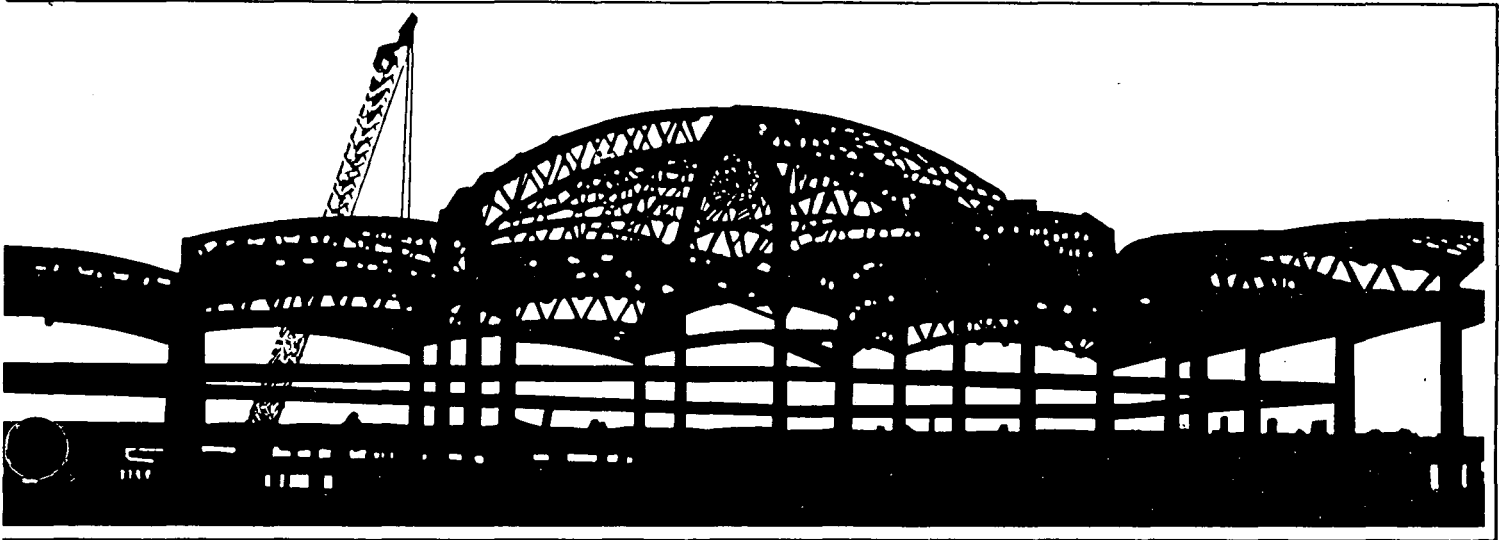


TECHNOLOGY EDUCATION PRODUCTION SYSTEMS

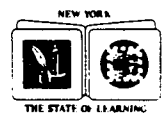
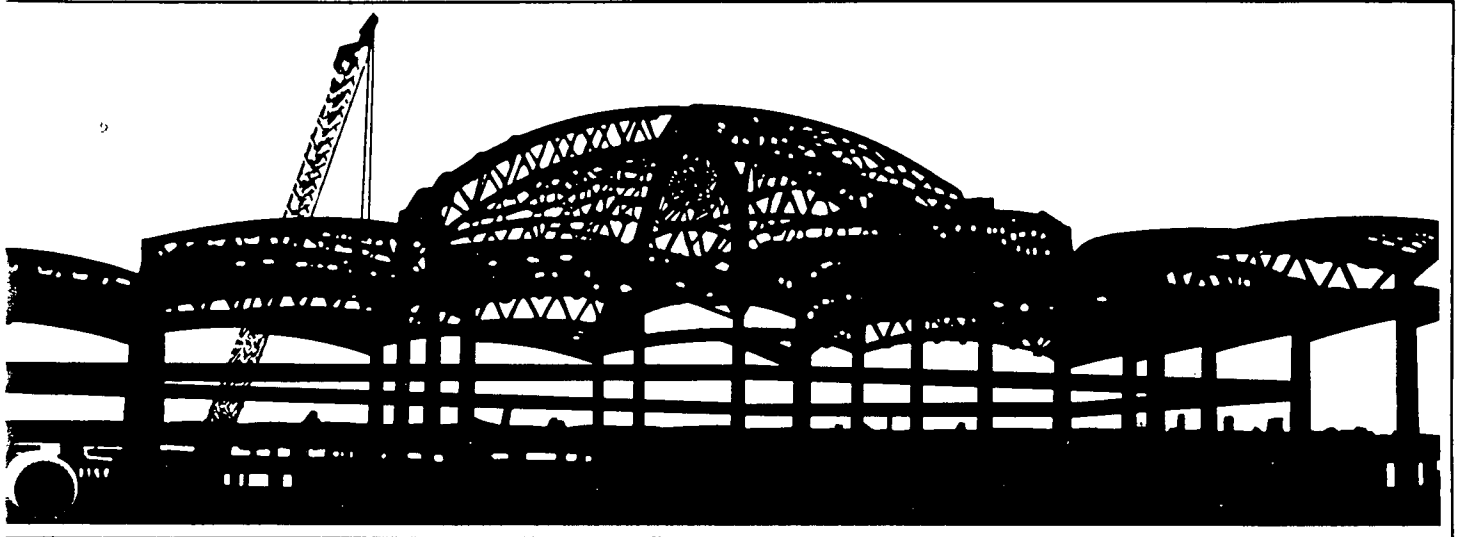
GRADES 9-12
SYSTEMS BLOCK COURSE



The University of the State of New York
The State Education Department
Division of Occupational Programs
Albany, New York 12234
Reprinted 1995

TECHNOLOGY EDUCATION PRODUCTION SYSTEMS

GRADES 9-12
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The University of the State of New York
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COURSE: PRODUCTION SYSTEMS

MODULE I: Basic Systems of Manufacturing

- TOPICS:**
- A. System Command Inputs
 - B. Resources for Manufacturing
 - C. Processes of Manufacturing
 - D. Outputs of Manufacturing
 - E. Control of Manufacturing

MODULE II: Basic Systems of Construction

- TOPICS:**
- A. Systems of Command Input
 - B. Resources for Construction
 - C. Processes of Construction
 - D. Outputs of Construction
 - E. Control of Construction

PREREQUISITES: None

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TOTAL TEACHING TIME: 18 weeks

July 1986

COURSE: PRODUCTION SYSTEMS

COURSE OVERVIEW

One of the key activities of society is that of production. Production can be defined as the processing of materials and knowledge to make products. Production can be divided into two major categories - manufacturing and construction. If an object is produced in a factory, the procedure is considered to be manufacturing. If it is produced or assembled on site, it is considered to be construction. Each has its unique concepts and techniques in our technological society.

This course in Production Systems has been divided into two, nine-week modules with the following emphasis:

Manufacturing Systems. Most of the material possessions used by consumers came from manufacturing enterprises. It is important for a student learning about the world to understand the major concepts of this phase of production. This module is directed to the manufacturing aspects of production. It is organized around the universal systems model with inputs, resources, processes, outputs and control as major categories. These five content organizers have been directly related to manufacturing.

Construction Systems. Most of the residential buildings, commercial buildings, roadways, dams, and bridges used by man are a result of construction activity. This module is directed to the construction aspect of production. Like manufacturing, it is organized around the universal systems model with inputs, resources, processes, outputs, and control as major categories. In this instance, these five categories have been specifically tailored to construction activities.

Currently, new developments and materials such as robotics, superplastics, fiber optics, lasers, and computer-aided design systems are being utilized in production systems. These developments and automated production systems are related to careers, worker qualifications, and employment possibilities. New products and the utilization of resources have economic, social, and environmental impacts. These are all important considerations in the Production Systems course.

INSTRUCTIONAL METHODOLOGY

This course will require a laboratory equipped with tools and machines essential to student manufacturing and/or construction project activity. Emphasis in both modules should be given to hands-on learning. Approximately 75 percent of the class time should be devoted to student performance activity. The remaining 25 percent will be devoted to theory and instruction.

Time is a limiting factor and requires that the instructor carefully structure the course. The content outline for each module provides a complete overview of the topics to be covered. Varying amounts of time can be spent on certain areas depending upon the teacher's structuring of the curriculum. It is expected, however, that each area of the module outlines be covered in some way to offer a complete view of the industry.

Safety and career information are extremely important and should be stressed throughout each module.

SPECIAL POPULATIONS PROVISION

Many students with handicapping conditions have, by definition, the intellectual capacity to master the curricular content requirements for a high school diploma. Such students must attain the same academic standards as their non-handicapped peers in order to meet these requirements. Students with handicapping conditions are provided instruction in a wide variety of settings from regular education classes to special education classes. Teachers of this course should become aware of the needs of those students with handicapping conditions who have been appropriately placed within their classes. Instructional techniques and materials must be modified as necessary so that the information can be attained by such students.

Each course includes suggestions for modifying instructional strategies and materials to meet the needs of students with handicapping conditions. These possibilities and suggestions are intended to provide teachers with a few examples and should be viewed as a base from which teachers in both regular and special education can develop additional strategies.

YOUTH LEADERSHIP SKILLS

Development of leadership skills is an integral part of occupational education in New York State. The New York State Education Department states that "Each education agency should provide to every student the opportunity to participate in student leadership development activities. All occupational education students should be provided the opportunity to participate in the education activities of the student organization(s) which most directly relate(s) to their chosen instructional program"

Leadership skills have been incorporated into the New York State occupational education curricula to assist students to become better citizens with positive qualities and attitudes. Every individual should develop skills in communication, decision making/problem solving, human relations, management, and motivational techniques.

Leadership skills may be incorporated into the curricula as competencies (Performance Objectives) to be developed by every student, or included within the Suggested Instructional Strategies. Teachers providing instruction through occupational education curricula should familiarize themselves with the competencies. Assistance may be requested from the State advisor of the occupational student organization related to the program area.

Students who elect to become active members of one of the student leadership organizations chartered by the New York State Education Department have the advantage of a practical forum to demonstrate leadership skills in an action oriented format and have the potential for recognition of their achievements at the local, state, and national levels.

COURSE: PRODUCTION SYSTEMS

COURSE CREDIT

This course is part of the new State sequence in Technology Education. It is one of three half-unit courses which have been identified as systems courses. They are: Communication Systems, Production Systems, and Transportation Systems. Students completing a high school sequence in Technology Education must have successfully completed any two of these three systems courses.

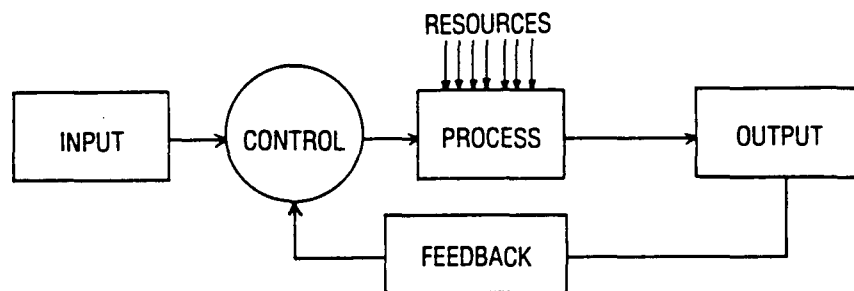
In addition to being taken to fulfill sequence requirements, this course may also be taken by any student as an elective. If the instructor uses this syllabus as a guide for instruction, students may be granted Regents credit for the course.

OVERVIEW OF THE MODULE

GOAL

The student will be able to understand the significance of inputs, resources, processes, outputs, and control of manufacturing technology, given informative presentations and laboratory activities demonstrating these concepts.

MANUFACTURING SYSTEMS MODEL



DESCRIPTION

This module is directed to the manufacturing aspects of production. It is organized around five topics: manufacturing inputs, resources, processes, outputs, and control. These five categories have then been specifically tailored to manufacturing and correlate very closely to the universal systems model.

The content outline for this module is considered complete for the manufacturing concept. Varying amounts of time can be spent on certain areas, however, according to the individual teacher's structuring of the curriculum. A sample time line can be seen in the content outline.

Most all of the material possessions used by consumers come from manufacturing enterprises. It is important for a student learning about the world to understand the major concepts of this phase of production.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

SKILLS, KNOWLEDGES, AND BEHAVIORS TO BE DEVELOPED

The student will be able to:

1. Identify the universal systems model as it relates to manufacturing technology
2. Assess the importance of manufacturing technology to society, in the manner that it provides man with useful articles for everyday life
3. Delineate the necessary resources for manufacturing in our current society
4. Analyze and demonstrate the various processes of manufacturing technology
5. Evaluate the products and impacts of a manufacturing enterprise as to their quality and also their effect on the society and environment
6. Utilize mathematical and scientific principles in the solving of practical manufacturing problems within the laboratory setting
7. Demonstrate problem-solving and analytical thinking skills in solutions to simple engineering problems within the context of laboratory activities

CONTENT OUTLINE

I. System Command Input

- A. Desired product
 1. Needs assessment
 2. Product specifications
 3. Pre-production planning
- B. Expected impacts
 1. Environmental
 2. Economic
 3. Societal
 4. Personal

II. Resources

- A. People
 1. Job classification/career preparations
 2. Organizational structure
 3. Recruitment
- B. Information
 1. History
 - a. Handcrafting
 - b. Mechanization (Industrial Revolution)
 - c. Automation
 2. Safety
 3. Technical knowledge
 - a. Research and development
 - b. Planning
 - c. Engineering

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

CONTENT OUTLINE, continued

- C. Materials
 - 1. Raw material secural
 - 2. Conversion from raw materials to industrial materials
 - 3. Procurement (purchasing)
 - 4. Comparative characteristics
- D. Tools/machines
 - 1. Function/selection
 - 2. Operating techniques
 - 3. Maintenance
- E. Capital
 - 1. Sources
 - 2. Disbursement
- F. Energy
 - 1. Types
 - 2. Applications
- G. Time
 - 1. Quantity
 - 2. Management

III. Processes

- A. Forming
 - 1. Casting/molding
 - 2. Compressing/stretching
- B. Separating
 - 1. Shearing
 - 2. Chip removal
 - 3. Non-traditional
- C. Combining
 - 1. Mechanical fastening
 - 2. Adhesion/cohesion
 - 3. Mixing
 - 4. Coating
 - 5. Assembling
- D. Conditioning
 - 1. Thermal
 - 2. Chemical
 - 3. Mechanical

IV. Outputs

- A. Products
 - 1. Packaging
 - 2. Distribution
 - 3. Reclamation
 - 4. Servicing

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

CONTENT OUTLINE, continued

- B. Impacts
 - 1. Environmental
 - 2. Economic
 - 3. Societal
 - 4. Personal

V. Control

- A. Reasons
 - 1. Quality assurance
 - 2. Profitability
- B. Methods
 - 1. Monitor
 - 2. Compare
 - 3. Adjust

GENERAL INSTRUCTIONAL STRATEGIES

Sample instructional strategies are described in the section that follows, but they may appear somewhat fragmented without a description of the overall plan for the module. This section on General Instructional Strategies is included to communicate the nature of the module in a more cohesive form. The overall strategy is to involve students with the organization of a company that will set up a production line to actually produce, and possibly sell, the chosen product. Some other general strategies would include:

1. Appropriate product. The instructor should take care to involve students with the appropriate degree of difficulty when choosing a product. Students will often choose a product that is too difficult, due to their naivete.

2. Time management. The instructor should manage the allotted time for the course with enough flexible time at the end of the module to make up for manufacturing bugs that occur during the production. If the production runs smoothly and there is some time left, the instructor can have the class produce more products than were originally planned, or find an alternate activity for the students. Nothing is more frustrating for students, however, than not to finish the production of a product they have taken so long to design and organize.

3. Activity selection. The selection of an activity should fulfill the requirements of the course performance objectives and not solely rely on the needs of the school and community, or on the whims of the student. Careful activity selection should fulfill the objectives and be motivational to the students.

4. Instructional sequence. The display of the course outline in this document might suggest a sequential teaching strategy. Although this may be true to some extent, it is not absolutely necessary. The instructor may decide, for instance, to offer instruction on quality control early in the semester, even though it is listed at the end of the content outline. The sequence of topics can be changed to facilitate the individual needs of the instructor and setting, although all the performance objectives must be accomplished to complete the syllabus satisfactorily.

5. Time management. The five topics identified in the content outline, namely, command input, resources, processes, outputs, and control are not equal in terms of the amount of time to be devoted to each topic. A suggested division of time might be:

<u>Topic</u>	<u>Instructional Time</u>
System Command Inputs	5% (approximately 1 hour)
Resources for Manufacturing	30% (approximately 8 hours)
Processes of Manufacturing	50% (approximately 14 hours)
Outputs of Manufacturing	5% (approximately 1 hour)
Control of Manufacturing	10% (approximately 3 hours)

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

GENERAL INSTRUCTIONAL STRATEGIES, continued

6. Tool skill. Tool skill is a very important part of the success of the activity associated with this module. The instructor should identify the tools required to fulfill the activity and spend a sufficient amount of time to assure that the students have the necessary technical and safety skill on those selected tools. If this means a week or more of instruction on tools, the instructor should reschedule time in the remainder of the course to comply with other performance objectives.

7. Field trips. A field trip to a manufacturing plant is an excellent strategy for accomplishing many of the objects in rapid succession.

8. Slides. Color 35 mm slides provide an easy and valuable way for the instructor to bring a manufacturing plant into the laboratory. They are particularly useful if field trips are not possible, but both strategies together can provide a powerful experience for students.

9. Prototypes. If time allows, each student should be asked to design and build a prototype of a possible product. The class may then vote on the product they would like to market and sell.

10. Sales market. The instructor should decide on the size of the sales market ahead of time. Will just enough products be produced so each class member receives one? Will they be sold to the school community? Will they be offered to the entire town? The scale of the market will require the management of many variables.

11. Written responses. Several of the curriculum objectives can be completed by written reports. The instructor is encouraged to offer these assignments as homework. This will allow the maximum amount of available laboratory time for actual hands-on production.

12. Computer graphics. The use of computer programs for the design and engineering of plans is a popular technique used today. Instructors may demonstrate this software if the equipment is available.

13. Sample instructional strategies. Many more instructional strategies are listed after the performance objectives than can normally be accomplished by the instructor. They are offered as "idea stimulators" for the teacher, and should be considered as such. They have also been arranged so that Strategy "a" corresponds with Suggested Performance "a". This matching of competencies is offered as a convenience to teachers.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: System Command Inputs

SUGGESTED TEACHING TIME: 1 hour

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES*

1. Following instruction, and when given one or more possibilities by the instructor, the student will formulate a goal for a manufacturing enterprise project, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student will be able to:

- a. Evaluate the need for the chosen product
- b. Produce a list of required specifications for the chosen product
- c. Simulate steps involved in pre-production planning, including market surveys and cost analysis.

2. Following instruction, and when given production variables by the instructor, the student will predict possible impacts of their manufacturing enterprise, with a degree of accuracy and understanding acceptable to the instructor.

In order to do this, the student will be able to:

- a. Recognize critical anticipated relationships that exist among environmental, economic, social, and personal impacts.
- b. Research and present aspects of each type of impact

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)

The instructor will have several examples of class manufacturing runs available for the students to see. Some of the aesthetic elements of each design may be left up to the students to complete.

2. (P.O. #1b)

The students will individually, and then as a group, complete a list of specifications for the chosen product.

3. (P.O. #1c)

With the instructor as a resource, the students will complete all the planning for the production run, taking into account the many variables that must be considered.

*NOTE: Each performance objective in this module is written without specific reference to criteria for evaluation. The minimum performance level is left to the discretion of the individual instructor, due to the diversity of the student population to be served (low achievers, average, high-achievers, special) and the range in grade-level for this offering.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: System Command Inputs

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

4. (P.O. #2a)

The students might brainstorm a list of possible impacts that the manufacturing of their product might have regarding environmental, economic, social, and personal concerns.

5. (P.O. #2b)

Divide the class into four groups and have each group research and present aspects of each type of impact.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Resources for Manufacturing

SUGGESTED TEACHING TIME: 8 hours

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will explain the process of examining the preparations and utilization of personnel as a resource for manufacturing, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Analyze different job classifications common to the manufacturing industry and the career preparation required
 - b. Describe the structure used in organizing personnel of a manufacturing company
 - c. List the methods that are employed by industry to recruit and train people necessary for the enterprise
2. Following instruction, the student will demonstrate the ability to utilize the resource of technical and historical information in the safe production of their product, with a degree of understanding and proficiency acceptable to the instructor.

In order to do this, the student will be able to:

- a. Identify major historical developments in handcrafting, mechanization, and automation
 - b. Perform in a safety program to set safety standards on a daily basis, 100 percent of the time
 - c. Identify and utilize R & D, planning and engineering techniques in the manufacture of their product
3. Following instruction, the student will describe the utilization of materials in a manufacturing enterprise, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Identify the source and use of common raw materials
 - b. Explain the processes of converting raw materials into industrial materials
 - c. Discuss the methods of procuring industrial materials and supplies for a product
 - d. Classify the comparative characteristics of industrial materials
4. Following instruction, the student will demonstrate basic operating principles of tools and machines, with a degree of efficiency acceptable to the instructor.

In order to do this, the student must be able to:

- a. Select the proper tool or machine to perform a given function
- b. Demonstrate the safe and proper use of the tools and machines in the laboratory situation
- c. Exercise the proper care and maintenance of tools and equipment

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Resources for Manufacturing

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES, continued

5. Following instruction, the student will explain the process of accessing the need for capital and finances needed in the development and completion of manufactured products, with a degree of completeness and understanding acceptable to the instructor.

In order to do this, the student must be able to:

- a. Identify several sources of capital
- b. Describe how finances are dispersed

6. Following instruction, students will identify the various types of energy commonly used in the manufacturing process and determine the best application for a specified tasks, with a degree of completeness and understanding acceptable to the instructor.

In order to do this, the student must be able to:

- a. List the common types of energy available and used by a manufacturing enterprise
- b. Match a given energy source to a task to be performed

7. Following instruction, the student will explain why time is a necessary resource to the manufacturing process, and that its quantity must be apportioned and managed to achieve an efficient and profitable enterprise, with a degree of completeness and understanding acceptable to the instructor.

In order to do this, the student must be able to:

- a. Analyze the amount of time required for their manufacturing enterprise
- b. Establish goals and objectives as related to available time and organize the people and processes to be successful and profitable

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)
 - a. Have the students use the Dictionary of Occupational Titles and the Occupational Outlook Handbook to look up career information.
 - b. The instructor or the library specialist may demonstrate the use of the computer terminal to access the GIS Program (Guidance Information System) and retrieve information regarding specific job titles, career preparation, and preparation institutions.
 - c. Interview a worker (parent, relative) to determine job duties, educational preparation, opportunities, and advantages/limitations.
 - d. Roleplay different personnel positions (e.g., given a position and a specific situation, the student will participate in that role).
 - e. Have students write a job description for the part/role they played in the class corporation.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Resources for Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

2. (P.O. #1b)

- a. Examine the personnel charts of various organizations and describe the line of authority. Suggestions: (1) large business, (2) the school system, (3) the lab personnel system for cleanup.
- b. Students may be asked to write letters to manufacturing concerns requesting an organization chart that can be used in discussion and/or as a model for establishing a student company.
- c. Plan a personnel system to be used with a student corporation.

3. (P.O. #1c)

- a. Under the guidance of the instructor, students may develop a list of characteristics that employers like workers to exhibit.
- b. Look in the classified ads of the local newspaper for employment/job descriptions.
- c. Students may be assigned to small groups, provided a sample product, and instructed to develop a personnel plan which includes a list of all employees needed and any special training required.

4. (P.O. #2a)

- a. The instructor may deliver a lesson using transparencies to outline the major developments prior to the Industrial Revolution. The lesson would be directed toward evolution of processes rather than memorization of names and dates.
- b. Make a collection of drawings to show human development through use of tools (e.g., spear, plow, rocks, hammers).
- c. Distribute to students a list of selected events, technological discoveries, and inventions (not in chronological order) that occurred before the Industrial Revolution and have students place them in order.
- d. Discuss the evolution of cottage crafts in the Pre-Industrial Revolution. Then divide the class into groups of four or five and have them discuss and choose a particular cottage craft that the groups would like to make. Have them report to the class the items they have chosen.
- e. Show the series "Connections", by James Burke, from the British Broadcasting Corporation, and available from University of Pennsylvania, Buffalo State University, and other loan institutions.
- f. Students may be assigned to gather recent newspaper articles on manufacturing experiments in space and to list and discuss the implications of this technological advancement.
- g. Students will select or be assigned a technology/science fair project as an individual activity.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Resources for Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

5. (P.O. #2b)

- a. The instructor should be a prime source of role modeling when it comes to the safe operation of tools and equipment. The instructor should provide demonstrations on the care and use of tools and equipment and set the tone for a safe work atmosphere.
- b. Students may be required to demonstrate their knowledge and preliminary skill in the operation and/or use of equipment or hand tools, through a series of safety quizzes and practical tests, under the instructor's direct supervision.
- c. Students should follow a uniform "qualifying procedure" when learning to use a machine. They will use machines to build their project.
- d. Have students make up a laminated plastic ID card that can be punched to indicate that they are machine qualified. These can be worn to show names and identify students for roll call.
- e. The student manufacturing company should provide for a safety inspector whose job is to observe that students demonstrate, by daily behavior, safe work procedures to be followed when using tools and machines.
- f. Have students conduct a monthly safety inspection. (Teacher may purposely "hide" some infractions for students to find.)

6. (P.O. #2c)

- a. Brainstorm product ideas that could be used for a class manufacturing enterprise.
- b. Set up a "screening" procedure so the class can evaluate the feasibility of projected products.
- c. Collect four or five different types of notebooks used by students. Place the notebooks in front of the class and discuss each design's advantages and limitations. Have class then select the best qualities of each. Charge the students with designing a new type of notebook that incorporates all the best qualities. Compare the different designs and select one to be developed as a prototype.
- d. Divide the class into small design groups and, having developed working drawings, construct models or prototypes of a selected product of the group.
- e. Have students participate in the development and application of a consumer survey instrument to be used to help select a product for the class to manufacture.
- f. Have students conduct a market survey of a proposed product, using working models or prototypes. Each student will interview prospective customers and gather data about consumer demand and product feasibility.
- g. Have students enter and build a "competitive engineering project" for a AIAA Metric 500 ASME competition.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Resources for Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

7. (P.O. #3a)
 - a. Students may explore the possibility of extracting raw materials located on school grounds or within their own neighborhood for conversion to industrial materials. Examples may include: clay, sand, gravel, trees, and plant life.
 - b. Make a collection of "raw" materials and arrange on a display table, e.g., kinds of wood for identification, or bottles of iron ore, limestone, etc.). This may be a student or instructor activity.

8. (P.O. #3b)

Students may be involved in a lab activity of converting locally procured raw materials into industrial products.

9. (P.O. #3c)

Assign an activity of procuring industrial materials for the manufacture of a product, given a list of standard stock items and manufacturers' product guides.

10. (P.O. #3d)
 - a. Examine a variety of manufactured products to determine what materials were used in their fabrication, and assess what characteristics were important to their inclusion in that product.
 - b. Ask students to determine the best material for a given part of the class production based on a comparative characteristic study.
 - c. Develop simple testing devices to show the comparative characteristics of materials, such as, flexibility, elasticity, hardness, corrosion resistance, tensile strength, compression strength, shear strength, etc.
 - d. Provide a laboratory activity where students are called upon to perform various types of testing and data gathering. Examples to be considered include: tests of tensile strength of materials, strength of adhesives, strength of joints in wood products, methods of fastening, etc.

11. (P.O. #4a)
 - a. Provide an activity where hand tools and equipment are numbered. Given a list of names and uses, students will then match the number of the tool or equipment with the proper name and use.
 - b. Given the choice of a variety of machines or tools that will perform similar functions, the students should determine which of those machines or tools will best perform a given task. For example, given a table saw, band saw, jig saw, electric miter box, and portable power saws, the student will utilize the machine(s) that will provide the best picture-frame miter.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Resources for Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

12. (P.O. #4b)

Demonstrate the proper use of hand tools and equipment. Students may then participate in a line-production activity where this learning about hand tools and equipment can be applied.

13. (P.O. #4c)

- a. The students' lab activity requirement may include a specific amount of time to perform maintenance of hand tools and equipment.
- b. Demonstrate methods of sharpening, cleaning, and storing tools for over a vacation period.
- c. Repair a tool from home, e.g., remove rust; sharpen; weld; heat treat; grind a plane blade, chisel, or screwdriver; sharpen scissors; repair handles.

14. (P.O. #5a)

- a. Set up a competitive situation between groups in the class to research and develop a list of sources of capital. Establish a specified time limit. A master list may then be developed using ideas from each group.
- b. Develop a collection of clippings from the financial section of local newspapers. Highlight "new" industry that will mean additional jobs.
- c. Have students select a common stock from those listed on the New York Stock Exchange and chart its progress for several weeks.
- d. Sell stock for a school enterprise.
- e. Have students select a manufacturing corporation, and have them send away for a prospectus that can be studied and compared with others received by classmates.

15. (P.O. 5b)

- a. Design and produce an accounting system that could be used for the class industry.
- b. Make predictions of the break-even point for the class industry.

16. (P.O. 6a)

- a. Have students telephone representatives of various utilities to gather data on utility availability, cost, and other pertinent factors.
- b. Arrange for a tour of the school so that students may observe firsthand the complicated system of providing utilities.

17. (P.O. #6b)

- a. Make a cost analysis of different energy sources to perform a given task (for example, heating a house with electricity, wood, gas, oil, or coal).

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Resources for Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

17. (P.O. #6b), continued
 - b. Discuss why certain industries are located in close proximity with the power source.
 - c. Have the students state the source and estimate the cost of energy used during their manufacturing enterprise.

18. (P.O. #7a)
 - a. Draw a flowchart to show the flow of parts, sub-assemblies, storage points, etc.
 - b. Have students conduct a time study to improve the efficiency of a given task (e.g., use a fixture to cut a part to size instead of measuring constantly. Have a student cut 10 parts to length by measuring each piece vs. using a stop block on the fence of a radial arm saw.)

19. (P.O. #7b)
 - a. Have students establish a time line to apportion the time available to each of the tasks that must be performed (e.g., the flow of parts, pre-production planning and tooling up for production, production and packaging, and distribution).
 - b. Following the manufacturing exercises, discuss ways and means in which time might have been saved.
 - c. Calculate the man-hours of labor in each of the student manufactured products. Discuss ways in which the labor costs could be reduced.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Processes of Manufacturing

SUGGESTED TEACHING TIME: 14 hours

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will synthesize the general processes of forming materials; i.e., casting/molding, and compressing/stretching, with a degree of completeness and accuracy satisfactory to the instructor.

In order to do this, the student must be able to:

- a. Identify and/or demonstrate techniques of casting/molding
- b. Explain and/or show techniques for compressing/stretching materials

2. Following instruction, the student will synthesize the general processes of separating materials; i.e., shearing, chip-removal, and non-traditional methods, to the satisfaction of the instructor.

In order to do this, the student must be able to:

- a. Identify and/or demonstrate techniques for shearing materials
- b. Explain and/or show techniques for chip-removal processes
- c. Describe and/or use techniques for the non-traditional methods of separating materials

3. Following instruction, the student will synthesize the general processes of combining materials; i.e., mechanical fastening, adhesion, cohesion, mixing, coating, and assembling, to the satisfaction of the instructor.

In order to do this, the student must be able to:

- a. Identify and/or demonstrate techniques used for mechanical fastening
- b. Explain and/or show techniques used in the adhesion and/or cohesion of materials
- c. Describe and/or use techniques in mixing materials
- d. Identify and/or show techniques for coating materials
- e. Demonstrate and/or explain techniques for assembling materials and components

4. Following instruction the student will analyze the conditioning processes used in manufacturing including heat treating, rolling, plasticizing, drying, etching and other similar techniques, with a degree of completeness and understanding acceptable to the instructor.

In order to do this, the student must be able to:

- a. Distinguish among thermal, chemical, and mechanical conditioning techniques
- b. Describe the conditioning processes used in each of those manufacturing processes

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Processes of Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)
 - a. Provide a product with several components to be disassembled, and require students to identify which components were produced by the casting/molding process.
 - b. Have students make castings using various materials; e.g., hot metals, concrete, plaster, clay, polyester, plastisol, etc.
 - c. Have students prepare a mold for casting; e.g., out of sand, plaster, rubber, or vacuum formed plastic.
2. (P.O. #1b)
 - a. Given specific items formed by stretching/compressing techniques, ask students to identify the process, equipment, and materials used and to explain how the techniques are accomplished.
 - b. Make and bend a material using a simple, lab-made jig.
 - c. Bend a product, or parts, using commercial bending machines.
 - d. Have students forge a project, e.g., a screwdriver, chisel, awl, etc.
3. (P.O. #2a)
 - a. Use demonstrations with student participation to illustrate various methods of shearing materials with lab equipment.
 - b. Design a required project that will provide students experience with the use of the shearing process.
4. (P.O. #2b)
 - a. Set up a simple production line with jigs and fixtures where students may experience several chip-removal processes.
 - b. Use hand tools and power tools to indicate the efficiency and accuracy possible when drilling, sawing, milling, etc.
5. (P.O. #2c)
 - a. Arrange a field trip to a local high-technology facility where students can observe non-traditional separating methods, such as laser beam milling, electrical discharge machining (EDM), electro-chemical machining (ECM), etching, etc.
 - b. Students may participate in the production of a printed circuit board which is to be screen printed with a resist, and chemically etched to produce a circuit.
 - c. Show films to demonstrate non-traditional methods of separating materials (e.g., EDM, laser cutting, etc.). One source: "Non-traditional Processes", McKnight Publishing.
6. (P.O. #3a)
 - a. Have students research a particular mechanical fastening technique and report to the class the advantages and limitations of the fastener.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Processes of Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

6. (P.O. #3a), continued
 - b. The instructor may provide a laboratory activity where each student will experience mechanical fastening techniques through the completion of experimental samples.
 - c. Make a collection of common fasteners used in the lab.
 - d. Make a comparison of advantages of nailing versus the use of wood screws.
7. (P.O. #3b)
 - a. Students may be given the homework assignment of identifying and listing adhesion and/or cohesion used around their home.
 - b. Run a comparison of adhesive strengths on similar pieces of wood.
 - c. Have students make a product to demonstrate adhesion techniques, e.g., a laminated plastic card.
 - d. Demonstrate and allow students to weld a demonstration piece.
 - e. Make a cohesive lamination using acrylic and a heated hydraulic press.
8. (P.O. #3c)
 - a. Measure and mix ingredients for a plaster cast or concrete casting.
 - b. Mix polyester resin with required amount of MEKP catalyst to pour a casting; or use body filler to patch.
 - c. Mix ingredients to make a custom glaze; test fire and then evaluate.
9. (P.O. #3d)
 - a. Demonstrate techniques for coating materials, and have students apply them through product application.
 - b. Make a demonstration board to show treatment of material with various coating treatments.
 - c. Apply rust-proofing paint, reflective paints, absorbing paints; then compare qualities.
 - d. Silk screen a sign using reflective coating and bead application.
 - e. Use plastisol or organisol to coat handles of tools.
 - f. Apply coatings using the fluidized bed coating techniques for plastic.
 - g. Test for the abrasive resistance of various applied coatings.
10. (P.O. #3e)
 - a. The instructor may explain and demonstrate procedures for the assembly of components into final products in preparation for line production.
 - b. Students should obtain assembly instruction on consumer products that require some assembly, such as bicycles, toys, etc., and analyze the difficulty or ease of assembly based on the instructions provided.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Processes of Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

11. (P.O. #4a)
 - a. Demonstrate the techniques used to condition tool steel to a specific hardness and temper.
 - b. Make a display of various products that owe their usefulness to conditioning techniques.
 - c. Examine various materials before and after conditioning by using high magnification (or photographs of same).

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Outputs of Manufacturing

SUGGESTED TEACHING TIME: 1 hour

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will explain the importance of packaging, distributing, reclaiming, and servicing manufactured products, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Describe the importance of packaging as it relates to marketing and protection of the product
 - b. Identify the systems and methods of distributing materials and products
 - c. Assess the significance of the reuse and/or reclamation of manufactured products.
 - d. Recognize that proper installation, preventive maintenance, and repair are essential elements in the servicing of a manufactured product.
2. Following instruction, the student will interpret the environmental, economic, societal, and personal impacts connected with manufacturing products, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Explain the possible effects that the manufacturing of products may have upon the environment
- b. Determine the economic impacts that manufactured products may have on the economy
- c. Describe some of the societal impacts that might occur due to a manufacturing enterprise
- d. Analyze the effects that manufacturing may have upon the individual

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)
 - a. Package an egg to survive a long drop.
 - b. Have a cooperative package design contest for students. Cooperate with the art department.
 - c. Have students participate in a product engineering activity which may deal with a current issue from the newspaper.
2. (P.O. #1b)
 - a. Students will chart the flow of the product from production to the consumer.
 - b. Plan a scheme for distribution and sales using resources such as homeroom reps, student store, PTA, PA system, and bulletin boards.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Outputs of Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

3. (P.O. #1c)
 - a. Recycle a glass bottle into a useful product, such as a vase or mug.
 - b. Reclaim and recycle plastic materials by regrinding.
 - c. Reclaim aluminum cans for casting.

4. (P.O. #1d)
 - a. Have students discuss modular electronic components used in high technology and the changing roles of service personnel.
 - b. Have students visit a servicing facility for household items and interview service personnel to determine the changes that may have taken place in the last decade.
 - c. Have students participate in a scheduled maintenance program.
 - d. Have students read directions for the assembly and maintenance of some piece of equipment.
 - e. Have students design a maintenance manual for a product.

5. (P.O. #2a)
 - a. Prepare several "What would happen if" questions for discussion.
 - b. Explain environmental hazards found in the home. Catalog all the products used in the home and screen for hazards.

6. (P.O. #2b)
 - a. Have the students calculate profit/loss, breakeven point, profit margin, etc.
 - b. Lead a discussion on the part manufacturing plays in the growth or decline of the economy.
 - c. Students may discuss the possible effects of a plant shutdown on the local economy.

7. (P.O. #2c)
 - a. Have the students interview their parents to determine what labor-saving devices they have now that they did not have when they were a child. Discuss if society is better as a whole for these devices.
 - b. Have the students make a list (for homework) of the things in their life, and in the society in general, that are not mass manufactured.
 - c. Discuss how society has changed because of all the things that are now manufactured that were not several hundred years ago.
 - d. Develop a collection showing old Sears catalogs, magazine ads, and other historical cues to the way in which our society has changed due to manufacturing technology.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Outputs of Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

8. (P.O. 2d)
 - a. Lead a discussion on how manufacturing impacts the lives of individuals in the community, including income, lifestyle, living conditions and environment.
 - b. Have students prepare a research report that deals with the effects of the rapid changes brought about by high technology, concentrating on possible retraining requirements and individual salary growth potential.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Control of Manufacturing

SUGGESTED TEACHING TIME: 3 hours

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will identify the reasons for continually controlling the resources used in manufacturing, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Explain reasons for quality assurance as it relates to the manufacturing system
- b. Explain reasons for increased profitability in a manufacturing enterprise

2. Following instruction, the student will outline methods of how resources are controlled in a manufacturing system, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Develop monitoring techniques for the manufacturing enterprise
- b. Use comparison methods to determine inferior products
- c. Adjust the manufacturing system to compensate for problems that are causing inferior products, inefficiency, and waste

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)

- a. The student will experience the role of quality-control inspector by comparing produced parts with various inspection gauges.
- b. Students will gather evidence that quality control measures were practiced during the production of consumer products purchased for the household (i.e., inspector labels found packaged with clothing items).
- c. Make classes competitive in their desire to produce the best product. Incentives and awards may be provided.
- d. Compare the quality and cost of real products (tools, appliances, cars, etc.)

2. (P.O. #1b)

- a. Chart the quality of production. Relate to profit and loss.
- b. Keep all the waste stock used during manufacturing and estimate its cost. Show the students how this effects profitability.

3. (P.O. #2a)

- a. Have the students develop appropriate monitoring techniques in the production of their product.
- b. Have students list methods of monitoring things (i.e., temperature, moisture content, quantity, volume, length, width, height, etc.).

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING
TOPIC: Control of Manufacturing

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

4. (P.O. #2b)

- a. The students should build or use a simple comparison device or tool (go/no go gauge, etc.) for some aspect of their manufacturing run.
- b. Have students constantly compare the product being manufactured to the original specifications.

5. (P.O. #2c)

- a. Have one student keep a list of all the adjustments that had to be made during the manufacturing run, and report them to the class. This person could be the quality-control officer.
- b. Give the students simple products with problems, and have them adjust resources to make the project better (poor paint job, casting with cavities, wood project falling apart, etc.).

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

TEACHER RESOURCES

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COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

TEACHER RESOURCES, continued

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COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

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FILMSTRIPS

- "Product Design"
- "Obtaining Managerial Approval"
- "Tooling Design"
- "Quality Control"
- "What's in a Name"
- "Developing A Marketing System"
- "Packaging"
 - o "Developing Production Methods"
 - o "Manufacturing: An Integral Part of Society"

Available from:

Manufacturing Forum
Industrial Education and Technology
Ball State University
Muncie, IN 47306

- "What is Manufacturing"
- "The Materials of Manufacturing"
- "The Tools and Processes of Manufacturing"
- "Forming Processes in Manufacturing"
- "Separating Processes in Manufacturing"
- "The Combining Processes in Manufacturing"
- "Research and Development in Manufacturing"

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF MANUFACTURING

TEACHER RESOURCES, continued

"Types of Production in Manufacturing"
"The Final Manufactured Product"
"Energy Sources for Manufacturing"

Available from:
McKnight Publishing Company
Bloomington, IL 61701
(309) 663-1341

TRANSPARENCIES

"Introduction to Manufacturing and Management"
"Research and Development"
"Production"
"Marketing"
"Industrial Relations"
"Financial Affairs"
"Labor Unions"

Available from:
Manufacturing Forum
Industrial Education and Technology
Ball State University
Muncie, IN 47306

A complete set of 30 transparencies on manufacturing processes is available from:

DCA Education Products, Inc.
424 Valley Road
Warrington, PA 18976

A complete set of 38 transparencies on manufacturing materials is available from:

DCA Educational Products, Inc.
424 Valley Road
Warrington, PA 18976

FILMSTRIPS AND TRANSPARENCIES

"Manufacture; People, Processes, & Products"

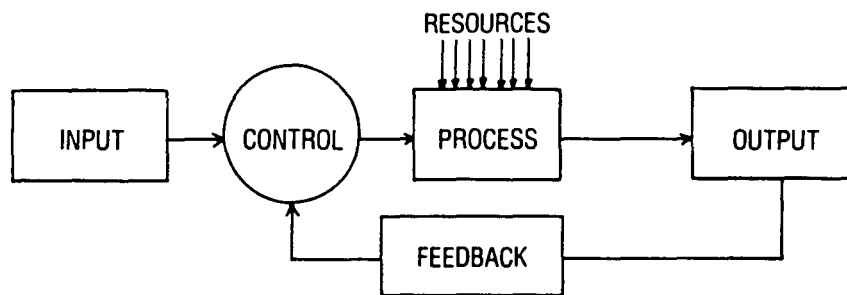
Available from:
New Concepts Corporation, Rochester
80 Commerce Drive
Rochester, NY 14623 \$195.00

OVERVIEW OF THE MODULE

GOAL

Upon successful completion of this module the student will be able to understand the significance of inputs, resources, processes, outputs, and control of construction technology, given informative presentations and laboratory activities demonstrating these concepts.

CONSTRUCTION SYSTEMS MODEL



DESCRIPTION

One of the key activities of society is that of production. Production can be defined as the processing of materials and knowledge to make products useful in our lives. Production can be divided into two major categories -- manufacturing and construction. If an object is produced in a factory, the procedure is considered to be manufacturing. If it is produced on site, it is considered to be construction. Each has its unique concepts and techniques in our technology.

This module is directed to the construction aspects of production. It is organized around the universal systems model with inputs, resources, processes, outputs, and control as major categories. These three categories have then been specifically tailored to construction and correlate very closely to the universal systems model.

The content outline for this module is considered a complete sequence for the construction concept. Varying amounts of time can be spent on certain areas according to the individual teacher's structuring of the curriculum. It is expected, however, that each area of the outline be covered in some way to offer a complete view of the construction activity of society. A sample time line is offered in the content outline.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION

SKILLS, KNOWLEDGES, AND BEHAVIORS TO BE DEVELOPED

The student will be able to:

1. Identify the universal systems model as it relates to construction technology
2. Assess the importance of construction technology to society in the manner that it provides shelter, roadways, dams, and other constructed projects for humans
3. Delineate the necessary inputs and resources for the process of construction technology
4. Analyze and demonstrate various processes of construction technology
5. Evaluate projects and control of construction as to their quality and effect on society and the environment
6. Utilize mathematical and scientific principles in the solving of practical construction problems within the laboratory setting
7. Demonstrate problem solving and analytical thinking skills in solutions to simple engineering problems within the context of laboratory activities

CONTENT OUTLINE

I. System Command Input

- A. Desired project
 1. Needs assessment
 2. Project specifications
 3. Pre-construction planning
- B. Expected impacts
 1. Environmental
 2. Economic
 3. Societal
 4. Personal

II. Resources

- A. People
 1. Job classification/career preparation
 2. Organizational structure
 3. Recruitment

CONTENT OUTLINE, continued

- B. Information
 - 1. History
 - a. Residential
 - b. Non-residential
 - 2. Safety
 - 3. Technical Knowledge
 - a. Research and development
 - b. Planning
 - c. Engineering
 - C. Materials
 - 1. Raw material secural
 - 2. Conversion from raw materials to industrial materials
 - 3. Procurement (purchasing)
 - 4. Comparative characteristics
 - D. Tools/machines
 - 1. Function/selection
 - 2. Operating techniques
 - 3. Maintenance
 - E. Capital
 - 1. Sources
 - 2. Disbursement
 - F. Energy
 - 1. Types
 - 2. Applications
 - G. Time
 - 1. Quantity
 - 2. Management
- III. Processes
- A. Foundations
 - 1. Materials
 - 2. Types
 - B. Superstructures
 - 1. Residential
 - 2. Non-residential
 - C. Enclosure Systems
 - 1. Flooring
 - 2. Walls
 - 3. Roofing
 - 4. Ceiling
 - 5. Insulating
 - D. Utility Systems
 - 1. Electrical
 - 2. Plumbing
 - 3. Heating/cooling
 - 4. Communications

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION

CONTENT OUTLINE, continued

V. Outputs

- A. Completed project
 - 1. Site completion
 - 2. Maintenance
- B. Impacts
 - 1. Environmental
 - 2. Economic
 - 3. Societal
 - 4. Personal

V. Control

- A. Reasons
 - 1. Quality assurance
 - 2. Profitability
- B. Methods
 - 1. Monitor
 - 2. Compare
 - 3. Adjust

GENERAL INSTRUCTIONAL STRATEGIES

Sample instructional strategies are described in the section that follows, but they may appear somewhat fragmented without a description of the overall strategy for the module. This section on General Instructional Strategies, therefore, is included to explain the nature of the module in a more cohesive form

The overall strategy is to involve students with hands-on activity of an actual construction project. With the time restraints that are given, a small-scale project, something like a storage shed or a wall section, would probably be the most appropriate. There are other general strategies that the instructor might want to employ, however.

1. Models. Building models can provide useful activity for many of the stated objectives, but the instructor must realize that the focus of the course should be more toward actual construction.

2. Community projects. The instructor is encouraged to solicit the community for small building projects that can be handled by the size and expertise of the class and that permit the performance objectives of the module to be met.

3. Instructional sequence. The display of the course outline in this document might suggest a sequential teaching strategy. Although this may be true to some extent, it is not absolutely necessary. The instructor may decide, for instance, to offer instruction on quality control early in the semester, even though it is listed at the end of the content outline. The sequence of topics can be changed to facilitate the individual needs of the instructor and setting, although all performance objectives must be accomplished to complete the syllabus satisfactorily.

4. Time management. The five topics identified in the content outline, namely, command input, resources, processes, outputs, and control are not equal in terms of the amount of time to be devoted to each topic. A suggested division of time might be:

<u>Topic</u>	<u>Instructional Time</u>
System Command Inputs	5% (approximately 1 hour)
Resources for Construction	30% (approximately 8 hours)
Processes of Construction	50% (approximately 14 hours)
Outputs of Construction	5% (approximately 1 hour)
Control of Construction	10% (approximately 3 hours)

5. Tool skill. Tool skill is a very important part of the success of the activity associated with this module. The instructor should identify the tools required to fulfill the activity and spend a sufficient amount of time to assure that the students have the necessary technical and safety skill on those selected tools. If this means a week or more of instruction on the tools, the instructor should reschedule time in the remainder of the course to comply with other performance objectives.

GENERAL INSTRUCTIONAL STRATEGIES, continued

6. Storage. Space for storage of construction materials and projects can be a problem in many laboratories that were not designed with this type of activity in mind. The instructor should plan for activities that can take advantage of good weather, or activities that can be scaled down in size to adjust to the space available in the laboratory.

7. Field trips. A field trip to a building project can be an invaluable strategy for accomplishing many of the objectives in rapid succession. The instructor should find a project, such as a housing development, that is in varying stages of completion. This will provide the opportunity for the students to see several of the construction steps as they are actually occurring. Also, a "field trip" around the mechanical rooms of the school is an excellent way to communicate concepts relating to commercial structures.

8. Slides. Color, 35 mm slides provide an easy and valuable way for the instructor to bring construction projects to the laboratory. They are particularly useful if field trips are not possible, but they may also be used along with the field trip strategy. An instructor may visit a project site with a camera and take two or three rolls of film to capture quickly the several stages of the project. Also, large-scale projects, such as roads, dams, factories, and the like, might best be captured on film.

9. Computer graphics. The use of computer programs for the design and engineering of construction plans is a popular technique used today. Instructors may demonstrate this technology if the equipment is available.

10. Written responses. Several of the curriculum objectives can be covered by written reports. The instructor is encouraged to offer these assignments as homework. This will allow the maximum amount of available laboratory time for the actual hands-on construction project.

11. A construction company. Many instructors may want to organize an actual construction company with their class. This is an excellent strategy to get students involved with design, purchasing, scheduling, and many other objectives of the course.

12. Sample instructional strategies. Many more instructional strategies are listed after the performance objectives than can be accomplished by the instructor. They are offered as "idea stimulators" for the teacher, and should be considered as such. They have also been arranged so that Strategy "a" corresponds with Supporting Performance Objective "a". This matching of strategies with supporting competencies is offered as a convenience to teachers.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: System Command Inputs

SUGGESTED INSTRUCTIONAL TIME: 1 hour

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES,

1. Following instruction, the student will formulate a goal for a construction project, given one or more possibilities by the instructor, with a degree of completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Evaluate the needs for the chosen project
 - b. Produce a list of required specifications for the chosen project
 - c. Plan the pre-construction variables relating to the project
2. Following instruction, the student will predict possible impacts of their construction project, given construction variables by the instructor, with a degree of understanding and accuracy acceptable to the instructor.

In order to do this, the student will be able to:

- a. Identify several relationships that exist among environmental, economic, social, and personal, impacts
- b. Explain the possible effect of these various factors as they apply to the student's selected construction project

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)
 - a. With the help of the instructor, the students will choose a construction project for the semester, based on the limitations present. Of course, one of the major needs is the completion of the course performance objectives.
 - b. Develop a statement of needs for a project that is to be built by the class.
2. (P.O. #1b)
 - a. The students will individually, and then as a group, complete a list of specifications for the chosen construction project.
 - b. Have the students develop a bill of materials for their project.

*NOTE: Each performance objective in this module is written without specific reference to criteria for evaluation. The minimum performance level is left to the discretion of the individual instructor, due to the diversity of the student population to be served (low achievers, average, high achievers, special) and the range in grade level for this offering.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: System Command Inputs

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

3 (P.O. #1c)

- a. With the instructor as a resource, the students will plan all the construction variables that must be considered.
- b. Display a complete set of plans used in residential, commercial, industrial, and transportation structures. Plans should include a complete set of specifications.

4. (P.O. 2a)

The students could brainstorm a list of possible impacts a construction project might have regarding environmental, economic, social, and personal concerns.

5. (P.O. 2b)

Site examples of specific construction projects that had serious problems by not forecasting impacts.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Resources for Construction

SUGGESTED INSTRUCTIONAL TIME: 8 hours

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will analyze the preparation and utilization of personnel as a resource in construction projects, with a degree of completeness and accuracy acceptable to the instructor.

In order to do this, the student must be able to:

- a. Analyze the major job classifications of workers in the construction industry and the training required
- b. Describe the structure used in organizing personnel of a construction company
- c. List the methods employed by the construction industry to recruit and train people

2. Following instruction, the student will utilize the resource of technical and historical information in the safe construction of their project, with a degree of accuracy and understanding acceptable to the instructor.

In order to do this, the student must be able to:

- a. Identify major historical developments in residential and non-residential construction
- b. Perform in a safety program to set safety standards on a daily basis, 100% of the time
- c. Identify and utilize R & D, planning and engineering techniques in the construction of their project

3. Following instruction, the student will demonstrate the ability to use appropriate materials in his/her construction project, with a degree of understanding acceptable to the instructor.

In order to do this, the student must be able to:

- a. Identify the source and use of common raw materials
- b. Explain the processes of converting raw materials to construction materials
- c. Explain the methods of procuring construction materials supplies for a project
- d. Explain comparative characteristics of construction materials

4. Following instruction, the student will demonstrate basic operating principles of construction-related tools and machines, with a degree of proficiency acceptable to the instructor.

In order to do this the student must be able to:

- a. Select the proper tool or machine to perform a given function
- b. Demonstrate the safe and proper use of the tools and machines in the laboratory situation
- c. Exercise the proper care and maintenance of tools and equipment

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Resources for Construction

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES, continued

5. Following instruction, the student will relate the need for capital and finance to the development of construction projects, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Identify several sources of capital
- b. Discuss how finances are dispersed

6. Following instruction, students will identify the various types of energy commonly used by the construction industry and the best type to perform a given function, with a degree of accuracy and understanding acceptable to the instructor.

In order to do this, the student must be able to:

- a. List the common forms of energy used by the construction industry
- b. Match a given energy source to a task to be performed

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)
 - a. After the instructor has made a list of job classifications in the construction industry, have students describe the training required for each classification.
 - b. With the teacher providing a list of construction job classifications, have each student consult the Occupational Outlook Handbook, list the educational requirements of each job classification, describe the need for such personnel, and identify the function and duties of each job classification.
2. (P.O. #1b)
 - a. Students might be asked to place a list of job titles in a line-staff organizational chart of a company, real or fictitious.
 - b. Through the use of an organizational chart, the teacher may illustrate how a construction company is structured into various departments, lines of control, and how each department influences the other.
 - c. Either by student choice or teacher assignment, Organize the class into a construction company for the purpose of initiating a small construction project. Student names and job titles should be placed on an organizational chart to illustrate the structure of the student construction company.
3. (P.O. #1c)
 - a. Have students simulate the formation of a construction company. They should then apply and be interviewed for positions.
 - b. Have students design and complete applications for various jobs.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Resources for Construction

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

4. (P.O. #2a)
 - a. Students may describe some of the many material-joining techniques (peg, mortise and tenon, lime mortar, welding, etc.) that were used during various construction eras.
 - b. The instructor might develop a list of different construction techniques that have occurred throughout history. After appropriate instruction, students should be asked to place the events in proper chronological order. (This might make a good homework assignment and not take up laboratory instruction time.)
 - c. Develop a list of construction techniques and have students identify the approximate time period when each technique was used.
 - d. Using a time line and diagrams of structures, the instructor should illustrate how construction projects have been developed to meet the needs of society. This time line should cover the period of prehistoric man to today's construction projects.

5. (P.O. #2b)
 - a. Students are given a list of commonly occurring safety infractions. A discussion should ensue on the possible effects of these actions.
 - b. The instructor might develop a safety quiz that students must retake until they are able to master the questions with 100 percent accuracy.
 - c. Have each student demonstrate his/her ability to operate power equipment safely, by taking a performance test.
 - d. Arrange a troubleshooting exercise where students identify simulated hazards that were set by the instructor.
 - e. Given a laboratory setting in which students will work on a construction project, the instructor will demonstrate the proper and safe use of the various tools that students will be using.
 - f. The instructor, as a role model to the students, should on a daily basis set an example of how to work safely in a laboratory setting 100 percent of the time.

6. (P.O. #2c)
 - a. Students might be asked to draw a rough sketch (floor plan) of a "dream house" that has three bedrooms, kitchen, bath, living, dining, and utility rooms. Students should gain an appreciation of the difficulties encountered in design ideation.
 - b. Have students design a construction project that will involve the entire class and be reasonable in cost (tool shed, etc.).
 - c. Present the parameters of a class project and have students develop their own feasibility study. They could then report results to the class. An outline of the components of a feasibility study will help to provide student direction.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Resources for Construction

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

7. (P.O. #3a)
 - a. Have students make a list of common raw materials and where they are found, either locally or at a great distance.
 - b. With the aid of the instructor, have students brainstorm possible sources of raw materials for construction projects. Rationale for their choices should be given.
8. (P.O. #3b)
 - a. Have a group of students or, as a demonstration, process a log from its raw state to a dressed board.
 - b. Dig and produce a clay product.
9. (P.O. #3c)

Have students elect from members of the class purchasing department for a construction company that they will establish. Have those elected order the necessary materials and supplies for a residential home project, utilizing comparison shopping.
10. (P.O. #3d)
 - a. Have students test the strength of various materials having the same span and crosssection.
 - b. Simulate testing procedures, such as tensile, compression, and slump using hydraulic jacks or other simple load techniques.
11. (P.O. #4a)
 - a. The instructor may initiate a laboratory activity where students must use each of several basic hand tools used in the construction industry. An individual or small project such as a shed, dog house, and the like would be ideal for this strategy.
 - b. The instructor may ask to borrow some of the smaller specialty tools from a local builder to show the class on a specific day.
 - c. Using construction catalogues, the instructor should show the class specialty tools used in construction and explain their purposes.
12. (P.O. #4b)
 - a. Demonstrate the proper use of hand tools and equipment. Students may then participate in a construction activity where this learning about hand tools and equipment can be applied.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Resources for Construction

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

13. (P.O. #4c)

- a. The instructor may have students employ a maintenance program on the last class meeting, where the tools and equipment in the laboratory are cleaned and maintained. The maintenance program should be formalized and emulate one found in the construction industry. It should not involve mere janitorial cleaning work.
- b. Have students make a schedule of maintenance operations for tools that they have at home.
- c. Have students participate in maintaining the tools in the lab on a daily basis.

14. (P.O. #5a)

- a. Have students choose a local public project and identify the sources of funds that were used to complete the project. Some of the sources listed should be:
 1. savings
 2. mortgage
 3. investors
 4. other loans
 5. bond issues
 6. taxes
- b. Demonstrate the process of securing a loan from the school, parents, or a bank.

15. (P.O. #5b)

- a. Have students set up their own construction company for community projects. They should be paid a small salary (possibly \$0.10/hour) as well as for materials. Students should then be organized to make sure that materials are properly purchased and that enough money is left to pay the (minimal) wages and make a profit. The profit might go into the laboratory fund for tools, equipment, etc.
- b. Have a student appointed to become treasurer in charge of disbursing project funds.

16. (P.O. #6a)

- a. Develop a list of various types of energy used at a construction site.

17. (P.O. #6b)

- a. Have students list the possible causes of loss of time on a construction project (labor problems, inclement weather, unforeseen construction problems, etc).

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Processes of Construction

SUGGESTED INSTRUCTIONAL TIME: 14 hours

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES,

1. Following instruction, the student will differentiate between and describe the various types of foundation systems that are presently utilized in residential and non-residential construction, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Differentiate the advantages and limitations between at least two different materials used to construct foundations
- b. Explain or perform at least two different types of foundations

2. Following instruction, the student will evaluate and compare the various types of superstructures that are presently incorporated in the construction of residential and non-residential systems, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Describe the various materials which are used for superstructure systems
- b. Compare the similarities and differences between wood, metal, and concrete frame construction

3. Following instruction, the student will classify the function and importance of the various enclosure systems that are an integral component of a superstructure system, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Explain why superstructures should or must be enclosed
- b. Demonstrate how materials are utilized in the fabrication of flooring, wall, roofing, and ceiling enclosure systems
- c. Analyze the functions and application of insulation in enclosure systems

4. Following instruction, the student will appraise the functional importance of the electrical, plumbing, heating/cooling, and communications systems that may be installed in construction projects, with a degree of accuracy and completeness acceptable to the instructor..

In order to do this, the student must be able to:

- a. Explain utility source, delivery methods, and application within construction projects
- b. Indicate the relative importance of the various systems under varying conditions or circumstances

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Processes of Construction

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)
 - a. Have students perform a concrete slump test, according to ASTM procedures.
 - b. Have students mix and pour concrete into a mold for piers.
2. (P.O. #1b)
 - a. Students might build two models of a residential building, one employing an all-weather wood foundation and the other a foundation of poured concrete. Differences between the two techniques should become evident as the students progress.
 - b. Color slides, taken by the instructor, of a construction site employing different foundation types could be shown to the class.
 - c. Have students write a report on block bonding materials other than mortar.
 - d. One team of students may set forms and pour a small concrete section of foundation wall while another team builds a small section of a cement block foundation wall.
3. (P.O. #2a)
 - a. Have students identify where specific superstructure materials (wood, metal, concrete) might be used best in construction projects.
 - b. Have students select the proper floor joists from a floor joist chart for a particular application.
 - c. Students should identify structures in their community as to type of superstructure system used.
4. (P.O. #2b)
 - a. Using a heat source and surface thermometer, have students compare the conduction qualities of wood, metal, and concrete.
 - b. Have students compare the advantages and limitations of wood, metal, and concrete as a construction material, through the use of a chart, table, or graph.
5. (P.O. #3a)
 - a. Through the use of a scale model house, students should enclose the superstructure with various materials.
6. (P.O. #3b)
 - a. Have students calculate the number of squares of shingles needed to shingle a certain size roof, and have them apply the shingles.
 - b. Students should enclose a framed wall section with sheathing, vapor barrier, siding, shingles, and wallboard.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Processes of Construction

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

7. (P.O. #3a)
 - a. Have students determine the most appropriate R-value for a selected residential building project, and have them explain how the insulation should be installed (type and application technique).
 - b. Have students report on ways they might add insulation to their homes to make them more efficient.
 - c. Have students place different types of insulation material in various sections of a framed wall section.
 - d. Each student should calculate the R-values of different thicknesses of the various available insulation. The student will then determine the BTU loss at various temperatures and determine which insulation material is best under various conditions.

8. (P.O. #4a)
 - a. Have students add utility systems to a model home. The voltage could be less than 120 volts, and the other utilities could be on a small scale.
 - b. Have students wire several wall switches, receptacles, and lights.
 - c. Have students follow a plumbing layout plan and solder the copper tubing, elbows, and tees.

9. (P.O. #4b)
 - a. Arrange a field trip within the school itself to analyze utilities.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Outputs of Construction

SUGGESTED INSTRUCTIONAL TIME: 1 hour

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will describe site completion and maintenance activities that must be accomplished on a construction project, with a degree of accuracy acceptable to the instructor.

In order to do this, the student will be able to:

- a. List the final tasks for site completion
 - b. Explain the significance of preventative maintenance
2. Following appropriate instruction, the student will interpret the environmental, economic, societal, and personal impacts connected with construction projects, to the satisfaction of the instructor.

In order to do this, the student must be able to:

- a. Explain the possible effects that a construction project may have upon the environment
 - b. Determine the economic impacts that a construction project may have on the economy
 - c. Describe some of the societal impacts that would occur due to a construction project
 - d. Analyze the effects that a construction project may have upon an individual and/or community
3. The student will substantiate that time is a necessary resource to the construction process and that its quantity must be apportioned and managed to achieve an efficient and profitable construction project, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this, the student must be able to:

- a. Analyze the amount of time available for a construction project
- b. Establish goals and objectives as related to time and organize the process to be successful and profitable.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Outputs of Construction

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)
 - a. Have students write a report on what could be done to improve the landscaping of a particular home, school, or public building.
 - b. When the student construction project is completed, require students to remove all debris, return tools to their proper locations, and do general clean-up of all areas of work in the laboratory.

2. (P.O. #1b)
 - a. Have students go through their own home and make a list of all the things that are broken or that need maintenance attention.
 - b. The instructor may take pictures of a rundown house. (It would be wise to go to a distant community to take these pictures.) Have students identify the effects of poor maintenance over the course of time.
 - c. Have students write a maintenance plan for the next twenty years that would prevent deterioration of their homes.
 - d. Have students write suggestions to reduce home maintenance costs.
 - e. Have students keep a log of home repairs made by their parents or outside repairmen, the cost, and why the repairs were needed.

3. (P.O. #2a)
 - a. Students may pick a major construction project occurring in their specific area (like a highrise, power plant, etc.) and write a short essay on the possible environmental effects.
 - b. Have students identify where the waste materials are disposed from the industrial arts/technology laboratory in which they are working.
 - c. Identify environmental impacts on a diagram, such as a future wheel, which shows the reactive effects of a construction project.
 - d. Students should prepare an environmental impact statement for the location of their home. It should consider the effects on groundwater, and atmospheric pollution, traffic patterns, and wildlife.

4. (P.O. #2b)
 - a. Have students find a friend, relative, or acquaintance who has just bought his/her first home. Have the student interview that person, with specific questions given by the instructor and have the answers submitted as homework.
 - b. Discuss literature available from banks, chambers of commerce, etc. Inquire about financing and the economic impact that a major construction project might have on the local, state or national economy.
 - c. Students should become familiar with the effect of a mortgage loan, owner equity, local tax rates, tax deductions, and insurance costs on the personal finances of an individual.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Outputs of Construction

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

5. (P.O. #2c)
 - a. Have the students review magazines and find articles that relate to the improvement of society because of the construction process. Articles such as urban renewal, restoring historic structures, etc.
 - b. Have the students brainstorm what the home of the future might be like.
6. (P.O. #2d)
 - a. Have students identify a large, local construction project and debate on the effects, other than environmental and economic, that it will have on the lives of those that reside in the community.
 - b. The mayor of the town may be consulted to explain the possible effects that a construction project may have upon the individual and/or community.
 - c. A computer simulation program can be written to analyze various factors that concern the economic effects of a construction project. The program may analyze the variables and make predictions about possible economic effects on the individual and/or community.
7. (P.O. #3a)
 - a. Have students evaluate their construction project to determine ways in which time might have been more efficiently spent.
 - b. Discuss prefabricated vs. stick construction for example; prebuilt roof trusses vs. cut on site rafters. Prehung doors vs. cutting parts and assembling on site. Prebuilt fireplaces vs. masonry fireplaces.
 - c. The student construction company should organize the work and the workers to complete the project in an efficient and profitable manner.
8. (P.O. #3b)

As part of the pre-production planning, have students establish goals and objectives as related to time for their construction activity.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Control of Construction

SUGGESTED INSTRUCTIONAL TIME: 3 hours

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will identify the reasons for continually controlling the resources used in construction, with a degree of understanding acceptable to the instructor.

In order to do this, the student will be able to:

- a. Utilize quality control techniques throughout the building of a construction project
 - b. Increase the profitability of a construction project
2. Following instruction, the student will outline how resources are controlled in a construction system, with a degree of accuracy and completeness acceptable to the instructor.

In order to do this the student must be able to:

- a. Develop monitoring techniques for use during the construction project
- b. Use comparison techniques to check recent construction work against existing plans
- c. Adjust the construction process to compensate for problems that are causing inferior quality

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P.O. #1a)

- a. Have each student conduct quality-assurance inspections during the construction process.
- b. During the construction process, students should be expected to consult the working drawings to determine if materials and construction techniques are correct and as specified in the plans.
- c. Use an illustrated home buyers guide to show the difference between the cost of a high quality home and a home with less quality.

2. (P.O. #1b)

Chart the control of resources in construction and relate to profit and loss.

3. (P.O. #2a)

- a. Have students use a simple monitoring device, such as a level, plumb bob, tape measure, etc.
- b. Have the students develop appropriate monitoring techniques during the class construction project.

COURSE: PRODUCTION SYSTEMS
MODULE: BASIC SYSTEMS OF CONSTRUCTION
TOPIC: Control of Construction

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

4. (P.O. #2b)

Have a designated student frequently check and compare the construction progress against the plans.

5. (P.O. #2c)

Have one student keep a list of all the adjustments that had to be made during the construction project. As quality control officer, this student could make reports to the class.

COURSE: PRODUCTION SYSTEMS

SUGGESTIONS FOR STUDENTS WITH SPECIAL NEEDS

Students who are educationally handicapped and appropriately mainstreamed should be exposed to all of the concepts involved in this course. The success of these students may depend, however, on how the information is presented. Different teaching approaches are often the key. Below are some suggestions for assisting students with handicapping conditions to benefit from the instruction provided through the modules and to demonstrate their knowledge and skills in relation to the Performance Objectives and Supporting Competencies contained in the course outline.

1. Provide students with an outline of key concepts included in each of the major topics covered. This can serve as a study guide for the student during the course.
2. Allow students to tape record key informational lectures to use in conjunction with written notes for studying course material.
3. For some students, worksheets and other written material may need to be simplified and organized so as to present concepts in a more gradual manner.
4. Written directions and instruction for class work may be helpful for some students in addition to those provided verbally.
5. Some students can benefit from maintaining a notebook which is organized sequentially and contains key information necessary to achieve the course competencies.
6. Have student observe another student performing a particular task and record the various steps involved. The student can then use this information as a guide when attempting a similar task.

MODULE: BASIC SYSTEMS OF CONSTRUCTION

RESOURCES

PRINT

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MODULE: BASIC SYSTEMS OF CONSTRUCTION

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Professional Builder Magazine. Cahners Publishing Company, 270 St. Paul Street, Denver, CO 80206.

Schmidt, J.L., W.H. Lewis, & H.B. Olin. Construction Principals, Materials and Methods. Chicago, IL: American Savings and Loan Association Press, 1970.

Sheldon, R. Opportunities in Carpentry. Lincolnwood, IL: National Textbook Company, 1981.

Smith, R.C. Materials of Construction. New York: McGraw-Hill Book Company, 1973.

Sumichrast, M. Opportunities in Building Construction Trades. Lincolnwood, IL: National Textbook Company, 1982.

Wagner, W.H. Modern Carpentry. South Holland, IL: Goodheart-Wilcox Company, Inc., 1983.

Walker, L. American Shelter. Woodstock, NY: The Overlook Press, 1981.

FILMS

"The Foundation" - 30 minutes

"The Wood Shell" - 30 minutes

Available from:

Circle Oak Productions, Inc.
260 Katanah Avenue
Katanah, NY 10536

FILMSTRIPS

A complete selection available from:

Glencoe Publishing Co.
17337 Ventura Boulevard
Encino, CA 91316

A complete selection of sound filmstrips on residential construction available from:

McKnight Publishing Company
P.O. Box 2854
Bloomington, IL 61701

Bennett & McKnight
c/o Glencoe Publishing Co.
17337 Venturea Boulevard
Encino, CA 91316

MODULE: BASIC SYSTEMS OF CONSTRUCTION

FILMSTRIPS, continued

A complete selection of filmstrips from all phases of residential construction available from:

Prentice-Hall Media
Serv Code AJ
150 White Plains Road
Tarrytown, NY 10591

PUBLIC TELEVISION

Consult local listings for:

"This Old House"
"The Old Houseworks"
"Housewarming With Charlie Wing"

COMPUTER SOFTWARE (architectural drafting, carpentry, and masonry)

Goodheart - Wilcox Company, Inc.
123 West Taft Drive
South Holland, IL 60473

CURRENT RESEARCH LITERATURE

American Plywood Association
P.O. Box 11770
Tacoma, WA 98411
(206) 565-6600

Small Homes Council - Building Research Council
University of Illinois at Urbana-Champaign
One East Saint Mary's Road
Champaign, IL 61820

TECHNOLOGY LEARNING ACTIVITIES (TLAs)

One of the more unique aspects of the Technology Education Program has been the creation of Technology Learning Activities, or TLAs. TLAs will provide teachers with laboratory activities which can be used to enable students to meet the performance objectives and to communicate the major concepts identified in each of the curriculum modules. In addition to being used by teachers as actual laboratory activities, TLAs will serve as models for Technology teachers who are encouraged to develop their own.

This Technology Learning Activity has been prepared as a model for teachers to follow in developing additional laboratory activities.

Major concepts and performance objectives identified within the syllabus are accomplished through activity outlined on the page entitled "Procedure for this Activity."

Key elements of the Technology Learning Activities are the problem-solving approach incorporated within the activity, and the link between Technology and other disciplines established by the ten identified constants.

PRODUCTION SYSTEMS H.S. TECHNOLOGY LEARNING ACTIVITY

TLA TITLE: Introduction to Building 7 ft X 10 ft Storage Shed

MODULE: Construction Systems

TOPIC: Inputs, Resources, Processes, Outputs and Control TIME IN DAYS: 25

SKILLS, KNOWLEDGE AND BEHAVIORS

1. Identify the universal systems model as it relates to construction technology
2. Assess the importance of construction technology to society in the manner that it provides shelter, roadways, dams, and other constructed projects for man
3. Delineate the necessary resources for the process of construction technology
4. Analyze and demonstrate various processes of construction technology
5. Evaluate the projects and impacts of a construction enterprise as to their quality and effect on society and the environment
6. Utilize mathematical and scientific principles in the solving of practical manufacturing problems within the laboratory setting
7. Demonstrate problem-solving and analytical thinking skills in solutions to simple engineering problems within the context of laboratory activities.

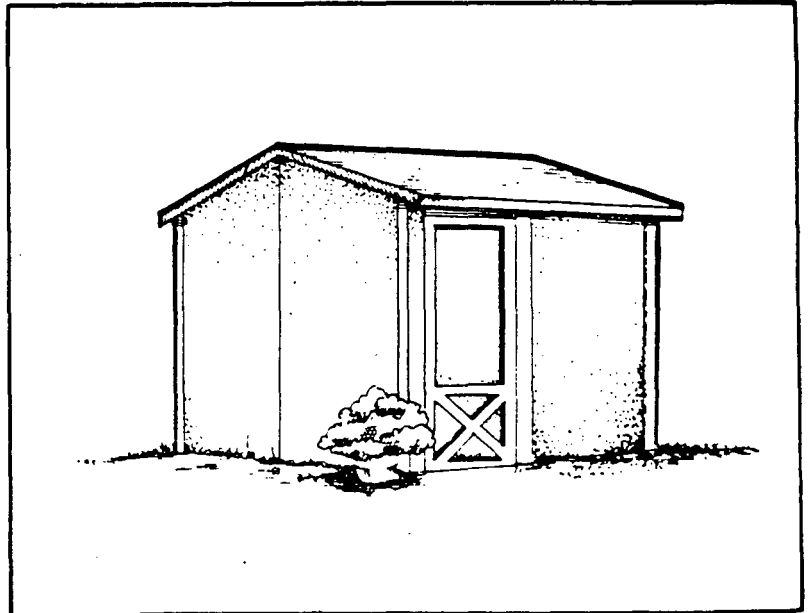
OVERVIEW OF TLA

In this TLA the students, through the construction of a small storage shed, will become aware of the various systems and subsystems that encompass framing out wall sections, trim, door, and window systems. The universal systems model will be examined as to how it relates to the system command input, expected impacts, resources, processes, outputs, and controls that are an integral part in the fabrication of the shed. In order to complete this TLA, the class will be divided into crews for the fabrication and erection of the structure.

EQUIPMENT AND SUPPLIES

Basic woodworking supplies and equipment:

- 2 X 4's
- Aspenite
- Roofing material
- Plywood
- Portable circular saw
- Chalk line
- Power stapler
- Tape rules
- See plans for additional supplies



=====PERFORMANCE OBJECTIVES=====

See syllabus for performance objectives related to the following topics:

Abbreviation

Inputs	-	INP
Resources	-	RES
Processes	-	PRO
Outputs	-	OUT
Control	-	CON

PROCEDURE FOR THIS ACTIVITY

Time Days	POs	Teacher Activity	POs	Student Activity
1		o Introduce the activity to the class.	Inp 1	o For homework, students will design their own variations of the plan that was given out.
		o Pass out floor and wall section plans to class.		
1	Inp 1	o Discuss alternative plans as to placement of doors, windows, and roof design.	Inp 2	o Identify economic, environmental impacts of construction
		o Describe impacts of construction		
1	Inp 2	o Collect student plans.	Inp 1	o Critique each plan that was handed in. Relate the importance to high quality and well-detailed plans to the construction process, especially the system command inputs of the desired project and expected impacts.
	Inp 1	o Examine each plan and lead discussion of positive and negative aspects of the plan.		
1		o Lead discussion on what is needed for the system command inputs of the desired project and expected impacts.		
	Inp 1			
1	Res 1	o Divide class into construction crews in according to skills and satisfaction with the planned structure.	Res 1	o Select plans and become familiar with other crew members.
	Res 2	o Begin to discuss safety in the class and on a construction job.	Res 2	o Take notes on safety.
1	Res 3&4	o Demonstrate portable circular saw and chalk line. Include safety lesson in demonstration.	Res 3&4	o Observe lesson and take notes.
		o Administer safety test.		o Take safety test.
1	Res 4	o Demonstrate how to use the claw hammer properly.	Res 4	o Observe lesson.
		o Demonstrate various nailing techniques used in frame construction.		o Take turns in practice session in which nailing techniques and use of portable circular saw are perfected.
15	Res 3&4	o Supervise, instruct crews, and monitor progress of each crew.	Res 3	o Crews begin to start construction of their shed. Work from selected plans to cut lumber and nail together to form shell of the shed.
1	Res 4	o Demonstrate use of the air stapler.		o Observe lesson and take notes.
		o Continue to monitor crew progress.		o Continue construction of shed.
	Res 3&4	o Demonstrate how to install doors, windows, and trim.	Res 3&4	o Continue to work on shed. Begin to install doors, windows, and trim.

Total Days

June 1986

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PROCEDURE FOR THIS ACTIVITY

Time Days	Teacher Activity	POs	Student Activity
1	o Continue to monitor activities of each crew.		o Complete this phase of the construction of the shed.
1	o Lead discussion on the universal systems model. Have students identify the resources that were needed for this phase of the construction project, the outputs that were realized, and the reasons and methods of control that were utilized during the construction period.	All POs Summary	o Relate their construction experience to the universal systems model, especially the elements of resources, processes, outputs, and control.
1	o Administer exam that deals with acquired skills and knowledge of the construction process and knowledge of the universal systems model as it specifically pertains to this phase of construction.		o Take exam.

CONSTANTS FOR INFUSION INTO THE TLA

- =====
- 5) COMMUNICATION SKILLS - Technical vocabulary development; following written and oral procedures

 - 6) SAFETY AND HEALTH - Proper safety procedures for handling of tools, equipment, and materials as they pertain to the specific activities involved

 - 7) PSYCHOMOTOR SKILLS - Development or improvement of eye-hand coordination and manual dexterity

 - 8) CAREER RELATED - Careers/occupations in construction industry (residential architecture, carpentry, masonry, supervisory positions); careers in sales (lumber yards) and forestry research

 - 9) CREATIVE PROBLEM SOLVING - Opportunities for creative problem solving will be provided by this TLA including: identification and definition of a problem, goal and criteria setting, generation of alternative solutions and recognition of limitations, optimization, testing, and evaluation.

 - 10) TRANSFER OF LEARNING - Application of systems approach to the understanding of more complex construction systems

=====BACKGROUND REFERENCES AND RESOURCES=====

See syllabus for books, magazines, and audiovisual resources.

EVALUATION

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The teacher should develop a two component evaluation system to determine if the student understands: (1) performance objectives and (2) skills, attitudes, knowledge & safety related to the specific lab activity.

(1) EVALUATION OF PERFORMANCE OBJECTIVES (Examples)

1. Have students analyze finished product for conformance to input of the provided plans. Analyze how the universal systems model provides feedback, control, and adjustment mechanisms so that the final project relates to the original plans.
2. Have students analyze the seven resources to the construction project and determine which was most important and why. Which was the least important. Why?

(2) EVALUATION OF SKILLS, ATTITUDES, KNOWLEDGE & SAFETY (Examples)

1. Which is the proper size of construction lumber for the floor joists in the constructed shed? A) 2 x 4, B) 2 x 6, C) 2 x 8, D) 2 x 10
2. When using the portable circular saw, is it ever proper to remove the blade guard? Explain.
3. Placing nails at an angle to the studs is known as:
A) fingernailing, B) straight nailing, C) toenailing,
D) frame nailing.

APPENDIX:

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