GSE: Physics

SP1: Obtain, evaluate, and communicate information about the relationship between distance, displacement, speed, velocity, and acceleration as functions of time.

a. Plan and carry out an investigation of one-dimensional motion to calculate average and instantaneous speed and velocity.
   - ✓ *Analyze one-dimensional problems involving changes of direction, using algebraic signs to represent vector direction.*
   - ✓ *Apply one-dimensional kinematic equations to situations with no acceleration, and positive, or negative constant acceleration.*

b. Use motion graphs analyze/illustrate the relationships among position, velocity, and acceleration, as functions of time.

c. Ask questions to compare and contrast scalar/vector quantities and distance vs displacement.

d. Analyze and interpret data of two-dimensional motion with constant acceleration.
   - ✓ *Resolve position, velocity, or acceleration vectors into components (x and y, horizontal and vertical).*
   - ✓ *Interpret problems to show that objects moving in two dimensions have independent motions along each coordinate axis.*
   - ✓ *Design an experiment to investigate projectile motion of an object by collecting and analyzing data using kinematic equations.*
   - ✓ *Calculate range and time in the air for a horizontally launched projectile.*

SP2. Obtain, evaluate, and communicate information about how forces affect the motion of objects.

a. Construct an explanation based on evidence using Newton's Laws of how forces affect the acceleration of a body.
   - ✓ *Explain & predict the motion of a body in absence of a force & when forces are applied using Newton's 1st Law (inertia)*
   - ✓ *Calculate the acceleration for an object using Newton's 2nd Law, including situations where multiple forces act together.*
   - ✓ *Identify equal/opposite forces between interacting bodies and relate their magnitudes and directions using Newton's 3rd Law.*

b. Develop and use a model of a Free Body Diagram to represent the forces acting on an object (*equilibrium/non-equilibrium.)*

c. Calculate magnitudes & vector components for gravitational force, force, friction forces, tension forces, & spring forces.

d. Gather evidence to identify the force or force component responsible for causing an object to move along a circular path.
   - ✓ *Calculate the magnitude of a centripetal acceleration.*

e. Use Newton's Universal Law of gravitation to show/express the mathematical relationship of mass, distance & force.

SP3. Obtain, evaluate, and communicate information about the importance of conservation laws for mechanical energy and linear momentum in predicting the behavior of physical systems.

a. Ask questions to compare and contrast open and closed systems.

b. Analyze, evaluate, and apply the principle of conservation of energy and the Work-Kinetic Energy Theorem.
   - ✓ *Calculate the kinetic energy of an object.*
   - ✓ *Calculate the amount of work performed by a force on an object.*
   - ✓ *Plan and carry out an investigation of closed systems demonstrating conservation and rate of transfer of energy (power)*
   - ✓ *Use the principle of conservation of momentum to explain how the brief application of a force creates an impulse.*
   - ✓ *describe and perform calculations involving one dimensional momentum.*
   - ✓ *connect the concepts of Newton's 3rd law and impulse.*
   - ✓ *experimentally compare and contrast inelastic and elastic collisions.*

SP4. Obtain, evaluate, and communicate information about the properties and applications of waves.

a. Mathematically describe how the velocity, frequency, and wavelength of a propagating wave are related.

b. Develop and use models to describe and calculate characteristics related to the interference and diffraction of waves

c. Construct an argument that analyzes the production and characteristics of sounds waves.
   - ✓ *Doppler Effect, standing waves, wavelength, amplitude/energy of the wave, and the relationship between frequency and pitch.*

d. Plan and carry out investigations to characterize the properties and behavior of electromagnetic waves.
   - ✓ *Properties: amplitude, frequency, wavelength, energy, color, polarization, spectral composition, wave speed in transparent.*
   - ✓ *Analyze experimentally & mathematically aspects of reflection and refraction of light waves using optical ray diagrams.*
   - ✓ Plan and carry out investigations concerning Snell's Law, optical ray diagrams, and thin lens equation

e. Investigate & describe changes in diffraction patterns (geometry & wavelength) for mechanical & electromagnetic waves.

SP5. Obtain, evaluate, and communicate information about electrical and magnetic force interactions.

a. Use models/diagrams to compare/contrast the electric & gravitational forces between two charged objects.

b. Carry out investigations to demonstrate & qualitatively explain charge transfer by conduction, friction, and induction.

c. Construct an explanation based on evidence of the behavior of charges in terms of electric potential energy.

d. Investigate (Ohm's Law) the relationship between voltage, current, & power for DC circuits.
   - ✓ *different circuit configurations and calculations of equivalent resistance are expected.)*

e. Investigate the relationship between electric currents & magnetic fields. (the design of motors and generators.)

SP6. Obtain, evaluate, communicate information about nuclear changes of matter and technological applications.

a. Develop & use models to explain, compare, and contrast nuclear processes including radioactive decay, fission, and fusion.

b. Compare/Contrast mechanisms & characteristics of radioactive decay. (Include: alpha, beta, and gamma decays effects.)

c. Calculate the amount of substance present after a given amount of time based on its half-life
   - ✓ *relate this to the law of conservation of mass and energy.*