FAME Public Charter School

Physics w/lab CP

Course Description:
This is a lab intensive introductory course in the foundations of physics. Emphasis is on the development of an understanding of physics principles, as well as problem solving with the use of mathematics. The laboratory work is designed to help students develop reasoning skills and the ability to apply physics principles. The knowledge gained from the laboratory component will enable students to understand in practical and concrete ways their own physical make-up, the functioning of the natural world around them, and contemporary scientific and environmental issues.

Course Goals/Major Outcomes:
Students will work towards mastering the California State Physics Content Standards. Student understanding of the standards will be measured by teachers, working collaboratively, to consider a multifaceted view of what constitutes a mature understanding of concepts. Upon completion of this course students will understand that:

1. Newton's law predicts the motion of most objects.
2. The laws of conservation of energy and momentum provide a way to predict and describe the movement.
3. Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat.
4. Waves have characteristic properties that do not depend on the type of wave.
5. Electric and magnetic phenomena are related and have many practical applications.

"*In subjects of which on has no knowledge, one must obtain knowledge either by learning from someone else, or by discovering it for oneself. That which is learnt, therefore, comes from another and by outside help; that which is discovered comes by one's own efforts and independently. To discover without seeking is difficult and rare, but if one seeks, it is frequent and easy; if however, one does not know how to seek, discovery is impossible."* - Archytas

Course Objectives:
1. To engage students in open-ended investigative processes by using scientific problem solving
2. To provide application of concepts students have seen in their study materials which reinforce and clarify scientific principles and concepts
3. To involve multiple senses in three-dimensional rather than two-dimensional learning experiences that are important for greater retention of concepts and for accommodation of different learning styles
4. To stimulate students to understand the nature of science including its unpredictability and complexity
5. To provide opportunities to engage in collaborative work and to model scientific attitudes and behaviors
6. To develop mastery of techniques and skills needed for potential science, engineering, and technology majors
7. To ensure science course transferability to four-year schools.

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Course Outline:

The Science of Physics

Unit 1. The Realm of Physics
- A. Definition of Physics
- B. Measurements in experiments
- C. The language of physics

Lab 1: Experimental Errors and Uncertainty
Objective: To gain an understanding of experimental errors and uncertainty

Lab1: Measurement: Length, Mass, Volume, Density, and Uncertainty
Objective: To make basic distance, mass, density, and time measurements
To make calculations of volume and density, using proper units
To use spreadsheet software to practice graphing the relationship between the circumference of a circle and its diameter

Lab3: Trigonometric Measurements
Objective: To review basic trigonometric functions
To measure the height of a building using trigonometry

Mechanics

Unit 1. Motion in One Dimension
- A. Displacement and velocity
- B. Acceleration
- C. Falling objects

Unit 2. Two-Dimensional Motion and Vectors
- A. Intro. to vectors
- B. Vector operations
- C. Projectile motion
- D. Relative motion

Unit 3. Forces and the Laws of Motion
- A. Changes in motion
- B. Newton's first law
- C. Newton's second and third laws
- D. Everyday forces

Unit 4. Work and Energy
- A. Work
- B. Energy
- C. Conservation of energy
- D. Work, energy, and power

Unit 5. Momentum and Collisions
- A. Momentum and impulse

B. Conservation of momentum
C. Elastic and inelastic collisions

Unit 6. Rotational Motion and the Law of Gravity
A. Measuring rotational motion
B. Tangential and centripetal acceleration
C. Causes of circular motion

Unit 7. Rotational Equilibrium and Dynamics
A. Torque
B. Rotation and inertia
C. Rotational dynamics
D. Simple machines

Lab 1: Data Collection:
Objective: To make predictions and to collect velocity data

Lab 2: Acceleration
Objective: To calculate the acceleration of an object rolling down and inclined plane

Lab 2. Friction
Objective: To provide an understanding of the concept of friction
To calculate the coefficient of friction of an object by two methods

Lab3. Simple Machine: Level
Objective: To explore the concept of mechanical advantage using levers

Lab 4: Simple Machine Pulley
Objective: To investigate the properties of a pulley and its use as a simple machine

Lab 5: Pendulum and the Calculation of g
Objective: To calculate the acceleration due to gravity by observing the motion of pendulum

Lab 6: Centripetal Acceleration
Objective: To calculate the centripetal acceleration of a spinning object

Lab 7. Hooke's Law
Objective: To investigate Hooke's Law and to determine the spring constant for two springs and a rubber band

<u>Matter and Thermal Energy</u>

Unit 1. Fluid Mechanics
A. Fluids and buoyant force
B. Fluid pressure and temperature
C. Fluids in motion
D. Properties of gas

Unit 2. Heat
- A. Temperature
- B. Defining heat
- C. Changes in temperature and phase
- D. Controlling heat

Unit 3. Thermodynamics
- A. Relationships between heat and work
- B. Thermodynamic processes
- C. Efficiency of heat engines
- D. Entropy

Lab 1: Specific Heat Capacity of Metals
Objectives: To measure the specific heat capacity of two different metals

Waves

Unit 1. Vibrations and Waves
- A. Simple harmonic motion
- B. Measuring simple harmonic motion
- C. Properties of waves
- D. Wave interactions

Unit 2. Sound
- A. Sound waves
- B. Sound intensity and resonance
- C. Harmonics

Unit 3. Light and Reflection
- A. Characteristics of light
- B. Flat mirrors
- C. Curved mirrors
- D. Color and polarization

Unit 4. Refraction
- A. Refraction
- B. Thin Lenses
- C. Optical phenomena

Unit 5. Interference and Diffraction
- A. Interference
- B. Diffraction
- C. Coherence

Lab 1: Determining the Speed of Sound Using the Resonance of Longitudinal Waves
Objective: To measure the speed of sound in air using the resonance of longitudinal wave

Lab 2: Reflection and Refraction
Objectives: To verify the law of reflection by measuring some incident and reflection angles off of a mirrored surface and to determine the relationship between the refraction of light and Snell's law

Lab 3: Diffraction Grating
Objective: To observe the interference pattern produced by shining a laser beam through a diffraction grating and to determine the distance between the slits in the grating given the wavelength of the laser light or to determine the wavelength of the laser light given the distance between the slits in the diffraction grating.

Lab 4: Polarized Light
Objective: To study the polarization of light, polarizing filters, and light intensity changes through polarizing filters

<u>Electricity and Magnetism</u>

Unit 1. Electric Forces and Fields
- A. Electric charge
- B. Electric force
- C. The electric field

Unit 2. Electrical Energy and Capacitance
- A. Electrical potential energy
- B. Potential difference
- C. Capacitance

Unit 3. Current and Resistance
- A. Electric current
- B. Resistance
- C. Electric power

Unit 4. Circuits and Circuit Elements
- A. Schematic diagrams and circuits
- B. Resistors in series or in parallel
- C. Complex resistor combinations

Unit 5. Magnetism
- A. Magnets and magnetic fields
- B. Electromagnetism and magnetic domains
- C. Magnetic force

Unit 6. Introduction and Alternating Current
- A. Induced current
- B. Alternating current, generator, and motors

C. Inductance

Lab 1: Static Electricity or Electrostatics
Objective: To explore the concepts of static electricity and to discover how many types of electrical charges exist and how they interact with each other

Lab 2: Electric Fields
Objective: To experimentally investigate the concept of the electric field
To determine the shape of equal potential lines surrounding charged objects

Lab 3: Introduction to Electrical Circuits
Objective: To build and understand the principles of a simple electric circuit
To learn to use the various functions of a digital multimeter (DMM), including ammeter, voltmeter, and ohmmeter

Lab 4: Resistors in Series and Parallel
Objective: To learn how resistors are used in series and in parallel

Lab 5: Semiconductor Temperature Sensor
Objective: To construct an electric thermometer consisting of a silicon diode,10K resistor, and 1.5 V battery connected in series
To find the voltage vs. temperature relationship of the diode

Lab 6: Capacitance of a Circuit
Objective: To observe and describe the behavior of a capacitor in a DC circuit

Lab 7: Electric Motor
Objective: To make a simple electric motor and to investigate how it works

<u>Atomic and Nuclear Physics</u>

Unit 1. Atomic Physics
A. Quantization of energy
B. Models of the atom
C. Quantum mechanics

Unit 2. Modern Electronics
A. Conduction in the solid state
B. Semiconductor applications
C. Superconductors

Unit 3. Subatomic Physics
A. The nucleus
B. Nuclear decay
C. Nuclear reactions
D. Particle physics

Lab: Radioactive Decay Simulation

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Objective: To simulate the decay of a hypothetical radioactive element
To graph the results of the simulated decay
To determine the half-life and decay constant of the element

Key Assignments:
In addition to chapter readings, assignments, quizzes, and tests, students will complete the following:

All labs must be completed. All questions that are presented in the laboratory manuals must be completed and a thorough write up (per the directions in the lab manual) of each of the labs must be submitted and retained in the student's portfolio

Curriculum:
Holt Physics: Holt, Rinehart, and Winston
Physics: Principles and Problems: Glencoe McGraw-Hill 1999

Laboratory Manual and Kit:
At Home Science, Inc: Physics Kit

This course may also be completed at a local community college

Instructional Methods and/or Strategies:

Students will be expected to develop and present work samples described under the key assignments section as well as those required in the textbook/curriculum used. Students will work independently through the text as a primary resource. In order to support this process teachers will provide each student:

*Opportunities to discuss and define complex issues orally or via email
*Modeling of activities and expected outcomes
*A variety of print and non-print resources
*Modeling of study strategies appropriate for different learning styles
*Discussions around points of view
*Opportunities to summarize, analyze, compare/contrast, describe, classify, and persuade
*Opportunities for practice in preparation for presentations

Assessment Methods and/or Tools:
A variety of assessment tools will be used. Written work, as described above, will be corrected in collaboration between the student, teacher, and parent. Assessment tools include but are not limited to:

*Standardized tests, including STAR
*Criterion based tests
*Portfolio assessments
*Student Journals
*Teacher observation
*Performance assessments using cameras and recorders

*Student self-evaluation
*Surveys and questionnaires
*Written work, quizzes, and final exams must be completed at 75% accuracy rate to receive credit