

FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

Course Outline Physics

Date: March 2004

Subject Area: Physical Science

Proposed Grade Level(s): 11 & 12

Course Length: 1 Year

Grading: A-F

Number of Credits: 5/Semester

Prerequisites: Successful completion of Algebra and Geometry (with at least a 'C')

BRIEF 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 any fields in 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
- To use hands-on experience to devise a scientific model and to use that model to predict physical behavior
- To learn to think using critical thinking processes

STUDENT READING COMPONENT:

Students will read at the 12th and 13th grade levels from textbooks, laboratory assignments, and research from the Internet and library. The primary textbook used is *Glencoe Physics* (1999, 2002 editions) as well as lessons from the Modeling Physics High School curriculum from Arizona State University (<http://modeling.asu.edu/Curriculum.html>)

STUDENT WRITING COMPONENT:

Lab assignments will be done on a regular basis and detailed written reports will be turned in.

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 and associated California State Content Standard addressed:
<http://www.cde.ca.gov/standards/science/physics.html> Content Standard *italicized*

1. Mechanics

The student will:

- a. Perform labs involving position, speed, and acceleration (*1 a-d*)
- b. Interpret the meaning of an acceleration-time, speed-time, or position-time graph, and given one of the graphs, will draw the other two (*1 a-d*)
- c. Differentiate between average speed and instantaneous speed (*1 a-d*)
- d. List several examples of vectors and scalars (*1 j*)
- e. Add and subtract vectors (*1 j*)
- f. Demonstrate the vector relationships between position, velocity, and acceleration in circular motion (*1 f-l*)
- g. Solve navigation problems using vectors (*1 f-l*)
- h. Recognize the effect of different frames of reference on problem solving (*1 f-l*)
- i. Differentiate between scalar and vector problems (*1 f-l*)
- j. Solve problems involving constant acceleration (*1 f-l*)
- k. Derive a velocity-time graph and a position-time graph from raw data (Lab) (*1 f-l*)

2. Dynamics

The students will:

- a. Determine the effect of a constant force on the motion of an object (Lab) (*1 a-d*)
- b. Find the relationship between mass, acceleration, and force (Lab) (*1 a-d*)
- c. Determine the weight and mass of an object (*1 a-d*)
- d. Describe simple harmonic motion (*1 a-d*)
- e. Calculate trajectories of objects in free fall (*1 a-d*)
- f. Identify all forces acting on a given body and predict its subsequent motion (*1 a-d*)

3. Gravitation

The student will:

- a. Recognize Kepler's Laws (*1 e-g*)
- b. Calculate universal gravitational attraction forces (*1 e-g*)
- c. Relate universal gravitation to Newton and Kepler's Laws (*1 e-g*)

4. Momentum

The student will:

- a. Determine the relationship between impulse and momentum (*2 d-g*)
- b. Discover the law of conservation of momentum (Lab) (*2 d-g*)
- c. Find the center of mass of a system (*2 d-g*)
- d. Use conservation of momentum as a means of predicting motions between interacting bodies (*2 d-g*)
- e. Investigate momentum conservation during the collision of two objects in two dimensions (Lab) (*2 d-g*)

5. Energy

The student will:

- a. Define work (Energy) (*2 a-c, h*)
- b. Derive the relationship between work and kinetic energy (*2 a-c, h*)
- c. Analyze transfers of kinetic energy from one mass to another (Lab) (*2 a-c, h*)
- d. Differentiate between elastic and non-elastic collisions (*2 e, g*)
- e. Derive and apply conservation of kinetic energy and momentum (*2 c, g*)
- f. Define potential energy (*2 b-c, g-h*)
- g. Solve potential energy problems involving gravity and springs (*2 g-h*)
- h. Determine gravitational potential for cases near the earth's surface and for cases far from the earth (*2 b*)
- i. Calculate escape and binding energies for the earth (*2 b*)
- j. Develop equations for orbiting bodies (*2 b*)
- k. Determine the relationships between gravitational potential energy, spring potential energy, and kinetic energy in a dynamic system (Lab) (*2 c, h*)

- l. Determine the spring constant for a spring (Lab) (2 c,h)

6. Heat and Thermodynamics

The student will:

- a. Define *heat* flow and *work* as two forms of energy transfer between systems. (3 a)
- b. Describe and explain the first law of thermodynamics and the conservation of energy law. (3 b)
- c. Recognize that 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 *temperature* of the object is a measure of the average kinetic energy of a group of atoms/molecules. (3 c)
- d. Define entropy as a measure of the disorder of a system and recognize that entropy increases as time goes on (the second law of thermodynamics). (3 d-f)
- e. Solve problems involving heat flow, work, and efficiency in a heat engine. (3 g)

7. Electricity

The student will:

- a. Recognize the effects between objects of various signed charges (Lab) (5 e, k-m)
- b. Explain the attraction between charged objects and neutral conductors or insulators (5 e, k-m)
- c. Describe and analyze charging by induction (Lab) (5 e,k-m)
- d. Develop a model for electrostatic interactions (5 e,k-m)
- e. Predict quantized charge from Coulomb's experiment (Lab) (5 e,k-m)
- f. Describe conservation of charge (5 e,k-m)
- g. Apply Coulomb's Law (5 e,k-m)
- h. Draw electric fields (5 e,k-m)
- i. Analyze electric fields near various conductors (5 e,k-m)
- j. Derive, using gravitational potential as a model, electrical potential energy (5 e,k-m)
- k. Tell how to determine the constant in Coulomb's Law (5 e,k-m)
- l. Describe experiments to determine electric charge on ions, mass of ions, and speed of ions (5 e,k-m)
- m. Solve problems using elementary charge units of Volt-Amp-Coulomb units or combinations of each. (5 a-c)
- n. Apply Ohm's Law (5 a-c)
- o. Explain the theory behind resistance in various conductors (5 a-c)
- p. Analyze the motion of electrons in metals, semiconductors, or in vacuum (5 a-c)
- q. Find the effect of distance on force between two electric charges (Lab) (5 e)

8. Magnetism

The student will:

- a. Define the magnetic field (5 f-h)
- b. Discover the direction of the magnetic field due to a current (Lab) (5 f-h)
- c. Calculate the magnitude and direction of magnetic forces due to currents or moving charges (5 f-h)
- d. Determine the various factors influencing the magnetic force (Lab) (5 f-h)
- e. Derive the cyclotron equation and use it to determine the mass of an ion (5 n)
- f. Measure the mass of an electron (Lab) (5 n)

9. Waves

The student will:

- a. Discover wave properties experimentally (Lab) (4 a-c)
- b. Predict the shape of a wave produced by the super position of two waves (4 a-c)
- c. Describe the shape of two waves as they reflect off and transmit through each other (4 f)
- d. Draw the resultant reflection of a wave off various surfaces (4 f)
- e. Determine the reflection and refraction laws for waves (Lab) (4 f)
- f. Identify the angles of reflection, incidence, and refraction (4 f)
- g. Describe the motion of a wave front (4 f)
- h. Find the period, wave length, frequency, and speed of a wave (Lab) (4 a-d)
- i. Analyze the pattern produced by wave diffraction (Lab) (4 f)

- j. Locate the positions of nodal lines for various wavelengths, source separations, and phases(Lab) (4 f)
- k. Develop a relationship between speed, frequency, wavelength, and period of a wave (4 a-d)

10. Light Behavior

The student will:

- a. Locate an image in a plane mirror using parallax (Lab)
- b. Analyze various shadows using ray optics
- c. Discover the laws of reflection (Lab)
- d. Distinguish between real and virtual images
- e. Find the image properties of a parabolic mirror (Lab)
- f. Determine Snell's law of refraction (Lab)
- g. Locate all images produced by a lens (Lab)
- h. Construct the image positions for a parabolic mirror and for a lens
- i. Predict optical ray paths involving cases of total internal reflection
- j. Explain dispersion in a prism and predict its effect in lenses
- k. Observe diffraction
- l. Calculate various refracted light rays using incident light rays
- m. Derive and calculate critical angles and index of refraction for various materials

11. Wave Model for Light (4 e)

The student will:

- a. Explain the color fringes in the diffraction pattern of white light
- b. Measure the wavelength of red light using diffraction patterns (Lab)
- c. Develop an equation for double source interference
- d. Observe and develop an equation for single source diffraction (Lab)
- e. Interpret light in terms of electromagnetic waves
- f. Identify some difficulties with the wave model of light

12. Particle of Model for Light

The student will:

- a. Describe an experiment to illustrate the photoelectric effect
- b. Given appropriate data, determine the maximum energy of a photon
- c. List the basic features of a particle model for light
- d. Interpret the photoelectric effect in terms of photons
- e. Determine the energy of a photon given its wavelength of frequency
- f. Explain one way of measuring the speed of light
- g. List at least one difficulty with a particle model of light

13. Atomic Structure

The student will:

- a. Observe the effects of alpha scattering
- b. Develop a model for the atom based on alpha scattering
- c. Identify scattering angle and aiming error
- d. Describe the extent of the electric field in the atom

14. Atoms and Spectra

The students will:

- a. Predict atomic stability
- b. Dissect atomic spectra
- c. Explain absorption spectra
- d. Find and explain the visible spectra lines in Hydrogen (Lab)
- e. Predict emission lines and energies given an energy level diagram

Evaluation Procedure:

Grades will be based on the following:

1. Tests and quizzes

2. Laboratory work
3. Homework assignments

LAB FEE, IF REQUIRED: None

SUBJECT AREA CONTENT STANDARDS TO BE ADDRESSED:

Please refer to Detailed Units of Instruction.

DISTRICT ESLRs TO BE ADDRESSED:

- **Self-directed learners:** Students will be expected to use their school agendas to keep track of assignments. It is their responsibility to keep up with their work, have assignments turned in on time and be prepared for class each day
- **Effective Communicators:** Written and oral communications are both important in this class. Students will be expected to communicate effectively as they explain the concepts of physics as they relate to class activities.
- **Quality Producers:** Assessment of class work requires students to be quality producers in order to be successful in this class.
- **Constructive Thinkers:** The lab activities that students are involved in require analysis and application of learned concepts. In order to synthesize and apply course concepts, students need to be constructive thinkers.
- **Collaborative Learners:** Lab activities and research engineering projects are done in cooperative groups. Students need to be collaborative learners in order to adequately complete these tasks.
- **Responsible Citizens:** Prompt class attendance and active, creative involvement in class activities emphasizes the need for students to be responsible citizens.