Pequea Valley School District
STEM

Unit 1: CNC Manufacturing **Course: STEM9** **Grade: 9th**

Planning the Focus Based on the Desired Result

What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s)

- How has computer-aided manufacturing affected society's ability to produce products?

STEM9

- Computer Manufacturing vs. Traditional Manufacturing
- G-Coding
- Troubleshooting Coding
- Engineering and Design Process
- Calculating Slope

Keystone Eligible Content/PA Core Standard

3.2.10.B Apply process knowledge and organize scientific and technological phenomena in varied ways
3.2.10.D Identify and Apply the technological design process to solve problems.
3.7.10.A Identify and safely use a variety of tools, basic machines, materials, and techniques to solve problems and answer questions
3.8.10.C Evaluate possibilities consequences and impacts of scientific and technological solutions

Pacing: Approximate number of class sessions per unit

- 14 Days

Tier 3 Vocabulary (Content specific vocabulary)

- G-Code
- CAM (Computer-Aided Manufacturing)
- Troubleshooting
- Slope
- CNC
- Coordinate Plane
- X,Y, and Z Axes
- Point of Origin
- Router

Know - What do students need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Learners will know how to create basic G-Code commands.
- Learners will know how to plot points on a 3-dimensional plane.
- Learners will know how to use a CNC router.
- Learners will be able to troubleshoot coding.
- Learners will be able to use slopes to solve complex problems.

Understand - What do students need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Learners will understand how computer-aided manufacturing has impacted the manufacturing industry.
- Learners will be able to troubleshoot a problem and find the best solution.

Learning Outcome - What do students need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- CNC Project - Learners will utilize the CNC router to create a vertical marble maze with appropriate slopes to create a challenging puzzle.
- Summative Assessment - Learners will complete a practical exam drafting G-codes.

Assessments:

- Project is Aligned to the Algebra Keystone

Software/Resources:

Authentic Learning Experiences:

- Learners have the opportunity to tour Charles and Alice to learn about computer-aided manufacturing.

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Unit 2: Deck Modeling **Course: STEM 9** **Grade: 9**

Planning the Focus Based on the Desired Result

What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s)
How is a scale model of a deck designed and prototyped?

Keystone Eligible Content/PA Core Standard
3.2.10.B Apply process knowledge and organize scientific and technological phenomena in varied ways
3.2.10.D Identify and Apply the technological design process to solve problems.
3.6.10.C Apply Physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, research and design to real world problems.
3.7.10.A Identify and safely use a variety of tools, basic machines, materials, and techniques to solve problems and answer questions

Pacing: Approximate number of class sessions per unit
- 20 Days

Tier 3 Vocabulary (Content specific vocabulary)
Header, ledger, tread, riser, Joist, end joist, baluster, top rail, cap rail, footing, girder, stringer, decking, architecture scale, miter saw

Know - What do students need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***
- Proportions
- How to read an architecture scale
- Parts of a deck

Understand - What do students need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***
- How to use an architectural scale
- How Deck parts are properly used
- How to create a scale model drawing

- How to use tools and materials to construct a scale model

Learning Outcome - What do students need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will create a scale drawing of a deck that meets specific criteria.
- Learners will construct a scale model of a deck that meets specific criteria.
- Learners will present and sell their deck designs to the class

Assessments:

- Learners will take an assessment on deck parts.
- Algebra I Keystones

Software/Resources:

- Authentic Learning experience: Jim Stauffer from Ames construction

Pequea Valley School District
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Unit 3: Concrete Testing **Course: STEM9** **Grade: 9th**

Planning the Focus Based on the Desired Result

What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s)

How can materials be tested to determine their appropriate application?

- Following Directions/Process
- Proportions
- Materials Testing
- Analyzing and Creating Scatter Plots
- Collecting Data
- Solving Linear Equations with a Graphing Calculator

Keystone Eligible Content/PA Core Standard

3.2.10.B Apply process knowledge and organize scientific and technological phenomena in varied ways
3.2.10.D Identify and Apply the technological design process to solve problems.
3.6.10.C Apply Physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, research and design to real world problems.
3.7.10.A Identify and safely use a variety of tools, basic machines, materials, and techniques to solve problems and answer questions

Pacing: Approximate number of class sessions per unit

- 9 Class Periods

Tier 3 Vocabulary (Content specific vocabulary)

- Concrete
- Cement
- Mortar
- Scatter Plot
- Linear Equation
- Slope
- Y-Intercept
- Regression

- Dependent Variable
- Independent Variable
- PSI

Know - What do students need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Learners know how to follow directions and mix mortar samples using proportions.
- Learners know how to test mortar for strength using an industrial compression strength tester.
- Learners will be able to create a scatter plot to represent data.
- Learners will be able to create a mathematical model (linear equation) to represent data and predict future data points.

Understand - What do students need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Learners will understand how to complete material testing to produce data and format mathematical models.

Learning Outcome - What do students need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will complete the Concrete Testing project. This project requires learners to collect data, graph the data on a scatter plot, and create a linear equation to mathematically model the data.
- They will Understand why it is important for material testing and how material testing impacts use.

Assessments: Project is Aligned to the Algebra Keystone

Software/Resources:

<u>Authentic Learning Experience</u>:

- This unit includes a partnership with Dutchland Concrete and consists of a guest speaking opportunity and a local plant tour.

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Unit 4: Maglev Vehicle **Course: STEM 9** **Grade: 9**

Planning the Focus Based on the Desired Result

What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s)

- How does aerodynamics affect the acceleration of a maglev vehicle?

Keystone Eligible Content/PA Core Standard

3.2.10.B Apply process knowledge and organize scientific and technological phenomena in varied ways
3.2.10.D Identify and Apply the technological design process to solve problems.
3.6.10.C Apply Physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, research and design to real world problems.
3.7.10.A Identify and safely use a variety of tools, basic machines, materials, and techniques to solve problems and answer questions

Pacing: Approximate number of class sessions per unit

- 13

Tier 3 Vocabulary (Content specific vocabulary)
Magnetism, Lodestone, electromagnetism, voltage, current, drag, turbulence, drag coefficient, acceleration, maglev

Know - What do students need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- The characteristics of magnets and electromagnetism
- How aerodynamics affects acceleration in a maglev vehicle
- What a vacuum former does

Understand - What do students need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How electromagnets are used in society
- The procedures to operate the vacuum former

Learning Outcome - What do students need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will design and prototype a maglev vehicle that will be tested for acceleration on a maglev track and photogates. This vehicle will be prototyped of foam and then finalized with a vacuum former.
- Learners will use materials to create an complete an electromagnetic lab

Assessments:

Software/Resources:

- Vacuum former

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Unit 5: Simple Machines **Course: STEM 9** **Grade: 9**

Planning the Focus Based on the Desired Result\

What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s)
How are simple machines used to create a mechanical advantage?

Keystone Eligible Content/PA Core Standard
3.2.10.B Apply process knowledge and organize scientific and technological phenomena in varied ways
3.2.10.D Identify and Apply the technological design process to solve problems.
3.6.10.C Apply Physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, research and design to real world problems.
3.7.10.A Identify and safely use a variety of tools, basic machines, materials, and techniques to solve problems and answer questions

Pacing: Approximate number of class sessions per unit
- 22

Tier 3 Vocabulary (Content specific vocabulary)
Fixed pulley, movable pulley, compound pulley, input force, output force, mechanical advantage, direct variation, box and whisker plot, quartile, mean, Drive gear, follower gear, idle gear, spur gear, worm gear, RPM, gearing up, gearing down, gear train, torque, speed, input, output

Know - What do students need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***
- Mechanical advantage
- How to calculate mechanical advantage using proportions
- How to read a spring scale
- Types of gears and gearing systems
- Types of pulleys

Understand - What do students need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- How to use gears to create speed or torque
- How pulleys can be used to create a mechanical advantage

Learning Outcome - What do students need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will set up and test the mechanical advantage of pulley systems. They will complete a pulley lab that requires learners to measure input and output forces, calculate mechanical advantage, and design their own pulley system.
- Learners will Complete a slow car collision lab. Students will collect data to determine the speed of their car. This info is placed on a graph and then solved using a system of equations to determine the collision time and location.
- Learners will use gears and legos to construct a car that moves the slowest. They will calculate the gear ratio, motor rpm, and distance of their car and test them to check for accuracy

Assessments:

- Gear calculations Quiz

Software/Resources:

- Legos
- Pulleys
- Spring scale

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Unit 6: Rocketry **Course: STEM9** **Grade: 9th**

Planning the Focus Based on the Desired Result

What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s)

How are rockets designed and constructed?

- Systems of Inequalities
- Custom Manufacturing vs. Mass Production
- Rocket Construction
    - Fin Design
    - Engine Assembly
    - Parachute Design
- Introduction to Trigonometry
- Laser engraver

Keystone Eligible Content/PA Core Standard

3.2.10.B Apply process knowledge and organize
3.2.10.D Identify and Apply the technological design process to solve problems.scientific and technological phenomena in varied ways
3.6.10.C Apply Physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, research and design to real world problems.
3.7.10.A Identify and safely use a variety of tools, basic machines, materials, and techniques to solve problems and answer questions

Pacing: Approximate number of class sessions per unit

- 11 Days

Tier 3 Vocabulary (Content specific vocabulary)

- Manufacturing
- Systems of Inequalities
- Cosine
- Sine
- Tangent
- Nose Cone

- Apogee

Know - What do students need to **know** in order to be able to do and understand? ***List concepts, such as facts, formulas, key vocabulary and knowledge "nuggets".***

- Learners will know how rockets function.
- Learners will know how to calculate the height of an object using basic trigonometry.
- Learners will understand how to use inequalities to solve design problems.

Understand - What do students need to **understand**? What is the **big idea**? ***List broad concepts or "big ideas" in a statement of enduring understanding.***

- Learners will understand how rockets function and how math can be used to determine the highest point of the flight path.

Learning Outcome - What do students need to be able to **accomplish** by the unit's end? ***List skills and competencies.***

- Learners will create a system of inequalities to determine the most effective ratio of custom and mass produced rockets in a given time.
- Learners will design, build, and launch a rocket to calculate the highest point reached when launched.

Assessments:

- Project is Aligned to the Algebra Keystone

Software/Resources:

- Laser engraver