

OXFORD HIGH SCHOOL SCIENCE DEPARTMENT
HONORS PHYSICS CURRICULUM

#346 Physics (H) (11-12) Full Year 1.0 Credit

This course is designed to be a hands-on inquiry-based exploration of physics with increased focus on high level analysis and computation to express scientific thinking for students who want to pursue higher level study of the sciences. Always focused on making the connections between science and technology and their impact on the quality of our lives, the study of physics uses multiple pathways of scientific reasoning with specific emphasis on mathematical-analytical problem solving to explore force and motion, thermodynamics, waves and optics, electricity and magnetism, and atomic and nuclear physics. The prerequisites for this course include a teacher recommendation, Algebra II, and Chemistry. *This course can be used to meet the science OR technology graduation requirements.

ENDURING UNDERSTANDINGS (BROAD IDEAS, USUALLY GROUNDED IN THE DISCIPLINE):

Science is a creative endeavor that uses logical, analytical processes.

SCIENTIFIC INQUIRY

EI-A Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.

EI-B Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.

EI-C Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists

SCIENTIFIC LITERACY

EL-A Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.

EL-A Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.

SCIENTIFIC NUMERACY

EN-A Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.

COURSE SPECIFIC GOALS (ALIGNED WITH CONTENT STANDARDS):

SCIENTIFIC MEASUREMENT - Physics and other scientific disciplines are studied through experimentation and theoretical mathematics

UNIT ANALYSIS - Standards are established to measure the basic and derived units

LINEAR MOTION - Objects in the universe interact with one another by way of friction, tension, compression, spring, gravitational, and normal forces. The net force on an object is the vector sum of all the forces acting upon the object.

FORCES - Objects in the universe interact with one another by way of friction, tension, compression, spring, gravitational, and normal forces. The net force on an object is the vector sum of all the forces acting upon the object.

NEWTON'S LAWS - Newton's laws are not exact, but provide very good approximations for the analysis of forces, unless an object is small enough or larger enough the quantum and gravitational effects become important.

ENERGY - The total energy of the universe is constant; however, energy can be converted from one form to another and move from one system to another. Energy can be classified as potential or kinetic energy. Potential energy is stored energy and includes chemical, gravitational, electrostatic, elastic, and nuclear. Kinetic energy is the energy of motion.

MOMENTUM - The principles of conservation of momentum and energy can be used to solve problems involving elastic and inelastic collisions.

PROJECTILE MOTION – An object solely under the influence of gravity can be accurately depicted by analysis of its horizontal and vertical components of velocity and displacement

CIRCULAR MOTION – An object revolving around a single axis experiences a constant, centripetal force perpendicular to the object's velocity, directed toward the center.

NEWTON'S LAW OF GRAVITATION – Every particle in the universe is attracted to every other particle by a force that is directly proportional to the product of the particle's mass and inversely proportional to the square of the distance between products.

THERMAL DYNAMICS – Heat(energy) transfers affect the phase and temperature of substances, which tries to reach a state of equilibrium

SIMPLE HARMONIC MOTION – Objects that undergo motion under constraints of a spring or string behave in a periodic, predictable motion

WAVE MECHANICS – Waves carry information that help us sense and communicate with the world

SOUND – Compression of atoms/molecules create waves that transfer information

Electrostatics – Electronic Interactions at the atomic level are capable of transferring energy

SIMPLE CIRCUITS – The laws of electrodynamics in combinations of capacitors, resistors and batteries make up of the most basic, useable circuits present in all electronics

MAGNETISM – Magnetic properties in permanent and electromagnets are widely used in many everyday and scientific applications

LIGHT – Electromagnetic radiation exhibits a wave/particle duality that exhibits both practical and scientific applications

REFRACTION – Different geometric shape of lenses distorts light rays and equations are used to predict and measure the ray distortion

DIFFRACTION – Light acts as a wave when interacting with diffraction gratings

LASERS – Coherent and non-coherent light have specific properties that enable many scientific and everyday applications

QUANTUM MECHANICS – The atomic level exhibits unintuitive nature governed by laws of probability, uncertainty and fixed or quantized amount of energy

NUCLEAR PHYSICS – Dynamics of a nucleus can change the nature of an atom and harbor large quantities of energy

EXPECTED PERFORMANCES (ALIGNED WITH STATE EXPECTED PERFORMANCES)

THE NATURE OF SCIENCE

Enduring Understanding	Standard
EI-B	Identify questions that can be answered through scientific investigation
EI-C	Read, interpret and examine the credibility and validity of scientific claims in different sources of information
EI-A, EI-B	Design and conduct appropriate types of scientific investigations to answer different questions.
EI-B	Identify independent variables, dependent variables, constants and controls in an experiment.
EI-B, EN-A	Use appropriate tools and techniques to make observations and gather data.
EI-2, EN-A	Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.
EI-B, EN-A	Input data into a spreadsheet, program appropriate calculations, and generate graphs.
EI-3	Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.
EI-B, EI-C	Assess the reliability and validity of the data that was generated in an investigation and justify confidence in results.
EI-C	Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.
EI-A	Identify an issue and its implications completely.
EI-A	Develop an action plan that addresses all aspects of the issue in detail.
EI-A	Use a variety of reliable sources of relevant information, data, knowledge, or experiences to take and support a critical stance.

UNIT 1: SCIENTIFIC MEASUREMENT / UNIT ANALYSIS: *Scientific Measurement* - PHYSICS AND OTHER SCIENTIFIC DISCIPLINES ARE STUDIED THROUGH EXPERIMENTATION AND THEORETICAL MATHEMATICS. *Unit Analysis* - STANDARDS ARE ESTABLISHED TO MEASURE THE BASIC AND DERIVED UNITS

Duration: 1.5 weeks

Content Standards	Common Learning Experiences
<p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.1.9.2 -- Students will generate and revise hypotheses based upon empirical data and the requirements of logical reasoning</p> <p>07.0.1.9.3 -- Students will interpret the results of experimentation using statistical reasoning</p> <p>07.0.1.9.4 -- Students will critique scientific experiments or research by seeking out possible sources of bias in the design and analysis of data</p> <p>07.0.1.9.5 -- Students will suggest alternative ways of explaining data and criticize arguments in which data, explanations or conclusions are represented as the only ones worthy of consideration</p> <p>07.0.1.9.6 -- Students will prepare and present oral and written scientific reports that communicate in a logical sequence the process, results and validity of scientific experiments and research</p>	<p>1. Dimensional Analysis 2. Getting to Class On Time Lab 3. Case Studies/Logic Problems</p> <p>Specific Vocabulary: time, length, mass, unit, charge, dimensional analysis, scientific notation, significant figures,</p>

UNIT 2: LINEAR MOTION: OBJECTS IN THE UNIVERSE INTERACT WITH ONE ANOTHER BY WAY OF FRICTION, TENSION, COMPRESSION, SPRING, GRAVITATIONAL, AND NORMAL FORCES. THE NET FORCE ON AN OBJECT IS THE VECTOR SUM OF ALL THE FORCES ACTING UPON THE OBJECT.

Duration: 2.5 weeks

Content Standards	Common Learning Experiences
<p>07.0.13.5.2 -- Students will demonstrate that objects have inertia and momentum</p> <p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.1.9.3 -- Students will interpret the results of experimentation using statistical reasoning</p> <p>07.0.13.5.3 -- Students will recognize that the motion of one object can be described by measuring its position, direction and speed relative to another object</p> <p>07.0.13.5.4 -- Students will illustrate that changes in the speed and direction of an object are due to forces which have magnitude and direction</p> <p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.1.9.2 -- Students will generate and revise hypotheses based upon empirical data and the requirements of logical reasoning</p> <p>07.0.1.9.3 -- Students will interpret the results of experimentation using statistical reasoning</p> <p>07.0.1.9.4 -- Students will critique scientific experiments or research by seeking out possible sources of bias in the design and analysis of data</p> <p>07.0.1.9.5 -- Students will suggest alternative ways of explaining data and criticize arguments in which data, explanations or conclusions are represented as the only ones worthy of consideration</p> <p>07.0.1.9.6 -- Students will prepare and present oral and written scientific reports that communicate in a logical sequence the process, results and validity of scientific experiments and research.</p>	<p>1. www.PHET.com, Walking Man Analysis</p> <p>2. Oil Drop Lab</p> <p>3. Accel-a-saurus-Rex Lab</p> <p>Specific Vocabulary: distance, displacement, speed, velocity, acceleration, constant velocity, constant acceleration, kinematic equations,</p>

UNIT 3: FORCES: *Forces* - OBJECTS IN THE UNIVERSE INTERACT WITH ONE ANOTHER BY WAY OF FRICTION, TENSION, COMPRESSION, SPRING, GRAVITATIONAL, AND NORMAL FORCES. THE NET FORCE ON AN OBJECT IS THE VECTOR SUM OF ALL THE FORCES ACTING UPON THE OBJECT. *Newton's Laws* - NEWTON'S LAWS ARE NOT EXACT, BUT PROVIDE VERY GOOD APPROXIMATIONS FOR THE ANALYSIS OF FORCES, UNLESS AN OBJECT IS SMALL ENOUGH OR LARGER ENOUGH THE QUANTUM AND GRAVITATIONAL EFFECTS BECOME IMPORTANT.

Duration: 3 weeks

Content Standards	Common Learning Experiences
<p>07.0.13.5.2 -- Students will demonstrate that objects have inertia and momentum</p> <p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.1.9.3 -- Students will interpret the results of experimentation using statistical reasoning</p> <p>When forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest.</p> <p>The law $F = ma$ is used to solve motion problems that involve constant forces. When one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction.</p> <p>Applying a force to an object perpendicular to the direction of its motion causes the object to change direction.</p> <p>Newton's laws are not exact, but provide very good approximations unless an object is small enough that quantum effects become important.</p>	<ol style="list-style-type: none"> 1. Manual for training athletes 2. Balloon Rockets Competition 3. $F = MA$ Lab 4. Sports on the Moon: What would happen if a sport was played on the moon? 5. Paper Plate Physics Competition 6. Dialogue in the Spirit of Galileo 7. Friction Lab Exploration <p>Specific Vocabulary: force, electric force, electric charge, friction, gravitational force, mass, net force, normal force, weight, vector, vector diagram</p>

UNIT 4: ENERGY/MOMENTUM: *Energy:* THE TOTAL ENERGY OF THE UNIVERSE IS CONSTANT; HOWEVER, ENERGY CAN BE CONVERTED FROM ONE FORM TO ANOTHER AND MOVE FROM ONE SYSTEM TO ANOTHER. ENERGY CAN BE CLASSIFIED AS POTENTIAL OR KINETIC ENERGY. POTENTIAL ENERGY IS STORED ENERGY AND INCLUDES CHEMICAL, GRAVITATIONAL, ELECTROSTATIC, ELASTIC, AND NUCLEAR. KINETIC ENERGY IS THE ENERGY OF MOTION. *Momentum* - THE PRINCIPLES OF CONSERVATION OF MOMENTUM AND ENERGY CAN BE USED TO SOLVE PROBLEMS INVOLVING ELASTIC AND INELASTIC COLLISIONS.

Duration: 3 weeks

Content Standards	Common Learning Experiences
<p>07.0.13.5.2 -- Students will demonstrate that objects have inertia and momentum</p> <p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.1.9.3 -- Students will interpret the results of experimentation using statistical reasoning</p> <p>07.0.12.5.1 07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one for to another</p> <p>07.0.12.9.1 -- Students will classify various forms of energy as either kinetic or potential</p> <p>07.0.12.9.4 -- Students will explain that, although energy changes into different forms within a closed system, the total amount of energy remains unchanged, while the amount of useful energy is decreased</p> <p>Kinetic energy can be calculated by using the formula $E = (1/2)mv^2$.</p> <p>Changes in gravitational potential energy near Earth can be calculated by using the formula (change in potential energy) = mgh.</p> <p>Momentum is calculated as the product mv.</p> <p>Momentum is a separately conserved quantity different from energy.</p> <p>An unbalanced force on an object produces a change in its momentum.</p>	<ol style="list-style-type: none"> 1. Crash car dummies analysis report 2. Hit the Target Lab 3. Amusement Park Analysis 4. Egg vs. Sheet 5. Egg drop lab <p>Specific Vocabulary: energy, work, force, potential energy, kinetic energy, momentum, inelastic collision, elastic collision, impulse,</p>

UNIT 5: MULTI-DIMENSIONAL MOTION / FORCES: *Projectile Motion* – AN OBJECT SOLELY UNDER THE INFLUENCE OF GRAVITY CAN BE ACCURATELY DEPICTED BY ANALYSIS OF ITS HORIZONTAL AND VERTICAL COMPONENTS OF VELOCITY AND DISPLACEMENT. *Circular Motion* – AN OBJECT REVOLVING AROUND A SINGLE AXIS EXPERIENCES A CONSTANT, CENTRIPETAL FORCE PERPENDICULAR TO THE OBJECT’S VELOCITY, DIRECTED TOWARD THE CENTER. *Newton’s Law of Gravitation* – EVERY PARTICLE IN THE UNIVERSE IS ATTRACTED TO EVERY OTHER PARTICLE BY A FORCE THAT IS DIRECTLY PROPORTIONAL TO THE PRODUCT OF THE PARTICLE’S MASS AND INVERSELY PROPORTIONAL TO THE SQUARE OF THE DISTANCE BETWEEN PRODUCTS.

Duration: 2.5 Weeks

Content Standards	Common Learning Experiences
<p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.1.9.3 -- Students will interpret the results of experimentation using statistical reasoning</p> <p>07.0.1.5.2 -- Students will identify and control variables in experiments</p> <p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.13.5.3 -- Students will recognize that the motion of one object can be described by measuring its position, direction and speed relative to another object</p> <p>07.0.12.9.6 -- Students will understand that every objects exerts a gravitational force on every other object</p> <p>Analyze and describe projectile motion in terms of its acceleration and constant speed components</p> <p>Applying a force to an object perpendicular to the direction of its motion causes the object to change direction.</p>	<p>1. Rockets Lab/Hit the Target Lab 2. Centripetal Force Lab</p> <p>Vocabulary: Projectile motion, horizontal displacement, vertical displacement, horizontal velocity, vertical velocity, time, acceleration, range, max height, angle, centripetal force, centripetal acceleration, perpendicular force, pendulum, spring, simple harmonic motion, circular motion, angular acceleration, gravitational force,</p>

UNIT 6: THERMAL DYNAMICS: HEAT (ENERGY) TRANSFERS AFFECT THE PHASE AND TEMPERATURE OF SUBSTANCES ,WHICH TRIES TO REACHES A STATE OF EQUILIBRIUM.

Duration: 2 weeks

Content Standards	Common Learning Experiences
<p>07.0.13.5.2 -- Students will demonstrate that objects have inertia and momentum</p> <p>07.0.1.9.1 -- Students will gather and synthesize information concerning a problem</p> <p>07.0.1.9.3 -- Students will interpret the results of experimentation using statistical reasoning</p> <p>07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one for to another</p> <p>07.0.12.9.2 -- Students will recognize that heat energy is related to the disordered motion of atoms or molecules</p> <p>07.0.12.9.4 -- Students will explain that, although energy changes into different forms within a closed system, the total amount of energy remains unchanged, while the amount of useful energy is decreased</p> <p>07.0.11.5.4 -- Students will recognize that all matter is made up atoms which are too small to be seen directly through the microscope, but that indirect evidence can be used to construct a useful model of the atom</p> <p>07.0.11.9.2 -- Students will explain how the chemical and physical properties of substances are related to their atomic and molecular structures</p> <p>07.0.12.5.5 -- Students will understand that all physical changes, including changes of state, require energy</p>	<ol style="list-style-type: none"> 1. Baking Ice cream 2. Making Ice cream 3. Latent heat lab <p>Specific Vocabulary: temperature, internal energy, thermal equilibrium, heat, specific heat capacity, calorimetric, phase change, latent heat</p>

UNIT 7: VIBRATIONS AND WAVE MECHANICS: *Simple Harmonic Motion* – OBJECTS THAT UNDERGO MOTION UNDER CONSTRAINTS OF A SPRING OR STRING BEHAVE IN A PERIODIC, PREDICTABLE MOTION. *Wave Mechanics* – WAVES CARRY INFORMATION THAT HELP US SENSE AND COMMUNICATE WITH THE WORLD

Duration: 3.5 weeks

Content Standards	Common Learning Experiences
<p>07.0.11.5.8 -- Students will demonstrate that some properties (such as mass and volume) depend on the amount of material and some properties (such as density, melting point and boiling point) are independent of the amount of material.</p> <p>07.0.12.5.1 07.0.12.5.2 -- Students will identify energy transformations that occur in various systems (e.g., biological, mechanical, geological) and recognize that that is a by product of energy transformations</p> <p>07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one form to another</p> <p>07.0.12.9.5 -- Students will describe the nature of different types of waves, how they are produced, and how they transfer energy</p> <p>07.0.13.5.1 -- Students will identify evidence that waves (e.g., light, sound, radiant) can transfer energy between two points</p> <p>07.0.13.9.7 -- Students will recognize that waves may interact with the materials they enter</p>	<ol style="list-style-type: none"> 1. Hooke's Law Lab 2. Slinky Lab 3. Cartoon Waves 4. Analysis of Wave-driven Product <p>Specific Vocabulary: simple harmonic motion, amplitude, period, frequency, medium, mechanical wave, transverse wave, longitudinal wave, crest, trough, wavelength, constructive interference, destructive interference, standing waves, node/antinode,</p>

UNIT 8: SOUND: COMPRESSION OF ATOMS/MOLECULES CREATE WAVES THAT TRANSFER INFORMATION

Duration: 2 weeks

Content Standards	Common Learning Experiences
<p>07.0.11.5.3 -- Students will demonstrate that the kinetic molecular model of matter is useful in describing the structure and properties of solids, liquids and gases</p> <p>07.0.11.5.4 -- Students will recognize that all matter is made up atoms which are too small to be seen directly through the microscope, but that indirect evidence can be used to construct a useful model of the atom</p> <p>07.0.11.9.2 -- Students will explain how the chemical and physical properties of substances are related to their atomic and molecular structures</p> <p>07.0.12.5.5 -- Students will understand that all physical changes, including changes of state, require energy</p> <p>07.0.12.5.7 -- Students will compare and contrast different forms of energy in terms of their wavelengths on the electromagnetic spectrum.</p> <p>07.0.12.9.5 -- Students will describe the nature of different types of waves, how they are produced, and how they transfer energy</p> <p>07.0.12.9.7 -- Students will interpret the physical characteristics of sound, (including pitch and loudness) in terms of wave theory</p>	<ol style="list-style-type: none">1. Tuning Fork Lab2. Build an instrument3. Analyze concert Halls <p>Specific Vocabulary: compression, rarefaction, pitch, Doppler effect, intensity, decibel, resonance, fundamental frequency, harmonic series, timbre, beat</p>

UNIT 9: ELECTROSTATICS: ELECTRONIC INTERACTIONS AT THE ATOMIC LEVEL ARE CAPABLE OF TRANSFERRING ENERGY

Duration: 2.5 weeks

Content Standards	Common Learning Experiences
<p>07.0.11.9.2 -- Students will explain how the chemical and physical properties of substances are related to their atomic and molecular structures</p> <p>07.0.12.5. -- Students will identify energy transformations that occur in various systems (e.g., biological, mechanical, geological) and recognize that heat is a by product of energy transformations</p> <p>07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one form to another</p> <p>07.0.13.5.6 -- Students will understand that a complete circuit is necessary in order for electric current to flow</p> <p>07.0.13.9.9 -- Students will understand the differences in the flow of electrical energy in conductors, semi-conductors and insulators</p>	<p>1. Investigating Electric Charge Lab</p> <p>Specific Vocabulary: electrical conductor, electrical insulator, induction, electric field, charge, point charge, potential, electric potential, voltage, positive charge, negative charge, coulomb, coulomb charge</p>

UNIT 10: SIMPLE CIRCUITS: THE LAWS OF ELECTRODYNAMICS IN COMBINATIONS OF CAPACITORS, RESISTORS AND BATTERIES
 MAKE UP OF THE MOST BASIC, USEABLE CIRCUITS PRESENT IN ALL ELECTRONICS

Duration: 2 weeks

Content Standards	Common Learning Experiences
<p>07.0.12.5.2 -- Students will identify energy transformations that occur in various systems (e.g., biological, mechanical, geological) and recognize that hat is a by product of energy transformations</p> <p>07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one for to another</p> <p>07.0.12.5.5 -- Students will understand that all physical changes, including changes of state, require energy</p> <p>07.0.12.9.1 -- Students will classify various forms of energy as either kinetic or potential</p> <p>07.0.13.5.6 -- Students will understand that a complete circuit is necessary in order for electric current to flow</p>	<ol style="list-style-type: none"> 1. Mini-House Circuits 2. Investigating Resistors, Capacitors, batters 3. Destroy an electronic device day <p>Specific Vocabulary: resistance, resistors, capacitors, plates, potential, ampere, current, amps, batteries, series circuit, parallel circuit, Kirchoff's law, ohms law, power, DC circuit, AC circuit, power distribution,</p>

UNIT 11: MAGNETICS: MAGNETIC PROPERTIES IN PERMANENT AND ELECTROMAGNETS ARE WIDELY USED IN MANY EVERYDAY AND SCIENTIFIC APPLICATIONS

Duration: 2 weeks

Content Standards	Common Learning Experiences
<p>07.0.12.5.2 -- Students will identify energy transformations that occur in various systems (e.g., biological, mechanical, geological) and recognize that heat is a byproduct of energy transformations</p> <p>07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one form to another</p> <p>07.0.12.5.5 -- Students will understand that all physical changes, including changes of state, require energy</p> <p>07.0.12.9.1 -- Students will classify various forms of energy as either kinetic or potential</p> <p>07.0.13.5.6 -- Students will understand that a complete circuit is necessary in order for electric current to flow</p>	<ol style="list-style-type: none"> 1. RAFT assignment: Justin Timberlake Flies 2. Magnetic Poster Board Show 3. Speaker Design <p>Specific Vocabulary: magnetic, magnets, permanent magnet, ferromagnetic, electromagnet, north pole, south pole, magnetic field, magnetic domain, solenoid</p>

UNIT 12: LIGHT AND REFLECTION: ELECTROMAGNETIC RADIATION EXHIBITS A WAVE/PARTICLE DUALITY THAT EXHIBITS BOTH PRACTICAL AND SCIENTIFIC APPLICATIONS

Duration: 2 weeks

Content Standards	Common Learning Experiences
<p>07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one for to another</p> <p>07.0.12.5.6 -- Students will recognize that the sun produces energy in a range of wavelengths within the electromagnetic spectrum</p> <p>07.0.12.5.7 -- Students will compare and contrast different forms of energy in terms of their wavelengths on the electromagnetic spectrum.</p> <p>07.0.12.9.5 -- Students will describe the nature of different types of waves, how they are produced, and how they transfer energy</p> <p>07.0.13.9.4 -- Students will recognize that energy changes in atoms and molecules occur in fixed increments</p> <p>07.0.13.9.6 -- Students will explain how radiation and matter interact in terms of the absorption and emission of energy by individual atoms, molecules and their aggregates</p> <p>07.0.13.9.8 -- Students will recognize the types of radiation (e.g., light, radio, microwave, X-ray) which comprise the electromagnetic spectrum</p>	<ol style="list-style-type: none"> 1. Mirrors Lab 2. Demos/Optical Illusions 3. Examining the Human Eye <p>Specific Vocabulary: electromagnetic waves, microwave, radio wave, gamma ray, infrared waves, gamma waves, ultraviolet waves, visible waves, reflection, angle of incidence, angle of reflection, virtual image, real image, concave mirror, convex mirror, linear polarization, focal length, focal point, flat mirror</p>

UNIT 13: REFRACTION: DIFFERENT GEOMETRIC SHAPE OF LENSES DISTORTS LIGHT RAYS AND EQUATIONS ARE USED TO PREDICT AND MEASURE THE RAY DISTORTION

Duration: 2 weeks

Content Standards	Common Learning Experiences
<p>07.0.12.5.4 -- Students will recognize that energy exists in many forms (e.g., light, heat, chemical, electrical and mechanical) and that energy can be transformed from one for to another</p> <p>07.0.12.5.6 -- Students will recognize that the sun produces energy in a range of wavelengths within the electromagnetic spectrum</p> <p>07.0.12.5.7 -- Students will compare and contrast different forms of energy in terms of their wavelengths on the electromagnetic spectrum.</p> <p>07.0.12.9.5 -- Students will describe the nature of different types of waves, how they are produced, and how they transfer energy</p> <p>07.0.13.9.4 -- Students will recognize that energy changes in atoms and molecules occur in fixed increments</p> <p>07.0.13.9.6 -- Students will explain how radiation and matter interact in terms of the absorption and emission of energy by individual atoms, molecules and their aggregates</p> <p>07.0.13.9.8 -- Students will recognize the types of radiation (e.g., light, radio, microwave, X-ray) which comprise the electromagnetic spectrum</p>	<ol style="list-style-type: none"> 1. Lens Analysis/ Eye Glasses- Contacts research 2. Optics Bench <p>Specific Vocabulary: Law of refraction, lenses, concave lens, convex lens, medium, magnification, index of refraction, lens, total internal refraction, critical angle, dispersion, chromatic aberration</p>

UNIT 14: INTERFERENCE/DIFFRACTION: *Diffraction* – LIGHT ACTS AS A WAVE WHEN INTERACTING WITH DIFFRACTION GRATINGS. *Lasers* – COHERENT AND NON-COHERENT LIGHT HAVE SPECIFIC PROPERTIES THAT ENABLE MANY SCIENTIFIC AND EVERYDAY APPLICATIONS

Duration: 2 weeks

Content Standards	Common Learning Experiences
<p>07.0.12.5.7 -- Students will compare and contrast different forms of energy in terms of their wavelengths on the electromagnetic spectrum.</p> <p>07.0.12.9.5 -- Students will describe the nature of different types of waves, how they are produced, and how they transfer energy</p> <p>07.0.13.9.6 -- Students will explain how radiation and matter interact in terms of the absorption and emission of energy by individual atoms, molecules and their aggregates</p> <p>07.0.13.9.7 -- Students will recognize that waves may interact with the materials they enter</p>	<p>1. CD gratings/Lasers</p> <p>Specific Vocabulary: coherence, path difference, order number, diffraction, resolving power, laser, maser</p>

UNIT 15: ATOMIC PHYSICS: THE ATOMIC LEVEL EXHIBITS UNINTUITIVE NATURE GOVERNED BY LAWS OF PROBABILITY, UNCERTAINTY AND FIXED OR QUANTIZED ABOUT OF ENERGY

Duration: 3 weeks

Content Standards	Common Learning Experiences
<p>07.0.12.9.4 -- Students will explain that, although energy changes into different forms within a closed system, the total amount of energy remains unchanged, while the amount of useful energy is decreased</p> <p>07.0.13.9.1 -- Students will explain how the interactions between various energy forms and matter can produce physical, chemical and nuclear transformations</p> <p>07.0.13.9.2 -- Students will observe, measure and represent mathematically the changes in the various energy forms taking place during the physical and chemical transformation of substances</p> <p>07.0.13.9.3 -- Students will describe how energy changes can be related to structural processes and modifications at the atomic and molecular levels</p> <p>07.0.13.9.4 -- Students will recognize that energy changes in atoms and molecules occur in fixed increments</p> <p>07.0.13.9.5 -- Students will recognize that energy and new particles are released when the nuclei of heavy atoms (e.g., uranium, plutonium) split</p>	<ol style="list-style-type: none"> 1. Black Hole Sun 2. Research in recent advancements in Quantum mechanics <p>Specific Vocabulary: Blackbody radiation, photoelectric effect, ultraviolet catastrophe, photon, work function, Compton Shift, Emission Spectrum, Absorption spectrum, uncertainty principle</p>

UNIT 16: NUCLEAR PHYSICS: DYNAMICS OF A NUCLEUS CAN CHANGE THE NATURE OF AN ATOM AND HARBOR LARGE QUANTITIES OF ENERGY

Duration: 3 weeks

Content Standards	Common Learning Experiences
<p>07.0.12.9.4 -- Students will explain that, although energy changes into different forms within a closed system, the total amount of energy remains unchanged, while the amount of useful energy is decreased</p> <p>07.0.13.9.1 -- Students will explain how the interactions between various energy forms and matter can produce physical, chemical and nuclear transformations</p> <p>07.0.13.9.2 -- Students will observe, measure and represent mathematically the changes in the various energy forms taking place during the physical and chemical transformation of substances</p> <p>07.0.13.9.3 -- Students will describe how energy changes can be related to structural processes and modifications at the atomic and molecular levels</p> <p>07.0.13.9.4 -- Students will recognize that energy changes in atoms and molecules occur in fixed increments</p> <p>07.0.13.9.5 -- Students will recognize that energy and new particles are released when the nuclei of heavy atoms (e.g., uranium, plutonium) split</p>	<ol style="list-style-type: none"><li data-bbox="1419 431 1703 459">1. Black Hole Sun II<li data-bbox="1419 467 1877 495">2. Building a Nuclear Power Plant <p data-bbox="1371 574 1902 753">Specific Vocabulary: Isotope, Strong Force, Weak Force, binding energy, half-life, radioactive decay, protons, neutrons, fission, fusion, leptons, hadrons, mesons, baryons, neutrinos, quarks, antimatter</p>