

Unit	Lesson	Lesson Objectives
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One-Dimensional Motion and Forces**Speed and Velocity**

- Describe the motion of an object using different reference frames.
- Differentiate between speed and velocity.
- Interpret motion maps to describe linear motion.
- Use graphs and equations to solve speed and velocity problems.

Acceleration

- Distinguish between constant velocity and constant acceleration.
- Interpret motion maps to describe linear motion.
- Solve problems involving distance, time, velocity, and acceleration.
- Use graphs to analyze motion with constant acceleration.

Lab: Motion with Constant Acceleration

- Calculate the average velocity of a moving object.
- Recognize the relationships between position, time, velocity, and acceleration.
- Use graphs to determine acceleration.

Introduction to Forces

- Analyze free-body diagrams.
- Determine how net force affects the motion of an object.
- Identify and describe various forces.

Newton's First and Third Laws

- Describe Newton's first law of motion and how it relates to inertia.
- Explain Newton's third law of motion and how it relates to action and reaction forces.
- Use vectors to calculate the effect of forces on objects.

Newton's Second Law

- Calculate force, mass, or acceleration given the other two quantities.
- Describe Newton's second law of motion.
- Interpret free-body diagrams for accelerating objects.

Lab: Newton's Second Law

- Calculate the acceleration of a moving object.
- Determine how force and mass affect acceleration.

Impulse and Momentum

- Analyze and compare the momentum and impulse of different objects.
- Calculate mass, velocity, or momentum given the other two quantities.
- Describe impulse and how it relates to momentum.
- Solve problems involving impulse.

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Conservation of Momentum

Apply the law of conservation of momentum to analyze collisions between objects.

Describe the law of conservation of momentum.

Solve problems involving the conservation of momentum.

Use mathematical representations to show that the total momentum of a system of objects is conserved when there is no net force on the system.

Lab: Conservation of Linear Momentum

Calculate the momentum of a moving object before and after a collision.

Demonstrate that momentum is conserved during a collision.

Two-Dimensional Motion**Vectors**

Resolve a vector into horizontal and vertical components.

Use vector diagrams to determine the resultant vector.

Projectile Motion

Identify examples of projectile motion.

Recognize that the horizontal and vertical motions of a projectile are independent.

Solve problems involving projectile motion.

Universal Law of Gravitation

Describe the effect of gravity on an object.

Explain the relationships among gravitational force, mass, and distance.

Solve problems that involve the universal law of gravitation.

Use mathematical representations to predict the gravitational and electrostatic forces between objects.

Centripetal Acceleration

Define and identify examples of centripetal acceleration.

Describe and calculate tangential speed.

Solve problems involving centripetal acceleration.

Circular Motion

Describe how circular motion is caused by centripetal force.

Explain the relationship between centripetal force and inertia.

Interpret motion maps to describe circular motion.

Use centripetal force concepts to solve problems.

Orbital Motion

Explain how Newton's universal law of gravitation affects orbital motion.

Identify the forces acting on an object in orbit.

Solve problems involving the orbital speed and period of an object in orbit.

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Earth-Moon-Sun System

- Describe Kepler's three laws of planetary motion.
- Explain the effects of Earth, the moon, and the Sun on each other.
- Solve problems using Kepler's laws.

Work and Energy**Work and Power**

- Calculate work and power.
- Compare the work done in different situations.
- Define and describe work.
- Explain how work and power are related.

Potential Energy

- Identify and describe different types of potential energy.
- Solve problems involving the potential energy of an object.

Kinetic Energy

- Calculate kinetic energy, mass, or velocity given the other two quantities.
- Define kinetic energy and identify situations in which it's present.
- Describe the work-energy theorem and use it to solve problems.

Lab: Kinetic Energy

- Calculate the kinetic energy of objects of different mass.
- Determine the kinetic energy of objects at different speeds.
- Graph data to illustrate changes in kinetic energy.

Energy Transformations

- Analyze and interpret energy transfer diagrams.
- Explain how energy changes form.
- Identify and describe examples of energy transformations.
- Solve problems involving energy transformations.

Conservation of Energy

- Apply the law of conservation of energy to solve problems.
- Explain the law of conservation of energy.
- Use energy transfer diagrams to illustrate that energy is conserved.

Thermodynamics**Temperature and Heat**

- Describe specific heat and explain why it differs from one substance to another.
- Distinguish between temperature, thermal energy, and heat.
- Explain how temperature relates to kinetic energy.
- Solve problems involving specific heat.

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		<p>Heat Transfer</p> <ul style="list-style-type: none"> Describe how fluid movement transfers thermal energy by convection. Explain how electromagnetic waves transfer energy by radiation. Explain how molecular movement transfers thermal energy by conduction. <p>Lab: Mechanical Equivalent of Heat</p> <ul style="list-style-type: none"> Calculate gravitational potential energy and heat. Describe the conversion of gravitational potential energy to thermal energy in a system. Relate the potential energy of an object to the temperature change of water. <p>States of Matter</p> <ul style="list-style-type: none"> Differentiate among the four states of matter. Identify the properties of the fourth state of matter: plasma. <p>Changes of State</p> <ul style="list-style-type: none"> Explain and interpret heating curves. Identify and describe the six changes of state. Solve problems involving latent heat of fusion and latent heat of vaporization. <p>First Law of Thermodynamics</p> <ul style="list-style-type: none"> Apply the first law of thermodynamics to describe how heat engines work. Explain the first law of thermodynamics. Solve problems using the first law of thermodynamics. <p>Second Law of Thermodynamics</p> <ul style="list-style-type: none"> Apply the second law of thermodynamics to describe how heat engines work. Describe how the first and second laws of thermodynamics are related. Explain why entropy increases over time.
		<p>Energy in the Earth</p> <p>Earth's Interior</p> <ul style="list-style-type: none"> Compare and contrast the three main layers of Earth. Explain how geologists learn about Earth's interior. <p>Plate Tectonics</p> <ul style="list-style-type: none"> Distinguish the three types of plate boundaries. Explain the theory of plate tectonics. Identify the major tectonic plates. Relate plate tectonics to the formation of landforms. <p>Forces in Earth's Crust</p> <ul style="list-style-type: none"> Explain how stress in the crust affects Earth's surface. Explain why faults form in particular areas. Identify land features that result from plate movement.

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Lab: Plate Boundaries and Movement

- Compare and contrast the plate movements that cause earthquakes and volcanic eruptions.
- Describe the role of mantle convection in plate movement.
- Differentiate between the major types of plate boundaries.
- Examine how plate movements cause changes in Earth's surface.

The Sun's Energy

- Examine how energy is transferred from the core to space.
- Identify and describe the steps of hydrogen fusion.
- Recognize the types of energy emitted by the Sun.

Factors That Affect Climate

- Explain how various factors affect weather and climate.
- Explain what causes seasons.

Waves, Sound, and Light**Introduction to Waves**

- Compare and contrast transverse waves and longitudinal waves.
- Define waves and explain how they carry energy.
- Differentiate mechanical and electromagnetic waves.
- Identify everyday examples of transverse and longitudinal waves.

Wave Properties

- Analyze the relationship between wavelength, frequency, and wave speed.
- Identify and describe the properties of transverse and longitudinal waves.
- Identify factors that affect wave speed.
- Solve problems involving wavelength, frequency, and wave speed.
- Use mathematical representations to show relationships among the frequency, wavelength, and speed of waves traveling in various media.

Wave Interactions

- Compare and contrast constructive and destructive interference.
- Distinguish between absorption, transmission, reflection, refraction, and diffraction.
- Identify everyday examples of wave interactions.

Sound Waves

- Analyze how sounds are created and propagated.
- Examine how the Doppler effect applies to sound waves.
- Identify and describe properties of sound waves.

Radio Waves and Applications

- Analyze how radio waves are modified for use in different technologies.
- Explain why antennas are needed for technological devices that use radio waves.
- Identify and describe technological uses of radio waves.

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		Electromagnetic Waves <ul style="list-style-type: none">Identify and compare the different regions of the electromagnetic spectrum.Identify uses and applications of electromagnetic waves.Solve problems involving frequency, wavelength, speed, and energy.
		Dual Nature of Light <ul style="list-style-type: none">Calculate the energy of a photon.Describe and give evidence for the dual nature of light.Examine the photoelectric effect.
		Reflection and Refraction <ul style="list-style-type: none">Analyze and interpret ray diagrams.Apply Snell's law to solve problems.Differentiate between reflection and refraction.Use the law of reflection to make predictions.
		Mirrors <ul style="list-style-type: none">Distinguish between plane, concave, and convex mirrors.Interpret ray diagrams to predict the location, type, orientation, and size of an image formed by a mirror.Solve problems involving mirrors.
		Lenses <ul style="list-style-type: none">Distinguish between concave and convex lenses.Interpret ray diagrams to predict the location, type, orientation, and size of an image formed by a lens.Solve problems involving lenses.
		Diffraction <ul style="list-style-type: none">Analyze how light waves bend around objects.Identify everyday examples of diffraction.Solve problems involving diffraction.
		Electricity and Magnetism
		Electrostatics <ul style="list-style-type: none">Analyze the relationship between electric charge and electric force.Distinguish between conductors and insulators.Examine charging by friction, conduction, and induction.
		Coulomb's Law <ul style="list-style-type: none">Compare electric force with gravitational force.Examine the factors that affect the electric force between two objects.Solve problems using Coulomb's law.

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		Electric Fields <ul style="list-style-type: none">Analyze and interpret electric field lines.Describe the electric field due to a charge.Solve problems involving the electric field, charge, and force on an object.
		Ohm's Law <ul style="list-style-type: none">Examine current, resistance, and voltage.Solve problems involving current, charge, and time.Use Ohm's law to calculate voltage, current, or resistance.
		Electric Circuits <ul style="list-style-type: none">Apply Ohm's law to calculate voltage, current, or resistance in a parallel or series circuit.Compare and contrast parallel and series circuits.Identify circuits as open, closed, or short.Interpret circuit diagrams.
		Lab: Circuit Design <ul style="list-style-type: none">Calculate the power used by elements in a circuit.Construct series and parallel circuits.Use Ohm's law to calculate current, voltage, and resistance.
		Magnets and Magnetism <ul style="list-style-type: none">Analyze the magnetic field around a magnet.Determine how magnetic poles interact with each other.Distinguish between temporary and permanent magnets.Examine how magnetic domains are aligned in a magnet.
		Magnetic Field and Force <ul style="list-style-type: none">Analyze the magnetic field produced by a current-carrying wire.Apply the right-hand rule to determine the direction of the magnetic force on a charge.Solve problems involving magnetic force.Use the right-hand rule to determine the direction of the magnetic field in a current-carrying wire.
		Electromagnetic Induction <ul style="list-style-type: none">Examine how an electric current is produced by a magnet.Identify the characteristics of solenoids and electromagnets.Indicate how magnetism is produced by electric currents.
		Lab: Electromagnetic Induction <ul style="list-style-type: none">Examine how magnetic polarity affects the direction of induced current in a loop of wire.Recognize that a moving magnet can induce an electric field, causing current to flow in a loop of wire.

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Nuclear and Modern Physics		
Radioactivity		
<p>Determine possible problems associated with radioactive decay.</p>		
<p>Distinguish between alpha, beta, and gamma decay.</p>		
<p>Identify technological applications of radioactive decay.</p>		
<p>Use the half-life concept to describe the rate of decay of an isotope.</p>		
Lab: Half-Life Model		
<p>Interpret a graph showing the decay of a radioactive substance.</p>		
<p>Use a model to investigate half-life.</p>		
Origin and Evolution of the Universe		
<p>Analyze how stellar spectra are used to identify the composition and motion of a star.</p>		
<p>Describe the evolution of the universe.</p>		
<p>Distinguish between the different types of stars and their life cycles.</p>		
<p>Examine evidence for the big bang theory.</p>		
The Sun		
<p>Describe the structure, composition, and physical properties of the Sun.</p>		
<p>Discuss the different types of solar activity and explain how each activity affects Earth.</p>		
<p>Explain how the Sun generates energy.</p>		
<p>Science Practice: Describe units used by astronomers to measure the distance between the Sun and Earth.</p>		
Stars		
<p>Explain how a star forms.</p>		
<p>Explain how stars are classified.</p>		
<p>Explain what happens as a star runs out of fuel.</p>		
<p>Identify the physical properties of stars.</p>		
Atomic Spectra		
<p>Compare and explain the emission spectra produced by various atoms.</p>		
<p>Define spectroscopy and its applications.</p>		
<p>Outline the historical development of the atomic theory.</p>		
<p>Understand the concepts of emission and absorption spectra.</p>		
Technological Design		
<p>Compare and contrast technological design and scientific investigation.</p>		
<p>Describe the four stages of technological design.</p>		
<p>Evaluate a technological design or product to determine if it meets designated criteria.</p>		
Nanotechnology		
<p>Define nanotechnology.</p>		
<p>Explain the role of nanotechnology in applications such as medicine, electronics, and new biomaterials.</p>		
<p>Explain the role of quantum mechanics in nanotechnology.</p>		