Physics
Advanced High School Nature of Science & Advanced High School Physical Science
Standards, Supporting Skills, and Examples

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 2 Physical Science: Analyze forces, their forms, and their effects on motions.

Describing Motion: This unit moves the students to look at motion as a quantitative description of motion. The unit moves from speed to velocity and then finishes with acceleration.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Synthesis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.2.1A. Students are able to solve vector problems graphically and analytically.**	• draw and use motion diagrams to describe motion of an object • use the metric system during laboratories and problems solving • define speed and its relationship with space and time • differentiate between scalar and vector quantities • define and determine acceleration • relate velocity and acceleration to the motion of objects • define coordinate systems for motion problems • recognize that the chosen coordinate system affects the signs of the objects' positions • explain the difference between distance and displacement • construct motion graphs including position-time, velocity-time, and acceleration-time • interpret graphs to explain the position and motion of objects • determine mathematical relationships among position, velocity, acceleration, and time • apply graphical and mathematical relationships to solve constant-acceleration problems • describe the motion of objects in free fall • solve problems involving objects in free fall	• Laboratories including construction of graphs from calculations Examples: • Notion of Motion • How Fast is it Going? • How Does a Ball Roll? • Picket Fence • Quizzes of the problems from discussed equations • Comprehensive test	Text Book and support material: *Physics: Principles and Problems* Glencoe/McGraw-Hill, 2005 ISBN 0-07-845813-7 Vernier Software *Physics with Computers* by Appel, Gastineau, Bakken, and Vernier 3rd Edition ISBN 1-929075-29-4 Vernier Software & Technology, 2003

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Working with Forces: This unit describes how forces control motion using Newton's Laws.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.**	• define force • explain with examples Newton's law of inertia • use Newton's second law to solve problems • describe how the weight and the mass of an object are related • differentiate between actual weight and apparent weight • explain the tension in ropes and strings in terms of Newton's third law • define the normal force • determine the value of the normal force by applying Newton's second law • evaluate the sum of two or more vectors in tow dimensions, graphically • determine the components of vectors • solve for the sum of two or more vectors, algebraically, by adding the components of the vectors • understand the nature of friction and its role in opposing the motion of bodies • define friction force • distinguish between static and kinetic friction • solve force friction problems • determine the force that produces equilibrium when three forces act on an object • analyze the motion of an object on an inclined plane with and without friction	• Laboratory Examples • Newton's Laws Labs • Atwood's Machine	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 2 Physical Science: Analyze forces, their forms, and their effects on motions.

Motion in Two Dimensions: This unit extends the concepts developed earlier to motion in two dimensions.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.2.2A. Students are able to relate gravitational or centripetal force to projectile or uniform circular motion.**	• recognize that the vertical and horizontal motions of a projectile are independent. • relate the height, time in the air, and initial vertical velocity of a projectile using its vertical motion, and then determine the range using the horizontal motion • explain why an object moving in a circle at a constant speed is accelerated • describe how centripetal acceleration depends upon the object's speed and the radius of the circle • identify the force that causes centripetal acceleration • solve relative velocity problems	• Laboratory Examples • Paper River • Composition of Forces • Coefficient of Sliding Friction	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Gravitation: This unit introduces the laws governing planetary motion using both Kepler's laws and Newton's laws. Weight and weightlessness in orbit are also discussed.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.**	• relate Kepler's laws to the law of universal gravitation • calculate orbital speeds and periods • describe the importance of Cavendish's experiment • solve orbital motion problems using Newton's law of gravitational • relate weightlessness to objects in free fall • describe gravitational fields		

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 2 Physical Science: Analyze forces, their forms, and their effects on motions.

Rotational Motion: This unit uses Newton's laws and linear motion to explain how different parts of an object being rotated experience different velocities and accelerations. Torque and rotational equilibrium is also discussed.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.2.2A. Students are able to relate gravitational or centripetal force to projectile or uniform circular motion.**	• describe angular displacement • calculate angular velocity • solve problems involving rotational motion • describe torque and the factors that determine it • calculate net torque • calculate the moment of inertia • define center of mass • explain how the location of the center of mass affects the stability of an object • define the conditions for equilibrium	• Laboratory Examples • Torques	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Momentum: This unit discusses changes in motion of an object by considering an object's momentum before and after an impulse acts on it. Conservation of momentum is explain and implemented.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.**	• define and give examples of linear momentum • define the momentum of an object • determine the impulse given to an object • understand the relationship between impulse and momentum • define the angular momentum of an object • relate Newton's third law to conservation of momentum in collisions and explosions • recognize the conditions under which momentum is conserved • solve conservation of momentum problems in two dimensions	• Laboratory Examples • Impulse and Momentum	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 3 Physical Science: Analyze interactions of energy and matter.

Work, Power, and Energy: This unit develops the relationships between force, displacement, work, and energy. This unit also expands the concept of conservation introduced in momentum to the conservation of mechanical energy.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Application)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.3.1. Students are able to describe the relationships among potential energy, kinetic energy, and work as applied to the Law of Conservation of Energy.**	• learn how forces do work • calculate the work done by constant and varying forces • define kinetic and potential energy • describe the relationship between work and energy • identify how elastic potential energy is stored • apply the knowledge to solve kinetic and potential energy problems • understand the importance of the law of conservation of energy • apply the concept of conservation of energy to solve problems • analyze collisions to find the change in kinetic energy • calculate power used	• Laboratory Examples • Work and Power	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Thermal Energy: This unit will investigate the transfer of energy between the particles of matter. The kinetic energy in the motion of the particles that make up matter is called thermal energy and this energy can be transferred as heat.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.**	• describe thermal energy and compare it to potential and kinetic energies • distinguish between the different temperature scales • distinguish the difference between temperature, heat, and thermal energy • explain heat as the energy transferred between substances that are at different temperatures • define and apply specific heat to solve heat problems • apply the law of conservation of heat in order to solve heat exchange problems • define heats of fusion and vaporization • use heats of fusion and vaporization to solve phase change problems • interpret the various sections of a heating curve • show that heat can do work and is a form of energy • solve mathematically how mechanical energy is converted into heat energy • state the first and second laws of thermodynamics • distinguish between heat and work • define entropy	• Laboratory Examples • Work and Power	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 3 Physical Science: Analyze interactions of energy and matter.

Vibrations and Waves: This unit introduces the concept of periodic motion and the nature and characteristics of the transfer of energy through waves.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Synthesis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.3.1A. Students are able to explain wave behavior in the fundamental processes of reflection, refraction, diffraction, interference, resonance, and image formation.**	• describe the force in an elastic spring • determine the energy stored in an elastic spring • compare simple harmonic motion and the motion of a pendulum • explain how amplitude and energy are related • recognize the difference between mechanical and electromagnetic waves • identify how wave transfer energy without the transferring of matter • contrast transverse and longitudinal waves • relate wave speed, wavelength, and frequency • relate the wave's speed to the medium in which the wave travels • describe how waves are reflected and refracted at boundaries between media • study phenomena characteristics of wave motion such as rectilinear propagation, reflection, refraction, diffraction and interference • apply the principle of superposition to the phenomenon of interference • explain the law of reflection	• Laboratory Examples • Work and Power	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 3 Physical Science: Analyze interactions of energy and matter.

Static Electricity: This unit examines the electric charges at rest and the resulting effects.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Application)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.3.2A. Students are able to describe the relationship between charged particles, static electricity, and electric fields.**	• recognize the basic properties of the electrical interaction • demonstrate that charges objects exert forces, both attractive and repulsive • recognize that charging is the separation, not the creation, of electric charges • demonstrate how to charge an object by both conduction and induction • state the differences between conductors and insulators • explain how an electroscope detects the presence of charge • state Coulomb's law and how the force depends on charges and their separation • define the SI unit for charge • understand the vector nature of the electric force • solve problems using Coulomb's law • understand the cause of the attractive force on neutral objects	•Laboratory Examples •Static Electricity •Electric Fields	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 3 Physical Science: Analyze interactions of energy and matter.

Electric Fields: This unit covers the use of static electricity in the form of electric fields. It is the interaction between a test charge and the field at the location of the test charge that transfers energy. The electric field stores energy.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Application)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.3.2A. Students are able to describe the relationship between charged particles, static electricity, and electric fields.**	• define an electric field including how to measure it • distinguish between force and field • calculate problems relating electric fields, forces, and charge • diagram electric field lines • differentiate between electric fields and force lines • define electric potential difference in terms of work done moving a unit test charge • know the units of electric potential • solve problems relating potential difference and the work required to move a charge in uniform electric fields • define grounding • know where charges reside on solid and hollow conductors • recognize the relationship between conductor shape and field strength • define capacitance • calculate capacitor problems	• Laboratory Examples • Static Electricity • Electric Fields • Electric Capicators	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Current Electricity: This unit discovers the relationships between moving charges, resistance and voltage, Ohm's Law. Current electricity also includes the use of meters to analyze a circuit.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.**	• define an electric current and resistance and their correct units • describe Ohm's law and use Ohm's law to solve problems • describe the conditions that permit current to flow • construct completed electric circuits • understand the energy transfer in circuits • explain definition of power in electric circuits • differentiate between power and energy in an electric circuit • solve problems involving current, potential difference, and power • calculate problems involving current, potential difference, and resistance • diagram simple electric circuits • recognize the correct use of ammeters and voltmeters • explore ways to deliver electric energy to consumers near and far • explain how heaters convert electrical energy into thermal energy • define the kilowatt-hour • solve problems involving the use and cost of electrical energy	• Laboratory Examples • Electric Circuits • Ohm's Law for Resistance	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Series and Parallel Circuits: This unit allows the students to work with series and parallel circuits and the combination of them. The students will also learn about the application of circuits.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.**	• describe a series and parallel connection and state their important characteristics • calculate current, voltage drops, and equivalent resistance when devices are connected in series and in parallel • define a voltage divider and solve problems involving a voltage divider • describe a combination series-parallel circuit • calculate the equivalent resistance in a combination circuit • distinguish between voltmeters and ammeters and state the important characteristics of each • explain how each meter is wired into a circuit • explain how fuses, circuit breakers, and ground-fault interrupters protect household wiring	• Laboratory Examples • Static Electricity • Electric Fields • Electric Capicators	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Indicator 3 Physical Science: Analyze interactions of energy and matter.

Magnetic Fields: This unit covers the characteristics of permanent and temporary magnets. Magnetic fields also include forces caused by a magnetic field.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.** **9-12.P.3.3A. Students are able to describe the relationship between changing magnetic and electric fields.**	• summarize the properties of magnets • describe magnetic fields around permanent magnets and between like and unlike poles • describe the field around a current-carrying wire • demonstrate the use of the right-hand rule in finding the direction of the field lines • explain the nature of the field due to both one and many wire loops • define magnetic induction • explain the direction of the force on a current-carrying wire in a magnetic field • list the factors that determine the magnitude of the force on a wire • solve problems involving a wire in a magnetic field • explain the design, operation and uses of a galvanometer • describe the design and operation of an electric motor • list the factors that determine the magnitude of the force on a moving charge in a magnetic field • solve problems involving the force on a moving charge	• Laboratory Examples • Magnetic Fields • Permanent Magnetics	

Indicator 2 Nature of Science: Apply the skills necessary to conduct scientific investigations.

Electromagnetic Induction: This unit discusses the creation of electric current from changing magnetic fields. Also included are the affects of changing magnetic fields or induced EMF.

Bloom's Taxonomy Level	Standard	Supporting Skills	Assessments	Resources
(Synthesis) (Evaluation) (Analysis)	**9-12.N.2.1A. Students are able to manipulate multiple variables with repeated trials.** **9-12.N.2.2A. Students are able to use statistical analysis of data to evaluate the validity of results**. **9-12.N.2.3A. Students are able to demonstrate correct precision in measurements and calculations.**	• describe how a changing magnetic field produces an electric current • define EMF and calculate EMF of wires moving in a magnetic field • explain how an electric generator works and how it differs from a motor • explain back-EMF and how it affects the operation of motors and generators • explain the nature of self-inductance and its effects in circuits • describe the transformer • determine the connection of turns ratio to voltage ratio	• Laboratory Examples • Motors	