Coal City Unit District #1
Introduction to Physics
Science Curriculum

SC.IP:1 **Students will use knowledge of balanced and unbalanced forces, fluid density, pressure, and the governing principles to evaluate the design of a water floating craft. (NGSS HS-PS: 2-1)**

SC.IP:1-1	Define mass, volume and weight and predict the way each would change with variations in density or gravity.
SC.IP:1-2	Calculate fluid density given values for volume, mass and/or weight. Express answers to these calculations using proper SI units.
SC.IP:1-3	Define and calculate pressure and fluid pressure.
SC.IP:1-4	List the forces that create fluid pressure and air pressure and explain how each type of pressure is affected by altitude, density and water depth.
SC.IP:1-5	Describe the cause and the effect of buoyant forces.
SC.IP:1-6	Identify the factors of floatation and use this principle to explain the vertical maneuvering of a submarine.
SC.IP:1-7	Determine the weight of, or buoyant force on, an immersed object.
SC.IP:1-8	Apply the concepts of Archimedes principle in designing and operating a two-man boat out of cardboard.
SC.IP:1-9	Describe the relationship between a fluid's speed and the pressure it exerts.
SC.IP:1-10	Use Bernoulli's Principle to explain the cause of lift in airplane flight.
SC.IP:1-11	Use the conversion factor method for converting SI units. (e.g. liters, kilograms)
SC.IP:1-12	Employ the steps of Scientific Method: describe a problem, identify its variables, formulate a hypothesis, and write a procedure for a controlled experiment that will solve the problem.
SC.IP:1-13	Plan and conduct an experiment maintaining controlled conditions.
SC.IP:1-14	Analyze experimental data and write an evidence-supported conclusion.

SC.IP:2 Students will use mathematical representations and real life applications of Newton's Laws of Motion. (NGSS HS-PS: 2-1)

SC.IP:2-1	Define key components to Newton's Laws of Motion: mass, net force, acceleration, and inertia, and provide everyday examples of each.
SC.IP:2-2	Apply Newton's 1st Law of Motion to objects in motion or at rest; acknowledging no change will occur to velocity unless unbalanced forces act on them by making predictions.
SC.IP:2-3	Contrast the effect balanced and unbalanced forces have on static and moving objects, especially resulting from frictional forces.
SC.IP:2-4	Apply Newton's 2nd Law of Motion to an object experiencing unbalanced forces, and be able to compute either mass or rate of acceleration given the values of force involved (using the GUESS method).
SC.IP:2-5	Create a two-variable graph from a set of data, determine the slope of the line (when applicable), and interpret the relationship between these variables.
SC.IP:2-6	Describe the type of relationship that exists between mass and acceleration (with net force constant), and between net force and acceleration (mass constant). This relationship should also be illustrated using values on a graph.
SC.IP:2-7	Defend the need for airbags in a car using Newton's 1st and 2nd Laws.
SC.IP:2-8	Provide examples of, and make predictions in compliance with, Newton's 3rd Law of Motion.
SC.IP:2-9	Use vector quantities for combinations of forces to determine net force.
SC.IP:2-10	Calculate rate of acceleration using the GUESS method.
SC.IP:2-11	Describe the conditions of an object in free fall and relate the conditions to the resulting motion.

SC.IP:3 **Students will use mathematical representations and real life applications of the Law of Conservation of Momentum. (NGSS HS-PS: 2-2; NGSS HS-PS: 2-3)**

SC.IP:3-1	Identify the SI measuring units for length, time and mass, and determine which prefix to best include with these units when appropriate.
SC.IP:3-2	Calculate average speed using the GUESS problem solving method.
SC.IP:3-3	Contrast instantaneous and average speed.
SC.IP:3-4	Define the two factors for momentum (mass and velocity).
SC.IP:3-5	State the Law of Conservation of Momentum and apply this law to collision systems.
SC.IP:3-6	Calculate momentum of an object in a closed system.
SC.IP:3-7	Compare and contrast elastic and inelastic collisions in terms of momentum transfer and conservation.
SC.IP:3-8	Predict the final velocity of an object in a system where a collision (both elastic and inelastic) has occurred.
SC.IP:3-9	Explain the mathematical meaning of impulse, and the way it equates to changes in momentum.
SC.IP:3-10	Apply an understanding of the effect of time on impulse, force, velocity and momentum when explaining the benefit of "following through" and "cushioning" in sports.
SC.IP:3-11	Defend the need for safety features using the momentum-impulse theorem.(e.g. crumple zones, airbags)
SC.IP:3-12	Dispute (classroom debate) the necessity of installing seat belts on school buses.

SC.IP:4 **Students will create a computational model to analyze the change in energy of one component in a system, when the change in energy of the other component(s) and energy flows in and out of the system are known. (NGSS HS-PS 3-1; NGSS HS-PS 3-2)**

SC.IP:4-1	Define and list examples of the major forms of energy.
SC.IP:4-2	Apply the GUESS problem solving method in solving for the gravitational potential energy of objects in a system.
SC.IP:4-3	Apply the GUESS problem-solving method in solving for the kinetic energy of objects in a system.
SC.IP:4-4	Define work and power in both verbal and mathematical terms.
SC.IP:4-5	Perform work and power calculation problems, given values for force, time and displacement.
SC.IP:4-6	State the law of conservation of energy and apply it to a simple system. (e.g. free falling object, swing)
SC.IP:4-7	Using the Law of Conservation of Energy, create a diagram illustrating changes in energy that take place to a closed system.
SC.IP:4-8	Describe the conversions of energy that take place in real-life applications. (e.g. batteries, wind turbines, combustion engines)
SC.IP:4-9	Describe the effect of work on a system.
SC.IP:4-10	Define friction and describe its effect on a system.
SC.IP:4-11	Justify the need for the reduction of friction in an engine system.
SC.IP:4-12	Design, build, and refine a device that converts energy from one form to another. (e.g. Mousetrap Powered Car, Water Powered Elevator, Marble Roller Coaster)
SC.IP:4-13	Determine the coefficient of kinetic friction of a shoe using collected data, and relate this value to changes in the shoe's weight and the type of floor surface.
SC.IP:4-14	Investigate the work done on a stationary object when the colliding object experiences variations in initial potential energy.

SC.IP:5 **Students will develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. (NGSS HS-PS 1-1; NGSS HS-PS 1-8)**

SC.IP:5-1	Describe the basic structure of an atom, and use information from the periodic table to create a two-dimensional atom model for a given element including such properties as number of protons, electrons, neutrons, ground state energy levels, as well as electron configuration.
SC.IP:5-2	Provide two examples of isotopes and explain what makes each an isotope.
SC.IP:5-3	Compare and contrast the Bohr and Rutherford atomics models of the atom.
SC.IP:5-4	Describe how spectroscopy is used in the determination of gas composition.
SC.IP:5-5	Describe the role strong nuclear force and electrostatic (Coulomb's) forces play in the stability of the nucleus.
SC.IP:5-6	Predict the product(s) that would result from each of the following processes of radioactive decay: alpha, beta, and gamma.
SC.IP:5-7	Simulate the property of half life by conducting a statistical activity of elimination.
SC.IP:5-8	Apply an understanding of radioactive half-life by predicting the age of a sample given its change in isotopic composition.
SC.IP:5-9	Compare and contrast nuclear fission, nuclear fusion and energy produced from burning fossil fuels.
SC.IP:5-10	Explain how the law of conservation of energy applies to nuclear and coal burning power plants.
SC.IP:5-11	Participate in a classroom debate for the expansion of nuclear power or for the development of alternate energy sources, like biofuels, solar and wind power.

SC.IP:6 **Students will use mathematical representations and real life applications of the Laws of Thermodynamics. (NGSS HS-PS: 3-4)**

SC.IP:6-1	Relate temperature to thermal energy and thermal expansion.
SC.IP:6-2	Describe the spontaneous flow of heat, and relate this to the idea of objects "feeling warm" or "feeling cold".
SC.IP:6-3	State the first law of thermodynamics and provide a mathematically based example of how this law can be observed in everyday life.
SC.IP:6-4	Clarify the 2nd law of thermodynamics by contrasting the use of an insulated cooler and refrigerator.
SC.IP:6-5	Calculate thermal energy changes using calorimetry measurements.
SC.IP:6-6	Describe the significance of an object's specific heat capacity.
SC.IP:6-7	Distinguish between the three methods of heat transfer: conduction, radiation and convection in terms of modality, and identify examples for each.
SC.IP:6-8	Relate the properties of a material to its ability to prevent the loss of heat.
SC.IP:6-9	Describe how the specific heat of water affects the climate of a certain area (e.g. Chicago lakefront, Iceland).
SC.IP:6-10	Investigate the effect of mass, temperature and composition on the flow of heat between materials.
SC.IP:6-11	Investigate the effect of a container's color, thickness and composition on its ability to resist loss of heat.

SC.IP:7 **Students will use mathematical representations to describe relationships among the properties of waves, including frequency, wavelength, energy, amplitude and speed of waves traveling in various media. (NGSS HS-PS 4-1; NGSS HS-PS 4-3)**

SC.IP:7-1	Draw and label the different attributes of a wave (e.g. crest, rest position).
SC.IP:7-2	Identify the properties of a mechanical wave (period, frequency, wavelength, speed, and amplitude), and describe their mathematical relationship.
SC.IP:7-3	Compare and contrast the three types of mechanical waves.
SC.IP:7-4	Calculate the following properties of waves: speed, frequency, period and wavelength.
SC.IP:7-5	Define the properties of sound waves: pitch, intensity, loudness and identify contributing factors for each.
SC.IP:7-6	Identify the effect of medium composition and temperature on the speed of sound waves.
SC.IP:7-7	Summarize the cause and effect of the following wave behaviors: reflection, diffraction, refraction, Doppler Effect and standing wave formation..
SC.IP:7-8	Compare and contrast constructive and destructive interference of waves, and provide everyday examples of each.
SC.IP:7-9	Distinguish between the different parts of the electromagnetic spectrum, and identify how each type of wave is used.
SC.IP:7-10	Describe the basic idea of the photoelectric effect.
SC.IP:7-11	Explain and investigate the changes that take place to light waves as they pass through a lens (refraction).
SC.IP:7-12	Defend the idea or claim that light behaves like a particle using the photoelectric effect.
SC.IP:7-13	Defend the claim that light is a wave using information on wave behavior (reflection, interference).
SC.IP:7-14	Create a graphic organizer that displays the classification of wave types.
SC.IP:7-15	Plan and conduct an experiment that investigates the effect of amplitude on speed and analyzes collected data.
SC.IP:7-16	Collaborate with classmates, using a different wave media, and further investigate what does and what does not affect wave speed.

SC.IP:8 **Students will use a model to describe how variations in the flow of energy into and out of Earth's systems, naturally occurring phenomena and human activity all result in changes in climate. (NGSS HS-ES: 2-4; NGSS HS-ES: 3-5; NGSS HS-ES: 3-6)**

SC.IP:8-1	Describe the importance of the earth's atmosphere and list the most abundant gases in the atmosphere.
SC.IP:8-2	Distinguish between the four vertical layers of the atmosphere in terms of temperature change and other key properties.
SC.IP:8-3	Describe the process of adiabatic cooling that takes place in the troposphere, and the role it plays in cloud formation.
SC.IP:8-4	List factors that influence seasonal weather. (e.g. earth's rotation, topography, solar radiation)
SC.IP:8-5	Relate the uneven heating of the earth to the events that cause both local and global winds.
SC.IP:8-6	Summarize the sequence of energy transfer events that contribute to the warming and cooling of temperatures in the troposphere.
SC.IP:8-7	Plan and conduct an experiment that investigates the effect of carbon dioxide concentration on ambient temperature.
SC.IP:8-8	Identify the major factors that can influence the climate for a certain region (e.g. latitude, variation on solar radiation, winds, bodies of water).
SC.IP:8-9	Describe the role human activity has played in the changing of earth's climate.
SC.IP:8-10	Connect naturally occurring phenomena to changes in our planet's climate (e.g. large volcanic eruptions, Milankovitch Cycles and ocean circulation).
SC.IP:8-11	Analyze recent data on regional climate change (changes in temperature and precipitation) to forecast its future impact (e.g. on sea level, glacial ice volumes, or atmosphere and ocean composition).
SC.IP:8-12	Research a current issue dealing with major global climate change and present findings (e.g. acid rain, global warming, El Niño), and editorialize your findings.