Science Department
AP Physics 1 Algebra

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Effective Date: September 2024

Scope and Sequence

Unit	Topic of Study	Duration (Weeks)
1	Kinematics	5
2	Force & Translational Dynamics	6
3	Work, Energy, & Power	6
4	Linear Momentum	5
5	Torque & Rotational Dynamics	5
6	Energy & Momentum of Rotating Systems	3
7	Oscillations	2
8	Fluids	4

Unit 1
Kinematics
Summary and Rationale
The world is made up of objects that are in a constant state of motion. To understand the relationships between objects, students must first understand movement. Unit 1 introduces students to the study of motion and serves as a foundation for all of AP Physics 1 by exploring the idea of acceleration and showing students how representations can be used to model and analyze scientific information as it relates to the motion of objects.

Recommended Pacing

5 weeks (~12-17 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How can motion be described quantitatively and graphically?
- What is the difference between scalar and vector quantities?
- How are displacement, velocity, and acceleration related?
- How do graphical representations help us understand motion?
- How does an observer's frame of reference affect measurements of motion?
- How can multiple representations describe the same physical phenomenon?
- How can mathematical models be used to predict an object's motion?
- How is two-dimensional motion analyzed using vector components?
- Why can projectile motion be treated as two independent motions?
- How do physicists use models to make predictions about moving objects?

Unit Enduring Understandings:

- Motion can be described using scalar and vector quantities.
- Position, displacement, velocity, and acceleration provide different information about motion.
- Graphs, diagrams, equations, and verbal descriptions are complementary representations of motion.
- Velocity describes how position changes with time, while acceleration describes how velocity changes with time.
- Observations of motion depend on the chosen reference frame.
- Mathematical models can be used to describe and predict motion.

- Vector quantities can be resolved into components to simplify analysis.
- Horizontal and vertical motions can be analyzed independently in projectile motion.
- Multiple representations can describe the same physical system.
- Kinematics provides the foundation for understanding forces and dynamics.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 1.1 – Scalars and Vectors in One Dimension

- Distinguish between scalar and vector quantities.
- Represent one-dimensional vectors using magnitude and direction.
- Add and subtract vectors in one dimension.
- Apply sign conventions to represent direction of motion.
- Differentiate between distance and displacement.

Topic 1.2 – Displacement, Velocity, and Acceleration

- Define displacement, velocity, and acceleration as rates of change.
- Calculate average velocity and average acceleration.
- Distinguish between average and instantaneous quantities.
- Analyze motion undergoing constant acceleration.
- Use units and dimensions appropriately when describing motion.

Topic 1.3 – Representing Motion

- Construct and interpret position-time graphs.
- Construct and interpret velocity-time graphs.
- Construct and interpret acceleration-time graphs.
- Relate slopes and areas of graphs to physical quantities.
- Translate between graphical, mathematical, and verbal descriptions of motion.
- Use kinematic equations to model motion with constant acceleration.

Topic 1.4 – Reference Frames and Relative Motion

- Explain how measured motion depends on the observer's frame of reference.
- Analyze motion from different reference frames.
- Determine relative velocity between objects.
- Apply vector reasoning to relative motion situations.
- Interpret motion from inertial reference frames.

Topic 1.5 – Vectors and Motion in Two Dimensions

- Resolve vectors into perpendicular components.
- Determine resultant vectors from components.
- Analyze motion in two dimensions.
- Model projectile motion using independent horizontal and vertical motions.

- Apply vector mathematics to describe and predict projectile motion.
- Interpret graphical and mathematical representations of two-dimensional motion.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-
Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.
● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .
ML-
● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading
Gifted and Talented-
● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills
504-
Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.
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● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents
At Risk-
● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.

- [x] Communicate clearly and effectively and with reason.
- [ ] Consider the environmental, social and economics impacts of decisions.
- [x] Demonstrate creativity and innovation.
- [x] Employ valid and reliable research strategies.
- [x] Utilize critical thinking to make sense of problems and persevere in solving them.
- [ ] Model integrity, ethical leadership, and effective management.
- [x] Plan education and career paths aligned to personal goals.
- [x] Use technology to enhance productivity.
- [x] Work productively in teams while using cultural global competence.

Unit 2

Force and Translational Dynamics

Summary and Rationale

In Unit 2, students are introduced to the concept of force, which is an interaction between two objects or systems of objects. Part of the larger study of dynamics, forces provide the context in which students analyze and come to understand a variety of physical phenomena. This understanding is accomplished by revisiting and building upon the models and representations presented in Unit 1—specifically through the introduction of the free-body diagram. Students will further analyze the effect of forces on systems when they encounter Newton's second law in rotational form in Unit 5.

Recommended Pacing

6 weeks (~22-27 class periods - per AP recommendations in the CED)
Exam weight: 18-23%

Standards

HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS2-4: Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What causes an object to accelerate?
- How can forces be used to explain and predict motion?
- How do interactions between objects produce forces?
- How do Newton's Laws describe the behavior of moving objects?
- How can free-body diagrams be used to model physical systems?
- What is the relationship between net force, mass, and acceleration?
- How do gravitational forces affect the motion of objects?
- How do frictional forces influence motion?
- How do springs store and transfer energy through forces?
- How can circular motion occur even when speed remains constant?
- How do interactions between objects satisfy Newton's Third Law?
- How does choosing a system simplify the analysis of forces?

Unit Enduring Understandings:

- Forces arise from interactions between objects.
- A system can be analyzed by identifying the interactions acting on it.
- Free-body diagrams provide a useful model for representing forces acting on a system.
- Newton's First Law describes conditions under which an object's velocity remains constant.
- Net force causes acceleration.
- Newton's Second Law quantitatively relates force, mass, and acceleration.
- Forces always occur in interaction pairs as described by Newton's Third Law.
- Gravitational forces act between all objects with mass.
- Frictional forces depend on the interaction between surfaces.
- Elastic forces arise when objects are stretched or compressed.
- Circular motion requires a net force directed toward the center of the circular path.
- Mathematical models allow physicists to predict motion from force interactions.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 2.1 – Systems and Center of Mass

- Define a system and identify its boundaries.
- Determine which objects belong to a chosen system.
- Explain how interactions occur within and outside a system.
- Describe the significance of center of mass in analyzing motion.

Topic 2.2 – Forces and Free-Body Diagrams

- Identify forces acting on an object.
- Construct accurate free-body diagrams.
- Represent interactions using force vectors.
- Distinguish between balanced and unbalanced forces.
- Use free-body diagrams to support explanations of motion.

Topic 2.3 – Newton's Third Law

- Identify action-reaction force pairs.
- Describe interaction forces between objects.
- Explain why action-reaction pairs do not cancel.
- Apply Newton's Third Law to physical situations.
- Analyze interactions between multiple objects.

Topic 2.4 – Newton's First Law

- Explain the relationship between net force and constant velocity.
- Distinguish between balanced and unbalanced force situations.
- Apply the law of inertia to physical systems.
- Predict object motion when net force is zero.
- Evaluate motion using force-based reasoning.

Topic 2.5 – Newton's Second Law

- Relate acceleration to net force and mass.
- Apply Newton's Second Law mathematically and conceptually.
- Predict acceleration from force information.
- Analyze systems with multiple forces.
- Interpret data involving force, mass, and acceleration.

Topic 2.6 – Gravitational Force

- Calculate gravitational force between objects.
- Describe gravitational interactions qualitatively and quantitatively.
- Apply Newton's Law of Universal Gravitation.
- Relate gravitational force to weight near Earth's surface.
- Analyze motion influenced by gravity.

Topic 2.7 – Kinetic and Static Friction

- Distinguish between static and kinetic friction.
- Predict the direction of frictional forces.
- Analyze motion involving friction.
- Relate frictional force to surface interactions.
- Apply friction models to physical systems.

Topic 2.8 – Spring Forces

- Describe elastic forces using Hooke's Law.
- Calculate spring forces from spring displacement.
- Analyze systems involving stretched or compressed springs.
- Relate restoring forces to deformation.
- Represent spring interactions graphically and mathematically.

Topic 2.9 – Circular Motion

- Describe motion in a circular path.
- Explain centripetal acceleration and centripetal force.
- Identify forces responsible for circular motion.
- Analyze uniform circular motion using force models.
- Relate circular motion to Newton's Laws.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
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● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals

● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 3

Work, Energy, and Power

Summary and Rationale

In Unit 3, students are introduced to the idea of conservation as a foundational principle of physics, along with the concept of work as the primary agent of change for energy. As in earlier units, students will once again utilize both familiar and new models and representations to analyze physical situations, now with force or energy as major components. Students will be encouraged to call upon their knowledge of content and skills in Units 1 and 2 to determine the most appropriate technique for approaching a problem and will be challenged to understand the limiting factors of each technique.

Recommended Pacing

6 weeks (~22-27 class periods - per AP recommendations in the CED)
Exam weight: 18-23%

Standards

HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position

of particles (objects).
HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What is energy and how is it used to describe physical systems?
- How does energy provide an alternative way to analyze motion?
- How is work related to energy transfer?
- How do forces transfer energy into or out of a system?
- What determines the kinetic energy of an object?
- How is potential energy stored within a system?
- Why is conservation of energy one of the most powerful principles in physics?
- How can energy bar charts, diagrams, and mathematical models be used to analyze physical situations?
- What factors influence the rate at which energy is transferred?
- How does power describe energy transformations within a system?
- How can energy analysis simplify problems involving forces and motion?
- What are the limitations of conservation models in real-world systems?

Unit Enduring Understandings:

- Energy is a property of a system that can be transferred and transformed.
- Kinetic energy is associated with the motion of an object.
- Potential energy is associated with the relative position or configuration of objects within a system.
- Work represents the transfer of energy into or out of a system through forces.
- Energy may change forms while the total energy of a closed system remains constant.
- Conservation of energy provides a universal model for analyzing physical systems.
- The choice of system determines how energy transfers are represented.
- Energy representations can be used to predict the behavior of physical systems.
- Power describes the rate at which energy is transferred or transformed.
- Energy methods often provide simpler solutions than force-based analyses.
- Mathematical, graphical, and conceptual models can all be used to represent energy changes.
- Energy conservation applies across a wide range of physical phenomena.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 3.1 – Translational Kinetic Energy

- Define translational kinetic energy.
- Relate kinetic energy to the mass and speed of an object.
- Analyze how changes in speed affect kinetic energy.
- Use mathematical representations to calculate kinetic energy.
- Interpret physical situations using kinetic energy models.

Topic 3.2 – Work

- Define work as a transfer of energy.
- Determine when forces do positive, negative, or zero work.
- Calculate work performed by a force.
- Relate work to changes in a system's energy.
- Interpret graphical and mathematical representations of work.

Topic 3.3 – Potential Energy

- Describe potential energy as energy associated with system configuration.
- Analyze gravitational potential energy in physical systems.
- Explain how potential energy changes as system configuration changes.
- Calculate changes in potential energy.
- Relate force interactions to stored energy.

Topic 3.4 – Conservation of Energy

- Apply conservation of energy to physical systems.
- Construct energy models to analyze motion.
- Determine energy transfers into and out of systems.
- Use energy conservation to predict system behavior.
- Analyze situations involving multiple forms of energy.

Topic 3.5 – Power

- Define power as the rate of energy transfer.
- Calculate power using work and time relationships.
- Compare systems based on energy transfer rates.
- Analyze real-world applications involving power.
- Interpret graphical and mathematical representations of power.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

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- Allow use of assistive technology.
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- Have student repeat directions to check for understanding.
- Highlight text/ visual presentation.
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Gifted and Talented-

- Advance, accelerate, or compact content
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- Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

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- Modify readings and primary source documents

At Risk-

- Provide small group instruction for identified areas for growth
- Allow for alternate pathways for completion of assignments.
- Provide additional wait time for student responses to questions
- Pair oral instruction with visuals
- Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☑ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
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- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.

- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 4

Linear Momentum

Summary and Rationale

Unit 4 introduces students to the relationships between force, time, impulse, and linear momentum via calculations, data analysis, designing experiments, and making predictions. Students will learn how to use new models and representations to illustrate the law of conservation of linear momentum of objects and systems while gaining proficiency using previously studied representations. Using the law of conservation of linear momentum to analyze physical situations provides students with a more complete picture of forces and opportunities to revisit misconceptions surrounding Newton's third law. Students will also have the opportunity to make connections between momentum and kinetic energy of objects or systems and see under what conditions these quantities remain constant.

Recommended Pacing

5 weeks (~10-15class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How is momentum used to describe the motion of a system?
- What causes an object's momentum to change?
- How does impulse relate force, time, and changes in momentum?
- Why is momentum conserved in isolated systems?
- How can conservation laws be used to predict the outcomes of collisions?
- How do elastic and inelastic collisions differ?
- How can interaction forces during collisions be reduced?
- Why is momentum often more useful than force for analyzing collisions?
- How do system boundaries affect momentum analyses?
- How can mathematical models be used to predict collision outcomes?
- What evidence supports the conservation of momentum?
- How do momentum and energy provide different perspectives on physical interactions?

Unit Enduring Understandings:

- Momentum is a vector quantity that depends on mass and velocity.
- The momentum of a system changes when external forces act on the system.
- Impulse describes the effect of a force acting over a time interval.
- Impulse equals the change in momentum of a system.
- Conservation of momentum applies to isolated systems.
- Interactions between objects redistribute momentum within a system.
- System boundaries are important when analyzing momentum conservation.
- Elastic collisions conserve both momentum and kinetic energy.
- Inelastic collisions conserve momentum but not kinetic energy.
- Multiple representations can be used to analyze momentum and collisions.
- Mathematical models allow physicists to predict collision outcomes.
- Momentum conservation is one of the fundamental conservation principles in physics.

Evidence of Learning (Assessments)

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Objectives (SLO)

Topic 4.1 – Linear Momentum

- Define linear momentum as a vector quantity.
- Calculate the momentum of an object.
- Analyze how mass and velocity affect momentum.
- Represent momentum using vector models.
- Compare momenta of different objects and systems.

Topic 4.2 – Change in Momentum and Impulse

- Define impulse as the product of force and time.
- Relate impulse to changes in momentum.
- Interpret force-time graphs in terms of impulse.
- Analyze situations involving varying forces over time.
- Predict momentum changes resulting from applied forces.

Topic 4.3 – Conservation of Linear Momentum

- Define isolated systems for momentum analyses.
- Apply conservation of momentum to multi-object systems.
- Predict final velocities using momentum conservation.
- Analyze interactions involving momentum transfer.
- Evaluate whether momentum is conserved in a given system.

Topic 4.4 – Elastic and Inelastic Collisions

- Distinguish between elastic and inelastic collisions.
- Apply conservation of momentum to collision problems.
- Compare kinetic energy changes in different types of collisions.
- Analyze collision outcomes using mathematical models.
- Interpret graphical and conceptual representations of collisions.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

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- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☐ Work productively in teams while using cultural global competence.

Unit 5

Torque and Rotational Dynamics

Summary and Rationale

Unit 5 reinforces the Unit 2 ideas of force and linear motion by introducing students to their rotational analogs—torque and rotational motion. Although these topics present more complex scenarios, the tools of analysis remain the same. The content and models explored in the first four units of the course set the foundation for Units 5 and 6. During their study of torque and

rotational motion, students will be introduced to different ways of modeling forces. Throughout Units 5 and 6, students will compare and connect their understanding of linear and rotational motion, dynamics, energy, and momentum to develop holistic models to evaluate physical phenomena.

Recommended Pacing

5 weeks (~15-20 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How can rotational motion be described and analyzed?
- How is rotational motion similar to and different from linear motion?
- What causes an object to rotate?
- How does torque influence rotational motion?
- Why do some objects resist rotational acceleration more than others?
- How does mass distribution affect rotational dynamics?
- What conditions are required for rotational equilibrium?
- How can Newton's Laws be applied to rotating systems?
- How are translational and rotational motion connected?
- How can mathematical models be used to describe rotational systems?
- How do engineers use torque and rotational equilibrium in real-world designs?
- How can multiple representations be used to analyze rotational phenomena?

Unit Enduring Understandings:

- Rotational motion can be described using angular position, angular velocity, and angular acceleration.
- Many principles of linear motion have rotational analogs.
- Torque is the rotational equivalent of force.
- A net torque causes rotational acceleration.
- Rotational inertia depends on both mass and how that mass is distributed.
- Objects with greater rotational inertia are more resistant to changes in rotational motion.
- Rotational equilibrium occurs when the net torque acting on a system is zero.
- Newton's First Law applies to rotational motion when net torque is zero.
- Newton's Second Law applies to rotational systems through the relationship among torque, rotational inertia, and angular acceleration.
- Translational and rotational motion can occur simultaneously.
- Mathematical models provide powerful tools for predicting rotational behavior.
- Rotational principles explain the operation of many natural and engineered systems.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 5.1 – Rotational Kinematics

- Define angular position, angular displacement, angular velocity, and angular acceleration.
- Describe rotational motion using graphical, mathematical, and conceptual models.
- Analyze angular motion using rotational kinematic relationships.
- Compare linear and rotational quantities.
- Interpret graphical representations of rotational motion.

Topic 5.2 – Connecting Linear and Rotational Motion

- Relate angular displacement to linear displacement.
- Relate angular velocity to tangential velocity.
- Relate angular acceleration to tangential acceleration.
- Apply relationships between rotational and translational motion.
- Analyze systems that exhibit both types of motion.

Topic 5.3 – Torque

- Define torque as the rotational effect of a force.
- Determine the torque produced by a force acting on a system.
- Analyze how lever arm length influences torque.
- Predict rotational behavior using torque models.
- Represent torques using diagrams and vector reasoning.

Topic 5.4 – Rotational Inertia

- Describe rotational inertia as resistance to rotational acceleration.
- Compare rotational inertia for different mass distributions.
- Analyze how object shape affects rotational inertia.
- Relate rotational inertia to rotational motion.
- Use qualitative and quantitative models to compare rotating systems.

Topic 5.5 – Rotational Equilibrium and Newton's First Law in Rotational Form

- Determine conditions necessary for rotational equilibrium.
- Analyze static equilibrium situations involving torque.
- Apply Newton's First Law to rotating systems.
- Interpret physical situations involving balanced torques.
- Predict system behavior when net torque is zero.

Topic 5.6 – Newton's Second Law in Rotational Form

- Relate net torque to angular acceleration.
- Apply rotational forms of Newton's Second Law.
- Analyze systems experiencing rotational acceleration.
- Predict rotational behavior from force and torque information.
- Interpret experimental evidence supporting rotational dynamics models.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments

● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☐ Work productively in teams while using cultural global competence.

Unit 6

Energy and Momentum of Rotating Systems

Summary and Rationale

In Unit 6, students will apply their knowledge of energy and momentum to rotating systems. Similar to the approach used for translational energy and momentum concepts in Units 3 and 4, it is important that students have conceptual understanding of how angular momentum and rotational energy change due to external torque(s) on a system. Additionally, articulating the conditions under which the rotational energy and/or angular momentum of a system remains constant is foundational to working through more complex scenarios. Students will use the content and skills presented in both Units 5 and 6 to further study the motion of orbiting satellites and rolling without slipping in this unit.

Recommended Pacing

3 weeks (~8-14 class periods - per AP recommendations in the CED)
Exam weight: 5-8%

Standards

HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS2-4: Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do conservation laws explain the behavior of rotating systems?
- What determines the angular momentum of a system?
- Under what conditions is angular momentum conserved?
- How does torque change the angular momentum of a system?
- How can rotational kinetic energy be used to analyze physical systems?
- How are work and energy related in rotating systems?

- Why do objects spin faster when their rotational inertia decreases?
- How can rotational and translational motion occur simultaneously?
- What physical principles govern the motion of rolling objects?
- How does gravitational interaction produce orbital motion?
- How can conservation principles be used to predict the behavior of satellites and planetary systems?
- Why are energy and momentum considered fundamental quantities in physics?

Unit Enduring Understandings:

- Conservation laws provide a powerful framework for analyzing physical systems.
- Rotating systems possess angular momentum that depends on rotational inertia and angular velocity.
- Angular momentum is conserved in systems experiencing negligible external torque.
- Changes in rotational inertia can produce changes in angular velocity while conserving angular momentum.
- Torque changes the angular momentum of a system in the same way force changes linear momentum.
- Rotational kinetic energy is associated with the motion of rotating objects.
- Work done by a torque transfers energy into or out of a rotating system.
- Rolling motion combines translational and rotational motion into a single physical process.
- Conservation of energy can be applied to analyze rotating and rolling systems.
- Gravitational interactions are responsible for the motion of orbiting objects.
- Satellite motion can be understood through the combined application of conservation laws and gravitational models.
- The same conservation principles can explain phenomena ranging from spinning skaters and rolling wheels to planetary orbits and satellite motion.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 6.1 – Rotational Kinetic Energy

- Define rotational kinetic energy.
- Relate rotational kinetic energy to rotational inertia and angular velocity.
- Compare rotational and translational kinetic energy.
- Calculate rotational kinetic energy for rotating systems.
- Analyze energy transformations involving rotational motion.

Topic 6.2 – Torque and Work

- Explain how torque transfers energy to a rotating system.
- Relate rotational work to changes in rotational kinetic energy.
- Analyze systems in which torque performs work.
- Apply work-energy principles to rotating objects.

- Interpret rotational energy changes using mathematical models.

Topic 6.3 – Angular Momentum and Angular Impulse

- Define angular momentum for rotating systems.
- Relate angular impulse to changes in angular momentum.
- Analyze angular momentum using physical and mathematical models.
- Compare linear and angular momentum concepts.
- Predict rotational changes resulting from applied torques.

Topic 6.4 – Conservation of Angular Momentum

- Apply conservation of angular momentum to isolated systems.
- Predict rotational motion following changes in rotational inertia.
- Analyze interactions involving angular momentum transfer.
- Use conservation principles to explain rotational phenomena.
- Evaluate when angular momentum is conserved.

Topic 6.5 – Rolling

- Describe rolling motion as a combination of translation and rotation.
- Relate translational and rotational variables for rolling objects.
- Analyze energy transformations in rolling systems.
- Predict the behavior of rolling objects on inclined surfaces.
- Apply conservation laws to rolling motion.

Topic 6.6 – Motion of Orbiting Satellites

- Describe satellite motion using gravitational models.
- Relate orbital motion to gravitational force.
- Analyze energy changes in orbital systems.
- Explain the relationship between orbital speed and orbital radius.
- Apply conservation principles to satellite motion.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.

● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 7

Oscillations

Summary and Rationale

In Unit 7, students will apply previously-encountered models and methods of analysis to simple harmonic motion. They will also be reminded that, even in new situations, the fundamental laws of physics remain the same. Because this unit is the first in which students possess all the tools of force, energy, and momentum conservation—such as energy bar charts, free-body diagrams, and momentum diagrams—scaffolding lessons will enhance student understanding of fundamental physics principles and their limitations, as they relate to oscillating systems. Students will also use the skills and knowledge they have gained to make and justify claims, as well as connect new concepts with those learned in previous topics.

Recommended Pacing

2 weeks (~5-10 class periods - per AP recommendations in the CED)
Exam weight: 5-8%

Standards

HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What conditions produce simple harmonic motion?
- Why do some systems naturally oscillate about an equilibrium position?
- How do restoring forces create periodic motion?
- What determines the frequency and period of an oscillator?
- How can oscillatory motion be represented mathematically and graphically?
- How are displacement, velocity, and acceleration related during simple harmonic motion?
- How does energy move between kinetic and potential forms in an oscillating system?
- Why does the total energy of an ideal oscillator remain constant?

- How can simple harmonic motion be used to model real-world systems?
- What common patterns are shared among different types of oscillating systems?
- How do physical properties of a system influence its oscillatory behavior?
- How do models help physicists describe and predict periodic motion?

Unit Enduring Understandings:

- Oscillations occur when a restoring force acts on a system displaced from equilibrium.
- Simple harmonic motion is a special type of periodic motion characterized by a restoring force that is proportional to displacement.
- Oscillating systems repeatedly exchange kinetic energy and potential energy.
- The total mechanical energy of an ideal oscillator remains constant.
- An oscillator's period and frequency depend on the physical properties of the system.
- Displacement, velocity, and acceleration vary in predictable ways during oscillatory motion.
- Equilibrium positions play a central role in analyzing oscillating systems.
- Mathematical models can be used to predict the behavior of oscillators.
- Graphical, mathematical, and conceptual representations describe the same oscillatory phenomena.
- Energy conservation provides a useful framework for analyzing oscillating systems.
- Simple harmonic motion serves as a model for many physical systems in nature and engineering.
- Periodic motion reveals repeating patterns that can be analyzed quantitatively.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 7.1 – Defining Simple Harmonic Motion (SHM)

- Define simple harmonic motion.
- Identify the characteristics of systems that exhibit SHM.
- Describe the role of restoring forces in oscillatory motion.
- Determine equilibrium positions in oscillating systems.
- Analyze physical situations involving SHM.

Topic 7.2 – Frequency and Period of SHM

- Define period and frequency.
- Relate frequency and period mathematically.
- Determine factors that influence oscillation frequency.
- Compare oscillatory systems using period and frequency.
- Apply mathematical relationships to periodic motion.

Topic 7.3 – Representing and Analyzing SHM

- Interpret graphical representations of oscillatory motion.
- Analyze displacement, velocity, and acceleration during SHM.
- Relate graphical representations to physical motion.
- Compare different representations of periodic motion.
- Construct models describing oscillatory behavior.

Topic 7.4 – Energy of Simple Harmonic Oscillators

- Analyze energy transformations in oscillating systems.
- Relate displacement to kinetic and potential energy.
- Apply conservation of energy to SHM systems.
- Determine locations of maximum and minimum energy.
- Predict changes in system behavior using energy models.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
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● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals

● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 8

Fluids

Summary and Rationale

In Unit 8, students consider how the forces and conservation laws studied in Units 1 through 4 can be applied to the study of ideal fluids. Unit 8 ties together the thematic threads that have been woven throughout the course, including the interactions between systems and the conservation of fundamental quantities.

Recommended Pacing

4 weeks (~12-17 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-PS2-4: Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a

combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How can fluids be described using particle and continuum models?
- How do density and fluid structure influence fluid behavior?
- What causes pressure within a fluid?
- How does pressure vary within fluids and fluid systems?
- How do fluids exert forces on objects immersed in them?
- Why do some objects float while others sink?
- How can Newton's Laws be applied to fluid systems?
- How do conservation laws explain fluid motion?
- How are mass, energy, and pressure related in moving fluids?
- Why does fluid speed affect fluid pressure?
- How can mathematical models be used to predict fluid behavior?
- How do fluid principles explain natural and engineered systems?

Unit Enduring Understandings:

- Fluids can be analyzed using both particle-level and macroscopic models.
- Density is a fundamental property that influences fluid behavior and interactions.
- Pressure results from forces distributed over an area within a fluid.
- Fluid pressure depends on depth and fluid properties.
- Fluids exert forces on objects immersed within them.
- Buoyant forces arise from pressure differences within a fluid.
- The relationship between buoyant force and weight determines whether an object floats or sinks.
- Newton's Laws can be applied to explain fluid interactions and fluid motion.
- Conservation of mass applies to moving fluids.
- Conservation of energy provides a framework for understanding pressure and fluid speed relationships.
- Changes in pressure, speed, and elevation are interconnected in flowing fluids.

- Fluid principles explain a wide range of phenomena, including transportation, engineering systems, weather processes, and biological systems.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 8.1 – Internal Structure and Density

- Define density and relate it to mass and volume.
- Compare densities of different materials and fluids.
- Describe fluids using particle and continuum models.
- Analyze how density affects fluid behavior.
- Apply density concepts to physical systems.

Topic 8.2 – Pressure

- Define pressure in terms of force and area.
- Calculate pressure in fluid systems.
- Explain how pressure changes with depth.
- Analyze pressure distributions within fluids.
- Interpret graphical and mathematical representations of pressure.

Topic 8.3 – Fluids and Newton's Laws

- Apply Newton's Laws to fluid systems.
- Explain buoyancy using force analysis.
- Determine buoyant forces acting on immersed objects.
- Predict whether objects will float or sink.
- Analyze fluid-object interactions using free-body diagrams.

Topic 8.4 – Fluids and Conservation Laws

- Apply conservation of mass to moving fluids.
- Apply conservation of energy to fluid systems.
- Relate fluid speed, pressure, and elevation.
- Analyze fluid flow using mathematical models.
- Interpret physical situations using conservation principles.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-
Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
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ML-

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● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

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- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☑ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.