Syracuse City School District
Career and Technical Education Program
Manufacturing Technology and Pre-Apprenticeship Program

Pathway Overview

Career Field

Manufacturing jobs are growing at the fastest rate in 23 years. Manufacturers are paying high hourly wages and highly valued benefits. They use tools and machines to make engines, computers, aircraft, ships, boats, toys, electronic devices, control panels, and more. Computer-controlled machine tools are used to produce precision metal parts, instruments, and tools. Apprenticeships focus on training for a specific career as students learn the trade by actually doing the job. Apprentices gain hands-on experience and have the opportunity to apply job skills while getting paid.

Career Pathway Opportunities

- Assembler
- Automation Technician
- CNC Operator
- Forklift Operator
- Injection Molding Technician
- Machinist
- Maintenance Mechanic
- Material Handler
- Mechanical Technician
- Metal and Plastic Machine Operator
- Milling Machine Operator
- Quality Assurance Auditor
- Quality Control Inspector
- Tool and Die Maker
- Testing Technician

Program

The Manufacturing Technology and Pre-Apprenticeship program will prepare students at the high school level to be considered as first in line for a Registered Apprenticeship as an Industrial Manufacturing Technician. Students will receive over 600 hours of classroom instruction in addition to at least 100 hours of on-the-job training in the manufacturing field of their choice. Students will receive assistance in matching up their interests and skills to a specific manufacturing career and will learn basic technical and career readiness skills that will prepare them for full apprenticeship. Students will participate in a variety of work-based learning activities including professional career coaching from one of over 45 local business partners, workplace visits, job shadowing, part-time school year and full-time summer internships, and paid pre-apprenticeship positions, with transportation arranged by SCSD.

Certification

- Regents Diploma with CTE Technical Endorsement
- OSHA Safety Certification
- Eligibility to take employer-based Manufacturing Skill Standards Council (MSSC) Certified Product Technician (CPT) Assessments in Safety, Quality Practices and Measurement, Manufacturing Processes and Production, and Maintenance Awareness.
- Other Relevant Certifications

Program Benefits

- Paid internship while attaining High School Diploma.
- Potential for a full paid apprenticeship immediately upon graduation.
- Increased academic success.
- Possible college tuition assistance from employers.
- Learning valuable skills and experience in a chosen industry.
- Participation in summer enrichment and additional educational resources.

Integrated Academics

1 CTE Integrated ELA Credit
1 CTE Integrated Math Credit

Equipment and Supplies

- **School will provide:** Textbook, up-to-date shop tools, supplies and safety equipment, transportation for all program-related activities
- **Student will provide:** Work boots or safety shoes (steel/composite toe preferred), long work pants.

Competencies

This Pathway curriculum includes eleven competencies identified in collaboration with the Manufacturers Association of Central New York and representatives of local business and industry.

For each topic within the competencies, the level at which each learning target is introduced is indicated by a ✓.

The key learning targets are aligned with the Work Standards of the Manufacturing Skill Standards Council (MSSC) required for certification as a Certified Product Technician (CPT) in the areas of:

- Safety → CPT-S
- Quality Practices and Measurement → CPT-QPM
- Manufacturing Processes and Production → CPT-MPP
- Maintenance Awareness → CPT-MA

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competencies	Topics	
Career Readiness and Communication	• Communication Skills • Teamwork, Collaboration and Leadership Skills • Conflict Resolution Skills	• Positive Work Ethic • Career Exploration and Planning • Personal Finance
Safety	• General Safety • OSHA 10 • Personal Protective Equipment (PPE) • Lockout Tagout	• Machine Guarding • Hazardous Chemicals and Safety Data Sheets • Hand and Power Tool Safety
Mathematics	• Mathematical Computation • Algebra, Geometry and Trigonometry	• Statistics • Mathematics in Manufacturing
Measurement	• Measurement Fundamentals • Tolerance • Torque • Steel Rule	• Micrometer • Caliper • Height Gage • Go/No Go Gage
Print Reading	• Prints, Diagrams, and Schematics	• Assembly Drawings
Materials	• Properties of Materials • Metals	• Plastics and Polymers • Ceramics and Glass
Material Handling	• Fundamentals of Hydraulics and Pneumatics • Fork Lift/PIT (Power Industrial Truck) Operation	• Lifting and Moving Devices • Rigging
Foundations of Manufacturing	• Trends and Technologies in Manufacturing • Lean Manufacturing Principles • Six Sigma Principles	• Basic Mechanical Systems • Machine Care and Maintenance (TPM: Total Productive Maintenance)
Assembly	• Basic Tool Use • Fasteners	• Basic Assembly Skills • Quality Control
Manufacturing Processes	• Soldering • Welding • Fundamentals of Machine Tools • Drill Presses	• Milling Machines • Grinding Tools • Lathes • CNC (Computer Numerical Control) Tools
Electrical Systems	• Basic Electrical Components • Electrical Safety	• Electrical Measurement and Measuring Instruments • Electrical Testing and Troubleshooting

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Crosswalk to NYS Department of Labor Industrial Manufacturing Technician

INDUSTRIAL MANUFACTURING TECHNICIAN Appendix B: Related Instruction	PRE-APPRENTICESHIP CURRICULUM Competencies	 Topics
Safety, Health and the Workplace		
General Workplace Safety	Safety	General Safety
First Aid & CPR	Safety	General Safety
Personal Protective Equipment (PPE)	Safety	Personal Protective Equipment
Right-to-Know/Safety Data Sheets (SDS)	Safety	Hazardous Chemicals and Safety Data Sheets
Asbestos Awareness	Safety	Hazardous Chemicals and Safety Data Sheets
Lockout/Tagout (LO/TO)	Safety	Lockout Tagout
Sexual Harassment Prevention Training	Safety	General Safety
OSHA 10-Hour General Industry	Safety	OSHA 10
Trade Theory and Skills		
Quality Practices & Measurement Module	Measurement	Measurement Fundamentals
Computer Fundamentals	Career Readiness and Communication	Career Exploration and Planning
Technical Drawings	Print Reading	Prints, Diagrams and Schematics
Trade Math	Mathematics	Mathematics in Manufacturing
Geometrical Dimensioning & Tolerancing	Measurement	Tolerance
Metrology	Measurement	Measurement Fundamentals
Manufacturing Production & Processes Module	Manufacturing Processes	Fundamentals of Machine Tools
Maintenance Awareness Module	Foundations of Manufacturing	Machine Care and Maintenance
Lean Manufacturing	Foundations of Manufacturing	Lean Manufacturing Principles
Tools & Equipment: Proper Care & Use	Assembly	Basic Tool Use
Emerging Trends and Technologies in Manufacturing	Foundations of Manufacturing	Trends and Technologies in Manufacturing.
Workplace Communications	Career Readiness and Communication	Communication Skills
Welding	Manufacturing Processes	Welding
Fundamentals of Mechanical Concepts	Foundations of Manufacturing	Basic Mechanical Systems
Fundamentals of Hydraulics and Pneumatics	Material Handling	Fundamentals of Hydraulics and Pneumatics

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Career Readiness and Communication

Topics:

- **Communication Skills**
- **Teamwork, Collaboration and Leadership Skills**
- **Conflict Resolution Skills**
- **Positive Work Ethic**
- **Career Exploration and Planning**
- **Personal Finance**

Key Questions	• What is the best way to communicate ideas clearly and succinctly? • How does worker convey professionalism in the workplace? • What skills and preparation are needed to pursue a career in manufacturing technology? • Why are successful job-seeking skills required in a competitive marketplace? • What are the qualities of a team player? • How can an individual be fiscally responsible?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,6,7,8,9,10	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,3,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,3,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 1,2,4,5	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 1,2,4,5	**Math** 7.EE.3 F-LE.1 A-SSE.1b	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
COMMUNICATION SKILLS (CPT-S)				
• Use effective oral and written communication skills, including use of word processing programs and email.	✓			
• Provide and comprehend directions or instructions.	✓			
• Give and respond to oral and written reports or presentations.	✓			
• Participate in group or team discussions.	✓			
• Engage in effective conversations with coworkers, supervisors, and clients.	✓			
• Maintain a professional tone in all communications.	✓			
• Avoid use of personal electronic devices during work hours and remain focused on the task at hand.	✓			
TEAMWORK, COLLABORATION AND LEADERSHIP SKILLS (CPT-S)				
• Explain the importance of teamwork to the overall operation of the business.	✓			
• Communicate effectively with other team members using a variety of methods (verbal, written, electronic).	✓			
• Collaborate with team members to solve problems and improve processes.	✓			
• Consider the group's success and not just individual achievement.	✓			
• Look for ways to help team members and recognize them for their contributions.	✓			
• Let team members know what is needed to get the job done.	✓			

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Provide clear documentation of assignments, goals, and timelines.	✓			
• Accept personal responsibility for successes and challenges on the job.	✓			
CONFLICT RESOLUTION SKILLS				
• Analyze and compare conflict resolution styles and explore successful methods of dealing with conflict.	✓			
• Facilitate positive and rational discussion in a non-threatening environment.	✓			
• Demonstrate the importance of language and tone in conveying one's point of view and how to use re-phrasing techniques for effective communication.	✓			
• Explain how listening is a form of respect and a tool for successful conflict resolution.	✓			
• Develop the ability to set aside emotions and take responsibility for one's role in conflict.	✓			
• Collaborate and negotiate mutually acceptable solutions.	✓			
• Participate in Career Coaching sessions to improve employability skills.	✓			
POSITIVE WORK ETHIC				
• Accept personal responsibility for work quality.	✓			
• Exhibit professional practices, including good habits of personal hygiene and appropriate dress.	✓			
• Cooperate in a pleasant and polite manner with clients, coworkers, and supervisors.	✓			
• Take directions willingly and follow instructions precisely.	✓			
• Follow established practices and procedures with exactness.	✓			
• Work without constant supervision.	✓			
• Find tasks to perform on one's own.	✓			
• Complete assigned tasks with in a timely manner and with a high degree of workmanship.	✓			
• Exhibit willingness to learn.	✓			
• Exhibit interest in making the organization more effective and productive.	✓			
• Maintain work standards in the midst of change.	✓			
• Exhibit flexibility and adaptability.	✓			
• Explain the importance of satisfactory attendance to the overall operation of the business.	✓			
• Limit tardiness, early departures, and absences to legitimate and essential occasions.	✓			
• Negotiate anticipated absences according to company policy.	✓			
• Call in to notify the supervisor of unanticipated absences.	✓			
CAREER EXPLORATION AND PLANNING				
• Research opportunities in the manufacturing technology field.	✓			
• Prepare/update portfolio of current skills.	✓			
• Create resume and cover letter.	✓			
• Describe the components of a successful job application process.	✓			
• Summarize the basic organization and respective functions of a typical corporation, including administration, sales and marketing, engineering, manufacturing and production, quality assurance, and accounting.	✓			
• Communicate with employers through the job shadow and internship experiences.	✓			
PERSONAL FINANCE				
• Calculate, track, and evaluate income and spending.	✓			
• Evaluate savings and investment options to meet short- and long-term goals.	✓			
• Analyze the costs and benefits of various types of credit and debt.	✓			
• Identify and evaluate types of risk and insurance.	✓			

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Safety

Topics:

- **General Safety**
- **OSHA 10**
- **Personal Protective Equipment (PPE)**
- **Lockout Tagout**
- **Machine Guarding**
- **Hazardous Chemicals and Safety Data Sheets**
- **Hand and Power Tool Safety**

Key Questions	• Why is safety important in the manufacturing industry? • How does a professional avoid injury? • What rules MUST be followed in order to ensure operator safety when working with machinery?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,7,8,9,11	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 3,5	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 2,4,5	**Math**	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
GENERAL SAFETY				
• Identify types and sources of workplace hazards common to various manufacturing settings and their consequences. (CPT-S)	✓			
• Describe the importance of compliance with safety standards including work site organization and cleanliness and explain how it affects overall production. (CPT-S)	✓			
• Identify general shop safety rules and procedures. (CPT-S)	✓			
• Perform safety and environmental inspections. (CPT-S)	✓			
• Complete a basic safety test before using any tools or shop equipment. (CPT-S)	✓			
• Identify marked safety areas. (CPT-S)	✓			
• Define and identify the various types of hot work and hot work hazards and describe a three-step approach to hot work safety.	✓			
• Identify important safety issues associated with steam and hot water boilers.				
• Identify common fire hazards in the manufacturing workplace. (CPT-S)	✓			
• Describe techniques for fire prevention. (CPT-S)	✓			
• Identify the location and the types of fire extinguishers and other fire safety equipment and demonstrate procedures for using fire extinguishers and other fire safety equipment. (CPT-S)	✓			
• Identify the location and use of eye wash stations. (CPT-S)	✓			
• Identify the location of the posted evacuation routes. (CPT-S)	✓			
• Perform emergency drills and participate in emergency teams. (CPT-S)	✓			
• Utilize proper ventilation procedures for working within the shop area. (CPT-S)	✓			

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Identify and interpret universal signs and symbols to ensure safety at job sites. (CPT-S)	✓			
• Summarize Right-to-Know regulations including hazardous materials and blood-borne pathogens. (CPT-S)	✓			
• Describe and follow safety procedures for lifting heavy objects, including safe lift operation. (CPT-S)	✓			
• Actively participate in improving safety conditions. (CPT-S)	✓			
• Communicate potential or actual safety concerns to peers and supervisors. (CPT-S)	✓			
• Report injuries, accidents, and incidents to peers and supervisors. (CPT-S)	✓			
• Identify a space as a "confined space" or a "permit-required confined space" based on OSHA definitions and identify the hazards of confined space entry and the related safety considerations. (CPT-S)	✓			
• Identify and explain how to avoid struck-by and caught-in-between hazards. (CPT-S)	✓			
• Describe first aid procedures for work-site accidents. (CPT-S)	✓			
• Obtain First Aid and CPR Certification.	✓			
• Participate in a minimum of 3 hours of Sexual Harassment Prevention Training.	✓			
OSHA 10				
• Complete the OSHA 10-hour Construction Training Course. (CPT-S)	✓			
• Explain OSHA regulations that apply to the manufacturing facility. (CPT-S)	✓			
• Comply with all organizational and OSHA safety policies and procedures. (CPT-S)	✓			
• Describe the safe work requirements for elevated work, including fall protection guidelines and OSHA regulations. (CPT-S)	✓			
PERSONAL PROTECTIVE EQUIPMENT (PPE)				
• Identify and describe the proper use of personal protective equipment (PPE) to protect workers from bodily injury. (CPT-S)	✓			
• Identify potential respiratory hazards and the basic respirators used to protect workers against those hazards. (CPT-S)	✓			
• Inspect and use PPE properly, including safety glasses, gloves, safety shoes, hearing protection, hard hats, and respiratory protection. (CPT-S)	✓			
• Comply with the required use of personal protective equipment (PPE) including safety glasses, ear protection, gloves, and shoes. (CPT-S)	✓			
• Select appropriate personal protective equipment and use according to manufacturer rules and regulations. (CPT-S)	✓			
LOCKOUT TAGOUT				
• Describe the hazards associated with the accidental release of energy. (CPT-S)	✓			
• Describe the different types of energy found in the work environment. (CPT-S)	✓			
• Explain the purpose of Lockout Tagout procedures. (CPT-S)	✓			
• List the steps in a Lockout Tagout procedure. (CPT-S)	✓			
• Describe safe work practices during Lockout Tagout procedures. (CPT-S)	✓			
• Explain proper start up procedures. (CPT-S)	✓			
MACHINE GUARDING				
• Describe at least two causes of machine accidents. (CPT-S)	✓			
• List three requirements for machine safeguards. (CPT-S)	✓			
• List five machinery parts that pose hazards when unguarded or improperly guarded. (CPT-S)	✓			
• List at least five types of machine guards. (CPT-S)	✓			
• List at least three types of devices used to safeguard machines. (CPT-S)	✓			
• Describe a situation that requires guarding a machine or part in order to prevent injury or accident. (CPT-S)	✓			
HAZARDOUS CHEMICALS AND SAFETY DATA SHEETS				
• Identify and demonstrate safe use, storage, and disposal of chemicals. (CPT-S)	✓			
• Identify various exposure hazards commonly found on job sites including solvents, toxic vapors, batteries, and acids. (CPT-S)	✓			
• Participate in an asbestos awareness course which includes the definition of asbestos, the types and physical characteristics of asbestos, its uses and applications, the health effects and procedures to follow in case of exposure.	✓			
• Describe the location, purpose and contents of a Safety Data Sheet (SDS). (CPT-S)	✓			
• Demonstrate procedures for using respiratory protection and eye wash stations. (CPT-S)	✓			
HAND AND POWER TOOL SAFETY				

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
• Identify and explain the safe use of various types of hand tools. (CPT-S)	✓			
• Identify and explain the safe use various types of power tools. (CPT-S)	✓			
• Analyze and describe the effects of unsafe tool applications for workers. (CPT-S)	✓			
• Analyze potential safety issues and make recommendations for their prevention. (CPT-S)	✓			
• Explain the importance of selecting the right tools for specific tasks. (CPT-S)	✓			
• Select and demonstrate proper tool use for project completion in compliance with all safety manuals, standards and regulations. (CPT-S)	✓			
• Demonstrate proper cleaning, storage, and maintenance of all tools. (CPT-S)	✓			

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Mathematics

Topics:

- **Mathematical Computation**
- **Algebra, Geometry and Trigonometry**
- **Statistics**
- **Mathematics in the Workplace**

Key Questions	• Why is knowledge of mathematics important in manufacturing technology? • How do math skills relate to specific manufacturing processes?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,6,7,8,9	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 2,6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 1,3	**Math** 5.NF.1,2,3,4 5.MD.3,4 6.RP.3 a,b,c,d 5.NBT.1,3,4,5,6,7 6.NBT.5 7.NS.1,2 A.REI.1 6.G.1 7.G.4,6 G-SRT.6,8 G-CO.1 G-GMD.1,3 G-MG.1,2 G-C.2 S-ID.1,2,3,4 S-IC.1 7.SP.1,2,3,4,5,6,7 7.EE.3 8.F.2 8.G.7,9 F-IF.4	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
MATHEMATICAL COMPUTATION				
• Identify whole numbers and their place values.	✓			
• Add, subtract, multiply and divide whole numbers with and without a calculator.	✓			
• Practice rounding and estimating.	✓			

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Describe integers and negative numbers.	✓			
• Solve addition and subtraction problems with negative integers.	✓			
• Explain the rules for multiplying and dividing with negative integers.	✓			
• Explain the parts of a fraction.	✓			
• Add, subtract, multiply, and divide fractions.	✓			
• Define equivalent fractions and show how to find lowest common denominators.	✓			
• Describe improper fractions and demonstrate how to change an improper fraction to a mixed number.	✓			
• Describe decimals and their place values.	✓			
• Explain how to round a decimal.	✓			
• Add, subtract, multiply, and divide decimals.	✓			
• Define percent.	✓			
• Use appropriate formulas to calculate percentages.	✓			
• Convert between decimals, fractions, and percentages.	✓			
• Apply formulas to determine ratios, fractions, and proportion measures.	✓			
ALGEBRA, GEOMETRY AND TRIGONOMETRY				
• List the correct order of mathematical operations.		✓		
• Read and interpret tables, graphs and charts.		✓		
• Apply formulas to solve problems.		✓		
• Identify the basic shapes used in the manufacturing industry and their characteristics.		✓		
• Explain and demonstrate how to calculate perimeter and area of two-dimensional shapes.		✓		
• Define perpendicular, parallel, and plane.		✓		
• Explain and demonstrate how to calculate volume of three-dimensional shapes.		✓		
• Use mathematical formulas to determine area and volume of various structures.		✓		
• Identify the parts of an angle.		✓		
• Identify various types of angles.		✓		
• Identify the major parts of a triangle.		✓		
• Define the Pythagorean Theorem.		✓		
• Define the three trigonometric ratios for a right triangle.		✓		
• Find missing right triangle information using the Pythagorean Theorem.		✓		
• Find missing right triangle information using the trigonometric ratios.		✓		
• Identify the major parts of a circle.		✓		
• Identify uses for circular dimensions.		✓		
STATISTICS				
• Define statistics and variation and describe how they are related.			✓	
• Describe probability and its relationship to sample size.			✓	
• Define random sampling.			✓	
• Explain how to find the mean of a set of values.			✓	
• Define median and mode.			✓	
• Explain the bell-shaped curve.			✓	
• Describe the types of bell-shaped curves.			✓	
• Define standard deviation.			✓	
• Describe the relationship between standard deviation and the bell-shaped curve.			✓	
• Describe the relationship between standard deviation and probability.			✓	
MATHEMATICS IN MANUFACTURING				
• Describe the importance of mathematics for manufacturing employees.	✓			

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
• Use basic math functions to complete workplace tasks.	✓			
• Determine the correct math application for specific manufacturing situations.	✓			
• Define Statistical Process Control (SPC).				✓
• Describe variation in manufacturing processes including patterns and measures of variation.				✓
• Monitor and control variation with variable and attribute control charts.				✓

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Measurement

Topics:

- **Measurement Fundamentals**
- **Tolerance**
- **Torque**
- **Steel Rule**
- **Micrometer**
- **Caliper**
- **Height Gage**
- **Go/No Go Gage**

Key Questions	• Why is it important to understand different measurement systems? • Why is accuracy important?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,6,7,8,9,11	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 1,3	**Math** N-Q.1,3 5.MD.1,2 5.NBT.3 7.EE.3 5.NF.1,2	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
MEASUREMENT FUNDAMENTALS				
• Determine the appropriate unit of measure for a task.	✓			
• Recognize and use standard units of length, weight, volume, and temperature. (CPT-QPM)	✓			
• Identify and convert units of length, weight, volume, and temperature. (CPT-QPM)	✓			
• Convert inches to decimal equivalents in feet.	✓			
• Convert fractions of inches to decimal equivalents in inches.	✓			
• Convert between standard and metric units. (CPT-QPM)	✓			
• Demonstrate the proper selection, use, and care of precision measurement equipment typically found in a manufacturing environment. (CPT-QPM)	✓			
• Identify basic semi-precision measuring tools and describe their major applications.	✓			
• Demonstrate proper reading of semi-precision measuring tools to their finest graduation.	✓			
• Identify precision measuring tools and describe their major applications.	✓			
• Demonstrate accurate reading of precision measuring tools to their finest graduation.	✓			
• Justify the use of a particular measuring tool based on tool and part characteristics.	✓			
• Describe factors affecting accurate measurement (dirt, temperature, improper measuring, tool calibration, etc.).	✓			

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Describe how measurement tool selection can contribute to part accuracy/inaccuracy.	✓			
• Distinguish between accuracy and precision.	✓			
• Describe the main purpose of calibration. (CPT-QPM)	✓			
• Identify the key factors that affect calibration. (CPT-QPM)	✓			
TOLERANCE				
• Identify why measurements are important in a manufacturing environment.	✓			
• Define tolerance.	✓			
• Identify how tolerance is determined.	✓			
• Describe the impact of tolerance on cost.	✓			
• Compare the tolerances that are possible in different machining operations.	✓			
• Identify advantages of different tolerance methods.	✓			
• Identify the relationship between dimensions and tolerance.	✓			
• Determine whether or not a selection of parts meet specifications.	✓			
TORQUE				
• Define torque and explain its importance in manufacturing.		✓		
• Describe methods for applying torque.		✓		
• Describe the effects of overtightening and undertightening.		✓		
• Describe methods for measuring torque and the factors that can affect torque accuracy.		✓		
• Explain how torque is calculated.		✓		
• Describe methods for inspecting bolted joints.		✓		
• Run torque checks on bolts.		✓		
• Explain the importance of inspecting torque tools.		✓		
STEEL RULE				
• Identify and describe the function of the steel rule. (CPT-QPM)	✓			
• Use a steel rule to make accurate linear measurements, both metric and inch. (CPT-QPM)	✓			
• Take measurements with a steel rule to nearest 1/16”. (CPT-QPM)	✓			
• Accurately record the measurements taken with a steel rule. (CPT-QPM)	✓			
• Add and subtract steel rule measure readings. (CPT-QPM)	✓			
MICROMETER				
• Identify and describe the function of the micrometer. (CPT-QPM)	✓			
• Identify commonly used micrometers. (CPT-QPM)	✓			
• Calibrate a micrometer. (CPT-QPM)	✓			
• Take measurements with a micrometer within the designed accuracy of the tool. (CPT-QPM)	✓			
• Accurately record the measurements taken with a micrometer. (CPT-QPM)	✓			
CALIPER				
• Identify and describe the function of calipers. (CPT-QPM)	✓			
• Take accurate measurements with a dial or digital caliper within the designed accuracy of the tool. (CPT-QPM)	✓			
• Accurately record the measurements taken with a caliper. (CPT-QPM)	✓			
HEIGHT GAGE				
• Identify and describe the function of a height gage.		✓		
• Take accurate measurements with a height gage within the designed accuracy of the tool.		✓		
• Accurately record the measurements taken with a height gage.		✓		
GO/NO GO GAGE				
• Identify and describe the function of a go/no go gage.		✓		
• Describe go/no-go gaging with plug gages.		✓		

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
• Measure with a go/no go gage and record the results.		✓		
• Distinguish between gaging and variable inspection.		✓		
• Select and use a use a go/no go gage to verify thread characteristics.		✓		

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Print Reading

Topics:

- **Prints, Diagrams, and Schematics**
- **Assembly Drawings**

Key Questions	• How do prints and drawings communicate project requirements? • Why is the ability to read and interpret plans and drawings a necessary skill to work in the manufacturing industry?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 1	**Math** N-Q.1,3 7.G.1 5.NBT.3 6.RP.3 7.EE.3	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
PRINTS, DIAGRAMS, AND SCHEMATICS				
• Identify the three basic elements of a print. (CPT-QPM)	✓			
• Describe the role prints play in the design and manufacturing process. (CPT-QPM)	✓			
• Interpret commonly used abbreviations and terminology. (CPT-QPM)	✓			
• Identify the types of dimensions. (CPT-QPM)	✓			
• Identify general note symbols and locate them on a print. (CPT-QPM)	✓			
• List the seven main steps in reading a print. (CPT-QPM)	✓			
• Determine tolerances associated with dimensions on a print. (CPT-QPM)		✓		
• Interpret electrical component drawings and schematics. (CPT-QPM)		✓		
• Interpret CNC programming diagram schematics. (CPT-QPM)			✓	
ASSEMBLY DRAWINGS				
• Identify and describe the purpose of assembly drawings. (CPT-QPM)		✓		
• Identify basic layout of drawings. (CPT-QPM)		✓		
• Identify types of lines within a drawing. (CPT-QPM)		✓		
• Identify item number symbols. (CPT-QPM)		✓		
• Identify general note symbols. (CPT-QPM)		✓		
• List the essential components found in the title block. (CPT-QPM)		✓		
• Locate bill of materials on a drawing. (CPT-QPM)		✓		
• List the components found in the revision block. (CPT-QPM)		✓		

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Materials

Topics:

- **Properties of Materials**
- **Metals**
- **Plastics/Polymers**
- **Ceramics/Glass**

Key Questions	• What forces affect a structure's ability to withstand stress? • What factors influence the strength and durability of a material? • What factors affect material selection for a specific manufacturing process?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,4,5,11	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 1,3,6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 2,3,5	**Math**	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
PROPERTIES OF MATERIALS				
• Identify four types of manufacturing materials and their common uses in manufacturing processes.	✓			
• Define physical, mechanical and chemical properties.	✓			
• Explain the physical properties of materials, including density, specific heat, melting and boiling point, thermal expansion and conductivity, electrical and magnetic properties.	✓			
• Describe how physical properties of materials relate to manufacturing applications.	✓			
• Explain the mechanical properties of materials, including strength, toughness, hardness, ductility, elasticity, fatigue and creep.	✓			
• Describe how mechanical properties of materials relate to manufacturing applications.	✓			
• Explain the chemical properties of materials, including oxidation, corrosion, flammability, and toxicity.	✓			
• Describe how chemical properties of materials relate to manufacturing applications.	✓			
METALS				
• Explain the classification system for metals.	✓			
• Describe the physical, mechanical and chemical properties of metals.	✓			
• Describe general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals.	✓			
• Distinguish between pure metals and alloy metals.	✓			
• Describe superalloys and their properties.	✓			
• List examples of nonferrous metals.	✓			
• Identify and describe the differences between ferrous and nonferrous metals.	✓			
• Describe common uses of ferrous and nonferrous metals in manufacturing applications.	✓			
PLASTICS AND POLYMERS				
• Explain the classification system for plastics and polymers.		✓		

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Describe the physical, mechanical and chemical properties of plastics and polymers.		✓		
• Identify and describe the differences between different types of plastics and polymers.		✓		
• Contrast the advantages and disadvantages of plastics and polymers.		✓		
• Distinguish between natural and synthetic polymers.		✓		
• Describe common uses of plastics and polymers in manufacturing applications.		✓		
CERAMICS/GLASS				
• Explain the classification system for ceramics and glass.		✓		
• Describe the physical, mechanical and chemical properties of ceramics and glass.		✓		
• Identify and describe the differences between different types of ceramics and glass.		✓		
• Describe common uses of ceramics and glass in manufacturing applications.		✓		
• Describe common uses of ceramics and glass in manufacturing.		✓		

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Material Handling

Topics:

- **Fundamentals of Hydraulics and Pneumatics**
- **Fork Lift/PIT (Power Industrial Truck) Operation**
- **Lifting and Moving Devices**
- **Rigging**

Key Questions	• How does technology make work more efficient, effective and/or productive? • How does one choose and safely use appropriate tools and machines in the manufacture of a product?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,11,12	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 3,4,5,6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 2,5	**Math** 7.EE.3 6.RP.3	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
FUNDAMENTALS OF HYDRAULICS AND PNEUMATICS				
• Explain the meaning of fluid power.			✓	
• List the various applications of fluid power.			✓	
• Differentiate between fluid power and transport systems.			✓	
• List the advantages and disadvantages of fluid power.			✓	
• Explain the industrial applications of fluid power.			✓	
• List the basic components of the fluid power.			✓	
• List the basic components of the pneumatic systems.			✓	
• Differentiate between electrical, pneumatic and fluid power systems.			✓	
FORK LIFT/PIT OPERATION				
• Explain the differences between a forklift/PIT and an automobile.			✓	
• Explain the operation and limitation of fork lifts/PITs.			✓	
• Explain where to find operating instructions, warnings, and precautions for different types of trucks.			✓	
• Identify and describe truck controls and instrumentation, where they are located, what they do, and how they work.				✓
• Explain the importance of visibility, including restrictions due to loading.				✓
• Describe where to determine vehicle capacity and stability.				✓
• Describe fork and attachment adaptation, operation, and use limitations.				✓
• Describe the process of refueling and/or charging and recharging of batteries.				✓
• Explain operator responsibilities for vehicle inspection and maintenance.				✓
• Interpret and apply operating instructions, warnings, or precautions listed in the operator's manual.				✓
• Demonstrate safe engine or motor operation and steering and maneuvering.				✓
• Describe safe operation according to various workplace conditions, including surface conditions; load composition and stability; load manipulation,				✓

Key Learning Targets (Students will know and be able to)	1	2	3	4
stacking, and unstacking; pedestrian traffic; narrow, restricted or hazardous locations; ramps and other sloped surfaces; closed environments with insufficient ventilation; and other potentially hazardous environmental conditions that could affect safe operation.				
LIFTING AND MOVING DEVICES				
• Identify lifting and moving devices commonly used for material handling, including block and tackle, drums, winches, pallet jacks, skids and rollers, slings, hoists, lifting stands, overhead and gantry cranes, and derricks.			✓	
• Describe the safe operation of common lifting and moving devices.			✓	
• Describe the importance of lifting device safety in the workplace.			✓	
• Describe inspections required by OSHA for lifting devices.			✓	
• Distinguish between operational and rated load tests.			✓	
RIGGING				
• Describe the importance of rigging inspection and safety.				✓
• Describe the procedures for inspecting chains.				✓
• Describe best practices for chain handling and care.				✓
• Describe how to prevent wire rope failure.				✓
• Distinguish between abrasion, corrosion, and diameter reduction in wire rope.				✓
• Distinguish between crushing, shock loading, and high stranding in wire rope.				✓
• Distinguish between different types of breaks in wire rope.				✓
• Describe procedures for inspecting natural fiber rope.				✓
• Describe the types of defects that can occur in synthetic fiber rope.				✓
• Describe procedures for inspecting slings, hooks, and shackles.				✓

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Foundations of Manufacturing

Topics:

- **Trends and Technologies in Manufacturing**
- **Lean Manufacturing Principles**
- **Six Sigma Principles**
- **Basic Mechanical Systems**
- **Machine Care and Maintenance (TPM: Total Productive Maintenance)**

Key Questions	• What factors influence manufacturing processes and decisions? • What are some principles of effective manufacturing? • What is the importance of continually monitoring human-designed systems? • How can proper resource preparation be used to improve product quality and production efficiency?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,6,7,8,11,12	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 1,2,3,5,6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 1,2,3,4,5	**Math** 7.EE.3	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
TRENDS AND TECHNOLOGIES IN MANUFACTURING				
• Describe current trends in manufacturing.		✓		
• Research an emerging technology in manufacturing.		✓		
• Describe the effect of new trends and technologies on current manufacturing processes.		✓		
• Compare and give examples of additive manufacturing, subtractive manufacturing and continuous process control in manufacturing.		✓		
LEAN MANUFACTURING PRINCIPLES				
• Describe basic lean manufacturing principles.			✓	
• Research the general history of Lean Manufacturing and its development.			✓	
• Describe the importance of continuous improvement.			✓	
• Describe the necessity of employee involvement.			✓	
• Describe 8 types of waste exemplified by the acronym DOWNTIME: Defects, Overproduction, Waiting, Not utilizing people, Transportation, Inventory, Motion, Extra process.			✓	
• Distinguish between inspection and error detection.			✓	
• Describe how lean companies achieve continuous product flow.			✓	
• Explain the concept of “value-added work”.			✓	
• Explain the appropriate lean manufacturing practices to apply in response to a specific problem.			✓	
• Identify and explain each component of 5S/6S: Sort, Set in Order, Sweep, Standardize, Self-Discipline/Sustain, and Safety.			✓	
• Describe the purpose, challenges and advantages to implementing a 5S/6S program.			✓	
SIX SIGMA PRINCIPLES				
• Define Six Sigma.			✓	

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Research the general history of Six Sigma and Continuous Improvement.			✓	
• Describe how Six Sigma practitioners choose a target problem.			✓	
• List and explain the fundamentals of Six Sigma: DMAIC (Define, Measure, Analyze, Improve, Control), Defining a process, Basic metrics (Defects per Unit (DPU), Defects per Million Opportunities (DPMO), First Time Yield (FTY), Rolled Throughput Yield (RTY), Cycle Time), Pareto Analysis (80:20 rule), Critical Quality Characteristics (CTQs), and Cost of Poor Quality (COPQ).			✓	
• Develop basic skills in failure analysis, including creating and using cause/effect and Fishbone diagrams, and conducting “5 Whys” root failure analysis.			✓	
• Distinguish between Six Sigma and lean initiatives.			✓	
BASIC MECHANICAL SYSTEMS				
• Define work as a measure of energy transfer.		✓		
• Distinguish between potential and kinetic energy.		✓		
• Describe Newton's Laws of Motion.		✓		
• Describe and compare types of simple machines, including levers, wheels and axles, pulleys, inclined planes, wedges, screws, gears, and cams.		✓		
• Compare the effectiveness of simple machines in completing different types of work.		✓		
• Describe the factors affecting mechanical advantage.		✓		
• Describe gravity and its effect on machines.		✓		
• Describe friction and its effect on machines.		✓		
• Explain how mechanical systems are composed of simple machines.		✓		
• Describe how basic mechanical systems are used in a manufacturing setting.		✓		
MACHINE CARE AND MAINTENANCE (TPM: TOTAL PRODUCTIVE MAINTENANCE)				
• Identify and describe the principles of TPM: Total Productive Maintenance.		✓		
• Describe the role of safety in TPM.		✓		
• Describe how TPM is connected to other types of maintenance approaches.		✓		
• Distinguish between autonomous maintenance, planned maintenance, and quality maintenance.		✓		
• Maintain a clean and safe work environment by keeping work areas clean and cleaning machine and hand tools when work is completed. (CPT-MA)		✓		
• Put tools away when work is finished. (CPT-MA)		✓		
• Keep aisles clear of equipment and materials. (CPT-MA)		✓		
• Perform and document preventive maintenance as required. (CPT-MA)		✓		
• Keep storage rooms well organized and free of clutter. (CPT-MA)		✓		
• Check machines for signs of wear and replace worn parts. (CPT-MA)		✓		
• Test machine lubricants according to maintenance schedule. (CPT-MA)		✓		
• Add specified machine lubricant according to manufacturer’s recommendations. (CPT-MA)		✓		
• Guard against Foreign Object Debris (FOD) and particulates from contaminating the workspace or product. (CPT-MA)		✓		
• Recognize potential maintenance issues with basic production systems, including knowledge of when to inform maintenance personnel about problems. (CPT-MA)		✓		

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Assembly

Topics:

- **Basic Tool Use**
- **Fasteners**
- **Basic Assembly Skills**
- **Quality Control**

Key Questions	• What are the basic techniques and components used in assembly? • How does one choose and safely use appropriate tools and machines in the manufacture of a product? • How can quality control be implemented to foster total product quality? • How can proper resource preparation be used to improve product quality and production efficiency? • How does technology make work more efficient, effective and/or productive?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,4,6,8,11,12	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 2,3,5,6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 1,2,3,4,5	**Math**	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
BASIC TOOL USE				
• Identify common hand tools and describe their basic applications.	✓			
• Demonstrate proper use of hand tools.	✓			
• Select necessary work holding devices and hand tools as dictated by the size and shape of the part plus the machining to be done.	✓			
FASTENERS				
• Explain the importance of fastener selection.	✓			
• Recognize the basic parts of threaded fasteners.	✓			
• Describe how fasteners are identified.	✓			
• Describe how to determine a fastener's diameter, length and size.	✓			
• Describe common fastener materials.	✓			
• Identify the mechanical properties that are most important to threaded fasteners.	✓			
• Explain the common failure modes that threaded fasteners might encounter in service.		✓		
• Identify common fastener head, drive and thread styles.		✓		
• List common point styles.		✓		
• Identify and differentiate common bolt and screw types.		✓		
• Describe how to install a bolt.		✓		
• Describe the characteristics of a bolted joint.		✓		
• Interpret the head markings and specifications assigned to threaded fasteners and nuts.		✓		
• Identify nuts according to their strength grade.		✓		
• Describe common nuts and washers and the basic ways in which each are applied.		✓		

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Describe identification markings for standard and metric fasteners.		✓		
BASIC ASSEMBLY SKILLS				
• Explain the steps in an assembly/production process. (CPT-MPP)			✓	
• Identify job assignments and team production goals. (CPT-MPP)			✓	
• Prepare work to be accomplished by studying assembly instructions, print specifications, and parts lists; gathering parts, subassemblies, tools, and materials. (CPT-MPP)			✓	
• Determine resources available for the production process. (CPT-MPP)			✓	
• Communicate production and material requirements and product specifications. (CPT-MPP)			✓	
• Set up equipment for the production process and position parts and subassemblies by using templates or reading measurements. (CPT-MPP)			✓	
• Assemble components by examining connections for correct fit; fastening parts and subassemblies. (CPT-MPP)			✓	
• Verify specifications by measuring completed component. (CPT-MPP)			✓	
• Document product and process compliance with requirements. (CPT-MPP)			✓	
• Resolve assembly problems by altering dimensions to meet specifications; notifying supervisor to obtain additional resources. (CPT-MPP)			✓	
• Keep equipment operational by completing preventive maintenance requirements; following manufacturer's instructions; troubleshooting malfunctions; calling for repairs. (CPT-MPP)			✓	
• Report problems in the assembly process and equipment faults to maintenance staff. (CPT-MPP)			✓	
• Maintain safe and clean working environment by complying with procedures, rules, and regulations. (CPT-MPP)			✓	
• Maintain supplies inventory by checking stock to determine inventory level; anticipating needed supplies; placing and expediting orders for supplies; verifying receipt of supplies. (CPT-MPP)			✓	
• Conserve resources by using equipment and supplies as needed to accomplish job results. (CPT-MPP)			✓	
• Coordinate work flow with team members and other work groups. (CPT-MPP)			✓	
• Prepare final product for shipping or distribution. (CPT-MPP)			✓	
QUALITY CONTROL				
• Describe “traceability”, quality stamps, and an employee’s role in accurately maintaining record of process and part compliance. (CPT-QPM)				✓
• Participate in periodic internal quality audit activities. (CPT-QPM)				✓
• Suggest continuous improvements. (CPT-QPM)				✓
• Monitor the production process and carry out basic testing and quality checks. (CPT-QPM)				✓
• Inspect materials and product/process at all stages to ensure they meet specifications. (CPT-QPM)				✓
• Document the results of quality tests by completing production and quality forms. (CPT-QPM)				✓
• Communicate quality problems. (CPT-QPM)				✓
• Take corrective actions to restore or maintain quality. (CPT-QPM)				✓
• Record process outcomes and trends. (CPT-QPM)				✓

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Manufacturing Processes

Topics:

- **Soldering**
- **Welding**
- **Fundamentals of Machine Tools**
- **Drill Presses**
- **Milling Machines**
- **Grinding Tools**
- **Lathes**
- **CNC (Computer Numerical Control) Tools**

Key Questions	• How can we take a material and alter it to create something useful that serves a specific purpose? • How does one choose and safely use appropriate tools and machines in the manufacture of a product? • How can proper resource preparation be used to improve product quality and production efficiency? • How does technology make work more efficient, effective and/or productive?

Assessment Evidence of Student Learning		**CCTC Standards**	**NYS Standards**	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,6,7,8,9,11,12	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 1,3,4,5,6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 2,3,5	**Math**	

Key Learning Targets (Students will know and be able to)	**1**	**2**	**3**	**4**
SOLDERING				
• Define solder and soldering.			✓	
• List the advantages and disadvantages of soldering.			✓	
• Define flux and list the common types of flux.			✓	
• Compare and contrast manual soldering with machine soldering.			✓	
• List and describe important soldering tools and accessories.			✓	
• Describe basic soldering preparation and safety procedures.			✓	
• List the basic steps of hand soldering.			✓	
• Describe heat processes involved in soldering.			✓	
• Describe safety precautions for working with solder and a soldering iron.			✓	
• Describe ways to prevent fires while soldering.			✓	
• List different joint types.			✓	
• Distinguish between properly and improperly soldered joints.			✓	
• Obtain J-Standard Soldering Certification.			✓	✓
WELDING				
• Explain the parts and function of a shop welding outfit.			✓	✓

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Explain the safety features of shop welding outfit.			✓	✓
• Demonstrate the protective clothing and the safety precautions that must be used for shop welding.			✓	✓
• Demonstrate the steps required to assemble a shop welding outfit.			✓	✓
• Safely turn on and shut down shop welding outfit.			✓	✓
• Practice the five basic weld joints.			✓	✓
• Describe the types of welds that can be made on each joint.			✓	✓
• Explain the parts of a fillet weld and a groove weld.			✓	✓
• Practice a stringer bead and a weave bead.			✓	✓
• Practice the four welding positions.			✓	✓
• Describe the conditions for welding in the four welding positions.			✓	✓
FUNDAMENTALS OF MACHINE TOOLS				
• List and describe common machine tools used in an industrial setting.			✓	
• Summarize the history and development of machine tools.			✓	
• Explain the importance and use of measurement and calibration when using machine tools.			✓	
• Explain the importance of watching gauges, dials or other indicators to make sure a machine is working properly.			✓	
• Explain the importance of determining the kind of tools and equipment needed to do a job.			✓	
• Explain the importance of determining causes of operating errors and deciding what to do about it.			✓	
• Explain the importance of conducting tests and inspections of products, services or processes to evaluate quality or performance.			✓	
• Explain the importance of performing routine maintenance on equipment and determining when and what kind of maintenance is needed.			✓	
• Explain the purpose and use of the Machinery's Handbook.			✓	
• Observe appropriate safety rules pertaining to general machine shop practices.			✓	
• Explain the use of work holders in machine tool operation.			✓	
• Describe the development of computer-controlled machine tools.			✓	
DRILL PRESSES				
• Identify the different types of drill presses found in the machine shop and describe their major applications.			✓	
• Identify the standard drilling and reaming tools and describe their characteristics and major applications.			✓	
• Demonstrate the proper cleaning, and care of the drill press.			✓	
• Properly set up the drill press and demonstrate the selection of the most appropriate and sharp drilling tool(s).			✓	
• Demonstrate proper use of drilling machines.			✓	
• Use applicable reference material to accurately calculate speeds for assigned drill press operations.			✓	
MILLING MACHINES				
• Demonstrate proper use of vertical milling machine.			✓	
• Demonstrate the proper setup, operation, care, cleaning, and lubrication of the vertical milling machine.			✓	
• Correctly identify common cutters and explain their basic applications.			✓	
• Identify and demonstrate the proper use of all controls and adjustments on the vertical milling machine.			✓	
• Identify the common work holding devices and select the most appropriate device based on part shape and type of machining to be done.			✓	
• Select the proper cutter and work holding device and demonstrate their proper installation and setup for an assigned milling operation.			✓	
• Use applicable reference material to accurately calculate speeds and feeds for an assigned milling machine operation.			✓	
GRINDING TOOLS				
• Describe the benefits of grinding.			✓	
• Identify common types of grinding machines and describe the major differences and applications.			✓	
• Demonstrate proper use of grinding abrasive machines.			✓	
• Describe and demonstrate the proper cleaning, lubrication, and care of precision grinding machines.			✓	
• Explain the identification, selection and application of common grinding wheels.			✓	
• Describe the proper selection and application of grinding fluids.			✓	

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Describe common problems and solutions in surface grinding.			✓	
• Describe the importance of safety during grinding.			✓	
• Identify types of automatic protections built into grinding machines.			✓	
LATHES				
• Demonstrate proper use of metal lathes.			✓	
• Demonstrate the proper cleaning, lubrication, and care of the metal lathe.			✓	
• Identify and describe the sizes and applications of common types of metal cutting lathes.			✓	
• Identify common parts and demonstrate the proper use of all controls and adjustments on the lathe.			✓	
• Identify and demonstrate the proper installation and application of standard tools and tool holders for the lathe.			✓	
• Identify common work holding devices and demonstrate proper procedure for changing and installing them.			✓	
• Use appropriate reference material to accurately calculate relevant speeds and depths of cuts as required for an assigned application.			✓	
CNC (COMPUTER NUMERICAL CONTROL) TOOLS				
• Properly identify common types of CNC machines and describe their size and general applications.				✓
• Identify common CNC operations.				✓
• Identify common CNC machine control systems and describe their major differences and applications.				✓
• Demonstrate proper planning for CNC machining.				✓
• Describe proper cleaning, care lubrication and operation of CNC machines.				✓
• Read and interpret CNC prints and drawings.				✓
• Describe cutting fluids/coolants for CNC machining and their proper application.				✓

SCSD Manufacturing Technology and Pre-Apprenticeship Program Curriculum

Competency: Electrical Systems

Topics:

- **Basic Electrical Components**
- **Electrical Safety**
- **Electrical Measurement and Measuring Instruments**
- **Electrical Testing and Troubleshooting**

Key Questions • How does one choose and safely use appropriate tools and machines in the manufacture of a product?

Assessment Evidence of Student Learning		CCTC Standards	NYS Standards	
Written • Assignments • Research Project • Quizzes and Tests • Self-Assessment	**Performance** • Team Process Assessment • Class Presentations • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,4,6,7,8,11,12	**ELA** 9-10R 1,2,4,7,8,9 9-10W 2,5,6,7 9-10SL 1,2,4,5,6 9-10L 1,2,3,4,5,6	 11-12R 1,2,4,7,8,9 11-12W 2,5,6,7 11-12SL 1,2,4,5,6 11-12L 1,2,3,4,5,6
		Cluster Standards MN 3,5,6	**Literacy** 9-10RST 1,2,4,7,9 9-10WHST 2,5,6,7	 11-12RST 1,2,4,7,9 11-12WHST 2,5,6,7
		Pathway Standards MN-PRO 2,5	**Math** A-REI.1 A-CED.4 5.NF.1,2	

Key Learning Targets (Students will know and be able to)	1	2	3	4
BASIC ELECTRICAL COMPONENTS				
• Describe basic principles of electrical theory.	✓			
• Describe the atomic structure of matter.	✓			
• Describe the units of electrical charge, voltage, current, resistance, capacitance, and power.	✓			
• Describe the factors that affect the movement of electrical charges.	✓			
• Clearly distinguish between direct (DC) and alternating (AC) current.	✓			
• State Ohms Law and graph the relationships between current, resistance, and voltage in circuits.	✓			
• Describe the effect on current when changing voltage or resistance.	✓			
• Use formulas and basic mathematics to solve Ohms Law problems.	✓			
• State Watts Law and graph the relationships between voltage, current, and power in circuits.		✓		
• Describe the effect on power if voltage, current or resistance is changed.		✓		
• Use formulas and basic mathematics to solve Watts Law problems.		✓		
• Describe the purpose and use of the National Electric Code (NEC).		✓		
• Identify basic electrical tools.		✓		
• Explain the differences between 110v and 220v circuits.		✓		
• Identify different types of circuit breakers.		✓		
• Identify proper wire size and colors and proper wiring techniques.			✓	
• Identify common electrical components and describe their function, including resistor, capacitor, relay switch, transformer, diode, transistor, battery, AC power supply, terminal post, switch, light bulb, induction coil, light emitting diode, earth ground, and chassis ground.			✓	
ELECTRICAL SAFETY				
• Identify common electrical hazards and explain how to avoid or minimize them in the workplace.	✓			
• Explain OSHA safety requirements for working in the electrical industry.	✓			

Key Learning Targets (Students will know and be able to)	1	2	3	4
• Explain the importance of lockout/tagout and describe the procedure.	✓			
• Describe the use of PPE for electrical hazard protection including rubber protective equipment, protective apparel, and eye and face protection.	✓			
• Verify energized/de-energized circuits.	✓			
• Inspect a typical power cord and GFCI to ensure their serviceability.	✓			
• Describe conditions likely to affect severity of electrical shock.	✓			
• Describe electrical shock in terms of body resistance and burns.	✓			
• Describe steps for helping a shock victim.	✓			
• Explain the importance of the rules, regulations, and criteria for the installation of electrical equipment of National Electrical Code.	✓			
ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS				
• Describe the proper configuration, handling, and storage of voltmeters, ammeters, Ohmmeters, and bench power supplies.		✓		
• Properly use electrical measuring instruments.		✓		
• Determine the values for electronic components from their markings and physical characteristics.		✓		
ELECTRICAL TESTING AND TROUBLESHOOTING				
• Troubleshoot electrical problems.			✓	
• Describe the operation of and procedures for testing resistors and capacitors in both a series and in a parallel circuit.			✓	