EAST PENN SCHOOL DISTRICT

Engineering Tech 2
JULY 15, 2025

Engineering Tech 2: Unit 1 - CNC Machining

STAGE 1 | DESIRED RESULTS
Context and relevance for student learning

Standards

3.5.9-12.A - Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.

3.5.9-12.K (ETS) - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

3.5.9-12.O - Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.

3.5.9-12.X - Implement the best possible solution to a design using an explicit process.

3.5.9-12.AA - Safely apply an appropriate range of making skills to a design thinking process.

Transfer

Students will be able to independently use their learning to...

- ☐ How CNC machines are used in the manufacturing process.

Meaning

UNDERSTANDINGS
Students will understand that...

- ☐ There is a difference between additive and subtractive manufacturing processes.
- ☐ G-code is the language used to control CNC machines and tell them what to do.
- ☐ Writing G-code manually means giving the machine step-by-step instructions for cutting toolpaths.
- ☐ Basic G-code commands control machine movements, speeds, and tool actions.
- ☐ Feed rates, speeds, and tool paths must be set correctly to get the right results.
- ☐ Absolute and relative coordinate systems require unique programming techniques.
- ☐ Specific safety procedures must be followed when working with CNC machines.

ESSENTIAL QUESTIONS
Students will keep considering...

- ☐ What is G-code, and why is it essential in CNC machining?
- ☐ How do you write G-code to control basic CNC machine movements?
- ☐ What are the common G-code commands used in manual programming?
- ☐ How do you optimize G-code for efficient and accurate milling?
- ☐ How do you verify that the toolpath will produce the correct final product when using a CNC machine?
- ☐ How do you troubleshoot common errors in G-code programming?

Acquisition(need to align with above and standards)

Students will know...
Disciplinary Core Ideas

- ☐ Criteria may need to be broken down into simpler ones that can be

Students will be skilled at...
Science and Engineering Practices

- ☐ Apply scientific ideas, principles, and/or evidence to provide an explanation of

3.5.9-12PP - Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making.	approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ☐ Analyze a complicated system to identify ways that it might fail in the future. Identify the most likely failure points and recommend safeguards to avoid future failures. ☐ Students develop, test and refine prototypes as part of a cyclical design process. ☐ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. Other knowledge ☐ G-Code is used for CNC milling, CNC turning, and 3D printing. ☐ CNC milling and turning are subtractive manufacturing processes and 3D printing is an additive manufacturing process. ☐ How to write g-code commands for linear interpolation and circular interpolation. ☐ How to use the machine's coordinate system for precise positioning.	phenomena and solve design problems, taking into account possible unanticipated effects. ☐ Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. Technology and Engineering Practices ☐ Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. ☐ Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking. ☐ Systems Thinking - Uses the systems model to show how parts of technological systems work together. Other Skills ☐ Operating CNC machines safely. ☐ Problem-solving and troubleshooting. ☐ Measuring with rulers. ☐ Plotting points in fractional inches. ☐ Manually writing g-code programs that involve linear and circular interpolation. ☐ Manually writing g-code programs that involve absolute and/or relative coordinate systems. ☐ Determining where a rapid vs. specified feed rate should be used. ☐ Polishing and finishing techniques.

Engineering Tech 2: Unit 2 - CAD/CAM Software

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.5.9-12.A - Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.

3.5.9-12.K (ETS) - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

3.5.9-12.X - Implement the best possible solution to a design using an explicit process.

3.5.9-12.AA - Safely apply an appropriate range of making skills to a design thinking process.

3.5.9-12PP - Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making.

Transfer

Students will be able to independently use their learning to...

- ☐ How computers are used to convert 2D and 3D models into CNC toolpaths.

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ A toolpath is a series of instructions that guide the CNC machine on how to move, cut, and shape a material.
- ☐ Choosing the right tools, cutting speeds, and feed rates is critical to achieving the desired results and ensuring the part is machined correctly.
- ☐ Simulating a toolpath in CAM software allows for detecting and fixing errors before the actual machining process begins.
- ☐ G-code is generated from CAM software and acts as the instruction set for CNC machines, controlling movement, tool changes, and other actions.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ What is a toolpath, and why is it important in CNC milling and turning?
- ☐ How are 2D or 3D designs created in CAD software used in CNC milling or turning?
- ☐ What steps are involved in producing a toolpath from a CAD drawing using CAM software?
- ☐ How can a toolpath be simulated in CAM software to check for errors before actual machining?
- ☐ What are the common errors to watch for when creating toolpaths, and how can they be corrected?
- ☐ How is G-code generated and post-processed from the CAM software to control the CNC machine?
- ☐ How does the programmer verify that the toolpath will produce the correct final product when using a CNC milling machine or CNC lathe?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

- ☐ Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
- ☐ Analyze a complicated system to identify ways that it might fail in the future. Identify the most likely failure

Students will be skilled at...

Science and Engineering Practices

- ☐ Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
- ☐ Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.

Technology and Engineering Practices

	points and recommend safeguards to avoid future failures. ☐ Students develop, test and refine prototypes as part of a cyclical design process. ☐ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. Other knowledge ☐ CAD software is used to design parts, and CAM software converts those designs into machine-readable toolpaths for CNC milling or turning. ☐ Various materials are polished using different polishing compounds.	☐ Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. ☐ Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking. ☐ Systems Thinking - Uses the systems model to show how parts of technological systems work together. Other Skills ☐ Operating different systems safely. ☐ Problem-solving and troubleshooting. ☐ Creating 2D designs using CAD software that is suitable for CNC milling or turning. ☐ Transferring a CAD design into a toolpath using CAM software. ☐ Identifying and correcting common toolpath errors when verifying the toolpath. ☐ Finishing and polishing techniques.

Engineering Tech 2: Unit 3 - Automotive Design

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.5.9-12.A - Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.

3.5.9-12.E - Evaluate how technology and engineering advancements alter human health and capabilities.

3.5.9-12.F - Evaluate a technological innovation that arose from a specific society's unique need or want.

3.5.9-12.H - Evaluate ways that technology and engineering can impact individuals, society, and the environment.

3.5.9-12.I (ETS) - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

3.5.9-12.N - Analyze and use relevant and appropriate design

Transfer

Students will be able to independently use their learning to...

- ☐ How engineering principles and design choices impact the safety, performance, and effectiveness of vehicles in real-world crash situations

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Car safety depends on design, materials, and engineering to protect passengers in a crash.
- ☐ The materials used in a car must be strong, lightweight, and able to resist impacts for safety and performance.
- ☐ The shape and design of a car affect how it absorbs and spreads crash forces to protect people inside.
- ☐ Crash tests give important information that helps engineers improve car designs and safety features.
- ☐ A good car design must balance safety, cost, and performance to meet needs and safety rules.
- ☐ Safety features like airbags, seat belts, and crumple zones work together to reduce injury in a crash.
- ☐ Crash test data is crucial for improving future car safety standards and designs.
- ☐ There are trade-offs between safety, cost, and performance in car design.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ What makes a car safe during a crash?
- ☐ How do the shape and design of a car affect its safety in a crash?
- ☐ How can engineering help make a car safer in a crash?
- ☐ How do crash test results help make cars safer?
- ☐ How does the weight and speed of a car affect the crash?
- ☐ How do features like airbags and seat belts work together to keep passengers safe?
- ☐ What are the responsibilities of car designers when it comes to safety?
- ☐ How do crash tests help improve car designs?
- ☐ What challenges do engineers face when making cars safe, while also keeping them affordable and performing well?

Acquisition(need to align with above and standards)

Students will know...

Disciplinary Core Ideas

- ☐ Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain

Students will be skilled at...

Science and Engineering Practices

- ☐ Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

thinking processes to solve technological and engineering problems. *3.5.9-12.O - Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.*	criteria over others (trade-offs) may be needed. ☐ Analyze a complicated system to identify ways that it might fail in the future. Identify the most likely failure points and recommend safeguards to avoid future failures. ☐ Students develop, test and refine prototypes as part of a cyclical design process. ☐ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. Other knowledge ☐ How vehicle design influences crash safety and occupant protection. ☐ How crash tests are conducted and what data is collected. ☐ The basic engineering principles involved in designing a crash-resistant vehicle. ☐ The roles of safety features such as airbags, seat belts, and crumple zones in a car. ☐ How crumple zones work to absorb impact energy and protect passengers during a crash. ☐ How to analyze the results of a crash test to improve vehicle design. ☐ How vehicle weight, speed, and energy affect the severity of a crash.	☐ Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. Technology and Engineering Practices ☐ Making and Doing - Demonstrates the ability to regulate and improve making and doing skills. ☐ Critical Thinking - Uses evidence to better understand and solve problems in technology and engineering, including applying computational thinking. ☐ Systems Thinking - Uses the systems model to show how parts of technological systems work together. Other Skills ☐ Problem-solving and troubleshooting. ☐ Proper measuring techniques. ☐ Applying basic engineering principles to design and test a crash-resistant vehicle. ☐ Designing and building models that simulate real-world crash scenarios. ☐ Analyzing crash test data to evaluate and improve vehicle design. ☐ Explaining how safety features like airbags, seat belts, and crumple zones work together to protect passengers. ☐ Conducting experiments and recording observations to assess how vehicle design influences crash safety.