PHYSICS

Course Description

The Physics class will present to the students principles of physics and challenge them to solve problems, complete experiments and generate written and oral reports on their work. Major topics in their physics class include safety, laboratory procedures and investigations, an understanding of mechanics, materials, waves, electricity, magnetism, and concepts of modern physics.

Course Outcomes

After successful completion of Physics, the student will be able to do the following:

1. demonstrate a solid knowledge of lab and safety rules and procedures
2. prepare, execute, and report (written and oral) on laboratory experiments
3. define key vocabulary terms
4. explain the fundamental laws of physics
5. demonstrate the math skills, measurements, vectors, and means to visualize data
6. describe motion and the mathematics of motion
7. define forces both linear and in two dimensions
8. explain gravitation
9. describe the conservation of momentum and energy
10. explain the concepts of energy, work, and simple machines
11. explain thermal energy
12. describe the states of matter
13. describe waves and energy transfer, sound, and light
14. explain mirrors, lenses, and light diffraction and interference
15. explain static electricity, electric fields, current electricity, and series and parallel circuits
16. explain magnetic fields, electromagnetic induction and electromagnetism
17. explain quantum theory, the atom, and solid state electronics
18. describe the nucleus and nuclear applications

Course Assessments:

1. participation in class and notes on lectures and readings
2. quizzes on key concepts
3. written reports
4. oral discussion on lectures, labs, and physics articles
5. chapter exams
6. semester exams worth 10-20% of their semester grade
7. statistical comparison of overall semester grades

Course Materials

Physics: Principles and Problems, by Paul Zitzewitz, et al. Materials include teacher wraparound edition, color transparencies, enrichment, problems and solutions manual, concept-development practice book, lab manual, next time questions.

Unit Outcomes

Unit I: Chapter 1 What is Physics, Chapter 2 A Mathematical Toolkit

Outcomes: Students will be able to do the following:

1. provide an overview of physics
2. diagram the location of safety equipment and demonstrate safety procedures in the lab
3. explain the scientific method and its use in experimentations
4. explain units of measurement and their use in chemistry
5. explain uncertainty of measurement including the concepts of precision and accuracy
6. explain how to use significant figures and scientific notation
7. define SI standards
8. create a graph between independent and dependent variables
9. interpret the meaning of the graphed data

Assessments: For each unit, students will be evaluated on their ability to do the following:

1. take notes from the text and lectures
2. complete homework assignments
3. pass quizzes on selected materials
4. pass an objective test on important terminology and concepts
5. work as a lab team to complete selected experiments
6. organize, prepare, execute, and report on selected experiments

Unit II: Chapter 3 Describing Motion, Chapter 4 Vector Addition, and Chapter 5 A Mathematical Model of Motion

Outcomes: Students will be able to do the following:

1. draw and use motion diagrams to describe motion
2. differentiate between scalar and vector quantities
3. define a displacement vector and determine a time interval
4. define velocity and acceleration operationally
5. relate the direction and magnitude of velocity and acceleration vectors to the motion of objects
6. create pictoral and physical models for solving motion problems
7. determine graphically the sum of two or more vectors
8. solve problems of relative velocity
9. determine algebraically the sum of two or more vectors
10. interpret graphs of position versus time
11. draw and define information presented in graphs
12. calculate the displacement of an object from the area under a v-t graph
13. determine from the curves on a velocity-time graph both the constant and instantaneous acceleration
14. calculate the velocity and the displacement of an object undergoing constant acceleration
15. describe the meaning of free fall
16. define the magnitude of the acceleration due to gravity

Assessments: See the assessments listed for Unit I above

Unit III: Chapter 6 Forces, Chapter 7 Forces and Motion in Two Dimensions

Outcomes: Students will be able to do the following:

1. define a force and differentiate between contact and long-range forces
2. explain Newton's second law of motion
3. explain Newton's first law and describe an object in equilibrium

4. describe how weight and mass of an object are related
5. differentiate between the gravitational force weight and what is experienced as apparent weight
6. define frictional force and distinguish between static and kinetic friction
7. describe simple harmonic motion and explain how the acceleration due to gravity influence such motion
8. explain Newton's third law
9. list the four fundamental forces
10. determine the force that produces equilibrium when three forces act on an object
11. explain that the vertical and horizontal motions of a projectile are independent
12. Determine the range of a projectile
13. explain the acceleration of an object moving in a circle at constant speed
14. describe how centripetal acceleration depends upon the object's speed and the radius of the circle
15. describe the direction of the force that causes centripetal acceleration
16. explain how the rate of circular motion is changed by exerting torque on it

Assessments: See the assessments listed for Unit I above

Unit IV: Chapter 8 Universal Gravitation, Chapter 9 Momentum and Its Conservation

Outcomes: Students will be able to do the following:

1. relate Kepler's laws of planetary motion to Newton's law of universal gravitation
2. calculate the periods and speeds of orbiting objects
3. relate weightlessness to objects in free fall
4. describe gravitational fields
5. distinguish between inertial mass and gravitational mass
6. contrast Newton's and Einstein's views on gravitation
7. define momentum of an object
8. determine the impulse given to an object
9. explain that impulse equals the change in momentum of an object
10. explain Newton's third law of motion to conservation of momentum in collisions and explosions
11. explain conservation of momentum

Assessments: See the assessments listed for Unit I above

Unit V: Chapter 10 Energy, Work, and Simple Machines, Chapter 11 Energy, Chapter 12 Thermal Energy, Chapter 13 States of Matter

Outcomes: Students will be able to do the following:

1. describe the relationship between work and energy
2. identify the force that does work
3. differentiate between work and power
4. demonstrate knowledge of why simple machines are useful
5. demonstrate an understanding of mechanical advantage in ideal and real machines
6. analyze compound machines and describe them in terms of simple machines
7. calculate efficiencies for simple and compound machines
8. calculate the kinetic energy of a moving object

9. determine how to find gravitational potential energy of a system
10. identify ways in which elastic potential energy is stored energy
11. describe the nature of thermal energy
12. define temperature and distinguish it from thermal energy
13. convert from various temperature scales
14. define specific heat and calculate heat transfer
15. define heats of fusion and vaporization
16. state the first and second laws of thermodynamics
17. define heat engine, refrigeration, and heat pump
18. define entropy
19. describe how fluids create pressure
20. explain Archimedes' and Bernoulli's principles
21. explain surface tension and capillary action
22. compare solids, liquids, gases, and plasmas at a microscopic level, and relate their properties to their structures
23. explain why solids expand and contract when the temperature changes

Assessments: See the assessments listed for Unit I above

Unit VI: Chapter 14 Waves and Energy Transfer, Chapter 15 Sound, Chapter 16 Light

Outcomes: Students will be able to do the following:

1. explain how waves transfer energy without transferring matter
2. contrast transverse and longitudinal waves
3. explain wave speed, wavelength, and frequency
4. explain how wave speed changes with the medium that it exists
5. explain reflection and refraction
6. demonstrate a knowledge of sound
7. relate the physical properties of sound waves to the way we perceive sound
8. explain the Doppler shift
9. describe the origin of sound
10. explain resonance
11. explain why there is a variation among instruments and voices using terms timbre, resonance, fundamental, and harmonic
12. explain why beats occur
13. explain that light is the visible portion of the electromagnetic frequencies
14. describe the ray model of light
15. define luminous intensity, flux, and illumination problems
16. explain the formation of color by light and by pigments or dyes
17. explain the cause of interference in thin films
18. describe methods for producing polarized light

Assessments: See the assessments listed for Unit I above

Unit VII: Chapter 17 Reflection and Refraction, Chapter 18 Mirrors and Lenses, Chapter 19 Diffraction and Interference of Light

Outcomes: Students will be able to do the following:

1. explain the law of reflection

2. distinguish between diffuse and regular reflection
3. calculate the index of refraction in a medium
4. explain total internal reflection
5. define critical angle
6. explain effects caused by the refraction of light in a medium with varying reactive indices
7. explain dispersion of light in terms of the index of refraction
8. explain how concave, convex, and plane mirrors form images
9. locate images using ray diagrams, and calculate image location and size
10. describe uses of parabolic mirrors
11. explain how optical instruments such as microscopes and telescopes work
12. relate diffraction of light to its wave characteristics
13. explain interference patterns
14. explain how diffraction gratings form interference patterns
15. explain how diffraction limits the ability of a lens to distinguish two closely spaced objects

Assessments: See the assessments listed for Unit I above

Unit VIII: Chapter 20 Static Electricity, Chapter 21 Electric Fields, Chapter 22Current Electricity, Chapter 23 Series and Parallel Circuits

Outcomes: Students will be able to do the following:

1. explain that objects that are charged exert forces, both attractive and repulsive
2. explain that charging is the separation of electrical charges
3. explain the differences between conductors and insulators
4. use Coulomb's law to solve problems relating to electric force
5. define and measure an electric field
6. diagram electric field lines
7. define and calculate electric potential difference
8. explain the charge on an electron
9. determine where charges reside on solid and hollow conductors
10. describe capacitance and solve capacitor problems
11. define an electric current and the ampere
12. describe conductors that create current in an electric circuit
13. draw circuits and recognize they are closed loops
14. define power in electric circuits
15. define resistance and Ohm's law
16. explain how electric current is converted to thermal energy
17. explain why high-voltage transmission lines are used to carry electricity over long distances
18. define kilowatt-hour
19. explain a series and parallel connection
20. calculate current, voltage drops, and equivalent resistance for devices connected in series and in parallel
21. describe a voltage divider
22. explain how fuses, circuit breakers, and ground fault interrupters protect household wiring

23. explain the important features of voltmeters and ammeters

Assessments: See the assessments listed for Unit I above

Unit IX: Chapter 24 Magnetic Fields, Chapter 25 Electromagnetic Induction, Chapter 26 Electromagnetism

Outcomes: Students will be able to do the following:

1. Describe the properties of magnets
2. relate magnetic induction to the direction on a current-carrying wire in a magnetic field
3. describe the design and operation of an electric motor
4. explain how a changing magnetic field produces an electric current
5. define electromotive force
6. describe how an electric generator works and how it differs from a motor
7. describe the difference between peak and effective voltage and current
8. explain Lenz's law and back EMF and how it affects the operation of motors and generators
9. explain self-inductance and how it affects circuits
10. describe a transformer
11. describe the measurement of the charge-to-mass ratio of the electron
12. explain how electric and magnetic fields can produce more electric and magnetic fields
13. explain how accelerated charges produce electromagnetic waves
14. explain the process by which electromagnetic waves are detected

Assessments: See the assessments listed for Unit I above

Unit X: Chapter 27 Quantum Theory, Chapter 28 The Atom, Chapter 29, Solid State Electronics Transition Metals and Coordination Chemistry

Outcomes: Students will be able to do the following:

1. describe the spectrum emitted by a hot body and explain the basic theory that underlies the emission of a hot-body radiation
2. explain the photoelectric effect
3. explain the Compton effect
4. describe evidence of the wave nature of matter
5. explain the dual nature of both waves and particles and the importance of the Heisenberg uncertainty principle
6. explain the structure of the atom
7. distinguish between continuous and line spectra
8. explain emission and absorption spectra
9. describe the shortcomings of the Bohr model of the atom
10. describe the quantum model of the atom
11. explain how a laser works
12. describe electron motion in conductors and semiconductors
13. compare and contrast n-type and p-type semiconductors
14. describe how diodes work
15. explain how a transistor can amplify of increase voltage changes

Assessments: See the assessments listed for Unit I above

Unit XI: Chapter 30 The Nucleus, Chapter 31 Nuclear Applications

Outcomes: Students will be able to do the following:

1. determine the number of neutrons and photons in nuclides
2. describe the forms of radioactive decay
3. describe half-life
4. describe the operation of particle detectors and particle accelerators
5. explain antiparticles, quarks, and leptons of matter
6. define binding energy in the nucleus
7. relate the energy releases in a nuclear reaction to the change in binding energy during the reaction
8. explain how radioactive isotopes can be artificially produced and used
9. explain nuclear fission and chain reaction
10. describe the operation of one or more types of nuclear reactors
11. describe the fusion process

Assessments: See the assessments listed for Unit I above