Constructive Thinkers:** Who will participate in many hands-on activities and labs that require them to analyze their results critically and apply what they have learned to new situations. Students will also develop models for molecular behavior.

- **Responsible Citizen:** By using their knowledge of chemistry and scientific inquiry to make informed decisions about issues related to chemistry and the environment, and in their daily lives.