Course Resources:

Physics EHS_syllabus.pdf

Unit	Benchmarks	Essential Questions	Learning Objectives	Instructional Strategies	Resources	Assessments
Months 1-12						
Introduction to Physics *(updated 1/29/21)*	SS.9P.1.3.3.1(A) Describe changes in society that have resulted from significant discoveries and advances in technology in physics. For example: Transistors, generators, radio/television, or microwave ovens. SS.9P.1.3.4.1(A) Use significant figures and an understanding of accuracy and precision in scientific measurements to determine and express the uncertainty of a result.	Why do we study physics? How can questions be answered through scientific inquiry?	Recall which Greek philosopher made contributions to physics Identify what physicists study Describe what Aristotle believed in terms of gravity Describe what Galileo Galilei believed in terms of gravity• Identify steps in the scientific method Identify if a hypothesis is a failure or success if it is rejected by the observations from an experiment Identify an example of a quantitative observation Recall which measurements contain uncertainty Identify the seven base units Convert expanded numbers into scientific notation Convert scientific notation into expanded numbers Count the number of significant figures in a number	direct instruction graphic aids videos simulation section review questions	1.0 Introduction to Physics 1.1 Scope of Physics Video: Wet Washcloth in Space Video: What is Physics? 1.2 Scientific Method Virtual Lab: Variables in Experiments Video: The Scientific Method 1.3 Scientific Measurement Video: How does a trader convert between different units and currencies? 1.4 Math and Tools for Physics	Module 1 Quiz
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 2: Vectors *(updated 1/29/21)*	SS.9P.2.2.1.1(A) Use vectors and free-body diagrams to describe force, position, velocity and acceleration of objects in two--dimensional space. SS.9P.2.2.2.1(A) Explain and calculate the work, power, potential energy and kinetic energy involved in objects moving under the influence of gravity and other mechanical forces.	What is a vector and how do you combine them?	Recall whether mass has a direction Recall whether vectors require a direction Identify when two vectors can be added arithmetically Use trigonometry to resolve vectors in different scenarios Use trigonometry to find an object's resultant velocity in different scenarios Recall the method(s) for adding vectors mathematically Identify the effect perpendicular vectors have on each other Use the Pythagorean Theorem to find the missing length of part of a right triangle in different scenarios Calculate total distance traveled in different scenarios Calculate displacement(on a straight line)in different	direct instruction graphic aids videos simulations section review questions Module Study Guide	2.0 Vectors 2.1 Resolving Vectors into Components Video: How to Break a Vector into components. 2.2 Vector Addition Video: Component Method of Vector Additions 2.3 Graphical Methods of Vector Addition Video: Vector Addition with Components Module 2 Study Guide	Module 2 Quiz

			scenarios			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 3: Motion in a Straight Line *(updated 1/29/21)*	SS.9P.1.3.3.1(A) Describe changes in society that have resulted from significant discoveries and advances in technology in physics. For example: Transistors, generators, radio/television, or microwave ovens. SS.9P.2.2.1.1(A) Use vectors and free-body diagrams to describe force, position, velocity and acceleration of objects in two--dimensional space. SS.9P.2.2.1.2(A) Apply Newton's three laws of motion to calculate and analyze the effect of forces and momentum on motion.	How can we accurately measure motion?	Recall whether distance and displacement have a direction Recall whether two objects can be the same distance from a single point but be in different positions Calculate distance traveled, final displacement, and position in a scenario Recall whether speed and velocity have a direction Calculate the Calculate the average speed, velocity, acceleration of an object Recall whether an object can have zero velocity but still have an acceleration and consistent velocity Recall whether an object can have zero acceleration but still have a consistent velocity Calculate the final velocity for an object given the velocity, acceleration, and time Calculate an object's displacement given the constant velocity and period of time Calculate an object's displacement from rest to a constant acceleration (given the period of time and constant acceleration) Calculate the velocity of an object when the acceleration first began (given the distance and constant acceleration) Calculate the final velocity for an object given the starting velocity, constant acceleration, and distance Describe Galileo's original statement about the motion of falling objects Recall whether all objects fall at the same rate of acceleration in the presence of air resistance Calculate how high an object will go into the air before it comes to rest given the initial velocity Calculate how far an object fell given how long it took to hit the ground	direct instruction graphic aids videos simulations section review questions Module Study Guide	3.0 Motion in a Straight Line 3.1 Position and Displacement Simulation Videos: Position, Distance v. Displacment 3.2 Average Velocity Simulations Video: Intro to Velocity 3.3 Instantaneous Velocity Simulation Video: V T Graph Or Velocity Time Graph 3.4 Average Acceleration Simulation 3.5 Uniform Acceleration Simulation 3.6 Displacement During Uniform Acceleration Video; Area under a velocity-time graph 3.7 Acceleration Due to Gravity Simulations Video: Acceleration due to Gravity	Module 3 Quiz

Unit	Benchmarks	Essential Questions	Learning Objectives	Instructional Strategies	Resources	Assessments
Months 1-12						
Module 4: Forces *(updated 1/29/21)*	SS.9P.2.2.1.2(A) Apply Newton's three laws of motion to calculate and analyze the effect of forces and momentum on motion. SS.9P.2.2.2.2(A) Describe and calculate the change in velocity for objects when forces are applied perpendicular to the direction of motion. For example: Objects in orbit. SS.9P.2.2.2.3(A) Use conservation of momentum and conservation of energy to analyze an elastic collision of two solid objects in one-dimensional motion.	How do you determine the net force acting on an object? How do Newton's laws affect our daily lives?	Identify who was the first to study forces as the cause for acceleration Calculate the mass of an object given the weight of the object sitting on the Earth Recall which two factors the force of friction between two blocks is related to Calculate the frictional force given the coefficient of friction and weight of an object Calculate the acceleration of a box being pushed given the value of the pushing force, coefficient of friction, and weight of the box Explain why there is no resulting motion of a book when you place it on a table Calculate the force required to accelerate an object given the mass of the object and desired acceleration Calculate the mass of an object given the net force exerted on the object and the object's acceleration Calculate the acceleration of an object given the net force exerted on the object and the object's mass Identify the force that is the reason why a rocket lifts off after air is forced out of the bottom of the rocket Identify the force related to why there's little resistance between a canoe and the surface of the water on a calm day Identify the force related to why a handrail doesn't move after an ice skater pushes off from it Recall which law explains why a bat is sent backwards after striking a ball	direct instruction graphic aids videos simulations section review questions Module Study Guide	4.0 Force 4.1 Weight simulation Video:The Difference between Weight and Mass simulations Videos: Friction is a Force, Mythbusters: Phonebook Friction, The Physics of Skydiving 4.2 Connecting Newton's First and Second Laws simulations Videos: What Forces are Acting on You, Newton's First Law of Motion,Newton's Second Law of Motion 4.3 Newton's Third Law simulations Video: Newton's Third Law of Motion	Module 4 Quiz
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						

Module 5: Motion in Two Dimensions *(updated 1/29/21)*	SS.9P.2.2.1.3(A) Use gravitational force to explain the motion of objects near Earth and in the universe.	How do variables such as launch angle, velocity, and altitude affect the maximum height and range of a launched projectile?	Identify the center of gravity for a ruler given the length of the ruler Describe the orientation of the normal force Describe the orientation of the parallel force Describe the nature of the weight of an object Recall the term for an object that is launched into the air Recall the term for the path followed by a projectile in motion Calculate how far an object will fly horizontally before it strikes the ground given the velocity and distance Calculate the speed of an object thrown horizontally from a cliff given the height of the cliff and how far away from the base of the cliff the object strikes the ground Calculate the time required for an object's entire trip up and down given the initial velocity and angle above the horizontal Calculate the maximum height of an object's trip up given the initial velocity and angle above the horizontal Calculate the horizontal distance traveled during flight given the initial velocity and angle above the horizontal Calculate the period of an object Calculate the centripetal acceleration of an object Identify what causes the centripetal acceleration of satellites orbiting the earth Calculate the centripetal force needed to keep a runner on a curve Calculate the maximum speed an object may be swung without breaking the string it's tied to	direct instruction graphic aids videos simulations section review questions Module Study Guide	5.1 Gravitational Force and Inclined Planes Simulaiton 5.2 Projectile Motion for an Object Launched Horizontally Simulation Video: Bullet Fired vs. Bullet Dropped 5.3 Projectile Motion for an Object Launched at an Angle Simulation Video: Ball Speed 5.4 Circular Motion Simulation Video: Circular Motion Demonstration 5.5 Centripetal Force simuation Video: Centrpetal Force	Module 5 Quiz
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 6: Universal Gravitation *(updated 1/29/21)*	SS.9P.1.3.3.1(A) Describe changes in society that have resulted from significant discoveries and advances in technology in physics. For example: Transistors, generators, radio/television, or microwave ovens.	What is gravity? Why is Kepler's third law significant?	Recall who invented the Law of Universal Gravitation Describe the relationship between force and distance Identify which objects exert a gravitational pull Describe what happens to the force of gravity as two objects	direct instruction graphic aids videos simulations section review questions Module Study	6.1 Newton's Universal Law of Gravity simulations Videos: What is Gravity, 2nd Floor Gravity 6.2 Orbital Motion simulation Videos:Why are Astronauts	Module 6 Quiz

	SS.9P.2.2.1.3(A) Use gravitational force to explain the motion of objects near Earth and in the universe. SS.9P.2.2.2.1(A) Explain and calculate the work, power, potential energy and kinetic energy involved in objects moving under the influence of gravity and other mechanical forces.		move farther apart Describe what happens to the force of gravity as two objects grow bigger and heavier Recall who invented an apparatus that determined the density of the planet and the value of the gravitational constant Describe the force of attraction between the moon and the Earth Identify why the Earth is attracted to the sun Identify what keeps the Earth from falling into the sun Identify what keeps a satellite from falling back to Earth Explain why objects in free fall have no weight Calculate a person's weight on Earth given his or her mass Calculate a person's mass on the moon given his or her mass on Earth Calculate a person's weight on the moon given his or her mass on Earth Recall the shape of a planetary orbit Explain what happens when a planet is near the sun Explain what happens when a planet is far away from the sun Identify what the variables in Kepler's Third Law represent Calculate the period of a planet using Kepler's third law	Guide	Weightless, Why does the Moon Orbit Earth 6.3 Kepler's Laws of Planetary Motion simulations Video: Understanding Kepler's Three Laws	

Unit	Benchmarks	Essential Questions	Learning Objectives	Instructional Strategies	Resources	Assessments
Months 1-12						
Module 7: Momentum *(updated 1/29/21)*	SS.9P.2.2.2.1(A) Explain and calculate the work, power, potential energy and kinetic energy involved in objects moving under the influence of gravity and other mechanical forces. SS.9P.2.2.2.3(A) Use conservation of momentum and conservation of energy to analyze an elastic collision of two solid objects in one-dimensional motion.	How can we predict the results of interactions?	Recall which letter represents momentum in physics equations Calculate the momentum of an object given its mass and velocity Calculate the velocity of an object given its mass and momentum Calculate the force required to bring an object to rest Calculate the impulse an object delivers to another object Calculate the average force an object exerts on another object Calculate the average acceleration of a baseball given its mass and the average force the bat exerted on the ball(7.1)•Identify the purpose of airbags in a car	direct instruction graphic aids videos simulations section review questions Module Study Guide	7.1 Momentum and Impulse simulations Video: Momentum and Force in Collisions 7.2 Conservation of Momentum in One Dimension Video: Richard Garriott Space Video Blog simulation 7.3 Conservation of Momentum in Two Dimensions simulation	Module 7 Quiz

			Identify the purpose of sandbags in front of abutments on the highway Describe the conservation of momentum in one dimension Describe the force of the impact between an insect and a car at the point of collision Explain why a bat's final velocity is significantly smaller than that of the baseball when hits Calculate the velocity of an object after a collision using the law of conservation of momentum Calculate the velocity of two objects after a collision using the law of conservation of momentum			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 8: Energy *(updated 1/29/21)*	SS.9P.2.2.2.1(A) Explain and calculate the work, power, potential energy and kinetic energy involved in objects moving under the influence of gravity and other mechanical forces.	What does “energy cannot be created or destroyed” mean?	Identify various collisions as most likely elastic or most likely inelastic Describe Newton’s cradle Calculate the velocity of an object after it collides with another object Identify examples of potential energy Describe how the kinetic and potential energy of an object changes when it is fired straight up into the air Identify the formula for calculating work Calculate the work done in lifting an object Identify the formula for calculating gravitational potential energy Calculate the gravitational potential energy of an object sitting on a shelf Calculate the velocity of a fallen object when it hits the floor (in the absence of air resistance) Calculate the amount of work a runner must do to accelerate from rest to a specific velocity given the runner's mass Identify examples of kinetic energy Identify the formula for calculating kinetic energy Calculate the kinetic energy of an object given its mass and	direct instruction graphic aids videos simulations section review questions Module Study Guide	8.1 Elastic and Inelastic Collisions simulations Video: The Science of Bouncing 8.2 Potential Energy simulations Video: Gravity 8.3 Kinetic Energy simulaitons Video: Kinetic Energy, Lecture: Kinetic Energy 8.4 Conservation of Energy simulations Video: Newton Ball Tricks	Module 8 Quiz

			final velocity			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 9: Work, Power, and Simple Machines *(updated 1/28/21)*	SS.9P.2.3.1.1(A) Analyze the frequency, period and amplitude of an oscillatory system. For example: An ideal pendulum, a vibrating string, or a vibrating spring-and-mass system.	How are energy, work and simple machines related?	Describe completing work from a physics standpoint Describe what happens if motion is perpendicular to force Identify a unit of work Calculate how much work is done lifting an object Calculate how much work is done by the force of gravity when an object falls Calculate how much work was done by a lawnmower (given the force, the angle at which the force is applied, and the distance covered by the lawnmower) Recall the term for a measurement of the force amplification of a machine Recall the term for the work done on the object you are trying to move Recall the term for the work that you do Describe the actual mechanical advantage Describe the ideal mechanical advantage Describe the relationship between input force and output force Explain why input will exceed the output in real machines Calculate effort force given the resistance force and the AMA Calculate the AMA of a system Calculate the IMA of a system Recall the term for the rate at which work is done Recall how to calculate power using work and time Assuming no friction, calculate the minimum work needed to push an object up an incline given the mass of the object, distance covered, and the angle of the incline Calculate how much power a person uses to climb a flight of stairs given the person's mass, the height of the flight of stairs, and the length of time it takes the person	direct instruction graphic aids videos simulations section review questions Module Study Guide	9.1 Work simulations Video: Work and Energy 9.2 Machine simulations 9.3 Power simulations Videos: How does Work ... Work?, Engineering Engines, Work, Energy and Power	Module 9 Quiz
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**

Months 1-12						
Module 10: Thermal Energy *(updated 1/28/21)*	SS.9P.2.3.4.1(A) Describe and calculate the quantity of heat transferred between solids and/or liquids, using specific heat, mass and change in temperature.	How is thermal energy transferred from one place to another?	Identify the accepted theory of heat Explain why metals feel cold even when they are at room temperature Describe the average kinetic energy and total kinetic energy of a hot object •Convert K to °C(10.1)•Convert °Cto K Identify what affects the amount of a temperature increase Describe what J/kg•K means Calculate how much heat was absorbed by a metal (given the mass of the metal, the change in temperature, and the specific heat of the metal) Calculate how high the temperature of a specific material will rise(given the mass of the material, the amount of heat added and at what temperature, and the specific heat of the material) Describe what happens when a substance is in the solid state •Describe what happens when a substance is in the liquid state Describe what happens when a substance is in the gaseous state Calculate how much of a specific material will melt (given the amount of heat added and at what temperature, and the heat of fusion of the material)	direct instruction graphic aids videos simulations section review questions Module Study Guide	10.1 Heat, Temperature, and Thermal Energy Transfer simulations Videos: Thermodynamics and Temperature, Blender, the Next Stove? 10.2 Specific Heat simulation 10.3 Calorimetry simulation Video: Chemistry Tutorial 10.4 Change of State simulation Videos: Energy and Changing Processes, Latent Heat of Fusion and Vaporization	Module 10 Quiz
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 11: The Fluid States *(updated 1/29/21)*	SS.9P.2.3.4.2(A) Explain the role of gravity, pressure and density in the convection of heat by a fluid.	How much force and pressure do fluids exert when they are at rest or in motion?	Recall where fluid pressure equations can be applied Identify the variables in the pressure equation Calculate the pressure applied to the ground by a person's feet given his or her mass and the area covered by the person's feet Calculate the water pressure at a faucet Calculate the water pressure on the bottom of the swimming pool Describe how much water weight a submerged object	direct instruction graphic aids videos simulations section review questions Module Study Guide	11.1 Fluid Pressure simulations Video: Liquid Pressure 11.2 Archimedes' Law simulation 11.3 Pascal's Law simulation Video: Principle of Hydraulic Lift 11.4 Combined Gas Law simulation Video: Combined Gas Law 11.5 Universal Gas Law simulation Video: Ideal Gas Law	Module 11 Quiz

			displaces Compare the force exerted by the fluid below a submerged object with the force exerted by the fluid above the submerged object Identify what happens when the weight of the fluid displaced by the object is greater than the weight of the object Calculate the buoyant force on a cylinder when it is under water and determine if it will sink or float given its mass, height, diameter, and the formula for finding the volume of a cylinder Calculate how much water an object would need to displace in order to float given its mass Calculate the largest mass that can be lifted by the input force in a hydraulic lift given the cross-sectional area of the input line, cross-sectional area of the output line, and the input force Calculate how far the output platform can be lifted in a hydraulic lift given the lift's ideal mechanical advantage and how far the input platform is depressed Identify equations related to the Combined Gas Law Calculate the volume of a sample of gas after a change in temperature and pressure given its original volume, temperature, and pressure			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 12: Waves and Energy Transfer *(updated 1/29/21)*	SS.9P.2.3.1.2(A) Describe how vibration of physical objects sets up transverse and/or longitudinal waves in gases, liquids and solid materials. SS.9P.2.3.1.3(A) Explain how interference, resonance, refraction and reflection affect sound waves. SS.9P.2.3.1.4(A) Describe the Doppler effect changes that occur in an observed sound as a result of the motion of a source of the sound relative to a receiver.	What are the characteristic properties and behaviors of waves?	Calculate the spring constant for springs given the mass and distance Calculate how far springs will compress given the mass and spring constant Describe the relationship between the period of a wave and its frequency Calculate the time lapse between successive wave crests given the wave frequency Calculate the velocity of a wave given the frequency and wavelength Calculate the frequency of a wave given the wavelength,	direct instruction graphic aids videos simulations section review questions Module Study Guide	12.1 Simple Harmonic Motion simulation Video: Tom Altman and HSM at the Exploriatorium 12.2 Transverse Wave simulation Video: Waves 12.3 Longitudinal Wave simulation Video: Sound Explained 12.4 Reflection of Mechanical Waves simulation Video: Bell Lab Wave Machine 12.5 Refraction of	Module 12 Quiz Midterm Exam

			velocity, and length of time Calculate how many complete waves are emitted in a time interval given the wavelength, velocity, and length of time Calculate how far the wave front is from the source of the sound after a given period of time given the wavelength, velocity, and length of time Calculate the angle of incidence given the total angle between the incident ray and the reflected ray Identify cases where the law of reflection applies Explain what happens to the reflected wave when a wave pulse travels from a more dense medium into a less dense medium Explain what happens to the reflected wave when a wave pulse travels from a less dense medium into a more dense medium Calculate the wavelength of a wave in the original medium given the wavelength of the wave in a new medium and the ratio of the sinrto sini Describe the wavelength of the sound you hear as an emergency vehicle's siren comes towards you Describe the wavelength of the sound you hear as an emergency vehicle's siren moves away from you Calculate what frequency you will hear from a train coming toward you Calculate what frequency you will hear from a train going away from you		Mechanical Waves simulation 12.6 Doppler Effect simulation Video: Doppler Effect	
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 13: Light *(updated 1/29/21)*	SS.9P.2.3.3.2(A) Explain and calculate how the speed of light and its wavelength change when the medium changes. SS.9P.2.3.3.3(A) Explain the refraction and/or total internal reflection of light in transparent media, such as lenses and optical fibers. SS.9P.2.3.3.4(A) Use properties of light, including reflection, refraction, interference	What aspects of light change as light passes from one medium to another?	Describe light in relation to electromagnetic radiation Identify what electromagnetic radiation consists of Identify the equation that describes the relationship for the velocity, wavelength, and frequency of electromagnetic waves Explain why we can see objects that do not generate light Identify objects that generate their own light	direct instruction graphic aids videos simulations section review questions Module Study Guide	13.1 Light simulation Video: Light in the Shadows 13.2 Lasers Video: How a Laser Works 13.3 Reflection simulation Videos: Law of Reflection, Reflection, The Physics of Invisibility Cloaks 13.4 Refraction simulation Videos: Refraction without	Module 13 Quiz

	refraction, interference, Doppler effect and the photoelectric effect, to explain phenomena and describe applications.			Identify objects that reflect light Describe what happens to the wavelength of light as the frequency increases Recall which objects allow light rays to pass through them without disrupting the organization of the rays Recall which objects allow light rays to pass through them but disrupt the organization of the rays Recall which objects do not allow light rays to pass through them Recall what color will appear when an object generates all frequencies of light •Recall what color will appear when an object absorbs all frequencies of light Identify what color a red apple will appear when illuminated by white light Identify what color a red apple will appear when illuminated by blue light Identify what color a red apple will appear when illuminated by red light Recall wha tthe acronym "laser" represents Recall what kind of light a laser produces Identify a way of exciting atoms so that light can be emitted by them Describe what is reversed when you look into a mirror Calculate the angle of incidence of a light ray striking a mirrored surface at a given angle to the surface Calculate the angle of reflection of a light ray striking a mirrored surface at a given angle to the surface Describe the speed of light in different media Describe refraction Identify what happens when light enters a more optically dense medium Identify what happens when light enters a less optically dense medium Calculate the angle of refraction for light passing from air into water at a given incident angle Identify what is necessary for total internal reflection to occur Identify an example of total internal reflection	Math, Snell's Law 13.5 Total Internal Reflection simulation Video: Bending the LIght	

			Calculate the critical angle for light passing from diamond into air Determine if a laser beam will pass out of plastic into the air given the index of refraction for the plastic, the index of refraction for the air, and the angle of incidence in the plastic			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 14: Geometric Optics *(updated 1/29/21)*	SS.9P.2.3.3.2(A) Explain and calculate how the speed of light and its wavelength change when the medium changes. SS.9P.2.3.3.3(A) Explain the refraction and/or total internal reflection of light in transparent media, such as lenses and optical fibers. SS.9P.2.3.3.4(A) Use properties of light, including reflection, refraction, interference, Doppler effect and the photoelectric effect, to explain phenomena and describe applications.	How do lenses and mirrors form images?	Describe what is reversed when you look into a plane mirror Determine the image height of an object placed in front of a plane mirror given how tall the object is and how far away from the mirror it is Determine the image distance of an object placed in front of a plane mirror given how tall the object is and how far away from the mirror it is Calculate the angle of reflection given the angle of incidence a laser beam strikes a plane mirror with Calculate the angle between the incident beam and the reflected beam given the angle of incidence a laser beam strikes a plane mirror with Calculate the angle that the reflected ray makes with the surface of a plane mirror given the angle to the normal; the laser beam strikes the plane mirror with Identify an application of a concave mirror Determine the image height of an object placed in front of a concave mirror given how tall the object is, how far away from the mirror it is, and the radius of curvature of the mirror Determine the image distance of an object placed in front of a concave mirror given how tall the object is, how far away from the mirror it is, and the radius of curvature of the mirror Describe the image of a convex mirror Identify an application of a convex mirror Determine the image distance	direct instruction graphic aids videos simulations section review questions Module Study Guide	14.1 Plane Mirrors simulations Video: Reflections 14.2 Concave Mirrors simulations Videos: Curved Mirrors, Drawing Concave Mirror Diagrams 14.3 Convex Mirrors simulation Video: Concave Lens and Convex Mirrors 14.4 Double Convex Lenses simulations 14.5 Double Concave Lenses simulations Video: Concave Lens and Convex Mirrors, Light and Lens Images	Module 14 Quiz

			of an object placed in front of a convex mirror given how far away from the mirror it is and the focal length of the mirror Describe the focal point(s) of double convex lenses Determine the image distance of an object to the left of a convex lens given how far to the left of the lens the object is, and the focal length of the lens Determine the image height of an object to the left of a convex lens given how tall the object is, how far to the left of the lens the object is, and the focal length of the lens Recall whether concave lenses only create virtual images Identify what must occur when using the lens equation with a concave lens			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 15: Diffraction and Interference of Light *(updated 1/29/21)*	SS.9P.2.3.3.2(A) Explain and calculate how the speed of light and its wavelength change when the medium changes. SS.9P.2.3.3.3(A) Explain the refraction and/or total internal reflection of light in transparent media, such as lenses and optical fibers. SS.9P.2.3.3.4(A) Use properties of light, including reflection, refraction, interference, Doppler effect and the photoelectric effect, to explain phenomena and describe applications. SS.9P.2.3.3.5(A) Compare the wave model and particle model in explaining properties of light.	What are the main conditions to produce interference of light?	Explain what it means for waves to be "in phase" Explain what it means for waves to be "out of phase" Calculate how far the center of the central bright band is to the first dark band given the wavelength of the monochromatic light, the width of the slit, and how far the slit is away from the screen Explain why the edges of shadows are often fuzzy Recall who proved that light is a wave Identify which waves can produce diffraction Recall where circular waves are produced when straight waves strike an impenetrable barrier Recall how many sources of waves you need to create interference patterns Identify what causes a cancelation of the two waves when two waves interfere •Identify what causes a summation of the two waves when two waves interfere Describe an instance of destructive interference Describe an instance of constructive interference Explain why dark bands are a result of destructive	direct instruction graphic aids videos simulations section review questions Module Study Guide	15.1 Single Slit Diffraction simulation Video: Single Slit Diffraction 15.2 Double Slit Diffraction simulation 15.3 Diffraction Gratings simulation Video: Diffraction Gratings	Module 15 Quiz

			interference Explain why bright bands are a result of constructive interference Calculate the separation between the slits given the wavelength of the light, how far apart the first order fringe is from the central line, and how far apart the screen is from the slits Calculate the wavelength of the light given how far apart the two slits are, how far apart the first order fringe is from the central line, and how far apart the screen is from the slits Recall what diffraction grating is composed of Calculate the distance between two lines on the diffraction grating given the lines/cma grating has Determine the wavelength of a spectral line given the lines/cm the diffraction grating has, and at what angle the discrete spectral line occurs in the first order spectrum Calculate the wavelength of the light of a line appearing from the central line on the screen given the spacing of the diffraction grating, how far the line appears from the central line on the screen, and how far the screen is from the grating Identify which color will be closest to the central white when white light is directed toward a diffraction grating causing its monochromatic bands to appear on the screen			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 16: Static Electricity *(updated 1/29/21)*	SS.9P.2.3.2.1(A) Explain why currents flow when free charges are placed in an electric field, and how that forms the basis for electric circuits.	How does an electric field affect charge movement?	Describe lightning Identify examples of static electricity Recall who determined that atoms contain electrons and protons Describe what happens when an atom is said to be a negative ion Describe what happens when an atom is said to be a positive ion Describe what happens when an atom is said to be neutral Describe what happens when	direct instruction graphic aids videos simulations section review questions Module Study Guide	16.1 Electric Charge and Electric Force simulations Video: Magnetic Levitation 16.2 Coulomb's Law simulations	Module 16 Quiz

			two neutral objects are brought near each other Describe what happens when two negatively charged objects are brought near each other Describe what happens when two positively charged objects are brought near each other Describe what happens when a negatively charged object is brought near a positively charged object Identify examples of conductors Identify examples of insulators Recall who determined the relationship between the electrical force, the size of the charge, and the separation between the charges Identify what it means when the sign of the electrical force between two charges is negative Identify what it means when the sign of the electrical force between two charges is positive Describe the constant K Calculate the force on Object A given the charges of Object A and Object B, the distance between Object A and Object B, and the constant of proportionality			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 17: Electric Fields *(updated 1/29/21)*	SS.9P.2.3.2.2(A) Explain and calculate the relationship of current, voltage, resistance and power in series and parallel circuits. For example: Determine the voltage between two points in a series circuit with two resistors.	How does an electric field affect charge movement?	Recall who developed the concept of an electric field Calculate the magnitude of an electric field given the charge and force Calculate the electric field intensity at the location of the test charge given the force on the test charge and value of the positive test charge Identify what happens when two negatively charged objects are brought near each other Identify what happens when two positively charged objects are brought near each other Identify what happens when a negatively charged object is brought near a positively charged object Identify what happens when two negatively charged objects are moved away from each	direct instruction graphic aids videos simulations section review questions Module Study Guide	17.1 Electric Fields simulations 17.2 Voltage simulations 17.3 Millikan Oil Drop Experiment simulations Video: Capacitors 17.4 Capacitors	Chapter 17 Quiz

			other Identify what happens when two positively charged objects are moved away from each other Identify what happens when a negatively charged object is moved away from a positively charged object Calculate the magnitude of the electric field strength between two large parallel plates given the potential difference and how far apart the plates are •Calculate the potential difference between two large parallel metal plates given how far apart they are, the magnitude of the electric field between them, and the charge of an electron Calculate what work is done between two large parallel metal plates when one electron is moved from the positive to the negative plate given how far apart they are, the magnitude of the electric field between them, and the charge of an electron Recall who determined the charge on a single electron Describe what happens when a charged conductor touches an uncharged conductor Recall whether spheres will always have the excess charge on the surface Explain why large trucks are grounded via a large chain hanging off the back Calculate the capacitance of two plates of a capacitor given their charges and potential difference Calculate how much charge flows from a battery when it is connected to a microfarad capacitor given the voltage of the battery and the capacitance of the capacitor			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 18: Current Electricity *(updated 1/29/21)*	SS.9P.1.3.3.1(A) Describe changes in society that have resulted from significant discoveries and advances in technology in physics. For example: Transistors, generators, radio/television, or	How is energy converted from one form to another?	Recall whether the charges in a circuit can be created or destroyed Identify what virtually all electric currents consist of Calculate the current that flows through a light bulb given the	direct instruction graphic aids videos simulations section review questions	18.1 Current simulations Video: Electric Current 18.2 Ohm's Law simulations Video: Ohm's Law 18.3 Energy Transfer in	Module 18 Quiz

	microwave ovens. SS.9P.2.3.2.3(A) Describe how moving electric charges produce magnetic forces and moving magnets produce electric forces. SS.9P.2.3.2.4(A) Use the interplay of electric and magnetic forces to explain how motors, generators, and transformers work.		power and voltage Calculate the power delivered to a light bulb given the voltage drop and current •Calculate the power consumed by an electric motor connected across battery terminals given the voltage and current Calculate how much electric energy is delivered in a given amount of time by an electric motor connected across battery terminals given the voltage and current •Recall what happens to the current if the potential stays the same and the resistance increases Recall what happens to the current if the resistance stays the same and the potential decreases Calculate the resistance in a circuit given the voltage and current Calculate how much current can be pushed through a resistor by a battery given the voltage and resistance Calculate the voltage required to push a given amount of current through the given resistance of a resistor Calculate how many joules of energy is provided by a heater given the resistance, voltage, and length of time Calculate how much energy in kWh an appliance uses per day given the current, voltage, length of time, and how many J are in a kWh Calculate how much it costs to run an appliance for a given amount of time given the current, voltage, length of time, how many J are in a kWh, and cost per kWh Recall what happens to the resistance if a wire conductor increases in diameter	Module Study Guide	Electric Circuits simulation Video: Electrical Energy 18.4 Controlling Current in Electric Circuits simulations Video: How Lightbulbs and Fuses Work	

Unit	Benchmarks	Essential Questions	Learning Objectives	Instructional Strategies	Resources	Assessments
Months 1-12						
Module 19: Electrical Circuits *(updated 1/29/21)*	SS.9P.2.3.2.2(A) Explain and calculate the relationship of current, voltage, resistance and power in series and parallel circuits. For example: Determine the voltage	How is energy utilized in an electric circuit?	Identify characteristics of anammeter Identify characteristics of a voltmeter •Given a sketch, identify which position would be appropriate for the placement of an	direct instruction graphic aids videos simulations section review questions	19.1 Ammeters and Voltmeters simulations Video: A Simple Circuit: Ammeters and Voltmeters 19.2 Series Circuits simulations	Module 19 Quiz

	between two points in a series circuit with two resistors. SS.9P.2.3.2.4(A) Use the interplay of electric and magnetic forces to explain how motors, generators, and transformers work.			for the placement of an ammeter Given a sketch, identify which position would be appropriate for the placement of a voltmeter Given a sketch, identify which position would be appropriate to hold anammeter that would read the total current through the circuit Given a sketch, identify which position could hold a voltmeter that would read the total voltage drop through the circuit Recall what must remain the same throughout a series circuit Calculate the total resistance of the circuit given the resistance in three resistors connected in series across a 120 V generator Calculate the current in the circuit given the resistance in three resistors connected in series across a 120 V generator Calculate the voltage drop across one of the resistors given the resistance in three resistors connected in series across a 120 V generator Calculate the equivalent resistance of the circuit given the resistance in three resistors connected in a series across a 80.0 V battery Calculate the current in the circuit given the resistance in three resistors connected in a series across a 80.0 V battery •Calculate the voltage drop across one of the resistors given the resistance in three resistors connected in a series across a 80.0 V battery •Recall when Ohm's Law applies Calculate the current through each branch of the circuit given the resistance in three resistors connected in parallel and placed across a potential difference of 30.0 V Calculate the equivalent resistance of the parallel circuit given the resistance in three resistors connected in parallel and placed across a potential difference of 30.0 V Calculate the total current through the circuit given the resistance in three resistors connected in parallel and	questions Module Study Guide	simulations Video: Series Circuit Basics 19.3 Parallel Circuits simulations Video: Series and Parallel Circuits 19.4 Combined Series Parallel Circuits simulations Video: Combination Circuit Simplification	

			placed across a potential difference of 30.0 V			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 20: Magnetic Fields *(updated 3/10/21)*	SS.9P.2.3.2.3(A) Describe how moving electric charges produce magnetic forces and moving magnets produce electric forces. SS.9P.2.3.3.6(A) Compare the wavelength, frequency and energy of waves in different regions of the electromagnetic spectrum and describe their applications.	How does a current create a magnetic field?	Recall how long magnets have been used in navigation Recall what can be concluded from the fact that the Earth's geographic north pole attracts the north poles of magnets Describe the force between two north poles Describe the force between a north pole and a south pole Recall where the strength of a magnetic field of a magnet is the strongest Describe ferromagnetic materials •Identify common ferromagnetic materials Explain why a magnet can attract a non-magnetized piece of iron Recall whether permanent magnets can lose their magnetic properties •Describe how electricity and magnetism are inextricably linked •Recall under which circumstance you would use the right hand rule to determine the relationships between the moving charged particle, magnetic field, and the force exerted Recall under which circumstance you would use the left hand rule to determine the relationships between the moving charged particle, magnetic field, and the force exerted Determine which way the path of a particle will bend in a scenario with a magnetic field Calculate what force acts on a wire given how long the wire is, how much current it carries, and the magnetic field strength the wire is perpendicular to Calculate what force acts on an electron moving at right angles to a magnetic field given how fast the electron is traveling, the magnetic field strength, and the charge of an electron •Describe what happens to the strength of an electromagnet if	direct instruction graphic aids videos simulations section review questions Module Study Guide	20.1 Magnet simulations Video: Crealev, Levitating, Floating, Flying 20.2 Magnetic Fields simulations Video: Magnetic Effect of Electric Current 20.3 Electromagnet simulations Video: Build an Electromagnet simulations Video: Build an Electric Motor 20.4 Electric Motor	Module 20 Quiz

			the number of loops of wire is increased Describe what happens to the strength of an electromagnet if the current in the wire is increased Explain why the magnetic field within a solenoid can be quite large Explain why the magnetic field in a solenoid is greatly increased if a piece of iron is placed inside the coil of wire Compare the magnetic fields of a solenoid and a charged electromagnet Describe what electric motors convert			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 21: Electromagnetic Induction *(updated 3/10/21)*	SS.9P.2.3.2.3(A) Describe how moving electric charges produce magnetic forces and moving magnets produce electric forces. SS.9P.2.3.2.4(A) Use the interplay of electric and magnetic forces to explain how motors, generators, and transformers work. SS.9P.2.3.3.1(A) Describe the nature of the magnetic and electric fields in a propagating electromagnetic wave. SS.9P.2.3.3.5(A) Compare the wave model and particle model in explaining properties of light. SS.9P.2.3.3.6(A) Compare the wavelength, frequency and energy of waves in different regions of the electromagnetic spectrum and describe their applications.	Why is Lenz's law important?	Recall whether electromotive force is a force Recall which unit electromotive force is measured in Describe what electrical generators convert Describe what electric motors convert Identify what EMF depends on Calculate the induced EMFof a straight wire moving perpendicularly through a magnetic field given the length of the wire, the velocity of the wire in the field, and the magnetic field strength Identify when the current generated in an electric generator will have the greatest EMF List the three things necessary to produce EMFmechanically Identify what will increase the output of a generator when it is increased Compare the average power of an AC current to the power of an equivalent DC current Calculate the effective voltage of a generator in a power plant given its maximum voltage Calculate the effective current delivered by a generator in a power plant given the maximum voltage and maximum current it delivers Calculate the effective current that flows through a light bulb placed across a generator in a power plant given the	direct instruction graphic aids videos simulations section review questions Module Study Guide	21.1 Electromotive Force simulation 21.2 Generators simulation 21.3 Lenz's Law simulation 21.4 Transformers simulation Video: Electromagnetism	Module 21 Quiz

			maximum voltage the power plant develops, the wattage of the bulb, and the maximum current that flows through the bulb Recall what happens when the light bulb is removed from a hand-cranked demonstration generator Describe how the same power can be transmitted using different levels of voltage and current Recall what power companies do before transmitting power over extended distances Recall what power companies do after transmitting power over extended distances Identify a way of causing relative motion between the charges in a wire and a magnetic field Calculate the voltage on the secondary coil of a particular step-up transformer in a scenario Calculate the current in the primary coil of a particular step-up transformer in a scenario Calculate the power in the primary circuit of a particular step-up transformer in a scenario Calculate the power in the secondary circuit of a particular step-up transformer in a scenario			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 22: The Nucleus *(updated 1/29/21)*	SS.9P.2.3.4.3(A) Compare the rate at which objects at different temperatures will transfer thermal energy by electromagnetic radiation.	Why do nuclei emit radiation?	Recall the year of the world's first observation of a neutrino in a hydrogen bubble chamber Recall what atoms of the same element always have the same number of in their nuclei Recall the smallest particles known to date Identify how many quarks there are Identify how many families of quarks there are Name the families of quarks Recall which type of interaction binds protons and neutrons together Identifythe parts of a nuclear symbol Determine the number of	direct instruction graphic aids videos simulations section review questions Module Study Guide	22.1 Quarks simulation Video: Inside the Atom 22.2 Isotopes and Nuclear Stability simulation Video: What are Isotopes? 22.3 Radioactivity simulation Video: Radiation and Radioactive Decay 22.4 Nuclear Reactions simulation Video: Radioactivity 22.5 Nuclear Reactors simulation Video: How a Nuclear Reactor Works	Module 22 Quiz

			neutron sand protons given a nuclear symbol Name the three types of radiation Identify the nuclear equation showing alpha decay of a given isotope Identify the nuclear equation showing beta decay of a given isotope Calculate the mass of an element after a given amount of time given its nuclear symbol, half life and starting mass •Calculate how many half lives an element will have after a given amount of time given its nuclear symbol and half life •Describe the projection of the world's supply of U-235 Recall what nuclear power plants use in order to produce electricity Identify what will function as fuel in a fission reactor Identify the difference between a nuclear power plant and a fossil fuel plant			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 23: The Atom *(updated 1/29/21)*	SS.9P.1.3.3.1(A) Describe changes in society that have resulted from significant discoveries and advances in technology in physics. For example: Transistors, generators, radio/television, or microwave ovens.	Who are the key individuals in the evolution of our understanding of the atom and what are their contributions?	Describe the size of the atom and what it is mostly filled with Recall who was one of the first to hypothesize the existence of atoms as indivisible particles Recall who suggested that the energy of atomic electrons came in packages and only whole packages could be absorbed or emitted Recall who was responsible for the gold foil experiment Recall who was the first to make careful quantitative measurements which allowed the compositions of compounds to be determined accurately Recall who established the Law of Definite Proportions Recall who established the Law of Simple Proportions Recall who created the first periodic table Recall who helped disprove the indivisibility of the atom Recall who proposed the "plum-pudding" model of the atom Recall who proposed the	direct instruction graphic aids videos simulations section review questions Module Study Guide	23.1 Bohr's Atomic Model simulation Video: Structure of the Atom (4) 23.2 Quantum Mechanical Atomic Model simulation Video: Structure of the Atom (6)	Module 23 Quiz

			nuclear model of the atom Recall what provided major clues to the electron arrangement in an atom Describe what the gold foil experiment demonstrated Recall how many electrons the largest known atom contains Describe the limitation of the wave-particle duality of electrons within the electron cloud Determine how many energy levels are necessary to contain a given number of electrons in an electron cloud Recall the number of electrons for the first four principal quantum numbers			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 24: Astrophysics *(updated 1/29/21)*	SS.9P.1.3.3.1(A) Describe changes in society that have resulted from significant discoveries and advances in technology in physics. For example: Transistors, generators, radio/television, or microwave ovens. SS.9P.2.2.1.3(A) Use gravitational force to explain the motion of objects near Earth and in the universe.	Who are the key individuals in the evolution of our understanding of the universe and what are their contributions?	Identify the model where the earth is the center of the universe Identify the model where the sun is the center of the universe Recall roughly how many years ago our universe began as a small, extremely dense point of matter Recall the dominant and highly supported theory of the origin of the universe Recall who was the first to think that the Earth was round Recall who was the first to suggest a sun-centered solar system Recall who contributed reasons for why objects follow Kepler's laws Recall who incorporated Aristotle's ideas on astronomy into the Catholic Church's theology Recall who is best known for his accurate and detailed collection of astronomical observations Recall who suggested that the orbits of the planets were elliptical and not circular Recall who provided powerful support for the Copernican system with observations from his telescope Recall who produced his three laws of planetary motion based on Tycho's observations	direct instruction graphic aids videos simulations section review questions Module Study Guide	24.1 History of Astronomy simulations Video: Tech Icons: Robert Wilson 24.2 Life Cycles of Stars Video: A Stars Lifecycle 24.3 The Hertzsprung Russell Diagram Video: HR Diagram	Module 24 Quiz

			Identify Kepler's Laws of Planetary Motion Identify what all stars begin as Recall when our Sun was probably born in a nebula Describe what stars spend the majority of their life fusing Describe the fusion occurring in our Sun Identify the correct life cycle for a very large mass star Identify what prevents a star from collapsing during its main sequence life time Identify which type of star has the shortest life span Identify which type of star has the longest life span Recall what the smallest stars end their life as Recall what medium-sized stars end their life as Recall what the largest stars end their life as Describe what happens after a star has lived through its red giant stage Recall the color of the stars with the highest surface temperature Recall the color of the stars with the lowest surface temperature Recall which stars are less bright than their temperature would predict Recall which stars are more bright than their temperature would predict Describe a luminosity of 100 based on the H-R diagram Explain why the Sun is more luminous than a white dwarf even though the Sun has a lower temperature than a white dwarf			
Unit	**Benchmarks**	**Essential Questions**	**Learning Objectives**	**Instructional Strategies**	**Resources**	**Assessments**
Months 1-12						
Module 25: Relativity *(updated 1/29/21)*	SS.9P.1.3.3.1(A) Describe changes in society that have resulted from significant discoveries and advances in technology in physics. For example: Transistors, generators, radio/television, or microwave ovens. SS.9P.2.2.2.1(A) Explain and calculate the work, power, potential energy and kinetic energy involved in objects moving	How is time defined in physics?	Recall who introduced the theory of special relativity Describe the special theory of relativity •Identify postulates of special relativity •Identify what changes as an object reaches the speed of light Describe an object's mass and the energy required to accelerate the object if it could	direct instruction graphic aids videos simulations section review questions Module Study Guide	25.1 Special Theory of Relativity simulations Videos: Can You Go the Speed of Light?, Simple Relativity 25.2 General Theory of Relativity simulation Videos: NEW Gravitational Wave Discovery, The Absurdity of Detecting	Module 25 Quiz Final Exam

	involved in objects moving under the influence of gravity and other mechanical forces.		equal or exceed the speed of light Identify the equation for mass-energy equivalence Calculate how much energy would be produced if a given amount of mass was completely converted into energy Given a scenario where a man stands on top of a moving car and tosses a wooden block straight up in the air, determine where the wooden block will come back down if there is no air resistance Given the speed at which a spaceship passes the earth, determine the length of a meter stick laying on a table in the ship and pointing in the direction of motion of the ship as measured by a person on the ship Given the speed at which a spaceship passes the earth, determine the length of a meter stick laying on a table in the ship and pointing in the direction of motion of the ship as measured by a person on the earth Determine if we need to make design changes to accommodate passengers and crew of a spaceship if the spaceship will shrink when it travels at a speed of 0.85 c Describe the theory of general relativity Compare a straight line on a curved surface and a straight line on a flat surface Describe what happens to a light beam when measured in the presence of an extreme gravitational field Recall what produces the same effect as acceleration Identify which event helped increase the acceptance of the theory of general relativity Recall what accurately predicts the movement of objects when gravitational field strength is extremely high Describe what the theory of relativity suggests about time on the top of a mountain compared to time at sea level Determine what speed you would measure for the speed of light arriving at your ship from a star given the speed		Gravitation, Neutron Star Gravitational Waves, Albert Einsteins Theory of Relativity	

			you are traveling toward the star			