PLANNED INSTRUCTION

A PLANNED COURSE FOR:

Physics

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Curriculum writing committee:

S. Rhule

Grade Level: 11/12

Date of Board Approval: _____2021___

Course Weighting: Physics

Category	Frequency	Weight
Major Assessments	**(≈2 per marking period)**	**45%**
Skills Application	**(≈6 per marking period)**	**30%**
Skills Practice	**(≈7 per marking period)**	**20%**
Participation	**(≈10 per marking period)**	**5%**
	Total	**100%**

Curriculum Map

Overview:
This course is structured to investigate the evolution of the Universe from the big bang to the present. The forces between matter and the energy possessed by matter will be studied on a theoretical and mathematical basis. Emphasis is on mathematical models used to describe motion, energy, forces, light, waves, sound, heat, elementary particles, and electricity & magnetism. Laboratory experiments are designed to test the mathematical models associated with established physical laws.

Time/Credit for the Course:

- FULL YEAR/ 1 SCIENCE CREDIT.

Goals:

Marking Period One

Unit 1: Energy

- The energy of a closed system may be analyzed mathematically.
- The position and velocity of an object or interacting objects can be represented and quantified in terms of its kinetic energy and potential energy.
- Forces may change energy by doing work.
- Energy may be exchanged between objects.
- Energy may be transformed from one type to another.
- The total amount of energy in a closed system is conserved.
- In every transformation of energy from one form to another, some of the energy is converted into thermal energy.

Unit 2: Light

- Electromagnetic waves are described in terms of wavelength, amplitude, velocity, and frequency.
- Electromagnetic waves are produced by the motion of electrically charged particles.
- Electromagnetic waves interact with matter.
- Electromagnetic waves in the form of visible light may reflect at the boundary between different media.
- Electromagnetic waves in the form of visible light may refract at the boundary

between different media.
- Refraction of visible light by a thin lens may produce a focused image on a screen.

Marking Period Two

Unit 3: Atomic & Nuclear

- Quarks and Leptons are the fundamental particles in the Universe.
- Protons and neutrons are composed of up quarks and down quarks.
- Atoms are composed of protons, neutrons and electrons.
- Fundamental particles and atoms are subject to the strong nuclear force, weak nuclear force, electromagnetic force, and gravitational force.
- Atomic nuclei are governed by the strong nuclear force and the electromagnetic force.
- Larger nuclei are unstable and undergo radioactive decay.
- Nuclear fission and fusion may release energy.

Unit 4: Gravity

- The evolution of gravitational models may be traced from the ancient Greeks through the beginning of western European science to Newton.
- Newton's Law of Universal Gravitation describes the gravitational force between two objects with mass.
- Kepler's Laws of Planetary Motion describe the motion of planets about the Sun.
- Satellite orbits may be analyzed using Newton's Law.
- Nuclear fusion and gravity determine the evolution of a star.
- Einstein's theory of general relativity describes the effect of mass on space and time.

Marking Period Three

Unit 5: Electricity & Magnetism

- There are two types of electric charge.
- Electric charge is conserved in the Universe.
- Electric charge is quantized in units of the fundamental charge of an electron.
- Materials may be classified as conductors, insulators, semiconductors, or superconductors depending on their ability to resist motion of charge.
- Electric charge affects the surrounding space in the form of an electric field.
- Electric fields exert forces on electric charges.
- Coulomb's Law describes the force between a pair of point charges.
- Simple series and parallel electrical circuits may be analyzed with mathematical models involving potential, current, and resistance.
- Magnetism results from electric charge in motion.
- Magnetic fields exert a force on a moving charge.
- Electric motors and generators involve the motion of electric charge in a magnetic field.
- Faraday's Law of Electromagnetic Induction describes the creation of electrical energy.
- Maxwell's Equations describe electromagnetic waves.

Unit 6: Motion

- Newton's Laws of Motion may be used to describe the characteristics of linear motion, circular motion, projectile motion and angular motion.
- Objects that move in translational motion are described in terms of position, velocity, and acceleration.
- All changes in translational motion are due to forces.
- When two surfaces of objects are in contact with each other, the force of friction between them depends on the nature of the materials in contact and the normal force. Impulse changes momentum.
- Vectors represent physical quantities described by both a direction and a magnitude and are manipulated according to specific mathematical rules.
- Vectors allow the separation of both motion and forces into horizontal and vertical components for the purposes of mathematical analysis.
- Impulse changes momentum.
- The Law of Conservation of Momentum may be used to analyze events occurring in isolated systems.
- The rotational motion of objects is described in terms of angular position, angular velocity, and angular acceleration.
- All changes in rotational motion are due to torques.
- The Law of Conservation of Angular Momentum may be used to analyze events occurring in isolated systems.
- Angular momentum conservation describes the angular motion observed throughout the Universe.

Marking Period Four

Unit 7: Special Relativity

- Einstein postulated that the speed of light in a vacuum is measured to be the same numerical value regardless of the motion of the source of the light and/or the observer of that light.
- The measurement of time by an observer depends on the motion of the observer relative to observers in other frames of reference.
- The measurement of length by an observer depends on the motion of the observer relative to observers in other frames of reference.
- The measurement of mass by an observer depends on the motion of the observer relative to observers in other frames of reference.
- Einstein described the equivalence of rest mass and energy.

Unit 8: Sound

- The waves produced by objects in simple harmonic motion interact with other waves and matter and result in the phenomena of wave superposition, interference, reflection, refraction, and resonance.
- A longitudinal wave model may be used to describe the characteristics of sound waves.
- Resonance is a wave phenomenon illustrating constructive interference.

Unit 9: Thermodynamics

- Specific heat capacity describes the temperature change of a substance when thermal energy is transferred.
- Latent heat describes the phase change of a substance when thermal energy is

transferred.
- Thermal energy may transfer between materials with different temperatures.
- Thermal energy is transferred between atoms by conduction, convection, and radiation.
- Phase changes occur at constant temperatures.
- Entropy describes the disorder of a system.
- Entropy increases in a natural process.

Big Ideas:

Unit 1
- Energy is conserved in the Universe.

Unit 2
- Electromagnetic waves transfer energy.

Unit 3
- Matter is composed of atoms.
- Atoms consist of a positively charged nucleus surrounded by negatively charged electrons.
- Nuclear reactions involve the mass-energy relationship discovered by Einstein.

Unit 4
- Mass is a basic property of matter possessed by some elementary particles.
- Mass determines how a particle interacts with space and time.
- The Newtonian gravity model describes the interaction of mass with space-time as a force.

Unit 5
- Electric charge is a basic property of some elementary particles.
- Electric charge determines how a particle is affected by electric fields and/or magnetic fields.

Unit 6
- Inertia is the resistance of mass to linear acceleration.
- Rotational inertia is the resistance of mass to angular acceleration.
- A net external force on a mass produces an acceleration of that mass.
- Momentum is conserved in systems with no net external force.
- Angular momentum is conserved in systems with no net external torque.

Unit 7
- Time is relative.
- Mass is a form of energy.

Unit 8
- Waves transfer energy.
- Sound is a longitudinal wave traveling through atoms.

Unit 9
- The Universe evolves in a direction of increasing entropy as described by the Second Law of Thermodynamics.

Textbook and Supplemental Resources:

- Conceptual Physics: The High School Physics Program
  ISBN: 978-0133647495
- Concept-Development Practice Book
  Conceptual Physics: The High School Physics Program
  ISBN: 978-0133647303
- Laboratory Manual
  Conceptual Physics: The High School Physics Program
  ISBN: 978-0130542571

Curriculum Plan

Unit 1: Energy **Time/Days:** 22

Standards:

PA Academic Standards: 3.2.10.B2, 3.2.10.B3, 3.2.C.B3, 3.2.P.B2, 3.2.12.B2.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,
S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,
S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,
S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3, S11.C.2.1.2,
S11.C.2.1.3, S11.C.2.2.1, S11.C.2.2.2, S11.C.2.2.3, S11.C.3.1.2, S11.C.3.1.3, S11.C.3.1.4, S11.C.3.1.5, S11.C.3.1.6

Eligible Content:

- Energy
- Work
- Power
- Conservation of Energy
- Simple Machines
- Efficiency

Objectives:

- Determine the amount of work done, given force and displacement. (DOK –2)
- Determine power, given work and time. (DOK – Level 2)
- Define energy in terms of work. (DOK – Level 1)
- Distinguish among mechanical energy, potential energy, and kinetic energy. (DOK – Level 1)
- Give examples of changes in potential energy. (DOK – Level 2)
- Describe the relationship between speed and kinetic energy. (DOK – Level 3)
- Describe the relationship between mass and energy. (DOK – Level 3)
- State the Law of Conservation of Energy. (DOK – Level 1)
- Define a simple machine and describe how it may change a force or a displacement. (DOK – Level 3)
- List the types of simple machines. (DOK – Level 1)
- Apply conservation of energy to a simple machine. (DOK – Level 4)
- Define ideal mechanical advantage (IMA) and use it to predict how a given machine will multiply a force or a displacement. (DOK – Level 2)
- Define actual mechanical advantage (AMA). (DOK – Level 1)
- Define efficiency and explain how friction and heat are involved in the difference between IMA and AMA. (DOK – Level 2)
- Explain how a compound machine may be constructed from combinations of simple machines. (DOK – Level 4)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts and test models
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 8-1, 8-2, 9-1, 9-2 & 9-3.
- Laboratory Manual Experiments: 21, 23, 24 & 26.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 2: Light **Time/Days:** 23

Standards:

PA Academic Standards: 3.2.10.B5, 3.2.P.B5, 3.2.12.B5.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,

S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,

S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,

S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3, S11.C.2.1.1

Eligible Content:

- Light
- Color
- Reflection and Refraction
- Lenses
- Diffraction and Interference

Objectives:

- Describe the particle-like properties of light. (DOK – Level 2)
- Describe the wave-like properties of light. (DOK – Level 2)
- Explain why it is much more difficult to measure the speed of light than the speed of sound. (DOK – Level 4)
- Describe the relation between light, radio, waves, microwaves, and x-rays. (DOK – Level 2)
- Know the properties of photons. (DOK – Level 2)
- Relate the energy of a photon to its wavelength or frequency. (DOK – Level 2)
- Explain what happens to light when it enters a substance and how the light frequency affects what happens. (DOK – Level 3)
- Explain Planck's quanta of light. (DOK – Level 2)
- Explain deBroglie wavelength of matter. (DOK – Level 3)
- Describe the wave-like properties of electrons. (DOK – Level 2)
- Understand the photoelectric effect. (DOK – Level 2)
- Give evidence to show that light waves are transverse. (DOK – Level 3)
- Explain why polarized sunglasses are helpful in cutting the glare of the Sun from horizontal surfaces such as water and roads. (DOK – Level 3)
- Explain why white and black are not colors in the sense that red, blue, and green are colors. (DOK – Level 4)
- Describe why the interaction of light with atoms or molecules of a material depends on the frequency of the light. (DOK – Level 4)
- Describe the factors that determine whether a material will reflect, transmit, or

absorb light of a particular color. (DOK – Level 4)
- Explain how color television screens are able to use only red, green, and blue pixels to display pictures in full color. (DOK – Level 3)
- Define complementary colors and give examples of primary and complementary pairs. (DOK – Level 1)
- Distinguish between color by addition and color by subtraction. (DOK – Level 2)
- Explain what the lines in a spectrum represent and how such a spectrum can be used to identify the presence of an element. (DOK – Level 3)
- Explain why the sky is blue, sunsets are red, and water is green-blue. (DOK -3)
- Distinguish between what happens to light when it strikes a metal surface and when it strikes a glass of water. (DOK – Level 2)
- Given the direction of an incident ray of light, predict the path of the reflected ray. (DOK – Level 2)
- Explain why the image formed by a mirror is a virtual image. (DOK – Level 2)
- Describe the conditions for diffuse reflection. (DOK – Level 2)
- Give examples of refraction of light and its effects. (DOK – Level 2)
- Explain how a prism separates white light into colors. (DOK – Level 3)
- Describe the conditions for the formation of a rainbow. (DOK – Level 3)
- Describe the process of total internal reflection. (DOK – Level 3)
- Solve numerical problems involving reflection and refraction. (DOK – Level 3)
- Distinguish between a converging and a diverging lens. (DOK – Level 2)
- Distinguish between a real image and a virtual image formed by a lens. (DOK –2)
- Given the focal length of a converging or diverging lens and the position of an object, construct a ray-tracing diagram that shows the position of the image. (DOK – Level 3)
- Give examples of how some optical instruments use lenses. (DOK – Level 2)
- Explain how the human eye focuses light. (DOK – Level 3)
- Give examples of aberrations in lenses. (DOK – Level 2)
- Solve numerical problems involving the position and size of objects and images. (DOK – Level 3)
- Explain why water waves have curved wave fronts after passing through a narrow opening. (DOK – Level 3)
- Describe the conditions necessary for visible diffraction of waves. (DOK – Level 3)
- Describe the conditions necessary for visible bright and dark fringes of light caused by interference. (DOK – Level 3)
- Explain what causes the bright and dark bands that appear when monochromatic light is reflected from a thin material. (DOK – Level 3)
- Explain what causes the colors that shine from soap bubbles and gasoline slicks on a wet surface. (DOK – Level 3)
- Distinguish between light from a laser and light from a lamp. (DOK – Level 2)
- Distinguish between a hologram and a photograph. (DOK – Level 2)
- Solve numerical problems involving diffraction and interference. (DOK – Level 3)
- Describe the conditions for beats. (DOK – Level 2)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction

- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts and test models
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 27-1, 27-2, 28-1, 29-1, 29-2, 29-3, 29-4, 29-5, 30-1, 30-2 & 31-1.
- Laboratory Manual Experiments: 71, 72, 75, 80 & 85.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 3: Atomic & Nuclear **Time/Days:** 22

Standards:

PA Academic Standards: 3.2.12.A2, 3.2.C.A3, 3.2.12.A3, 3.2.10.A5, 3.2.C.A5.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,

S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,

S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,

S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3

Eligible Content:

- The Atom and the Quantum
- The Atomic Nature of Matter
- The Atomic Nucleus and Radioactivity
- Nuclear Fission and Fusion

Objectives:

- Understand the Rutherford scattering experiment and be able to explain how it provides evidence for the existence of the atomic nucleus. (DOK – Level 4)
- Understand the concept of energy levels for atoms. (DOK – Level 2)
- Qualitatively explain the origin of emission or absorption spectra of gases. (DOK – Level 3)
- Describe the Bohr model for the hydrogen atom. (DOK – Level 2)
- State the contents of the nucleus of an atom. (DOK – Level 1)
- Define atomic number. (DOK – Level 1)
- Define mass number. (DOK – Level 1)
- Describe the relationship between neutron number and isotope. (DOK – Level 2)
- Distinguish between atomic number and mass number. (DOK – Level 2)
- Explain how the number of protons in an atomic nucleus determines the element. (DOK – Level 3)
- Explain how the strong nuclear force varies with distance. (DOK – Level 3)
- Describe the cause of the instability of larger nuclei. (DOK – Level 2)
- Distinguish between the three types of radioactive decay. (DOK – Level 2)
- Describe the penetrating power of alpha, beta, and gamma radiation. (DOK –2)
- Compare the relative sizes of the atoms of different elements. (DOK – Level 2
- Interpret the uncertainty in measurements described by quantum mechanics. (DOK – Level 4)
- Analyze the neutron number vs. proton number graph and use it to evaluate nuclear stability. (DOK – Level 4)
- Analyze the binding energy/nucleon vs. mass number graph and use it to predict fusion or fission. (DOK – Level 4)

- Interpret radioactive decay equations. (DOK – Level 3)
- Interpret nuclear reaction equations. (DOK – Level 3)
- Define half-life of a radioactive element. (DOK – Level 1)
- Solve numerical problems involving radioactive decay. (DOK – Level 3)
- Describe natural transmutation of elements. (DOK – Level 2)
- Diagram the decay of uranium-238 to lead-206. (DOK – Level 2)
- Describe artificial transmutation of elements. (DOK – Level 2)
- Explain how carbon-14 is used to date organisms that were once alive. (DOK –3)
- Describe the limitations of carbon-14 dating and the uncertainty in dates determined by it. (DOK – Level 4)
- Explain how uranium is used to date older, but non-living, materials. (DOK – 3)
- Describe the use of radioactive isotopes in agriculture, medicine, and engineering. (DOK – Level 3)
- Describe the radiation that we are all exposed to everyday. (DOK – Level 2)
- Describe the nuclear fission process. (DOK – Level 2)
- Identify and describe the main components of a fission reactor. (DOK – Level 2)
- Describe the nuclear fusion process. (DOK – Level 2)
- State some of the problems in controlling nuclear fusion in a laboratory. (DOK -1)
- Explain how a fusion bomb operates. (DOK – Level 4)
- Explain how a fission bomb operates. (DOK – Level 4)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts and test models
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 38-1, 39-1, 39-2 & 40-1.
- Laboratory Manual Experiments: 97, 98 & 99.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups

- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 4: Gravity **Time/Days:** 23

Standards:

PA Academic Standards: 3.2.P.B1, 3.2.P.B2, 3.2.P.B6, 3.2.10.B1, 3.3.10.B1, 3.3.10.B2, 3.3.12.B1, 3.3.12.B2.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,
S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,
S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,
S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3, S11.D.3.1.1,
S11.D.3.1.2, S11.D.3.1.3

Eligible Content:

- Universal Gravitation
- Satellite Motion
- General Relativity
- Stellar Evolution

Objectives:

- Understand Newton's Law of Universal Gravitation. (DOK – Level 2)
- Determine the force that one spherically symmetrical mass exerts on another. (DOK – Level 3)
- Determine the strength of the gravitational field at a given point inside a spherically symmetrical mass. (DOK – Level 3)
- Determine the strength of the gravitational field at a given point outside a spherically symmetrical mass. (DOK – Level 3)
- Understand the motion of a body in orbit under the influence of gravitational forces. (DOK – Level 2)
- Recognize that the motion of a body in orbit under the influence of gravitational forces does not depend on the body's mass. (DOK – Level 1)
- Describe qualitatively how the velocity, period of revolution, and centripetal acceleration depend on the radius of the orbit. (DOK – Level 4)
- Derive expressions for the velocity and period of revolution in an orbit. (DOK – 4)
- Apply conservation of angular momentum to determine the velocity and radial distance at any point in the orbit. (DOK – Level 4)
- Apply conservation of angular momentum and energy conservation to relate the speeds of a body at the two extremes of an elliptical orbit. (DOK – Level 4)
- Solve problems involving universal gravitation. (DOK – Level 3)
- Describe the general effect of a large mass on space and time. (DOK – Level 3)
- Describe the state of the universe at the time of the big bang. (DOK – Level 3)

- Describe the expansion of the universe since the time of the big bang. (DOK –3)
- Predict the future of the universe based on principles involving energy and gravity. (DOK – Level 3)
- Describe the fundamental and unifying ideas underlying string theory. (DOK –3)
- Explain Newton's idea that the Moon falls toward the Earth like an apple does. (DOK – Level 4)
- Explain why the Moon does not fall into the Earth and the planets do not fall into the Sun. (DOK – Level 3)
- State Newton's law of universal gravitation. (DOK – Level 1)
- Explain the inverse-square law relationship between distance and gravitational force. (DOK – Level 3)
- Explain why an astronaut in Earth orbit is apparently weightless but not weightless. (DOK – Level 3)
- Explain how the speed of a satellite in a circular orbit around the Earth is related to the distance an object falls from rest in one second due to gravity. (DOK – 4)
- Explain why gravity does not cause a change in the speed of a satellite in circular orbit. (DOK – Level 4)
- Solve numerical problems involving satellite motion. (DOK – Level 3)
- Apply conservation of energy to describe changes in the potential and kinetic energies of a satellite in circular and elliptical orbits. (DOK – Level 3)
- Explain why the speed of a satellite in a circular orbit is constant. (DOK – Level 3)
- Explain why the speed of a satellite in an elliptical orbit varies. (DOK – Level 3)
- Write the hydrogen fusion reaction occurring in a main sequence star. (DOK – 2)
- Describe the conversion of mass to energy during stellar fusion. (DOK – Level 2)
- Understand the successive fusion process from Hydrogen to Iron. (DOK – Level 2)
- State the conditions for a star to become a black hole. (DOK – Level 1)
- Define the event horizon of a black hole. (DOK – Level 1)
- Describe space and time near a black hole. (DOK – Level 3)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts and test models
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 13-1, 13-2, 13-3, 13-4 & 14-1.
- Laboratory Manual Experiments: 36, 37, 38 & 39.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 5: Electricity & Magnetism **Time/Days:** 22

41000000018750

Standards:

PA Academic Standards: 3.2.P.B2, 3.2.10.B4, 3.2.P.B4, 3.2.12.B4.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,
S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,
S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,
S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3, S11.C.2.1.1,
S11.C.3.1.4

Eligible Content:

- Electric Charge
- Electric Fields and Potential
- Electric Current
- Electric Circuits
- Magnetism
- Magnetic Force on a Moving Charge
- Electromagnetic Induction

Objectives:

- Explain how an object becomes positively charged, negatively charged, or not charged by electron transfer. (DOK – Level 2)
- Describe electrical forces between charged objects. (DOK – Level 2)
- Describe the relationship between the electrical force between a pair of point charges and the magnitude of those two point charges. (DOK – Level 2)
- Describe the relationship between the electrical force between a pair of point charges and the distance between those two point charges. (DOK – Level 2)
- Compare the strength of electrical force and that of gravitational force between two charged objects. (DOK – Level 3)
- Distinguish between a conductor and an insulator. (DOK – Level 2)
- Describe how an insulator can be charged by friction. (DOK – Level 2)
- Describe how a conductor can be charged by contact. (DOK – Level 2)
- Describe how a conductor can be charged by induction. (DOK – Level 2)
- Describe how an insulator can be charged by polarization. (DOK – Level 2)
- Solve numerical problems in electrostatics. (DOK – Level 3)
- Describe how the intensity of an electric field at two different points can be

compared. (DOK – Level 3)

- Describe how the direction of an electric field at a point is determined. (DOK – 3)
- Relate the spacing of electric field lines to the intensity of the electric field. (DOK – Level 2)
- Explain why a charged object in an electric field is considered to have electric potential energy. (DOK – Level 3)
- Describe the purpose of a Van de Graaff generator. (DOK – Level 2)
- Describe the conditions necessary for electric charge to flow. (DOK – Level 2)
- Describe what is happening inside a current carrying wire and explain why there is no net charge in the wire. (DOK – Level 3)
- Give examples of voltage sources that can maintain a potential difference in an electric circuit. (DOK – Level 1)
- Describe the factors that determine the resistance of a wire. (DOK – Level 2)
- Relate the current in a circuit to the resistance of the circuit and the voltage across it. (DOK – Level 2)
- Distinguish between direct current and alternating current. (DOK – Level 2)
- Distinguish between drift speed of conduction electrons in a current carrying wire and speed of energy transport. (DOK – Level 2)
- Relate the power used by an electrical device to its current and voltage. (DOK –2)
- Solve numerical problems involving electric current. (DOK – Level 3)
- Given a diagram of a battery and a bulb connected by wire, determine whether current will pass through the bulb. (DOK – Level 2)
- Distinguish between series circuits and parallel circuits. (DOK – Level 2)
- Predict what will happen in a series circuit if there is a break in the wire. (DOK -3)
- Relate the current at any point in a series circuit to the current at any other point in the circuit. (DOK – Level 3)
- Predict what will happen to the current at any point in a series circuit if an additional device is connected to the circuit. (DOK – Level 4)
- Predict what will happen in a parallel circuit if there is a break in any branch of the circuit. (DOK – Level 3)
- Relate the current in the lead to a parallel circuit to the current in each branch of the circuit. (DOK – Level 3)
- Predict what will happen to the current at any point in a parallel circuit if an additional device is connected to the circuit. (DOK – Level 4)
- Interpret a simple schematic diagram of a circuit. (DOK – Level 2)
- Given a circuit with two or more devices of equal resistance with some devices connected in series and some connected in parallel, determine the equivalent single resistance of the circuit. (DOK – Level 4)
- Explain the cause of overloading household circuits and how to prevent it from happening. (DOK – Level 4)
- Describe the differences and similarities between magnetic poles and electric charges. (DOK – Level 2)
- Interpret the strength of a magnetic field at different points near a magnet by using the pattern formed by iron filings. (DOK – Level 2)
- Relate the motion of electrons within a material to the ability of the material to become a magnet. (DOK – Level 2)

- Describe what happens to the magnetic domains of iron in the presence of a strong magnet. (DOK – Level 2)
- Explain why magnets lose their magnetism when dropped or heated. (DOK –3)
- Describe the magnetic field produced by a current-carrying wire and give examples of how it can be made stronger. (DOK – Level 4)
- Describe the conditions necessary for a magnetic field to exert a force on a charged particle in that field. (DOK – Level 3)
- Describe some practical applications of a magnetic field exerting a force on a current-carrying wire. (DOK – Level 4)
- Suggest possible causes for the Earth's magnetic field. (DOK – Level 4)
- Describe how voltage is induced in a coil of wire. (DOK – Level 3)
- Relate the induced voltage in a coil to the number of loops in the coil and the rate of change of external magnetic field intensity through the loops. (DOK – 2)
- Describe a generator and explain how it works. (DOK – Level 3)
- Compare and contrast the motor effect and the generator effect. (DOK – Level 2)
- Describe a transformer and explain how it works. (DOK – Level 3)
- Explain why transformers are used for transmission of electric power. (DOK –4)
- Relate the magnitude and direction of an induced electric field to the inducing magnetic field. (DOK – Level 2)
- Relate the magnitude and direction of an induced magnetic field to the inducing electric field. (DOK – Level 2)
- Explain how the electric and magnetic fields of an electromagnetic wave regenerate each other so that the wave pattern moves outward through space. (DOK – Level 3)
- Solve numerical problems involving electromagnetic induction. (DOK – Level 3)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts, such as Newton's Second Law experiment, Newton's Third Law experiment, Vector Addition experiment, Projectile Motion experiment
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 32-1, 32-2, 33-1, 33-2, 34-1, 34-2, 35-1, 35-2, 35-3, 36-1, 37-1 &
  37-2.
- Laboratory Manual Experiments: 86, 87, 88, 89, 90, 93 & 94.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 6: Motion **Time/Days:** 23

Standards:

PA Academic Standards: 3.2.10.B1, 3.2.P.B1, 3.2.P.B2, 3.2.P.B6, 3.2.12.B1, 3.2.12.B2.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,
S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,
S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,
S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3, S11.C.3.1.1,
S11.C.3.1.2, S11.C.3.1.3, S11.C.3.1.4, S11.C.3.1.5, S11.C.3.1.6

Eligible Content:

- Mechanical Equilibrium
- Linear Motion
- Projectile Motion
- Vectors and components of vectors
- Newton's First Law of Motion
- Newton's Second Law of Motion
- Newton's Third Law of Motion
- Frictional forces
- Force and Momentum
- Uniform Circular Motion
- Rotational Equilibrium
- Rotational Motion
- Torque and Angular Momentum

Objectives:

- Explain the idea that motion is relative. (DOK – Level 2)
- Define speed and velocity and distinguish between the two. (DOK – Level 2)
- Determine when a velocity is changing. (DOK – Level 1)
- Define acceleration. (DOK – Level 1)
- Solve one dimensional motion problems. (DOK – Level 3)
- Describe Aristotle's concepts of natural motion and violent action. (DOK -Level 1)
- Describe Copernicus' idea about the Earth's motion. (DOK – Level 1)
- Describe Galileo's contribution to the science of motion. (DOK – Level 1)
- Define inertia. (DOK – Level 1)
- State Newton's First Law of Motion. (DOK – Level 1)
- Distinguish among mass, volume, and weight. (DOK – Level 2)
- Explain how an object not connected to the ground can keep up with the moving Earth. (DOK – Level 3)

- Define net external force. (DOK – Level 1)
- State and explain the relationship between acceleration and net external force. (DOK – Level 2)
- State and explain the relationship between acceleration and mass. (DOK –2)
- Distinguish between the concepts of directly proportional and inversely proportional. (DOK – Level 2)
- State Newton's Second Law of Motion. (DOK – Level 1)
- Describe the effect of friction on a stationary object and on a moving object. (DOK – Level 2)
- Distinguish between force and pressure. (DOK – Level 2)
- Solve numerical problems involving Newton's Second Law. (DOK – Level 3)
- Explain why at least two objects are involved whenever a force acts. (DOK –2)
- State Newton's Third Law of Motion. (DOK – Level 1)
- Identify a reaction force when given an action force. (DOK – Level 1)
- Explain why the accelerations caused by an action force and by a reaction force do not have to be equal. (DOK – Level 4)
- Explain why an action force is not cancelled by its reaction force. (DOK – Level 4)
- Distinguish between a vector quantity and a scalar quantity, and give examples of each. (DOK – Level 2)
- Draw vector diagrams of forces and velocities. (DOK – Level 4)
- Explain the relationship between tension in a nearly horizontal wire and the angle between that wire and the horizontal. (DOK – Level 3)
- Resolve a given vector into components and find the vector represented by given components. (DOK – Level 3)
- Given two or more vectors, add them. (DOK – Level 4)
- Describe the motion of an object in free fall from rest. (DOK – Level 3)
- Describe the motion of an object thrown straight up until it returns and hits the ground, when air resistance is negligible. (DOK – Level 3)
- Determine the speed and distance an object falls at any time after it is dropped from rest. (DOK – Level 3)
- Describe how air resistance affects the motion of falling objects. (DOK – Level 2)
- Apply Newton’s second law to explain why the acceleration of an object in free fall does not depend on the mass of the object. (DOK – Level 4)
- Describe what happens to the acceleration and the velocity of a falling object when there is air resistance. (DOK – Level 2)
- Identify the reaction force to the action of the Earth’s gravity on a falling object. (DOK – Level 1)
- Compare the motion of an object which is rolled off a horizontal table to that of an object dropped from rest at the same time. (DOK – Level 3)
- Describe the changes in the horizontal and vertical components of the velocity of a projectile. (DOK – Level 2)
- Define momentum. (DOK – Level 1)
- Define impulse and relate it to change in momentum. (DOK – Level 2)
- Explain the relationship between force, time and change in momentum during a collision. (DOK – Level 3)
- Explain why impulses are greater when an object bounces during a collision than when the object simply stops. (DOK – Level 3)
- State the Law of Conservation of Momentum and explain its vector nature. (DOK –

Level 3)
- Distinguish between elastic and inelastic collisions. (DOK – Level 2)
- Solve conservation of momentum problems. (DOK – Level 3)
- Describe center of gravity. (DOK – Level 1)
- Distinguish among stable equilibrium, unstable equilibrium, and neutral equilibrium. (DOK – Level 2)
- Give examples of how a human is affected by the need to keep the body's center of gravity over the support base. (DOK – Level 2)
- Given the location of the center of gravity and the area of support of an object, predict whether the object will topple. (DOK – Level 2)
- Define torque and describe what it depends on. (DOK – Level 2)
- Describe the conditions for one torque to balance another. (DOK – Level 2)
- Given the location of the center of gravity of an object and the position and direction of the forces on it, tell whether the forces will produce rotation. (DOK – Level 3)
- Describe what the rotational inertia of an object depends on. (DOK – Level 3)
- Define angular momentum and describe the conditions under which it; (i) changes, (ii) remains constant. (DOK – Level 4)
- Give an example of a situation in which rotational speed changes but angular momentum does not. (DOK – Level 2)
- Solve numerical problems involving rotational mechanics. (DOK – Level 3)
- Distinguish between rotation and revolution. (DOK – Level 2)
- Distinguish between linear speed and rotational speed, and explain what each depends on. (DOK – Level 2)
- Give examples of centripetal force. (DOK – Level 2)
- Describe the resulting motion of an object if the centripetal force acting on it ceases. (DOK – Level 3)
- Explain how inertia, rather than an outward directed force, is responsible for the tendency of a rotating object to move toward the outside of its circular path. (DOK – Level 4)
- Describe how a simulated gravitational acceleration could be produced in a rotating space station. (DOK – Level 3)
- Solve numerical problems involving rotational speed, acceleration, and centripetal force. (DOK – Level 4)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities

- Collect data in lab situations to model concepts, such as Newton's Second Law experiment, Newton's Third Law experiment, Vector Addition experiment, Projectile Motion experiment
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 2-1, 3-1, 4-1, 5-1, 6-1, 7-1, 8-1.
- Laboratory Manual Experiments: 4, 11, 19.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 7: Special Relativity **Time/Days:** 5

Standards:

PA Academic Standards: 3.2.12.A3.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,
S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,
S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,
S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2, S11.A.3.3.3, S11.C.3.1.3

Eligible Content:

- Michelson-Morley Experiment
- Space-Time
- First Postulate of Special Relativity
- Second Postulate of Special Relativity
- Time Dilation
- Twin Paradox
- Length Contraction
- Mass Increase
- Mass-Energy Equivalence

Objectives:

- Explain the idea that time is relative. (DOK – Level 2)
- Describe the null result of the Michelson-Morley experiment. (DOK – Level 1)
- Define space-time. (DOK – Level 1)
- State Einstein's First Postulate of Special Relativity. (DOK – Level 1)
- State Einstein's Second Postulate of Special Relativity. (DOK – Level 1)
- Solve numerical problems involving Einstein’s time dilation equation. (DOK – Level 3)
- Describe relativistic length contraction. (DOK – Level 1)
- Describe relativistic mass increase. (DOK – Level 1)
- Solve numerical problems involving Einstein’s mass-energy equivalence equation. (DOK – Level 3)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions

- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts, such as Newton's Second Law experiment, Newton's Third Law experiment, Vector Addition experiment, Projectile Motion experiment
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 15-1, 15-2 & 16-1.
- Laboratory Manual Experiments: 86, 87, 88, 89, 90, 93 & 94.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 8: Sound **Time/Days:** 20

Standards:

PA Academic Standards: 3.2.P.B1, 3.2.P.B2, 3.2.10.B5, 3.2.P.B5, 3.2.12.B5.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,

S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,

S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,

S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3

Eligible Content:

- Waves
- Sound
- Speed of Sound
- Decibel Scale
- Resonance

Objectives:

- Relate a drawing of a sine curve to the crest, trough, amplitude, and wavelength of a wave. (DOK – Level 2)
- Describe the relation between the frequency and the period of a wave. (DOK – 2)
- Describe what it is that travels when a wave moves outward from a vibrating source. (DOK – Level 2)
- Describe what affects the speed of a wave in a given medium. (DOK – Level 2)
- Distinguish between a transverse wave and a longitudinal wave. (DOK – Level 2)
- Distinguish between constructive and destructive interference. (DOK – Level 2)
- Define a standing wave and explain how it occurs. (DOK – Level 2)
- Describe the Doppler Effect for sound and relate it to the blue and red shifts for light. (DOK – Level 4)
- Solve numerical problems involving the motion of waves. (DOK – Level 3)
- Relate the pitch of a sound to its frequency. (DOK – Level 2)
- Describe what happens to air when sound moves through it. (DOK – Level 3)
- Compare the transmission of sound through air with its transmission through solids, liquids, and a vacuum. (DOK – Level 3)
- Describe factors that affect the speed of sound. (DOK – Level 2)
- Give an example of forced vibration. (DOK – Level 2)
- Describe the conditions for resonance. (DOK – Level 2)
- Give examples of ways to control reflected sound. (DOK – Level 2)
- Explain the change in direction of a water wave when it crosses a boundary between deep and shallow water. (DOK – Level 3)
- Give examples of refraction of sound and its effects. (DOK – Level 2)

- Describe the conditions for beats. (DOK – Level 2)
- Solve numerical problems involving sound. (DOK – Level 3)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts, such as Newton's Second Law experiment, Newton's Third Law experiment, Vector Addition experiment, Projectile Motion experiment
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 25-1, 25-2, 25-3 & 26-1.
- Laboratory Manual Experiments: 66, 67, 68 & 69.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Curriculum Plan

Unit 9: Thermodynamics **Time/Days:** 20

Standards:

PA Academic Standards: 3.2.P.B3, 3.2.10.A3, 3.2.C.A3, 3.2.12.A3, 3.2.10.B3, 3.2.C.B3, 3.3.12.A6.

Anchors:

Grade 11 Science Alternate Eligible Content Assessment Anchor: S11.A.1.1.1, S11.A.1.1.2, S11.A.1.1.3,
S11.A.1.1.4, S11.A.1.1.5, S11.A.1.2.1, S11.A.1.2.2, S11.A.1.3.1, S11.A.1.3.2, S11.A.2.1.1, S11.A.2.1.2,
S11.A.2.1.3, S11.A.2.1.4, S11.A.2.1.5, S11.A.2.2.1, S11.A.2.2.2, S11.A.3.1.1, S11.A.3.1.2, S11.A.3.1.3,
S11.A.3.1.4, S11.A.3.2.1, S11.A.3.2.2, S11.A.3.2.3, S11.A.3.3.1, S11.A.3.3.2,S11.A.3.3.3

Eligible Content:

- Temperature, Heat, and Expansion
- Heat Transfer
- Solids
- Liquids
- Gases
- Change of Phase
- Thermodynamics

Objectives:

- Define temperature and explain how it is measured. (DOK – Level 1)
- Describe the relationship between temperature and kinetic energy. (DOK –2)
- Define heat and explain why it is incorrect to think of matter as containing heat. (DOK – Level 3)
- Describe what determines if heat will flow into or out of a substance. (DOK –2)
- Distinguish between internal energy and heat. (DOK – Level 2)
- Compare the specific heat capacity of different substances, given the relative amounts of energy required to raise the temperature of a given mass by a given amount. (DOK – Level 2)
- Give examples of how the high specific heat capacity of water affects climate. (DOK – Level 2)
- Give examples of the expansion of solids as they become warmer. (DOK –2)
- Explain the function of a bimetallic coil in a thermostat. (DOK – Level 4)
- Compare the thermal expansion of liquids to solids. (DOK – Level 2)
- Describe the unusual behavior of water as it is heated from –5°C to 10°C. (DOK – Level 2)
- Explain why water at certain temperatures contracts as it becomes warmer. (DOK – Level 4)
- Explain why two materials at the same temperature may not feel like they are at the same temperature when touched. (DOK – Level 3)

- Explain how quarks combine to form protons and neutrons. (DOK – Level 3)
- Explain how protons, neutrons, and electrons form atoms. (DOK – Level 3)
- Describe how proton number determines element. (DOK – Level 2)
- Describe how neutron number determines isotope. (DOK – Level 2)
- Describe how electron number determines chemistry. (DOK – Level 2)
- Relate temperature to average kinetic energy per atom. (DOK – Level 2)
- Use the kinetic theory of matter to distinguish between solid, liquid, and gaseous phases of matter. (DOK – Level 3)
- Use scaling to describe surface area to volume ratio and consequences for cells, animals, buildings, etc. (DOK – Level 3)
- Relate pressure in a fluid to depth. (DOK – Level 2)
- Describe how buoyancy results from pressure differences. (DOK – Level 2)
- State Archimedes' principle. (DOK – Level 1)
- State Pascal's principle. (DOK – Level 1)
- Describe the variation of atmospheric pressure with altitude. (DOK – Level 2)
- State Bernoulli's principle. (DOK – Level 1)
- Describe the relationship between atoms and elements. (DOK – Level 2)
- Give examples that illustrate the small size of atoms. (DOK – Level 1)
- Cite evidence for the existence of atoms. (DOK – Level 3)
- Distinguish between an atom and a molecule. (DOK – Level 2)
- Identify the three basic building blocks that make up an atom and state where in the atom each of the three is located. (DOK – Level 1)
- Explain the significance of the horizontal rows and the vertical columns in the periodic table. (DOK – Level 4)
- Describe how the plasma state of matter differs from the solid, liquid, and gaseous states. (DOK – Level 2)
- Cite evidence to show that many solids are crystals. (DOK – Level 3)
- Define density and explain why it is the same for different volumes or masses of the same material. (DOK – Level 2)
- Distinguish between an elastic material and an inelastic material. (DOK – Level 2)
- Predict the stretch for an applied force, given the stretch produced by a different force. (DOK – Level 3)
- Explain why the center of a horizontal steel girder need not be as wide as the top and bottom. (DOK – Level 3)
- Explain why making something larger by the same factor in all dimensions changes its strength in relation to its weight. (DOK – Level 3)
- Describe what determines the pressure of a liquid at any point. (DOK – Level 2)
- Explain what causes a buoyant force on an immersed or submerged object. (DOK – Level 3)
- Relate the buoyant force on an immersed or submerged object to the weight of the fluid it displaces. (DOK – Level 2)
- Describe what determines whether an object will sink or float in a fluid. (DOK –2)
- Given the weight of a floating object, determine the weight of the fluid it displaces. (DOK – Level 2)
- Describe how Pascal's principle can be applied to increase the force a fluid exerts on a surface. (DOK – Level 3)
- Solve numerical problems involving density and buoyancy. (DOK – Level 3)
- Explain what prevents the molecules in the Earth's atmosphere from either

escaping or settling to the ground. (DOK – Level 3)

- Describe the source of atmospheric pressure. (DOK – Level 2)
- Explain why water cannot be raised higher than 10.3 meters with a vacuum pump. (DOK – Level 3)
- Describe the relationship between pressure and density for a given amount of gas at a constant temperature. (DOK – Level 2)
- Explain what determines whether an object will float in air. (DOK – Level 3)
- Describe the relationship between the speed of a fluid at any point and the pressure at that point, when the flow is steady. (DOK – Level 2)
- Explain why porous materials with air spaces are better insulators than non-porous materials are. (DOK – Level 3)
- Explain how heat can be transferred quickly through liquids and gasses even though they are poor conductors. (DOK – Level 2)
- Distinguish between conduction and convection from an atomic point of view. (DOK – Level 2)
- Explain how heat is transmitted through empty space. (DOK – Level 2)
- Given the color and shininess of two objects, predict which one will absorb radiant energy more easily. (DOK – Level 2)
- Compare the ability of an object to emit radiant energy with its ability to absorb it. (DOK – Level 2)
- Relate the temperature difference between an object and its surroundings to the rate at which cooling occurs. (DOK – Level 2)
- Describe the processes of absorption and emission of the Sun's radiant energy by the atmosphere and surface. (DOK – Level 2)
- Describe the greenhouse effect. (DOK – Level 1)
- Solve problems involving the transmission of heat. (DOK – Level 3)
- Explain why evaporation is a cooling process. (DOK – Level 3)
- Explain why condensation is a warming process. (DOK – Level 3)
- Explain why a person with wet skin feels cooler in dry air than in moist air at the same temperature. (DOK – Level 3)
- Distinguish between evaporation and boiling. (DOK – Level 2)
- Explain why food takes longer to cook in boiling water at high altitude than it does at sea level. (DOK – Level 3)
- Explain why water containing dissolved substances freezes at a lower temperature than pure water does. (DOK – Level 3)
- Describe the circumstances under which something can boil and freeze at the same time. (DOK – Level 3)
- Give examples of the tendency of ice to melt under pressure and refreeze when the pressure is removed. (DOK – Level 2)
- Describe the conditions needed for a substance to absorb or release energy with no resulting change in temperature. (DOK – Level 3)
- Solve numerical problems involving the heat of fusion, heat of vaporization, and specific heat capacity. (DOK – Level 3)
- Describe the concept of absolute zero. (DOK – Level 2)
- State the first law of thermodynamics and relate it to energy conservation. (DOK – Level 2)
- Describe adiabatic processes and give examples. (DOK – Level 2)
- State the second law of thermodynamics and relate it to heat engines. (DOK – Level

2)
- Define the ideal efficiency of a heat engine in terms of input and output temperatures. (DOK – Level 1)
- Define entropy and give examples. (DOK – Level 1)

Core Activities and Corresponding Instructional Methods:

- Integrate academic and content specific vocabulary
- Analyze examples of applications of concepts
- Direct instruction
- Lead a classroom discussion that prompts students to compare and contrast various methods utilized in obtaining solutions
- Guided practice: Include step-by-step written explanation of solutions to open-ended questions
- Cooperative group work in pairs and small groups on activities such as Practice Development worksheets, Vector addition
- Spreadsheet program (Google Sheets or Microsoft Excel) to calculate or help solve for unknown quantities
- Collect data in lab situations to model concepts and test models
- Develop both a verbal and/or written logical argument to support conclusions about data obtained in a lab situation
- Concept Development Practice Pages: 21-1, 21-2, 22-1, 23-1, 23-2 & 24-1.
- Laboratory Manual Experiments: 49, 50, 51, 53, 54 & 55.

Assessments:

Diagnostic:

- Algebra I and Biology Keystone Exams
- The University of the State of New York Regents High School Examination: PHYSICS
- Informal discussion, introductory questions, warm up questioning

Formative:

- Daily Warm-ups
- Informal Questioning
- Teacher Observation
- Homework assignments/Classwork
- Exit tickets/Mini-quizzes
- In-class assignments
- Writing assignments
- Chapter Exercises
- Conceptual Physics Concept Development Practice Worksheets

Summative:

- Common Unit Assessment
- Quizzes
- Post-lab assessment questions and/or lab report

Checklist to Complete and Submit:

(Scan and email)

_____ Copy of the curriculum using the template entitled "Planned Instruction," available on the district website.

_____ The primary textbook form(s).

_____ The appropriate payment form, in compliance with the maximum curriculum writing hours noted on the first page of this document.

Each principal and/or department chair has a schedule of First and Second Readers/Reviewers. Each Reader/Reviewer must sign & date below.

First Reader/Reviewer Printed Name_____
First Reader/Reviewer Signature_____ Date_____

Second Reader/Reviewer Printed Name_____
Second Reader/Reviewer Signature _____ Date_____