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| **Lesson 1.1 History of Manufacturing** |

**Preface**

As manufacturing became increasingly important, the race to find newer and faster ways to produce products began. The computer revolutionized manufacturing, and manufacturers quickly grasped the advantages that computer-integrated manufacturing offers.

Today the computer monitors the complete enterprise. Automation has become a complete operational form. From the time the first piece of raw material enters the system to the time the finished product departs the system, it is tracked. A time versus profit tracking system has been implemented for inventory. Sometimes the stock is even tracked until it reaches the wholesaler and the retailer.

What does it take to keep such a manufacturing machine going? Most of what goes on in today’s manufacturing companies is driven by a system of computers networked to provide seamless movement from raw materials to finished product. That system is called Computer-Integrated Manufacturing (CIM). An understanding of how the CIM system works is important to the enterprise system. Without the use of computers, today’s manufacturing enterprise could not keep up with supply and demand.

As a CIM student, the ability to function in the manufacturing enterprise is dependent on a solid understanding of CIM principles. In this lesson students will study the components of a CIM enterprise system and how they work together. Students will perform research, present oral and written reports, and create a factory simulation.

**Concepts**

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.

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.

**Standards and Benchmarks Addressed**

***Standards for Technological Literacy***

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| **Standard 1:** | Students will develop an understanding of the characteristics and scope of technology. |
| **BM J:** | The nature and development of technological knowledge and processes are functions of the setting. |
| **BM K:** | The rate of technological development and diffusion is increasing rapidly. |
| **BM M:** | Most development of technologies these days is driven by the profit motive and the market. |
| **BM EE:** | Management is the process of planning, organizing, and controlling work. |
| **Standard 4:** | Students will develop an understanding of the cultural, social, economic, and political effects of technology. |
| **BM H:** | Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious. |
| **BM I:** | Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects. |
| **Standard 5:** | Students will develop an understanding of the effects of technology on the environment. |
| **BM G:** | Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling,. |
| **Standard 6:** | Students will develop an understanding of the role of society in the development and use of technology. |
| **BM J:** | A number of different factors, such as advertising, the strength of the economy, the goals of a company, and the latest fads contribute to shaping the design of and demand for various technologies. |
| **Standard 7:** | Students will develop and understanding of the influence of technology on history. |
| **BM G:** | Most technological development has been evolutionary, the result of a series of refinements to a basic invention. |
| **BM H:** | The evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools and materials. |
| **BM J:** | Early in the history of technology, the development of many tools and machines was based not on scientific knowledge but on technological know-how. |
| **BM N:** | The Industrial Revolution saw the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time. |
| **Standard 19:** | Students will develop an understanding of and be able to select and use manufacturing technologies. |
| **BM O:** | Manufacturing systems may be classified into types, such as customized production, batch production, and continuous production.  Optimization is an on going process or methodology of designing or making a product and is dependent on criteria and constraints. |
| **BM P:** | The interchangeability of parts increases the effectiveness of manufacturing processes. |

***National Science Education Standards***

**Science and Technology Standard E:** As a result of activities in grades 9-12, all students should develop

         **Understandings about science and technology**

**Science in Personal and Social Perspectives Standard F:** As a result of activities in grades 9-12, all students should develop understanding of

         **Natural resources**

         **Natural and human-induced hazards**

         **Science and technology in local, national, and global challenges**

**History and Nature of Science Standard G:** As a result of activities in grades 9-12, all students should develop understanding of

         **Science as a human endeavor**

         **Nature of scientific knowledge**

         **Historical perspectives**

***Standards for English Language Arts***

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| **Standard 1:** | Students read a wide range of print and nonprint texts to build an understanding of texts of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classical and contemporary works. |
| **Standard 4:** | Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes. |
| **Standard 5:** | Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences and for a variety of purposes. |
| **Standard 12:** | Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information). |

**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 presentation, and present findings to a group.

    Explain the different procedures used in manufacturing.

**Assessment**

*Explanation*

1.    Students will explain what manufacturing is and how it has changed through history.

2.    Students will explain the enterprise wheel: Why does it look as it does and how do the parts fit together?

3.    Students will explain topics in manufacturing based upon the research of other students.

*Interpretation*

4.    Students will interpret kaizen, explain how it applies to the manufacturing process, and discuss its advantages and disadvantages.

*Application*

5.    Students will use the enterprise wheel to summarize activities of an organization.

**Essential Questions**

1.    What is manufacturing and why is it important to our economy?

2.    What are the manufacturing procedures known as JIT, CIM, CAD, and lean manufacturing?

3.    What is kaizen and how is this technique used in manufacturing?

4.    What is the enterprise wheel and how does it illustrate a cohesive manufacturing procedure?

**Key Terms**

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| **Automated Guidance Vehicle (AGV)** | A computer-controlled system that uses pallets and other interface equipment to transport work pieces to NC machine tools and other equipment in a flexible manufacturing system. |
| **Automated Storage/Retrieval System (ASRS)** | A system that moves material either vertically or horizontally between a storage compartment and a transfer station or within a process. |
| **Automation** | The use of technology to ease human labor or extend the mental or physical capabilities of humans. |
| **Computer Aided Design (CAD)** | The use of computers in converting the initial idea for a product into a detailed engineering design. |
| **Computer Aided Manufacturing (CAM)** | The use of computers in converting engineering designs into finished products. |
| **Computer Integrated Manufacturing (CIM)** | A company-wide management philosophy for planning, integration, and implementation of automation. |
| **Dependent Variable** | A variable whose value depends on the value of another variable. |
| **Independent Variable** | The controlling factor between variables, on which the value of the other variable depends. |
| **Just in Time (JIT)** | A system that eliminates work-in-process (WIP) inventory by scheduling arrival of parts and assemblies for an operation at the time they are needed and not before. |
| **Kaizen** | Continuous improvement that involves all participants. |
| **Lean Manufacturing** | The systematic elimination of waste. |
| **Manufacturing** | A series of interrelated activities and operations that involve product design and the planning, producing, materials control, quality assurance, management, and marketing of that product. |
| **Robotics** | The science and technology of robots, their design, manufacture, and application. |
| **Six SIGMA** | Six Sigma at many organizations is a measure of quality that strives for near perfection. To achieve Six Sigma, a process must not produce more than 3.4 defects per million opportunities. |
| **Variable** | A quantity that can assume any of a set of values. |

**Day-by-Day Plans**

*Time: 4 days*

**Day 1:**

         The teacher will present [**Concepts**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/L1_1HistoryManufacturing.htm#Concepts),[**Key Terms**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/L1_1HistoryManufacturing.htm#Key_Terms), and[**Essential Questions**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/L1_1HistoryManufacturing.htm#Essential_Questions) in order to provide a lesson overview.

         The teacher will discuss the importance of journals and engineering notebooks and their differences.

         The teacher will distribute an engineer’s notebook to each student.

         Note: The teacher will determine whether students will record their notes in a daily journal, portfolio, or their engineer’s notebook. For purposes of written directions in the day-by-day for each lesson in this course, it will be assumed that students will record their notes in a journal. The journal may be a three-ring binder, spiral bound notebook, or electronic.

         The teacher will distribute [**Sample Engineer’s Notebook Entries**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Teacher_Guidelines/Student_Support_Documents/SampleEngineersNotebookEntries.htm) to each student and discuss what constitutes acceptable and unacceptable entries.

         The teacher will distribute [**Engineering Abbreviations and Symbols**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/PLTW_Curriculum_Support_Materials/Eng_Abbrev_Symbols.htm) and [**Engineering Formulas**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/PLTW_Curriculum_Support_Materials/Engineering_%20Formula%20Sheet.htm) then explain that these reference sheets will be used throughout the course.

         The teacher will distribute [**Activity 1.1.1 History of Manufacturing**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/A1_1_1HistoryManufacturing.htm).

         The teacher will present [**History of Manufacturing.ppt**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Powerpoints/History_Manufacturing.ppt)**.**

**Day 2:**

         The teacher will distribute [**Activity 1.1.2 Enterprise Wheel.**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/A1_1_2_Enterprise%20Wheel.htm)

         The teacher will present[**Enterprise Wheel.ppt.**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Powerpoints/Enterprise%20Wheel.ppt)

         Students will complete [**Activity 1.1.2 Enterprise Wheel**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/A1_1_2_Enterprise%20Wheel.htm)**.**.

         The teacher may choose to distribute a copy of the [**Enterprise Wheel Image**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/EnterpriseWheelImage.htm) to students for reference throughout the course.

         The teacher will assess students using the [**Activity 1.1.2 Enterprise Wheel Answer Key**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/A1_1_2_Enterprise%20Wheel%20Answer%20Key.htm).

         The teacher will distribute [**Project 1.1.3 Manufacturing Research**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/P1_1_3Manufacturing_Research.htm)and[**Project 1.1.3 Manufacturing Research Rubric**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/P1_1_3Manufacturing_Research_Rubric.htm).

         Students will preview the rubric to understand how their project will be evaluated.

         Students will continue [**Project 1.1.3 Manufacturing Research**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/P1_1_3Manufacturing_Research.htm).

**Day 3 – 4:**

         Students will complete [**Project 1.1.3 Manufacturing Research**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/P1_1_3Manufacturing_Research.htm) and present to class.

**Instructional Resources**

Presentations

[**History of Manufacturing.ppt**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Powerpoints/History_Manufacturing.ppt)

[**Enterprise Wheel.ppt**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Powerpoints/Enterprise%20Wheel.ppt)

Word Documents

[**Activity 1.1.1 History of Manufacturing**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/A1_1_1HistoryManufacturing.doc)

[**Activity 1.1.2 Enterprise Wheel**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/A1_1_2_Enterprise%20Wheel.doc)

[**Enterprise Wheel Image**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/EnterpriseWheelImage.doc)

[**Project 1.1.3 Manufacturing Research**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Unit_1/Activities/P1_1_3Manufacturing_Research.doc)

[**Engineering Abbreviations and Symbols**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/PLTW_Curriculum_Support_Materials/Eng_Abbrev_Symbols.doc)

[**Engineering Formulas**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/PLTW_Curriculum_Support_Materials/Engineering_%20Formula%20Sheet.doc)

[**Sample Engineer’s Notebook Entries**](mk:@MSITStore:C:\Documents%20and%20Settings\DAVID_ROEMER\Desktop\CIM\CIM_2010.chm::/Teacher_Guidelines/Student_Support_Documents/SampleEngineersNotebookEntries.doc)