TAMALPAIS UNION HIGH SCHOOL DISTRICT
Larkspur, California

Course of Study

HONORS PHYSICS 1-2

I. INTRODUCTION

Honors Physics 1-2 is a one-year introductory physical science for especially motivated and gifted students who have completed the prerequisites. The course draws on the physical sciences developed in Integrated Science 1-4 and provides an opportunity to expand on these topics for those students who prefer to study at a deeper level. The curriculum for Honors Physics is similar to the curriculum for Physics, but the level is more sophisticated and the pace is faster. Students receive an experience similar to that of a college level, algebra/trigonometry-based Physics course. This proposed course of study assumes no prior substantial exposure to physics, and should therefore, not be considered an advanced or second year course.

The course is designed to give all students the necessary background information and critical thinking skills needed to more fully understand the physical world in which they live. Data gathering and interpretation, team laboratory projects, and problem solving approaches are stressed. These skills are developed and applied within the context of the major concepts covered in the course (Mechanics, Waves, Optics, Electricity and Magnetism, and Modern Physics.)

Honors Physics 1-2 addresses the following district student learning outcomes:

- #1: Communicate articulately, effectively, and persuasively when speaking and writing.
- #3: Use technology to access information, analyze and solve problems, and communicate ideas.
- #5: Apply mathematical knowledge and skills to analyze and solve problems.
- #6: Demonstrate scientific literacy.
- #10: Analyze and propose solutions to contemporary issues using a variety of perspectives.
- #12 Demonstrate school-to-work/post-secondary transition skills and knowledge.

II. STUDENT LEARNING OUTCOMES

Students will:

A. Demonstrate knowledge and understanding of the principle themes of physics to include:

1. Mechanics
The unit on mechanics introduces measurement and motion. After students are familiarized with fundamental units of measurement and basic graphing skills, they are then given instruction on analyzing motion in one and two dimensions. Causes for motion are then considered, including Newton's Laws, centripetal forces, and the Law of Gravitation. Rotational motion is introduced and analogies

to one dimensional motion are considered. Energy, momentum, and angular momentum conservation principles are used to solve problems in mechanics. Students analyze freefalling objects and use dynamics tracks to investigate motion, energy and momentum in laboratory work.

The following two problems illustrate the typical level of rigor for an honors physics problem and a regular physics problem.

Regular: Find the range of a bullet fired from ground level at a speed of 750 m/s and aimed 20° above the horizontal.

Honors: An antitank gun is located on the edge of a plateau that is 60 m above the surrounding plain. It fires its shell at 240 m/s at 10° above the horizontal. A tank is sighted 2.2 km horizontally from the antitank gun. The tank sights the gun also and starts to move away with an acceleration of 0.90 m/s^2. How long should the gun crew wait before firing if they are to hit the tank?

The following major topics are covered in this unit

a. Kinematics
   1) Linear
   2) Two dimensional
b. Dynamics
   1) Newton's Laws of Motion
   2) Centripetal force
   3) Gravitation
   4) Work and energy
   5) Conservation of momentum and energy

2. Waves

The unit on waves introduces waves as a means of transferring energy without a transfer of matter. Students are given instruction concerning wave behaviors and many practical applications of waves (such as the Doppler Effect, the physics of musical instruments, and the colors produced in soap bubbles.) Students use elongated springs and wave tanks to investigate one and two dimensional wave behaviors. They use both plane and curved mirrors, as well as lenses to investigate optical properties.

The following two problems illustrate the typical level of rigor for an honors physics problem and a regular physics problem.

Regular: An object is placed 18 cm from a **convex** mirror which has a focal length of 6.0 cm. The object is 15 cm tall. How tall is the image?

Honors: A converging lens (f = 12.0 cm) is 28.0 cm to the left of a diverging lens (f = -14.0 cm). An object is located 6.00 cm to the left of the converging lens. Use the lens equation to determine the final image distance, measured from the diverging lens, and the overall magnification.

The following major topics are covered in this unit

a. Wave behavior
   1) Reflection
   2) Refraction
   3) Interference
   4) Diffraction
   5) Polarization
b. Sound Applications
   1) Doppler Effect
   2) Musical Instruments
   3) Optics
   4) Mirrors
   5) Lenses and Lens Systems

3. Electromagnetism

The unit on electromagnetism introduces concepts of static and current electricity, magnetism, and the relationship between electric and magnetic forces. Electric and magnetic fields are treated as analogous to gravitational fields. Behavior of static and current electricity, basic electrical circuits, and fundamental principles of motors and generators are investigated in laboratory work.

The following two problems illustrate the typical level of rigor for an honors physics problem and a regular physics problem.

Regular: If particle with a charge of 5.0×10^{-6} C is located 4.0 meters from another particle with a charge of -2.0×10^{-6} C, what is the magnitude of the force they exert on each other?

Honors: Four particles with charges of 6.0×10^{-6} C, 4.0×10^{-6} C, -5.0×10^{-6} C, and -2.0×10^{-6} C are located at the four corners of a square with sides 2.0 meters long. Find the potential at the center of the square.

The following major topics are covered in this unit

a. Static Electricity
   1) Coulombs Law
   2) Electric Potential
   3) Electric Field
b. Current electricity
   1) Resistance and Ohm's Law
   2) Series and parallel circuits
   3) DC and AC current
c. Magnetism
   1) Magnetic fields
   2) Electromagnetic induction - motors and generators

4. Modern Physics

The unit on modern physics covers physics discoveries during the 20th Century and modern areas of physics research. Most of the material is related to research at the atomic and subatomic level. Students are presented with the history of modern physics from the discovery of the Photoelectric Effect and radioactivity to the current Standard Model and the theories of particle physicists. A considerable portion of time is devoted to practical applications related to 20th Century discoveries such as medical x-rays, nuclear power and holography. Students investigate atomic physics by means of visible light spectroscopy and they investigate nuclear physics through the examination of radioactive sources with Geiger Counters.

The following two problems illustrate the typical level of rigor for an honors physics problem and a regular physics problem.

Regular: If a radioactive isotope of radium has a half life of 1620 years, how long will it take 40 grams of it to become 1.25 grams?

Honors: The $^{90}_{38}Sr$ produced in the fission reaction above has a half life of 29 years. If 2.0 gram of $^{90}_{38}Sr$ are produced in a nuclear explosion, what is the activity 10. years after it is produced?

The following major topics are covered in this unit

a. Atomic structure
   1) Photoelectric Effect
   2) Spectroscopy
   3) Lasers and Holography

b. Radioactivity
   1) Half-life
   2) Artificial Transmutations
   3) Nuclear Fission and Fusion

c. Particle physics
   1) Particle Accelerators
   2) Standard Model

2. Demonstrate critical thinking skills by forming hypotheses, analyzing student-generated data, and forming conclusions based on observations and inferences.

3. Demonstrate the ability to apply principles of physics to real world physical problems such as
   - the design of a musical instrument
   - the experimental determination of the appropriate amount of shielding to reduce radioactive exposure to an acceptable level.

4. Demonstrate an ability to effectively communicate results of experiments and research orally and in writing.

5. Use modern technology as a tool to enhance understanding of basic concepts of physics. These tools will include:
   - Computer word processing, spreadsheet, and graphing programs
   - Computer interfacing data acquisition systems
   - Photogate timing systems

III. ASSESSMENT

A. Student Assessment - Students will be informed of the grading criteria at the beginning of the semester.

1. Quizzes on discussions, homework, labs, and demonstrations
2. Laboratory reports
3. Tests and semester exams
4. Active participation on group projects

B. Course Assessment

Feedback from students will be collected through selected interviews and/or questionnaires.

Teachers will poll former students who enroll in college physics and have them assess their preparedness for college physics.

IV. METHODS AND MATERIALS

Primary source materials will be used in conjunction with a college level textbook (such as Contemporary College Physics).

This course is designed to be approximately 50% lab and project activity. Instruction will include a combination of discussion, demonstration, reading, inquiry, and inductive teaching strategies.

Students will be using scientific technology appropriate for physics. In addition, students will be expected to use word-processing and presentation graphics in preparation of their reports. As appropriate, databases, spreadsheets, and simulation software will be incorporated into the course. Telecommunications, such as the Internet, will be used in research, data collection, and information exchange.

V. GENERAL INFORMATION

A. Prerequisites

Students must pass an entrance exam given the previous spring.

B. Requirements Met

Honors Physics 1-2 fulfills one unit of the University of California “d" or "f” requirement, and one year of the district’s physical science requirement.