



Unit 1 - Scientific Thinking

Draft Date	Course	Duration	Grades	Subjects	Team
06-02-2026	HS H/CP Physics	2 Week(s)	11, 12	Science	Alicia Panzarella

Focus

We will start our journey into Newtonian Mechanics by first learning the fundamental mathematical skills necessary to collect and analyze data. This unit will focus on experimental design, the engineering design process, proper data collection in a physical science context, and finally on mastering the necessary skills to graphically analyze discovered information so that useful mathematical functions can be formed. By embracing what's known as the "Modeling Approach," students will start to hone in their communication and collaboration skills, while embracing the problem solving nature of being a scientist!

Stage 1: Learning Goals

Established Goals	Transfer
Standards	Long-Term Transfer Goals
Pennsylvania Academic Standards Science (2023): 9-12 Standards ■ 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. Clarifying Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Approach science as a reliable and testable way of knowing and explaining the natural world and designed world. (Life-Long Learner) (T1) ■ Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions. (Innovative Problem Solver) (T2) ■ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions. (Communicator) (T3) ■ Participate in respectful discourse with peers, teachers, and experts in the field to share ideas, perspectives, and findings. (Collaborator, Communicator) (T4)

Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. (3.2.9-12.1)

Profile of a CV Learner

- Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)
- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)
- Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)

Meaning

Understandings

What specifically do you want students to understand? What inferences should they make? Students will understand that...

- A controlled experiment involves careful manipulation of an independent variable and the ability to observe the affect on the dependent variable while accounting for experimental error. (U1)
- Data can be represented in a multitude of ways and the trends show the correlation between independent and dependent variables. (U2)
- The process of linearization is used to manipulate how the researcher views the data so that linear line mathematical techniques can be applied in order create proper mathematical models. (U3)

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering...

- How can one explain and predict interactions between objects within systems? (Q1)
- How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q2)
- What do I know? What do I need to find out? How does that help me? (Q3)
- How do I use labels, symbols, units of measure, tables, graphs, and vocabulary to analyze situations and/or share findings? (Q4)
- How do I get started when I am looking at this problem/challenge? What are some other ways I might think about this? (Q5)
- How do I apply the engineering process to engineering challenges, lab designs, and real world questions? (Q6)

Acquisition of Knowledge & Skill

Skills

What discrete skills and processes should students be able to use? Students can...

- I can make observations regarding a phenomena and create an essential question to test various aspects of the

Knowledge

What facts and basic concepts should students know and be able to recall?

Students will know...

- A controlled experiment includes a independent, dependent, and controlled variables. (K1)
- There are 6 recognizable trends in Newtonian Mechanics. Trends include no effect, linear, side opening parabolic, top opening parabolic, inverse, and quadratic. (K2)
- Non linear data must go through the mathematical process of linearization in order to form a proper mathematical model. (K3)
- The slope is the rate of change between the dependent and independent variable. The units follow the change in y over change in x equation. (K4)
- The y intercept is the point on the graph where, in the (x,y) coordinate, x is zero and the trend intersects on the y axis. The y intercept value has the same units as the dependent variable. (K5)
- The formation of a proper mathematical model includes the correct use of all variables titles, units, slope value, and y intercept value. (K6)

phenomena in order to gain a broader understanding. (S1)

- I can plot and analyze data by using a graphical analysis software. (S2)
- I can identify trends and differentiate between a no effect, linear, side opening parabolic, top opening parabolic, inverse, and quadratic relationship. (S3)
- I can create proper mathematical models from a given data set and trendline. Models include all proper titles, units, slope value, and y intercept value. (S4)
- I can engage in technical writing to explain a lab procedure, presentation of data tables, trends, models, and form evidence based conclusions. (S5)



Unit 2 - Constant Velocity

Draft Date 06-02-2026	Course HS H/CP Physics	Duration 3 Week(s)	Grades 11, 12	Subjects Science	Team Alicia Panzarella
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Focus

We will explore how position, velocity, and time are connected as we investigate the patterns of constant-velocity motion. Using the skills we developed in our first unit, we will design and conduct experiments, analyze our data, and develop mathematical models and graphs that describe motion. Through collaboration, discussion, and problem-solving, we will use evidence from our experiments to explain and predict how objects move. As **Innovative Problem Solvers**, we will question our results, refine our models, and apply our understanding of motion to situations beyond the classroom.

Stage 1: Learning Goals

Established Goals	Transfer
Standards	Long-Term Transfer Goals
Pennsylvania Academic Standards Science (2023): 9-12 Standards 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. Clarifying Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Work Together: Engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (Collaborator) (T1) ■ Solve Problems Effectively: Based on an examination of the problem/situation, initiate a plan, execute it, evaluate and explain the reasonableness of the solution. (Innovative Problem Solver) (T2) ■ Communicate Mathematically: Communicate effectively in a variety of ways based on purpose, task, and audience, using appropriate vocabulary. (Communicator) (T3) ■ Solve Problems Efficiently: Use skills, strategies, models, or manipulatives to increase efficiency and accuracy. (Innovative Problem Solver) (T4) ■ Recognize Relationships: Identify patterns and relationships to make sense of mathematical and/or real world situations. (Global Citizen) (T5) ■ Approach science as a reliable and testable way of knowing and explaining the natural world and designed world. (Life-Long Learner) (T6) ■ Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions. (Innovative Problem Solver) (T7)

Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. (3.2.9-12.1)

- Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions. (Communicator) (T8)
- Participate in respectful discourse with peers, teachers, and experts in the field to share ideas, perspectives, and findings. (Collaborator, Communicator) (T9)

Profile of a CV Learner

- Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)
- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)
- Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)

Meaning

Understandings

What specifically do you want students to understand? What inferences should they make? Students will understand that...

- On a position vs time graph, an object in constant velocity motion will create either a no effect trend line or a linear trend line. (U1)
- The slope of the position vs. time graph creates the velocity vs. time graph. The trend on a velocity vs. time graph will appear as a horizontal line which indicates a “no effect” for that option of the graph. (U2)
- The CV equation of $X_f = Vt + X_i$ is created by applying the skill of proper model formation to a linear trend line. (U3)
- The area under the velocity vs time graph curve is the objects total displacement for that section of motion. (U4)
- The CV equation can be used to predict the motion of the object and can be used to solve for all variables in the equation if known quantities can be derived graphically, through collected data, or via prompts. (U5)

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering...

- How do I explain my ideas or approach to others? How does sharing that inspire my own and others’ thinking? (Q1)
- When I’m listening to an idea or approach, what questions do I have? How do I share them to grow my own and other’s thinking? (Q2)
- What is the problem, and why does this problem exist and need solving? (Q3)
- How do I come up with a solution that can potentially help with this problem? (Q4)
- How do I work to design, test, and rework the solution based on feedback from the target audience? (Q5)
- As I am speaking/writing... What am I trying to say? How do I explain my ideas or approach for a specific purpose and audience? What details are appropriate to include to clarify my message? How can I utilize accessibility tools to ensure diverse audiences can understand me? What adjustments do I need to make? (Q6)

- Does my answer/solution make sense? How do I test it? (Q7)
- How do I use various tools and skills to assess the validity of my answer or solution to a complex real world problem? (Q8)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?
Students will know...

- The slope of a position versus time graph is velocity. (K1)
- The constant velocity equation is $X_f = Vt + X_i$ (K2)
- A scalar function only has magnitude whereas a vector function has both magnitude and direction. (K3)
- Distance is the total path traveled by the object. (K4)
- The area under the velocity vs. time graph "curve" is displacement. (K5)
- Displacement is the change in position from the initial position to the final position regardless of the path taken. (K6)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can take the slope of a position vs. time graph in order to calculate the constant velocity of an object. (S1)
- I can take the area under the curve of a velocity vs. time graph can determine an object's displacement. (S2)
- I can use proper mathematical models in order to predict future phenomena. (S3)



Unit 3 - Uniform Acceleration

Draft Date 06-02-2026	Course HS H/CP Physics	Duration 2 Week(s)	Grades 11, 12	Subjects Science	Team Alicia Panzarella
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Focus

We will continue our journey through kinematics by investigating how and why an object's motion changes over time. Through a discovery-based lab, we will collect and analyze data to uncover the patterns of uniform acceleration and develop our own graphical and mathematical models of motion. We will use position-, velocity-, and acceleration-time graphs along with kinematic equations to solve problems, explain motion, and communicate our reasoning in extended-response settings. As **Innovative Problem Solvers**, we will use evidence from our investigations to test, refine, and apply our models to real world scenarios.

Stage 1: Learning Goals

Established Goals	Transfer
Standards	Long-Term Transfer Goals
Pennsylvania Academic Standards Science (2023): 9-12 Standards 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. Clarifying Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions. (Innovative Problem Solver) (T1) ■ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system. (Global Citizen, Innovative Problem Solver) (T2) ■ Explain how the natural and designed worlds are interrelated and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences. (Global Citizen, Communicator) (T3) ■ Participate in respectful discourse with peers, teachers, and experts in the field to share ideas, perspectives, and findings. (Collaborator, Communicator) (T4)

Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. (3.2.9-12.1)

Profile of a CV Learner

- Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)
- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)
- Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)

Meaning

Understandings

What specifically do you want students to understand? What inferences should they make? Students will understand that...

- When in uniform acceleration, a velocity vs. time graph can be represented as either a linear line or a line where the slope is zero. Both types of trends show that the slope of any velocity vs. time graph is acceleration. (U1)
- The area under the acceleration vs. time graph shows the change in velocity over time for a specific section of motion. (U2)
- Polynomial positive vs. time graphs and linear acceleration vs. time graphs create the three proper mathematical models that are the uniform acceleration kinematic equations. (U3)
- Depending on the type of motion, whether presented graphically, in words, or via a data set, the constant velocity equation or the uniform acceleration equations must be used appropriately based on the motion. (U4)
- The gravitational field, on Earth, produces a uniform acceleration for all free falling objects that is equivalent to an acceleration of -9.8m/s^2 . (U5)

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering...

- How do I use various tools and skills to assess the validity of my answer or solution to a complex real world problem? (Q1)
- How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q2)
- What is this judgment, conclusion, perspective based on? Does the mathematical logic hold up? (Q3)
- How do I use data to clarify a local/global challenge? What predictions/conclusions can I draw? (Q4)
- Does my answer/solution make sense? How do I test it? (Q5)

Acquisition of Knowledge & Skill	
Knowledge	Skills
What facts and basic concepts should students know and be able to recall? Students will know... ■ The slope of a velocity vs. time graph is acceleration. (K1) ■ Acceleration is the change in velocity over the change in time. (K2) ■ The area under the acceleration vs time graph is the change in velocity over time. (K3) ■ Acceleration due to gravity is -9.8m/s^2. (K4) ■ The velocity based kinematic equations is $V_f = at + V_i$. (K5) ■ The position based kinematic equation is $X_f = \frac{1}{2}at^2 + V_i(t)$ (K6) ■ An object is in free fall when gravity is the only force acting on the system. (K7)	What discrete skills and processes should students be able to use? Students can... ■ I can either take the slope of a line or the area under the curve in order to determine variables in the uniform acceleration equations. (S1) ■ I can utilize the kinematic equations appropriately in order to solve word based prompts, graphical analysis questions, or analyze real world problems. (S2) ■ I can recognize when an object is in free fall either graphically, from a data set, from a written prompt, or through analysis of a real world scenario. (S3)



Unit 4 - Projectile Motion

Draft Date	Course	Duration	Grades	Subjects	Team
06-02-2026	HS H/CP Physics	2 Week(s)	11, 12	Science	Alicia Panzarella

Focus

We will bring together our learning about constant velocity and uniform acceleration as we investigate how objects move in two dimensions. Through hands-on investigations and problem-solving, we will analyze horizontal, vertical, and angled motion while applying graphical, mathematical, and trigonometric models to describe what happens. We will use evidence, diagrams, and mathematical reasoning to analyze real-world athletic motion and communicate our findings to sports analysts, connecting physics to the way athletes and teams study performance. As **Innovative Problem Solvers and Communicators**, we will collaborate to test strategies, evaluate our reasoning, and clearly communicate our conclusions to authentic audiences.

Stage 1: Learning Goals

Established Goals	Transfer
Standards	Long-Term Transfer Goals
Pennsylvania Academic Standards Science (2023): 9-12 Standards 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. Clarifying Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... - Solve Problems Effectively: Based on an examination of the problem/situation, initiate a plan, execute it, evaluate and explain the reasonableness of the solution. (Innovative Problem Solver) (T1) - Communicate Mathematically: Communicate effectively in a variety of ways based on purpose, task, and audience, using appropriate vocabulary. (Communicator) (T2) - Approach science as a reliable and testable way of knowing and explaining the natural world and designed world. (Life-Long Learner) (T3) - Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions. (Innovative Problem Solver) (T4) - Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions. (Communicator) (T5)

constant force.

Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. (3.2.9-12.1)

Profile of a CV Learner

- Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)
- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)
- Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)

Meaning

Understandings

What specifically do you want students to understand? What inferences should they make? Students will understand that...

- Objects in projectile motion create a quadratic function when plotting position vs. time. (U1)
- Isolation of the position and time data for the horizontal component produces a linear line due to the lack of gravitational affects horizontally which creates constant velocity in the x component. (U2)
- Isolation of the position and time data for the vertical component produces a polynomial trend line due to the gravitational affects vertically which creates uniform acceleration in the y component. (U3)
- An object in projectile motion will experience free fall motion in the absence of any resistive forces. (U4)
- The application of trigonometric functions and the knowledge of right triangles can be used to determine initial and final velocities in their respective components. (U5)

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering...

- How can one explain and predict interactions between objects within systems? (Q1)
- Does my answer/solution make sense? How do I test it? (Q2)
- What is the best/most efficient way to solve this type of problem? (Q3)
- Does my approach make sense? What is another way of seeing/doing this? (Q4)
- How do I use various tools and skills to assess the validity of my answer or solution to a complex real world problem? (Q5)

Acquisition of Knowledge & Skill	
Knowledge	Skills
What facts and basic concepts should students know and be able to recall? Students will know... ■ A projectile object experiences constant velocity in the horizontal component. (K1) ■ A projectile object experiences uniform acceleration in the vertical component. (K2) ■ The velocity at maximum height is zero in the y component. (K3) ■ A projectile that starts and ends at the same position is considered a perfect parabola. (K4)	What discrete skills and processes should students be able to use? Students can... ■ I can apply the kinematic equations appropriately depending on the specific component of the object's motion. (S1) ■ I can analyze a position vs. time graph to determine the component of an object's motion represented by the data. (S2) ■ I can analyze a velocity vs. time graph to determine the component of an object's motion represented by the data. (S3) ■ I can identify the difference between an object that creates a perfect parabola and an object that does not. (S4) ■ I can apply my knowledge of graphical analysis and application of the kinematic equations in order to optimize results or critically analyze the variables presented in a real world situation. (S5)



Unit 5 - Forces and Newton's Laws

Draft Date 06-02-2026	Course HS H/CP Physics	Duration 4 Week(s)	Grades 11, 12	Subjects Science	Team Alicia Panzarella
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Focus

We will move from studying **how things move** to investigating **why they move** as we begin our journey into dynamics and Newton's Laws. Through discovery-based labs and hands-on investigations, we will explore Newton's three laws, create force diagrams, and use evidence to explain and predict the motion of objects. We will connect our understanding of forces to Newton's Second Law and extend our thinking into circular motion, discovering how familiar ideas from kinematics take on a new twist when objects move in circles. As **Innovative Problem Solvers and Life-Long Learners**, we will question how forces shape the world around us and apply our models to explain motion in everyday and real-world situations.

Stage 1: Learning Goals

Established Goals	Transfer
Standards	Long-Term Transfer Goals
Pennsylvania Academic Standards Science (2023): 9-12 Standards 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. Clarifying Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... - Approach science as a reliable and testable way of knowing and explaining the natural world and designed world. (Life-Long Learner) (T1) - Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions. (Innovative Problem Solver) (T2) - Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions. (Communicator) (T3) - Participate in respectful discourse with peers, teachers, and experts in the field to share ideas, perspectives, and findings. (Collaborator, Communicator) (T4)

constant force.

Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. (3.2.9-12.1)

Profile of a CV Learner

- Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)
- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)
- Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)

Meaning

Understandings

What specifically do you want students to understand? What inferences should they make? Students will understand that...

- Newton's three fundamental laws govern the macroscopic and microscopic movement of all particles. (U1)
- Newton's Second Law is the bridge that binds kinematics and dynamics to explain both how and why a system moves. (U2)
- A Free Body Diagram, or FBD, is the fundamental illustration that addresses all forces acting on a system. (U3)
- All motion is created either due to a balanced or unbalanced FBD. (U4)
- The force of friction equation is based on surface type, gravitation pull on the system, and the angle of the system. The frictional force is not dependent on the surface area. (U5)
- Newton's second law and kinematic equations are valid for both linear and uniform circular motion, but circular equations require adjustments to account for a constantly changing direction. (U6)

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering...

- What are some strategies I am using to check in and get feedback on my part? What are my next steps? (Q1)
- How do I explain my ideas or approach to others? How does sharing that inspire my own and others' thinking? (Q2)
- As I am speaking/writing... What am I trying to say? How do I explain my ideas or approach for a specific purpose and audience? What details are appropriate to include to clarify my message? How can I utilize accessibility tools to ensure diverse audiences can understand me? What adjustments do I need to make? (Q3)
- How can one explain and predict interactions between objects within systems? (Q4)
- Does my answer/solution make sense? How do I test it? (Q5)
- Does my approach make sense? What is another way of seeing/doing this? (Q6)
- How do I use labels, symbols, units of measure, tables, graphs, and vocabulary to analyze situations and/or share findings? (Q7)
- How do I use various tools and skills to assess the validity of my answer or

solution to a complex real world problem? (Q8)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?
Students will know...

- Newton's first law is that an object in motion states in motion and an object at rest stays at rest unless acted upon by an outside force. (K1)
- Net force is defined as the sum of all forces per component. (K2)
- Newton's Second Law states that the net force of a system is proportional to the product of the mass of the system and the acceleration of the system. (K3)
- Newton's Third Law states that for every action there is an equal and opposite reaction. (K4)
- The normal force is defined as the force that is perpendicular to the surface. (K5)
- The force of friction is equivalent to the friction coefficient multiplied by the normal force. (K6)
- The tangential velocity is equivalent to the circumferences divided by the period. (K7)
- When in uniform circular motion, UCM, the centripetal acceleration is equivalent to the square of the tangential acceleration divided by the radius of the circular path. (K8)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can create FBDs in order to determine if a system is balanced or unbalanced per component. (S1)
- I can identify the resulting motion due to the creation of the quantitative or qualitative FBD. (S2)
- I can apply kinematic concepts as a result of inferencing the type of motion created the by FBD. (S3)
- I can apply Newton's Second Law to both linear and circular motion. (S4)
- I can assess and apply the force of friction equation when appropriate. (S5)
- I can use data collection and graphical analysis techniques to determine if a system is accelerating and if friction is present. (S6)

- Centripetal force is defined as the sum of the forces causing circular motion. (K9)
- When in UCM, $F_{\text{net}} = ma$ becomes $F_c = ma_c$. (K10)



Unit 6 - Energy

Draft Date	Course	Duration	Grades	Subjects	Team
06-02-2026	HS H/CP Physics	2 Week(s)	11, 12	Science	Alicia Panzarella

Focus

We will continue our exploration of dynamics by investigating how energy moves and changes as objects interact with the world around us. Through hands-on investigations and real-world applications, we will explore different forms of mechanical energy and use the conservation of energy to explain and predict motion. We will apply our learning through an engineering challenge in which we design, build, and refine a **Rube Goldberg machine**, using energy transformations to create a successful sequence of events. As **Innovative Problem Solvers and Collaborators**, we will work together to test our designs, overcome challenges, and communicate how energy is transformed throughout our machines.

Stage 1: Learning Goals

Established Goals	Transfer
Standards	Long-Term Transfer Goals
Pennsylvania Academic Standards Science (2023): 9-12 Standards ■ 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. Clarifying Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model. Assessment Boundary: Assessment is limited to basic algebraic expressions or	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Solve Problems Effectively: Based on an examination of the problem/situation, initiate a plan, execute it, evaluate and explain the reasonableness of the solution. (Innovative Problem Solver) (T1) ■ Solve Problems Efficiently: Use skills, strategies, models, or manipulatives to increase efficiency and accuracy. (Innovative Problem Solver) (T2) ■ Approach science as a reliable and testable way of knowing and explaining the natural world and designed world. (Life-Long Learner) (T3) ■ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions. (Communicator) (T4) ■ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system. (Global Citizen, Innovative Problem Solver) (T5)

computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields. (3.2.9-12.0)

- 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 positions of particles (objects).

Clarifying Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

Assessment Boundary: N/A (3.2.9-12.P)

- Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Clarifying Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.

Meaning	
Understandings	Essential Questions
What specifically do you want students to understand? What inferences should they make? Students will understand that... ■ Energy can not be created nor destroyed, but it can be transferred to different types of energy and work within the system. (U1) ■ Mechanical energy focuses on the flow of energy between kinetic energy, potential energy, and the work required to move a system from its initial stage to the final stage. (U2) ■ Conservative forces do not require energy to get from the initial stage to the final stage. Only non conservative forces do work in order to move the system. (U3) ■ Non conservative forces follow Newton's Second Law in order to do work. (U4)	What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering... ■ How do I come up with a solution that can potentially help with this problem? (Q1) ■ How do I work to design, test, and rework the solution based on feedback from the target audience? (Q2) ■ What am I doing when I get stuck? What are some strategies I can try? How are they working? (Q3) ■ As I am speaking/writing... What am I trying to say? How do I explain my ideas or approach for a specific purpose and audience? What details are appropriate to include to clarify my message? How can I utilize accessibility tools to ensure diverse audiences can understand me? What adjustments do I need to make? (Q4) ■ How is energy transferred and conserved? (Q5) ■ How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q6) ■ What is the best/most efficient way to solve this type of problem? (Q7)

Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students. (3.2.9-12.Q)

Profile of a CV Learner

- Collaboration: Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)
- Communication: Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)
- Innovative Problem Solving: Students will be able to independently use their learning to approach new problems with curiosity and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)

Acquisition of Knowledge & Skill

Knowledge

What facts and basic concepts should students know and be able to recall?

Students will know...

- Kinetic energy is the energy associated with motion. (K1)
- Potential energy is the stored energy in a system either from gravitational positioning or elastic potential. (K2)
- Mechanical energy is the sum of kinetic and potential energy. (K3)
- The conservation of energy equality is $E_i = E_f$. (K4)
- Work is equal to the product of the non conservative net force multiplied by the distance traveled. (K5)

Skills

What discrete skills and processes should students be able to use? Students can...

- I can apply the conservation of energy to a stationary or moving object. (S1)
- I can determine the amount of work done to move a system by either applying energy or force concepts. (S2)
- I can analyze graphical data for a moving system to determine any variable within the conservation of equation or determine the amount of energy converted to a non mechanical form. (S3)



Unit 7 - Momentum

Draft Date	Course	Duration	Grades	Subjects	Team
06-02-2026	HS H/CP Physics	2 Week(s)	11, 12	Science	Alicia Panzarella

Focus

We will make our final stop in our quest to understand linear motion by investigating what happens before, during, and after objects collide. Through discovery-based labs, we will uncover the conservation of momentum and explore impulse as a connection between the forces of dynamics and the motion of kinematics. We will apply mathematical models, evidence, and critical thinking to analyze collisions and explain how momentum and forces change throughout an interaction. As **Innovative Problem Solvers and Communicators**, we will collaborate to investigate real-world collisions and clearly communicate our findings and reasoning.

Stage 1: Learning Goals

Established Goals	Transfer
Standards	Long-Term Transfer Goals
Pennsylvania Academic Standards Science (2023): 9-12 Standards ■ 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. Clarifying Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. Assessment Boundary: Assessment is limited to systems of two macroscopic	What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to... ■ Solve Problems Effectively: Based on an examination of the problem/situation, initiate a plan, execute it, evaluate and explain the reasonableness of the solution. (Innovative Problem Solver) (T1) ■ Solve Problems Efficiently: Use skills, strategies, models, or manipulatives to increase efficiency and accuracy. (Innovative Problem Solver) (T2) ■ Approach science as a reliable and testable way of knowing and explaining the natural world and designed world. (Life-Long Learner) (T3) ■ Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions. (Innovative Problem Solver) (T4) ■ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions. (Communicator) (T5) ■ Participate in respectful discourse with peers, teachers, and experts in the field to share ideas, perspectives, and findings. (Collaborator, Communicator) (T6)

bodies moving in one dimension.
(3.2.9-12.J)

- **Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision.**

Clarifying Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.

Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.
(3.2.9-12.K)

Profile of a CV Learner

- **Collaboration:** Students will be able to independently engage and meaningfully contribute to a team to reach a common goal, through mutual reflection, feedback, and shared responsibility. (PCVL.CO)
- **Communication:** Students will be able to independently and confidently adapt their writing and speaking in relation to audience, task, and purpose, as well as practice active listening to understand other perspectives, viewpoints, and cultures. (PCVL.CM)
- **Innovative Problem Solving:** Students will be able to independently use their learning to approach new problems with curiosity

Meaning

Understandings

What specifically do you want students to understand? What inferences should they make? Students will understand that...

- Momentum is conserved in both elastic and inelastic collisions for all parts of the system. (U1)
- The distinguishing factor between an elastic and inelastic collision is whether or not kinetic energy is conserved or if energy is transformed to a different type. (U2)
- Newton's Second Law provides the connection between an object's change in momentum over time to the object's acceleration during a collision. (U3)
- Impulse is the product of the collision force and time of collision. (U4)
- Mechanical energy is conserved regardless of the type of collision. (U5)

Essential Questions

What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering...

- How can one explain the structure, properties, and interactions of matter? (Q1)
- How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q2)
- Does my answer/solution make sense? How do I test it? (Q3)
- What is the best/most efficient way to solve this type of problem? (Q4)
- Does my approach make sense? What is another way of seeing/doing this? (Q5)
- How do I explain my ideas or approach for a specific purpose and audience? How does sharing that inspire my own and others' thinking? (Q6)
- How do I use labels, symbols, units of measure, tables, graphs, and vocabulary to analyze situations and/or share findings? (Q7)
- How do I apply the engineering process to engineering challenges, lab designs, and real world questions? (Q8)

and creativity while consistently seeking growth through self-reflection and a willingness to accept constructive feedback. (PCVL.IPS)

Acquisition of Knowledge & Skill	
Knowledge	Skills
What facts and basic concepts should students know and be able to recall? Students will know... ■ Momentum (p) is the product of mass and velocity. (K1) ■ The conservation of momentum is written as $P_i = P_f$. (K2) ■ The second equality line of a conservation of momentum problem depends on whether the collision is elastic or inelastic. (K3) ■ Impulse is equal to the area under the curve of the Force vs. Time graph. (K4)	What discrete skills and processes should students be able to use? Students can... ■ I can compute the change in an object's momentum regardless of the type of collision. (S1) ■ I can equate Newton's Second Law to impulse and a momentum change depending on the given and asked for quantities. (S2) ■ I can transfer computed information from kinematics, forces, momentum, and energy depending on the scenario. (S3)