Teacher: CORE CompIntManuf	Year: 2010-11
Course: CompIntManuf	Month: All Months

September

Principles of Manufacturing Concepts Addressed in Lesson

Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards
	Lesson 1.1: History of Manufacturing (8 days) 1. Manufacturing is a series of interrelated activities and operations that involve product design, planning, producing, materials control, quality assurance, management, and marketing of that product. 2. Manufacturing is essential to a healthy economy, including jobs and attainment of personal goals.	Lesson 1.1: History of Manufacturing (8 days) Performance Objectives It is expected that students will: • Explore manufacturing through research and projects. • Understand what the enterprise wheel represents and how it represents the overall manufacturing scheme. • Research a topic in manufacturing, develop a presentatio	Automated Guidance Vehicle (AGV) Automated Storage/Retrieval System (ASRS) Automation Computer Aided Design (CAD) Computer Aided Manufacturing (CAM) Computer Integrated Manufacturing (CIM) Dependent Variable Independent Variable Just in Time (JIT) Kaizen Lean Manufacturing				

	3. National manufacturing avoids health risks that are accepted in other countries. 4. Many careers are associated with the area of manufacturing. 5. Different procedures are used in the creation of products.	n, and present findings to a group. • Explain the different procedures used in manufacturing.	Manufacturing Robotics Six SIGMA Variable							
	Lesson 1.2: Control Systems (10 days) Concepts Addressed in Lesson 1. Flowcharting is a powerful graphical organizer used by technicians, computer programmers, engineers, and professionals in a variety of roles and	Lesson 1.2: Control Systems (10 days) Performance Objectives It is expected that students will: • Identify basic flowcharting symbols and discuss their functio	Automation Closed Loop Control System Decision Block Flow Chart Flow Lines Input/output Block Interface Iterative							

		responsibilities. 2. During the design and development process, flowcharting is used to plan and depict the process flow for an entire system and all of its subsystems. 3. Computer programmers use flowcharting symbols to graphically organize the flow of program control, including all inputs, outputs, and conditions that may occur. 4. Everyday products including cars, microwaves, ovens, hair dryers, coffee pots, and washing machines all use control systems to manage their operation.	ns. • Create a flowchart that portrays a manufacturing process. • Apply flowcharting to areas other than manufacturing. • Identify a control system and explain its application to manufacturing. • Model and create a program to control an automated system.	Open Loop Potentiometer Process Block Schematic Sequential Simulation						

October

Principles of Manufacturing Concepts Addressed in Lesson ~

Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards
	Lesson 1.3: The Cost of Manufacturing (14 days) Concepts Addressed in Lesson 1. When designing a control system, cost and safety are two key factors that must be considered. 2. Many factors come into play when calculating the cost of manufacturing a product. 3. Tradeoffs may be made between hiring highly skilled or experienced workers and keeping costs down. 4. The less time a part	Lesson 1.3: The Cost of Manufacturing (14 days) Performance Objectives It is expected that students will: • Create a control system that replicates a factory cell.· • Maximize the efficiency of the manufacturing system with respect to time and cost.· • Compare the efficiency of running multiple systems against that of	Fixed Costs Non-Value Added (NVA) Overhead Profit Raw Materials Value-Added Variable Cost				

		takes to make, the more potential profit is available. 5. Long term planning and investments may cost more up front but may provide additional savings in the future.	one large system.						

November

Manufacturing Processes

Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards
	Lesson 2.1: Designing for Manufacturability (10 days) Concepts Addressed in Lesson 1. Design is a process that is used to systematically solve problems. 2. Many considerations must be made when manufacturing a quality part.	Lesson 2.1: Designing for Manufacturability (10 days) Performance Objectives It is expected that students will: • Use the design process. • Use knowledge of design to analyze products with flaws.	Competent Defective Design Flaws Durability Economics Ethics Functionality Morality Purpose Quality Control				

		3. Material properties must be considered as part of the design process. 4. Manufacturers have an ethical responsibility to create safe products and to provide a safe work environment. 5. Manufacturers have a legal responsibility to provide safety information about their products. 6. Many engineering disciplines have a code of conduct or code of ethics that their members are expected to follow. 7. Analyzing case studies of engineering failures is a good way for engineers to avoid future failures.	• Use calculated volume, mass, surface area of parts to determine material cost, waste, and packaging requirements. • Use solid modeling software to improve a flawed design. • Determine whether a product is safe for a given audience (e.g., children under the age of three). • Make ethical decisions about manufacturing. • Create a product using solid modeling software.							

		Lesson 2.2: How We Make Things (6 days) Concepts Addressed in Lesson: 1. Prototyping is part of a design process where a physical model can be evaluated to refine the design. 2. Before raw material can be used in manufacturing, it must undergo primary processing. 3. The separating process is one of the oldest manufacturing processes. 4. Milling and shearing utilize the subtractive process to create products. 5. ECM,	Lesson 2.2: How We Make Things (6 days) Performance Objectives It is expected that students will: • Explain the difference between primary and secondary manufacturing processes.· • Analyze a product to propose the manufacturing processes used to create it.· • Explore manufacturing processes via research.·	3D Printing Additive Process Assembling Build Time Casting Ceramics Concept Model Conditioning Process Die Casting Electrical Discharge Machining (EDM) Electrochemical Machining (ECM) Exhaustible Resources Finishing Process Forging Forming Process Grinding Industrial Material Injection						

		EDM, water-, and laser-cutting are using newer technologies to enhance the accuracy and efficiency of material removal. 6. Metals, plastics, and ceramics are types of materials that are well suited to the manufacturing process. 7. The way in which a product is made is dependent upon the properties of the material that will be used.	• Explore the prototyping processes.	Molding Metals Molding Plastics Photopolymer Post Processing Primary Processing Prototype Rapid Prototyping Raw Materials Renewable Resources Sand Casting Separating Stereolithography Subtractive Process Vacuum Forming Water Jet Cutting						

Dec emb

Manufacturing Processes

Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards		
	Lesson 2.3: Product	Lesson 2.3: Product	Absolute						

er		Development (38 days) Concepts Addressed in Lesson 1. Many machines exist to perform manufacturing processes. 2. Machine code is an essential tool used to communicate with some machines. 3. Jigs and fixtures are essential in maintaining consistency and quality control. 4. Computer Aided Manufacturing (CAM) programming tools make it possible to manufacture physical models using Computer Aided Design (CAD) programs.	Development (38 days) Performance Objectives It is expected that students will: • Identify machines when given a process and identify the process that a given machine performs. • Determine the appropriate speed rate for a given material using a tool with a given diameter. • Determine the feed rate for a given material using a tool with a given diameter. • Read and interpret	Address Character Block Bench Grinder Computer Aided Manufacturing (CAM) Computer Numerical Control (CNC) Feed Fixture G & M Codes Incremental Jig Laser Lathe Machinability Milling Machine Modal Numerical Control (NC)						

		5. Products manufactured today have been greatly influenced by the advancement of machines and technology. 6. Several variables in machining operations affect the final product in manufacturing. 7. Profit margins are essential to a company's survival in a competitive market. 8. Prototyping is a major step in the design cycle of manufactured goods and has been greatly advanced with the advent and use of rapid prototyping processes.	G & M codes. • Transfer the drawings made in CAD to a CAM program. • Create numerical code using a CAM program. • Verify the creation of a part using simulation software. • Create parts using the machines demonstrated by the instructor. • Create a product on the computer using knowledge of manufacturing processes.	Parameter Part Program Preparatory Code Spindle Speed Tolerance V-Block Word						

J a n u	Elements of Automation							
	Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards

ary		Lesson 3.1: Introduction to Automation (19 Days) Concepts Addressed in Lesson 1. Many factors have influenced the evolution of automation. 2. A variety of automation careers exist. 3. Robots are widely used in industry to assist in the production of manufactured goods. 4. Robots have distinct advantages over humans in some industrial settings (e.g., hazardous environments, repetitive motion or long hours). 5. Robots and machines communicate	Lesson 3.1: Introduction to Automation (19 Days) Performance Objectives It is expected that students will: • Research a topic in automation. • Explore automation careers. • Identify the advantages and disadvantages of robotic labor versus human labor. • Explore materials handling. • Create and program virtual robotic work cells with	Automated Guided Vehicle (AGV) Automated Storage and Retrieval System (ASRS) Automation Computer Aided Manufacturing (CAM) Degrees of Freedom Flexible Manufacturing System Gripper Inventory Control Materials Handling Robot Robotics Servo Motor Stepper Motor						

	and coordinate their activities through a process called handshaking.	• simulation software. • Program the interface between a robot and another machine.							
	Lesson 3.2: Elements of Power (10 Days) Concepts Addressed in Lesson 1. Power is produced in many ways and transmitted through various forms (e.g. electrical, pneumatic, hydraulic, and motion). 2. Fluid power is inversely proportional to the area upon which	Lesson 3.2: Elements of Power (10 Days) Performance Objectives It is expected that students will: • Identify the three main power types. • Solve problems involving electrical, pneumatic, and mechanical power. • Convert power between units.	Ampere Electrical Current (I) Force Horsepower (HP) Hydraulic Joule Pounds per Square Inch (PSI) Pneumatic Power Revolutions per Minute (RPM) Servo Motor						

		the force is being applied. 3. Sensors provide feedback to control systems and products used by consumers. 4. Pneumatics is one form of fluid power that can be used to operate machines and products.	• Calculate torque and use it to calculate power. • Solve problems involving fluid power. • Construct a system to convert pneumatic power into mechanical power.	Stepper Motor Torque Velocity Viscosity Voltage (V) Watt Work						

Feb ruary

Elements of Automation

Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards
	Lesson 3.3: Robotic Programming and Usage (17 Days) Concepts Addressed in Lesson 1. Basic programming skills include variable	Lesson 3.3: Robotic Programming and Usage (17 Days) Performance Objectives It is expected that students will: • Build the Lynxmoti	Code Comment Debug Declare End Effector Home Input				

		declaration, loops, and debugging. 1. A variety of robots and unique programming languages are used in the manufacturing industry. 2. Many everyday products use microcontrollers. 3. Robots are used to perform diverse functions and work in diverse environments. 4. The size of a robot is based on the work envelope and payload needed to perform the task.	on robot if the robots are not already built. • Learn the programming language needed to operate the Lynx robot. • Create programs using robotic software that will allow the robot to perform a set of tasks. • Configure servo motors to operate the Lynxmotion robot. • Formulate a list of tasks in which the robot used in class can be used in a large scale CIM cell operation.	Joint Loop Microcontroller Output Payload Project Reliability Repeatability RIOS Roll Sequence Servo Motor Step Subroutine Syntax Work Envelope						

March	Integration of Manufacturing Elements						
Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards
	Lesson 4.1: Integration of Manufacturing Elements (10 Days) Concepts Addressed in Lesson 1. The process of mass production is used when the same product is created repeatedly. 2. A work cell is a group of machines in which each individual machine has its own specialty. 3. A flexible manufacturing system is one that can adapt to a wide variety of products. 4. Tradeoffs are made when one system is	Lesson 4.1: Integration of Manufacturing Elements (10 Days) Performance Objectives It is expected that students will: • Identify the three categories of CIM systems. • Compare and contrast the benefits and drawbacks of the three categories of CIM systems. • Identify the components of an FMS. • Create a process design chart for	Flexible Manufacturing System (FMS) Mass Production Process Design Chart Stand-alone Workcell				

		utilized over another. 5. Process flow design has a major impact on overall production time and product profit. 6. During the design and development process, flowcharting is used to plan and depict the detailed process flow for an entire system and all of its subsystems. 7. Flowcharting can be used to illustrate the phases of the product development process. 8. Manufacturing and automation careers are varied in scope and location	a manufacturing process. • Students will explore a manufacturing or automation career of interest and determine the appropriateness and steps required to be a professional in that role.							

April

Integration of Manufacturing Elements

Essential Questions	Content	Skills	Vocabulary	Assessments	Lessons	Resources	Standards
	Lesson 4.2: Manufacturing Application (37 Days) Concepts Addressed in Lesson 1. Process flow design has a major impact on overall production time and product profit. 2. During the design and development process, flowcharting is used to plan and depict the detailed process flow for an entire system as well as all of its subsystems. 3. Flowcharting can be used to illustrate the overall phases of the product development	Lesson 4.2: Manufacturing Application (37 Days) Performance Objectives It is expected that students will: • Identify the potential safety issues with a CIM system and identify solutions for these problems. • Understand the significance of teamwork and communication. • Design a manufacturing system that contains at least two automated components.	Delay Flow Process Chart Inspection Operation Process Flow Storage Transportation				

	process. 4. Safe operating procedures must be addressed in a CIM environment at all times to avoid serious injury. 5. Tradeoffs occur between efficiency and cost when choosing a manufacturing system. 6. Engineers choose appropriate sensors to ensure high quality part production. 7. Proper sequencing of automated operations is important in factory design. 8. Identification of correct electrical and fluid power systems is required to complete the desired manufacturing	• Complete the construction of each individual component of the miniature FMS and verify that each component works. • Assemble components into a working miniature FMS. • Refine each component to improve the total process flow and cycle time. • Start and maintain a journal that documents daily work.							

		system.								