Wallenpaupack Area School District
Planned Course Curriculum Guide

Science

Physics CTE

Course Description:
Physics CTE is an introduction to basic classical physics with laboratory experiences and is a detailed view of the world around us. The concepts of linear and nonlinear motion, forces, work and energy, momentum, and rotational motion are presented. The course uses the mathematics of algebra, geometry, and some trigonometry. Physics CTE focuses on the application of physics to the Engineering Program of Study.

Initial Creation Date and Revision Dates:
This curriculum was initially completed in the Spring of 2025 by Ryan Neenan. Completion Date:

Textbook Resource:
Physics, Serway & Faughn. © 2012 by Holt McDougal

Unit Breakdown (90 Days of 84 Minute Blocks):

1) Introduction to Physics (~5 days)
2) Linear Motion in One Dimension (~17 days)
3) Two-Dimensional Curvilinear Motion and Vectors (~12 Days)
4) Newton's Laws of Motion* (~27 days)
5) Application of Newton's Laws (Circular Motion and Gravitation) (~8 blocks)
6) Work and Energy (~8 blocks)
7) Momentum and Collisions (~8 blocks)

* This unit is expanded to cover the CTE concepts about rotational inertia and torque. This was part of the optional Unit 8 from Physics I, which has been removed for time purposes.
Any remaining days are devoted to the Final Exam and Exam Review

Wallenpaupack Area School District Curriculum	
COURSE: Physics I	**GRADE/S: 10-12**
UNIT 1: Introduction to Physics	**TIMEFRAME: ~5 Days**

PA STANDARDS/STEELS:

Standard - CC.2.2.HS.C.9

Prove the Pythagorean identity and use it to calculate trigonometric ratios.

Standard - CC.2.2.HS.D.9

Use reasoning to solve equations and justify the solution method.

Standard - CC.2.2.HS.D.10

Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

Standard - CC.2.3.HS.A.7

Apply trigonometric ratios to solve problems involving right triangles.

Standard - CC.2.4.HS.B.1

Summarize, represent, and interpret data on a single count or measurement variable.

Standard - CC.2.4.HS.B.3

Analyze linear models to make interpretations based on the data

UNIT OBJECTIVES:

Students will be able to:

1) Describe the basic ideas and methods behind the study of Physics.
2) Identify the applications of Physics to careers and everyday life.
3) Identify the differences between the Imperial and SI/Metric systems of measurement.
4) Convert measurements between the two systems.
5) Define the ideas of accuracy, previsions, and uncertainty in measurements.
6) Use different tools of measurement in laboratory exercises.
7) Understand the process of creating a graph in excel.
8) Identify the concept of slope and its meaning in a graph.
9) Apply the basic operations of geometry and algebra.
10) Understand the process of Dimensional Analysis.

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

1. Direct Instruction and Group Discussions on content
2. Lab activities on measurement and graph making.
3. Article on Uncertainty
4. Video about the Metric System
5. Worksheets on Unit Conversion and Algebra and Geometry concept review.

ASSESSMENTS:

1. Formative assessment from teacher observation and checks.
2. Summative quiz at the end of chapters/unit
3. Lab Activities

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

- Due to the varied level of experience in prior math and science classes, students may need DI on basic algebra concepts and/or unit conversions. Worksheets/quizzes may be modified to show learning goals. One on one instruction or extra practice may be used if necessary.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Physics, (Serway/Faughn), Chapter 1
- PASCO Hardware and Software
- General Lab Equipment

KEY VOCABULARY:

Accuracy, precision, uncertainty, units, metric system, dimensional analysis, meter, kilogram, second, scientific notation, linear, slope, significant figures, Pythagorean system, SOHCAHTOA.

Wallenpaupack Area School District Curriculum	
COURSE: Physics I	**GRADE/S: 10-12**
UNIT 2: Linear Motion in One Dimension	**TIMEFRAME: ~17 days**

PA STEELS:

3.2.9-12.P

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).

UNIT OBJECTIVES:

Students will be able to:

1) Describe motion in terms of displacement, time, velocity and acceleration.
2) Differentiate between distance and displacement and speed and velocity.
3) Differentiate between a vector and a scalar.
4) Explain the role of direction in terms of positive/negative numbers.
5) Explain the concept of acceleration and compare accelerated and non-accelerated motions.
6) Solve for the quantities of displacement, velocity, and acceleration.
7) Construct and interpret the graphs of position, velocity, and acceleration of an object over time.
8) Apply the concepts of constant acceleration to both horizontal and vertical movement, using kinematic equations to solve for motion variables.
9) Describe the difference between instantaneous and average kinematic measures.
10) Analyze the effect of gravity on vertical motion.
11) Describe the idea of free fall acceleration.
12) Calculate the acceleration due to gravity based on data from a free-fall device
13) Apply these concepts to different engineering careers

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

1) Direct instruction and group discussion on content
2) Labs on motion graphs, horizontal kinematics, and vertical kinematics.
3) Worksheets on Motion Graphs and Horizontal/Vertical Kinematics
4) Computer Simulations/Online Videos

ASSESSMENTS:

1. Formative assessment from teacher observation and checks.
2. Summative quiz at the end of chapters/unit
3. Lab Activities

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

- Some differentiation in learning math may be needed including expansion to reduce algebra and model handouts with graphic organizers on how to use equations.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Physics (Serway/Faughn), Chapter 2
- PASCO Hardware and Software
- General Lab Equipment

KEY VOCABULARY:
Kinematics, rectilinear motion, position, distance, displacement, scalar, vector, speed, velocity, time, average, instantaneous, acceleration, symmetry, acceleration due to gravity, air resistance

Wallenpaupack Area School District Curriculum	
COURSE: Physics I	**GRADE/S: 10-12**
UNIT 3: Two-Dimensional Curvilinear Motion and Vectors	**TIMEFRAME: ~12 Days**

PA STEELS:

3.2.9-12.P

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).

UNIT OBJECTIVES:

Students will be able to:

1) Differentiate between addition of scalars and addition of vectors.
2) Understand the process of graphically adding together vectors.
3) Describe the conceptual idea of adding, subtracting, and multiplying vectors by a constant.
4) Apply right triangle geometry to vectors to solve for individual components.
5) Find total vectors by adding components.
6) Describe the difference between polar and rectangular vector form.
7) Describe what mechanical principles govern projectile motion and provide optimal projection.
8) Define the idea of projectile motion involving free fall properties.
9) Calculate the horizontal and vertical components of a projectile's motion
10) Apply kinematics equations to two-dimension projectile motion to solve for various motion variables
11) Determine the needed angle to launch a projectile a specific range given the projectile's initial velocity
12) Apply these concepts to different engineering careers

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

1) Direct instruction and group discussion on content
2) Labs on vector addition and projectile motion
3) Worksheets on vector addition and projectile motion
4) Computer Simulations/Online Videos

ASSESSMENTS:

1. Formative assessment from teacher observation and checks.
2. Summative quiz at the end of chapters/unit
3. Lab Activities

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Some differentiation in learning math may be needed including expansion to reduce algebra and model handouts with graphic organizers on how to use equations.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Physics (Serway/Faughn), Chapter 3
- PASCO Hardware and Software
- General Lab Equipment

KEY VOCABULARY:
Vector, scalar, polar, rectangular, magnitude, direction, projectile, trajectory, components

Wallenpaupack Area School District Curriculum	
COURSE: Physics I	**GRADE/S: 10-12**
UNIT 4: Newton's Laws of Motion	**TIMEFRAME: ~27 Days**

PA STEELS:

3.2.9-12.I

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.

3.2.6-8.H

Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

UNIT OBJECTIVES:

Students will be able to:

1) Differentiate between different kinds of forces.
2) Explain the difference between mass and weight.
3) Solve for the total force on an object.
4) Label forces in a free body diagram
5) Understand the role of friction in various situations.
6) Explain the connection between normal force and friction force.
7) Apply vector algebra to solve for components of forces and a total of multiple forces.
8) Recognize equilibrium situations, and calculate the force required to obtain equilibrium
9) Apply Newton's Three Laws to various situations of human motion.
10) Describe the idea of inertia.
11) Identify the conditions that create the production of a maximum force.
12) Predict the direction and magnitude of an acceleration caused by a known net force.
13) Identify action-reaction pairs in various situations.
14) Identify the basic idea of the Standard Model and the Four Fundamental Forces
15) Identify key facts about Sir Isaac Newton.
16) Explain how to find an object's center of mass
17) Locate the centroid of a rectangle and a triangle
18) Distinguish between torque and force
19) Calculate moment forces (torques) given a specific axis
20) Apply Newton's 2nd Law to rotational mechanics
21) Recognize and apply the idea of rotational equilibrium
22) Differentiate between linear and rotational inertia
23) Compare the rotational inertia between different standard shapes
24) Determine the moment of inertia of different objects.
25) Apply these concepts to different engineering careers
26) Calculate the failure of a loaded structure

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

1) Direct instruction and group discussion on content
2) Labs on inertia (inertia balance), Newton's 2nd Law, Newton's 3rd Law, and Torque
3) Worksheets on Forces and Newton's Laws, and Torque
4) Computer Simulations/Online Videos
5) Biography Video on Sir Isaac Newton

ASSESSMENTS:

1. Formative assessment from teacher observation and checks.
2. Summative quiz at the end of chapters/unit
3. Lab Activities

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Some differentiation in learning math may be needed including expansion to reduce algebra and model handouts with graphic organizers on how to use equations. This chapter in particular employs solving multiple equations for multiple variables, which may need to be retaught for some lower math students. For enrichment, more complicated problems can be presented using Newton's 2nd Law and multiple objects.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Physics (Serway/Faughn), Chapter 4
- PASCO Hardware and Software
- General Lab Equipment

KEY VOCABULARY:

Force, Newton, Vector, Scalar, Internal, External, Field Force, Contact Force, Gravity, Normal Force, Tension, Friction, Coefficient of Friction, Static and Dynamic, Free Body Diagram, Net Force, Equilibrium, Components, Inertia, Newton's 1st Law, Newton's 2nd Law, Newton's 3rd Law, Standard Model, Symmetry, Center of Mass, Center of Gravity, balance, stability, pivot, fulcrum, torque, radius, rotational equilibrium, axis of rotation, lever, lever arm, angular motion, net torque, rotational inertia

Wallenpaupack Area School District Curriculum	
COURSE: Physics I	**GRADE/S: 10-12**
UNIT 5: Circular Motion and Gravitation	**TIMEFRAME: ~8 Days**

PA STEELS:

3.2.9-12.I

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.

3.2.9-12.L

Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

3.2.6-8.J

Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

3.2.6-8.K

Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

UNIT OBJECTIVES:

Students will be able to:

1) Understand the difference between tangential and radial (Centripetal) acceleration
2) List the requirements of circular motion.
3) Explain how circular motion is an application of Newton's 2nd Law
4) Describe the directions of centripetal acceleration and centripetal force
5) Solve for the centripetal acceleration and centripetal force of an object
6) Explain how the apparent existence of an outward force in circular motion can be explained as inertia resisting the centripetal force.
7) Describe the physical differences between horizontal circular motion and vertical circular motion of a mass on a string.
8) Identify centripetal forces in different physical situations
9) Explain how Newton's Law of Gravitation accounts for various phenomena, including satellite and planetary orbits, falling objects, and tides.
10) Recognize that Newton's Law of Gravitation describes the centripetal force of a body in circular orbit.
11) Describe the idea of an inverse square relationship among variables.
12) Apply Newton's Law of Gravitation to solve problems.
13) Understand that gravity comparatively to the other fundamental forces is a weak force.
14) Describe the idea of a gravitational field and how every object with mass emits one.
15) Apply Newton's Law of Gravitation to Centripetal Force equations to solve for the tangential speed and the period of an object in orbit.
16) List the basic ideas of Kepler's 1st and 2nd Law.
17) Solve for the Period and tangential speed of orbital bodies using Kepler's 3rd Law.
18) Explain the patterns of tangential speed and period in the planets and other orbital bodies of our solar system
19) Apply these concepts to different engineering careers

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

1) Direct instruction and group discussion on content
2) Labs on Circular Motion and Gravitation (Computer Simulated)
3) Worksheets on Circular Motion and Gravitation/Kepler's Laws
4) Computer Simulations/Online Videos
5) COSMOS Video: "When Knowledge Conquered Fear"

ASSESSMENTS:

1. Formative assessment from teacher observation and checks.
2. Summative quiz at the end of chapters/unit
3. Lab Activities

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Some differentiation in learning math may be needed including expansion to reduce algebra and model handouts with graphic organizers on how to use equations.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Physics (Serway/Faughn), Chapter 7 (Sections 1-3 Only)
- PASCO Hardware and Software
- General Lab Equipment

KEY VOCABULARY:

Tangential velocity, centripetal acceleration, centripetal force, Newton's Law of Gravitation, Universal Gravitational Constant, Gravitational Field, Cavendish Experiment, tides, Kepler's 1^{st} Law, Kepler's 2^{nd} Law, Kepler's 3^{rd} Law, Periodic motion, Period

Wallenpaupack Area School District Curriculum	
COURSE: Physics I	**GRADE/S: 10-12**
UNIT 6: Work and Energy	**TIMEFRAME: ~8 Blocks**

PA STEELS:

3.2.9-12.O

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.

3.2.9-12.P

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)

3.2.9-12.Q

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

3.2.6-8.L

Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and speed of an object.

3.2.6-8.O

Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

3.2.6-8.P

Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

UNIT OBJECTIVES:

Students will be able to:

1) Recognize the difference between the scientific and everyday definition of work.
2) Define work by relating it to force and displacement
3) Identify situation when work is being done and when it is not.
4) Calculate the net work done on an object when multiple forces are applied to it.
5) Describe the relationship between work and energy.
6) Apply the work-kinetic energy theorem to solve problems.
7) Differentiate between work and power.
8) Differentiate between kinetic and potential energy.
9) Differentiate between mechanical and other forms of energy.
10) Solve for different kinds of energy.
11) Identify the types of energy in different situations.
12) Explain how a “system” is used in conservation of energy.
13) Differentiate between an open and closed system.
14) Identify situations in which conservation of energy is valid.
15) Solve for various quantities using the idea of conservation of energy.
16) Apply these concepts to different engineering careers

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

1) Direct instruction and group discussion on content
2) Labs on Work/Power and Conservation of Energy
3) Worksheets on Work/Power/Energy and Conservation of Energy
4) Computer Simulations/Online Videos

ASSESSMENTS:

1. Formative assessment from teacher observation and checks.
2. Summative quiz at the end of chapters/unit
3. Lab Activities

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Some differentiation in learning math may be needed including expansion to reduce algebra and model handouts with graphic organizers on how to use equations. This particular chapter is generally easier due to the fact that Energy is a scalar. "Energy Tables" are used to help guide students who are struggling.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Physics (Serway/Faughn), Chapter 5
- PASCO Hardware and Software
- General Lab Equipment

KEY VOCABULARY:

Work, Joule, Power, Watt, Horsepower, Kinetic Energy, Gravitational Potential Energy, Elastic Potential Energy, mechanical energy, internal energy, heat energy, conservation of energy, system, open system, closed system

Wallenpaupack Area School District Curriculum	
COURSE: Physics I	**GRADE/S: 10-12**
UNIT 7: Momentum and Collisions	**TIMEFRAME: ~8 Days**

PA STEELS:

3.2.9-12.J

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.

3.2.9-12.K

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

3.2.6-8.G

Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

UNIT OBJECTIVES:

Students will be able to:

1) Define the ideas of momentum and impulse.
2) Compare the momentum of different moving objects.
3) Identify examples of change in the momentum of an object
4) Summarize the importance of the differences of time and force in decreasing momentum.
5) Describe the interaction between two objects in terms of the change in momentum of each object.
6) State the law of conservation of momentum.
7) Solve for a variety of variables using conservation of momentum.
8) Differentiate between elastic, inelastic, and reverse (explosion) collisions.
9) Compare the total momentum and energy of two objects before and after they interact in different kinds of collisions.
10) Explain how collisions can happen in more than one dimension.
11) Apply these concepts to different engineering careers

INSTRUCTIONAL STRATEGIES/ACTIVITIES:

1) Direct instruction and group discussion on content
2) Labs on Momentum/Impulse and Conservation of Momentum
3) Worksheets on Momentum Impulse and Conservation of Momentum
4) Computer Simulations/Online Videos
5) Video on Car Collisions / Conservation of Momentum

ASSESSMENTS:

1. Formative assessment from teacher observation and checks.
2. Summative quiz at the end of chapters/unit
3. Lab Activities

DIFFERENTIATED INSTRUCTION (Acceleration/Enrichment):

Some differentiation in learning math may be needed including expansion to reduce algebra and model handouts with graphic organizers on how to use equations.

RESOURCES (Technology Based Resources, Text Resources, etc.):

- Physics (Serway/Faughn), Chapter 5
- PASCO Hardware and Software
- General Lab Equipment

KEY VOCABULARY:

Momentum, impulse, conservation of momentum, elastic, inelastic, reverse collision