

**FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT**

**Course Outline  
Honors Physics**

**Date:** May 2001

**Subject Area:** Physical Science

**Proposed Grade Level(s):** 12

**Course Length:** 1 Year

**Grading:** A-F

**Number of Credits:** 5/Semester

**Prerequisites:** A/B Honors Chemistry, pass screen test, Algebra II, taking Pre-Cal

**COURSE DESCRIPTION:**

Honors physics is a lab science course covering dynamics, kinematics, light, electricity, magnetism, atomic structure, and quantum systems. Homework is required, as well as lab reports and engineering design research projects. 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.

An honors course is differentiated from regular courses in terms of student expectancies by the breadth and complexity of material covered during the course. Upon completion of honors courses, students will receive weighted grade points as per District Policy 5126.3.

**GENERAL GOALS/PURPOSES:**

1. To prepare the science-oriented student for college physics and engineering courses
2. To learn the basic theories of optics, mechanics, wave theory, magnetism and electricity
3. To develop a logical step-wise method of problem solving
4. To use hands on experience to devise a scientific model and to use that model to predict physical behavior
5. 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.

**STUDENT WRITING COMPONENT:**

1. Lab assignments will be done on a regular basis and detailed written reports will be turned in.
2. Two major design research projects will be conducted which will include a written paper detailing the student's engineering design.

**STUDENT ORAL COMPONENT:**

1. Students will work collaboratively during laboratory experiments.
2. Students will orally present their research projects to the class.

## **DETAILED UNITS OF INSTRUCTION:**

(Student Expectations for each unit)

### I. Kinematics

#### A. The student will:

1. Perform labs involving position, speed, and acceleration
2. Interpret the meaning of an acceleration-time, speed-time, or position-time graph, and given one of the graphs, will draw the other two
3. Differentiate between average speed and instantaneous speed
4. List several examples of vectors and scalars
5. Add, subtract, and scalar multiply vectors
6. Demonstrate the vector relationships between position, velocity, and acceleration in circular motion
7. Solve navigation problems using vectors
8. Recognize the affect of different frames of reference on problem solving
9. Differentiates between scalar and vector problems
10. Solve problems involving constant acceleration
11. Derive a velocity-time graph and a position-time graph from raw data (Lab)

#### B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.

scalar	instantaneous velocity
vector	instantaneous acceleration
position	centripetal acceleration
average speed	vector components
average velocity	displacements
average acceleration	

### II. Dynamics

#### A. The students will:

1. Determine the effect of a constant force on the motion of an object (Lab)
2. Find the relationship between mass, acceleration, and force (Lab)
3. Determine the weight and mass of an object
4. Describe simple harmonic motion
5. Calculate trajectories of objects in free fall
6. Identify all forces acting on a given body and predict its subsequent motion

#### B. Concept Words/Terms – The student will demonstrate knowledge of the following Concepts Words/Terms by using them in written and/or oral communication.

newton	weight
force	simple harmonic motion
mass	frame of reference
inertial mass	fictitious force
gravitational mass	free fall

### III. Gravitation

#### A. The student will:

1. Recognize Kepler's Laws
2. Calculate universal gravitational attraction forces

### 3. Relate universal gravitation to Newton and Kepler's Laws

- B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in oral and/or written communication.
- |            |              |
|------------|--------------|
| geocentric | heliocentric |
|------------|--------------|

#### IV. Momentum

A. The student will:

1. Determine the relationship between impulse and momentum
2. Discover the law of conservation of momentum (Lab)
3. Find the center of mass of a system
4. Use conservation of momentum as a means of predicting motions between interacting bodies
5. Investigate momentum conservation during the collision of two objects in two dimensions (Lab)

- C. Concept Word/Terms – The student will demonstrate knowledge of the following Concept Word/Terms by using them in written and/or oral communication.

momentum	center of mass
impulse	conservation law

#### V. Energy

A. The student will:

1. Define work (Energy)
2. Derive the relationship between work and kinetic energy
3. Analyze transfers of kinetic energy from one mass to another (Lab)
4. Differentiate between elastic and non-elastic collisions
5. Derive and apply conservation of kinetic energy and momentum
6. Define potential energy
7. Solve potential energy problems involving gravity and springs
8. Determine gravitational potential for cases near the earth's surface and for cases far from the earth
9. Calculate escape and binding energies for the earth
10. Develop equations for orbiting bodies
11. Analyze systems for total mechanical energy
12. Interpret force compression curves
13. Determine the relationships between gravitational potential energy, spring potential energy, and kinetic energy in a dynamic system (Lab)
14. Determine the spring constant for a spring (Lab)

- B. Concepts Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.

work	friction
energy	kinetic energy
spring constant	mechanical energy
potential energy	escape energy
joule	elastic
binding	universal
gravitational constant	

## VI. Electricity

### A. The student will:

1. Recognize the effects between objects of various signed charges (Lab)
2. Explain the attraction between charged objects and neutral conductors or insulators (Lab)
3. Describe and analyze charging by induction (Lab)
4. Develop a model for electrostatic interactions
5. Predict quantized charge from Coulomb's experiment (Lab)
6. Describe conservation of charge
7. Apply Coulomb's Law
8. Draw electric fields
9. Analyze electric fields near various conductors
10. Derive, using gravitational potential as a model, electrical potential energy
11. Tell how to determine the constant in Coulomb's Law
12. Describe experiments to determine electric charge on ions, mass of ions, and speed of ions
12. Solve problems using elementary charge units of Volt-Amp-Coulomb units or combinations of each
14. Analyze the motion of electrons in metals, semiconductors, or in vacuum
15. Find the effect of distance on force between two electric charges (Lab)

### B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.

electron	proton
electric force	electron volt
insulator	field line
volt	conductor
static charge	amp
potential	induction
ohm	electric field
elementary charge	Coulomb
electrical potential	battery
oscilloscope	energy
ion	

## VII. Atomic Structure

### A. The student will:

1. Observe the effects of alpha scattering
2. Develop a model for the atom based on alpha scattering
3. Identify scattering angle and aiming error
4. Describe the extent of the electric field in the atom

### B. Concept Words/Terms – The student will demonstrate knowledge of the following Concepts Words/Terms by using them in written and/or oral communication.

scattering angle	alpha particle
aiming error	Rutherford model

## VIII. Magnetism

### A. The student will:

1. Define the magnetic field
2. Discover the direction of the magnetic field due to a current (Lab)

3. Calculate the magnitude and direction of magnetic forces due to currents or moving charges
4. Determine the various factors influencing the magnetic force (Lab)
5. Derive the cyclotron equation and use it to determine the mass of an ion
6. Apply Ohm's Law
7. Explain the theory behind resistance in various conductors
8. Measure the mass of an electron (Lab)

B. Concept Words/Terms – The student will demonstrate knowledge if the following Concept Words/Terms by using them in written and/or oral communication.

magnetic field	volt
neutron	amp
cyclotron	ohm
induced	resistance
current	ammeter

## IX. Light Behavior

A. The student will:

1. Locate an image in a plane mirror using parallax (Lab)
2. Analyze various shadows using ray optics
3. Discover the laws of reflection (Lab)
4. Distinguish between real and virtual images
5. Find the image properties of a parabolic mirror (Lab)
6. Determine Snell's law of refraction (Lab)
7. Locate all images produced by a lens (Lab)
8. Construct the image positions for a parabolic mirror and for a lens
9. Predict optical ray paths involving cases of total internal reflection
10. Explain dispersion in a prism and predict its effect in lenses
11. Observe diffraction
12. Calculate various refracted light rays using incident light rays
13. Derive and calculate critical angles and index of refraction for various materials

B. Concept Terms – The student will demonstrate knowledge of the following terms.

Reflection	dispersion
Refraction	index of refraction
Real image	critical angle
Virtual image	angle of incidence
Angle of refraction	angle of reflection

## X. Particle of Model for Light

A. The student will:

1. Describe an experiment to illustrate the photoelectric effect
2. Given appropriate data, determine the maximum energy of a photoelectron
3. List the basic features or a particle model for light
4. Interpret the photoelectric effect in terms of photons
5. Explain one means of measuring the speed of light
6. List at least one difficulty with a particle model of light

B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.

photon	ultraviolet
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intensity  
photoelectron

infrared

## XI. Waves

### A. The student will:

1. Discover wave properties experimentally (Lab)
2. Predict the shape of a wave produced by the super position of two waves
3. Describe the shape of two waves as they reflect off and transmit through each other
4. Draw the resultant reflection of a wave off various surfaces
5. Measure the speed of a wave (Lab)
6. Determine the reflection and refraction laws for waves (Lab)
7. Identify the angles of reflection, incidence, and refraction
8. Describe the motion of a wave front
9. “Stop” the motion of a periodic wave using a stroboscope (Lab)
10. Find the period, wave length, frequency, and speed of a wave (Lab)
11. Observe wave dispersion (Lab)
12. Analyze the pattern produced by wave diffraction (Lab)
13. Demonstrate and analyze interference in one and two dimension (Lab)
14. Locate the positions of nodal lines for various wavelengths, source separations, and phases (Lab)
15. Analyze the effect on the nodal pattern for changes in source separation, phase, speed, frequency, period, angle, and distance (Lab)
16. Develop a relationship between speed, frequency, wavelength, and period of a wave

### B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.

frequency	phase
dispersion	wavelength
node	refraction
speed of propagation	interference
periodic	period
diffraction	super position
transmission	amplitude

## XII. Wave Model for Light

### A. The student will:

1. Explain the color fringes in the diffraction pattern of white light
2. Measure the wavelength of red light using diffraction patterns (Lab)
3. Develop an equation for double source interference
4. Observe and develop an equation for single source diffraction (Lab)
5. Interpret light in terms of electromagnetic waves
6. Identify some difficulties with the wave model of light

### B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.

electromagnetic waves	electromagnetic spectrum
diffraction	interference

### XIII. Photons

- A. The student will:
1. Explain the photoelectric effect in terms of photons
  2. Determine the energy of a photon given its wavelength or frequency
  3. Analyze the wave-particle duality of light
- B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.

### XIV. Atoms and Spectra

- A. The students will:
1. Predict atomic stability
  2. Dissect atomic spectra
  3. Explain absorption spectra
  4. Find and explain the visible spectra lines in Hydrogen (Lab)
  5. Predict emission lines and energies given an energy level diagram
- B. Concept Words/Terms – The student will demonstrate knowledge of the following Concept Words/Terms by using them in written and/or oral communication.
- |                |               |
|----------------|---------------|
| spectra        | stability     |
| emission lines | absorption    |
| lines          | ionization    |
| ground state   | electron volt |

### EVALUATION PROCEDURE:

Grades will be based on the following:

1. Tests and quizzes
2. Laboratory work

LAB FEE, IF REQUIRED: None

### SUBJECT AREA CONTENT STANDARDS / ESLRs TO BE ADDRESSED:

- 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. In this respect, success depends on being a **self-directed learner**.
- 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.
- Assessment of class work requires students to be **quality producers** in order to be successful in this class.
- 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**.
- Lab activities and research engineering projects are done in cooperative groups. Students need to be **collaborative learners** in order to adequately complete these tasks.
- Prompt class attendance and active, creative involvement in class activities emphasizes the need for students to be **responsible citizens**.