Physics

Core Ideas/Crosscutting Concepts:

Kinematics
How can motion be described?

How is motion measured?

Can the motion of objects be predicted?

The learner will define average speed.

The learner will define instantaneous speed.

The learner will calculate instantaneous speed for a x vs. t of constant velocity.

The learner will define displacement.

The learner will define velocity and speed.

The learner will define acceleration.

The learner will find acceleration given vf, vi, and t.

The learner will be able to use kinematic equations to solve for one variable in a problem.

The learner will describe the motion of a freely falling object.

The learner will describe the acceleration of a freely falling object.

The learner will describe the motion of an object rising and falling.

The learner will describe the x, v, and a of a freely falling object.

The learner will apply kinematic equations to freely falling objects.

The learner will recognize the independence of horizontal and vertical motion.

The learner will state the nature of horizontal and vertical motion (a, v, and x) for a freely falling object.

The learner will calculate xi, vi, vf, and t for an object moving in two dimensions.

The learner will apply the symmetry of a freely falling object to an object moving in two dimensions.

The learner will recognize the similarities in movement between a projectile projected at an angle and a vertically projected object.

The learner will calculate the components of a velocity vector.

The learner will calculate the x, v, and t for a projectile at various points along trajectory.

The learner will apply the kinematic equations in a lab setting to calculate the takeoff speed and point of landing of a projectile.

Learning Targets:

Motion

Graph interpretations

Position vs. time

Velocity vs. time

Acceleration vs. time

Problem solving

Using graphs (average velocity, instantaneous velocity, acceleration, displacement, change in velocity)

Uniform acceleration including free fall (initial velocity, final velocity, time, displacement, acceleration, average velocity)

Projectiles

Independence of horizontal and vertical motion

Problem-solving involving horizontally launched projectiles

Core Ideas/Crosscutting Concepts:

Newton's Laws of Motion

What causes objects to move?

What factors influence the motion of an object?

How can the motion of an object be predicted?

The learner will define inertia and state Newton's First Law of Motion.

The learner will apply Newton's First Law to everyday phenomena to explain their behavior.

The learner will define force and state its result on objects.

The learner will quantitatively relate force, mass, and acceleration to each other.

The learner will state Newton's Second Law of Motion.

The learner will give examples of the consequences of Newton's Second Law involving everyday phenomena.

The learner will apply Newton's Second Law to explain why objects fall at identical rates.

The learner will state Newton's Third Law of motion

The learner will explain why equal and opposite forces do not cancel each other out

The learner will explain the difference between equal forces and equal effects

The learner will express a force vector in terms of its components.

The learner will calculate the resultant force when 2 or more forces act concurrently.

The learner will differentiate between kinetic and static friction.

The learner will calculate the frictional force acting on an object.

The learner will calculate the net force acting on an object

The learner will calculate the acceleration and all kinematic quantities in a real-life problem.

Learning Targets:

Forces, momentum and motion

Newton's laws applied to complex problems

Gravitational force and fields

Elastic forces

Friction force (static and kinetic)

Air resistance and drag

Forces in two dimensions

Adding vector forces

Motion down inclines

Centripetal forces and circular motion

Core Ideas/Crosscutting Concepts:

Work and Energy

What is energy?

What are the different forms of energy?

When do objects have energy?

When/how is energy conserved?

The learner will define work.

The learner will calculate the work done by a given force.

The learner will give examples of at least 3 simple machines.

The learner will explain how a simple machine seems to make work easier but actually makes it harder.

The learner will identify the output and input work of a simple machine.

The learner will calculate the input and output work of a simple machine.

The learner will explain and calculate the efficiency of a simple machine.

The learner will explain and calculate the ideal and actual mechanical advantage of a simple machine.

The learner will show the equivalence between work and potential energy.

The learner will show the equivalence between work and kinetic energy.

The learner will calculate the potential and kinetic energies of different locations for a free falling object.

The learner will show that the potential plus kinetic energies are the same (Law of Conservation of Energy).

The learner will apply the Law of Conservation of Energy to a rollercoaster.

Learning Targets:

Energy

Gravitational potential energy

Energy in springs

Nuclear energy

Work and power

Conservation of energy

Core Ideas/Crosscutting Concepts:

Momentum

What is momentum?

How is momentum measured?

What does it mean to say that momentum is conserved?

The learner will be able to define impulse and momentum.

The learner will be able to explain different means of achieving a change in momentum.

The learner will be able to give examples of impulses and change in momentum over short and long time intervals.

The learner will be able to calculate momentum and velocity for masses involved in elastic collisions.

The learner will be able to show that momentum and kinetic energy are conserved in elastic collisions.

The learner will be able to make systematic observations of mass and velocity in inelastic collisions.

The learner will be able to calculate momentum and velocity for masses in inelastic collisions using conservation of momentum.

The learner will be able to calculate momentum and velocity for masses involved in explosion using conservation of momentum.

The learner will be able to define angular momentum and explain the consequences of conservation of angular momentum in real-life situations.

Learning Targets:

Forces, momentum and motion

Momentum, impulse and conservation of momentum

Core Ideas/Crosscutting Concepts:

Momentum

What is momentum?

How is momentum measured?

What does it mean to say that momentum is conserved?

The learner will be able to define impulse and momentum.

The learner will be able to explain different means of achieving a change in momentum.

The learner will be able to give examples of impulses and change in momentum over short and long time intervals.

The learner will be able to calculate momentum and velocity for masses involved in elastic collisions.

The learner will be able to show that momentum and kinetic energy are conserved in elastic collisions.

The learner will be able to make systematic observations of mass and velocity in inelastic collisions.

The learner will be able to calculate momentum and velocity for masses in inelastic collisions using conservation of momentum.

The learner will be able to calculate momentum and velocity for masses involved in explosion using conservation of momentum.

The learner will be able to define angular momentum and explain the consequences of conservation of angular momentum in real-life situations.

Learning Targets:

Momentum, impulse and conservation of momentum

Core Ideas/Crosscutting Concepts:

Waves and Sound

What are waves?

What are their characteristics?

What phenomena can be explained using wave theory?

The learner will define a wave

The learner will describe a transverse wave and a longitudinal wave and compare the natures of these waves.

The learner will define wavelength, amplitude, and period.

The learner will describe the superposition of two waves.

The learner will describe the reflection of a wave from a barrier.

The learner will describe what refraction is and what causes it.

The learner will describe the behavior of waves upon encountering the boundary between two media.

The learner will relate wave speed, wavelength, and frequency of a wave.

The learner will describe standing waves and their cause.

The learner will calculate the frequencies that create standing waves.

The learner will explain resonance.

The learner will be able to explain how sound is produced.

The learner will be able to describe what role frequency and amplitude have in perceiving sound.

The learner will be able to describe how sound travels and what factors influence its speed.

The learner will be able to explain how humans perceive sound and in what range they hear.

The learner will be able to explain how resonance is produced and what conditions must exist for its production.

The learner will be able to describe the effect of beats and explain how it is produced.

The learner will be able to explain what the Doppler effect is and how it is created.

Learning Targets:

Waves

Wave properties

Conservation of energy

Interference

Diffraction

Core Ideas/Crosscutting Concepts:

Light

What is light?

How is it perceived?

What determines the color of light?

How does wave theory explain light?

What phenomena can be explained using the wave theory of light?

The learner will be able to name the parts of the eye and explain their function in perceiving light.

The learner will be able to explain the role of rods and cones in perceiving color and motion.

The learner will be able to name the primary colors of light.

The learner will be able to name the color that results when two or three primary colors are added together.

The learner will be able to explain why the sky is blue.

The learner will be able to explain why the sun is yellow.

The learner will be able to explain why sunsets are red/orange.

The learner will be able to name the three primary subtractive colors.

The learner will be able to name the color that results when two or more primary subtractive colors are added together.

The learner will be able to predict the perceived color of an object when illuminated by different colored lights.

Learning Targets:

Waves

Light phenomena

Diffraction patterns

Wave – particle duality of light

Visible spectrum and color

Core Ideas/Crosscutting Concepts:

Optics

How does light behave in different media?

How does wave theory explain optical phenomena?

How do mirrors and lenses work and why do they give the effects they produce?

The learner will be able to state the law of reflection.

The learner will be able to describe the image characteristics of a plane mirror.

The learner will be able to give examples of refraction of light.

The learner will be able to apply refraction of light to explain the production of mirages.

The learner will be able to describe what total internal reflection is and the conditions necessary to produce it.

The learner will be able to name the significant points on a concave mirror.

The learner will be able to explain how light behaves upon hitting a concave mirror.

The learner will be able to describe the image characteristics for concave and convex mirrors and for converging and diverging lenses.

The learner will be able to draw ray diagrams for all object locations for concave and convex mirrors and for converging and diverging lenses

The learner will be able to calculate the location, size, and orientation for images formed by concave and convex mirrors and converging and diverging lenses.

Learning Targets:

Waves

Wave properties

Reflection

Refraction

Light phenomena

Ray diagrams (propagation of light)

Law of reflection (equal angles)

Snell's law

Core Ideas/Crosscutting Concepts:

Electrostatics

What phenomena can be explained using electric charge?

When is static build-up dangerous and when is it not?

How is lightning produced?

The learner will describe whether two charged objects would be attracted or repelled from one another.

The learner will explain how an object can be charged by conduction.

The learner will explain how an object can be charged by induction.

The learner will explain the behavior of a charged and uncharged electroscope in the presence of a charged object.

The learner will explain the lack of static electricity on humid days.

The learner will calculate the force between charged objects using Coulombs Law.

Learning Targets:

Electricity and magnetism

Charging objects (friction, contact and induction)

Coulomb's law

Electric fields and electric potential energy

Core Ideas/Crosscutting Concepts:

Electric Circuits

How do electric circuits function?

What are the advantages and disadvantages of different types of circuits?

How do households use electricity?

The learner will define voltage, current, and resistance.

The learner will state Ohm's Law and calculate voltage, current, or resistance.

The learner will explain the difference between current and voltage.

The learner will construct a complete circuit.

The learner will construct a complete circuit using a circuit diagram.

The learner will describe the basic differences between a series and parallel circuit.

The learner will give examples of uses for series and parallel circuits.

The learner will draw a circuit diagram using correct symbols.

The learner will show the correct placement of a voltmeter and an ammeter.

The learner will measure the current and voltage in a series and parallel circuit.

The learner will calculate the voltage, current, and total resistance for series, parallel, and complex circuits.

The learner will state the general characteristics of series and parallel circuits.

Learning Targets:

Electricity and magnetism

DC circuits

Ohm’s law

Series circuits

Parallel circuits

Mixed circuits

Applying conservation of charge and energy (junction and loop rules)

Magnetic fields and energy

Electromagnetic interactions