



Accelerated Physics

Course Description:

Accelerated Physics is the study of the properties and interactions of matter and energy. Through hands-on explorations that integrate math and technology, students will develop a strong understanding of content and skills. During the first semester, the content focus is force and motion with crosscutting concepts of patterns and cause and effect relationships. During the second semester, the content focus is energy (in a wide variety of forms) with crosscutting concepts of systems and the law of conservation of energy. The course is designed to lay a strong foundation of science concepts and skills that will be built upon in subsequent science courses.

Accelerated Physics will cover more topics at a greater depth and faster pace than Physics. Students taking Accelerated Physics should have a strong understanding of basic algebra. Trigonometry and advanced mathematical techniques will be taught and used throughout the course. It is highly recommended that students taking Honors Geometry or higher enroll in Accelerated Physics. Students in Geometry should enroll in Accelerated Physics if they are comfortable with the pace and mathematical requirements. Students in Algebra should enroll in Physics.

Grade Level(s): 9th

Course Scope and Sequence:

Unit 1: Balanced Forces

Unit 2: Constant Velocity

Unit 3: Unbalanced Forces and Acceleration

Unit 4: Energy

Unit 5: Work, Power, and Efficiency

Unit 6: Electricity

Unit 7: Waves

9-12 Physics

Unit 1: Balanced Forces

If the forces on an object are balanced, there will be no change in its velocity. The motion of an object can be described by mathematical, graphical, verbal, and/or pictorial models.

Unit Essential Learning Targets

<i>Enduring Understandings</i> Transferable, conceptual big ideas having enduring value (These help organize “Know” and “Do” items)	<i>Essential Questions</i>
- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. - Use mathematical representations of phenomena to describe explanations.	- Open ended to promote inquiry - These highlight big ideas that this unit will require students to address
<i>Students must know:</i> Straightforward facts, concepts, and vocabulary	<i>Students must be able to:</i> Skills such as techniques, approaches, and processes (not necessarily specific performance goals)
- Inertia is a property of mass - Mass is a measurement of matter; weight (force of gravity) is dependent on the mass and the gravitational force of a nearby object - The relationship between different forces at rest or constant velocity - The relationship between the action force and the reaction force is equal in quantity and opposite in direction	- Measure forces acting on an object - Identify and describe the forces acting on an object using a force diagram - Gather data and analyze the relationship between the force of gravity on an object and its mass - Gather data and analyze the relationship between the force of friction on an object and its normal force

Missouri Learning Standards

Priority Standard A Language (Code)

- 9-12.PS2.A2** Use mathematical representations to support and verify the concepts that the total momentum of a system of objects is conserved when there is no net force on the system.
- 9-12.PS2.A3** Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

9-12 Physics
Unit 1: Balanced Forces

Unit Pacing Guide and Suggested Resources

Week 1: Inertia stations, Inertia notes, Inertia concept practice

Week 2: Force diagrams, Comparing Mass vs. Weight

Week 3: Mass vs. Weight Force Diagrams, Friction Force, Friction Force Diagrams

Week 4: Friction, Action-Reaction Forces (Newton's third law), Summative Assessment

9-12 Physics

Unit 2: Constant Velocity

If the forces on an object are balanced, there will be no change in its velocity. The motion of an object can be described by mathematical, graphical, verbal, and/or pictorial models.

Unit Essential Learning Targets	
<i>Enduring Understandings</i> Transferable, conceptual big ideas having enduring value (These help organize “Know” and “Do” items)	<i>Essential Questions</i> • Open ended to promote inquiry • These highlight big ideas that this unit will require students to address
• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Use mathematical representations of phenomena to describe explanations.	• What factors affect momentum? • What factors affect constant velocity? • What is the relationship between an object’s position and change in time? • What does the slope of a position-time graph represent?
<i>Students must know:</i>	<i>Students must be able to:</i>
• The relationship between mass and velocity in regards to momentum • The relationship between position and time in regards to constant velocity	• Skills such as techniques, approaches, and processes (not necessarily specific performance goals) • Measure the position and time of an object moving at constant velocity • Interpreting a graph of the position vs time of an object moving at constant velocity • Create a model to describe the conservation of momentum

Missouri Learning Standards
Priority Standard: • 9-12.PS2.A2 Use mathematical representations to support and verify the concepts that the total momentum of a system of objects is conserved when there is no net force on the system. • 9-12.PS2.A3 Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

9-12 Physics
Unit 2: Constant Velocity

Unit Pacing Guide and Suggested Resources

Week 1: Motion Maps, Position-Time Graphs

Week 2: Calculations for Constant Velocity, Velocity-Time Graphs

**Week 3: Introduction to Momentum, Momentum Calculations and Practice,
Conservation of Momentum**

Week 4: Modeling Momentum, Summative Assessment

9-12 Physics

Unit 3: Unbalanced Forces and Acceleration

Forces on an object are unbalanced, its velocity (speed or direction) will change. The change is directly proportional to the net force and inversely proportional to the object/system's mass. The motion of an object can be described by mathematical, graphical, verbal, and/or pictorial models.

Unit Essential Learning Targets	
<i>Enduring Understandings</i> - Transferable, conceptual big ideas having enduring value (These help organize "Know" and "Do" items) - Specific and useful generalizations, not facts or vocabulary - Strategic Principles in skill areas	<i>Essential Questions</i> - Open ended to promote inquiry - These highlight big ideas that this unit will require students to address
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. - Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. - Use mathematical representations of phenomena to describe explanations. - Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.	- What is the relationship between the net force and acceleration on an object? - What is the effect on an object's motion when forces are not balanced? - How could a device be designed and refined to protect an object from forces during a collision?
<i>Students must know:</i> Straightforward facts, concepts, and vocabulary	<i>Students must be able to:</i> Skills such as techniques, approaches, and processes (not necessarily specific performance goals)
- The relationship between force, mass and acceleration. - The relationship between the force and mass of objects that are falling. - The relationship between position and time in regards to non constant velocity.	- identify and describe the forces acting on an object using a force diagram. - Measure the position and time of an object moving at non constant velocity. - Interpret a graph of the position vs time of an object moving at non constant velocity - Identify forces acting on a falling object. - Interpret a graph of the velocity vs time of an object moving at non constant velocity.

9-12 Physics

Unit 3: Unbalanced Forces and Acceleration

Missouri Learning Standards

Priority Standard:

- **9-12.PS2.A.1** Analyze data to support and verify the concepts expressed by Newton's 2nd law of motion, as it describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- **9-12.PS2.A3** Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Unit Pacing Guide and Suggested Resources

Week 1: Motion Maps, Derive Position-Time Graph with Acceleration

Week 2: Acceleration Problem Solving, Free Fall Problem Solving

Week 3: Unbalanced Force Diagrams, Net Force, Introduce $F=ma$

Week 4: $F=ma$ Calculations , Summative Assessment

Week 5: Egg Drop Project

COURSE TITLE AND GRADE

Unit 4: Energy

Energy can take various forms and can transfer within, into, or out of systems by various means. In a closed system, the total amount of energy stays the same.

Unit Essential Learning Targets	
<i>Enduring Understandings</i> - Transferable, conceptual big ideas having enduring value (These help organize “Know” and “Do” items) - Specific and useful generalizations, not facts or vocabulary - Strategic Principles in skill areas	<i>Essential Questions</i> - Open ended to promote inquiry - These highlight big ideas that this unit will require students to address
- Create a computational model or simulation of a phenomenon, designed device, process, or system. - Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	- Where does energy come from? - What factors affect gravitational potential energy? - What factors affect kinetic energy? - What factors affect elastic potential energy?
<i>Students must know:</i> Straightforward facts, concepts, and vocabulary	<i>Students must be able to:</i> Skills such as techniques, approaches, and processes (not necessarily specific performance goals)
Various types of energy (i.e. kinetic, gravitational potential, elastic potential, chemical, nuclear, dissipated, etc.)	Apply the Law of Conservation of Energy qualitatively and quantitatively

COURSE TITLE AND GRADE

Unit 4: Energy

Missouri Learning Standards

Priority Standard:

- 9-12.PS3.A.1 Create a computational model to calculate the change in the energy of one component in a system when the changes in energy are known.
- 9-12.PS3.A.2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
- 9-12.PS3.A.3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Unit Pacing Guide and Suggested Resources

Week 1: Types of energy, Conservation of Energy, Energy Transformation Project

Week 2: Problem Solve Gravitational Potential energy, Problem Solve Kinetic Energy (with the exception of velocity), Problem Solve Elastic Potential Energy (with the exception of length)

Week 3: Finish Problem Solving, Conservation of Energy Problem Solving

Week 4: Review and Summative Assessment

COURSE TITLE AND GRADE

Unit 5: Work, Power, Efficiency

Energy can take various forms and can transfer within, into, or out of systems by various means. In a closed system, the total amount of energy stays the same.

Unit Essential Learning Targets	
<i>Enduring Understandings</i> - Transferable, conceptual big ideas having enduring value (These help organize “Know” and “Do” items) - Specific and useful generalizations, not facts or vocabulary - Strategic Principles in skill areas	<i>Essential Questions</i> - Open ended to promote inquiry - These highlight big ideas that this unit will require students to address
- Create a computational model or simulation of a phenomenon, designed device, process, or system. - Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	- What factors affect the efficiency of a system? - How are work and energy related? - What factors affect mechanical power?
<i>Students must know:</i> Definitions of work, power, and efficiency	<i>Students must be able to:</i> - Quantitatively determine work, power, and efficiency - Describe the effect of work on kinetic energy and potential energy

Missouri Learning Standards
Priority Standard: 9-12.PS3.A.1 Create a computational model to calculate the change in the energy of one component in a system when the changes in energy are known. 9-12.PS3.A.2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). 9-12.PS3.A.3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

COURSE TITLE AND GRADE Unit 5: Work, Power, Efficiency

Unit Pacing Guide and Suggested Resources
Week 1: Work Concept, Relate Work to Energy (LOL diagrams)
Week 2: Finish LOL Diagrams, Work Problem Solving, Power Concept and Problem Solving
Week 3: Power Problem Solving, Efficiency Calculations, Summative Assessment

COURSE TITLE AND GRADE

Unit 6: Electricity

Energy is transferred by the movement of charge in a circuit. Devices (light bulbs, motors, appliances...) in a circuit transfer energy from one form to another.

Unit Essential Learning Targets	
<i>Enduring Understandings</i> - Transferable, conceptual big ideas having enduring value (These help organize “Know” and “Do” items) - Specific and useful generalizations, not facts or vocabulary - Strategic Principles in skill areas	<i>Essential Questions</i> - Open ended to promote inquiry - These highlight big ideas that this unit will require students to address
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. - Create a computational model or simulation of a phenomenon, designed device, process, or system.	- What is electrical energy? - What are electrostatic forces? - How are series and parallel circuits similar and different?
<i>Students must know:</i> Straightforward facts, concepts, and vocabulary	<i>Students must be able to:</i> Skills such as techniques, approaches, and processes (not necessarily specific performance goals)
- The concepts of current, voltage, and resistance, and electrical power. - The differences and similarities between series and parallel circuits	- Qualitatively describe the flow of charge and energy through a DC electric circuit (simple, series, and parallel) - Describe and draw simple circuits and calculate voltage, current, and resistance using Ohm’s Law - Describe and draw series circuits and calculate voltage, current and resistance - Describe and draw parallel circuits and calculate voltage, current and resistance (only calculating total equivalent resistance using Ohm’s Law) - Describe and calculate the power of a circuit, relate power to brightness

COURSE TITLE AND GRADE

Unit 6: Electricity

Missouri Learning Standards

Priority Standard A

- 9-12.PS3.A.1 Create a computational model to calculate the change in the energy of one component in a system when the changes in energy are known.
- 9-12.PS3.A.2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
- 9-12.PS3.A.3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- 9-12.PS3.C.1 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

Unit Pacing Guide and Suggested Resources

Week 1: Electrostatics, Applications of Energy project

Week 2: Introduction to Current, Voltage, and Resistance with Ohm's law

Week 3: Series Circuits, Parallel Circuits, Series and Parallel Comparison

Week 4: Electrical Power and Brightness

Week 5: Review and Summative Assessment

COURSE TITLE AND GRADE

Unit 7: Waves

Energy is transferred by the movement of waves through a medium. Energy is transferred by light. The wavelength of light affects its appearance, properties, and the energy it stores. Systems exist in the natural world

Unit Essential Learning Targets	
<i>Enduring Understandings</i> • Transferable, conceptual big ideas having enduring value (These help organize “Know” and “Do” items) • Specific and useful generalizations, not facts or vocabulary • Strategic Principles in skill areas	<i>Essential Questions</i> • Open ended to promote inquiry • These highlight big ideas that this unit will require students to address
• Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. •	• How are waves related to energy? • What is light? • What is sound?
<i>Students must know:</i>	<i>Students must be able to:</i>
• The parts of transverse and longitudinal waves. • The parts of the electromagnetic spectrum. • The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	• Describe the relationship between wave speed, wavelength, and frequency. • Describe interference, resonance, and standing waves. • Describe how the Doppler Effect occurs when an object moves in relationship to a wave. • Calculate wave speed, wavelength, and frequency.

Missouri Learning Standards
Priority Standard: • 9-12.PS4.A.1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

COURSE TITLE AND GRADE
Unit 7: Waves

Unit Pacing Guide and Suggested Resources

Week 1: Wave anatomy, Wave Problem Solving, Interference, Resonance, Standing Waves

Week 2: Sound, Applications of Sound

Week 3: Electromagnetic Spectrum, Electromagnetic Spectrum Calculations

Week 4: Review and Summative assessment