TECHNOLOGY EDUCATION

Grades 9-12

PROGRAM/COURSE Production Research and Development

Draft for field test and orientation use during the 1985-86 school year.

NOTE: Reprint for use during the 1986-87 school year.

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INSTRUCTIONS (NOTES)

PHASE - Development

ELEMENT - Technology

MODULE NO. Production Research and Development

TOPICS: Resources for Research and Development
Processes of Research and Development
Outputs of Research and Development

PREREQUISITES - None

prepared by

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TOTAL TEACHING TIME - 60 hours (approx. 20 weeks)

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INSTRUCTIONS (NOTES)

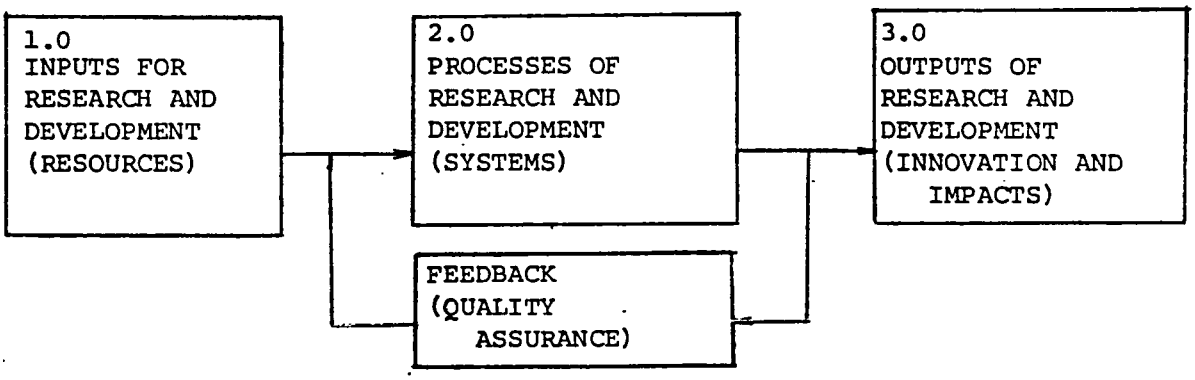
MODULE: Production Research and Development

OVERVIEW OF THE MODULE

Goal:

The student will be able to understand the significance and procedures of the research and development process when used in the production of material goods, the improvement of industrial processes, and the acquisition of new knowledge.

RESEARCH AND DEVELOPMENT SYSTEMS MODEL



Description:

Manufacturing and construction activities of humans are heavily reliant upon the research and development process to continually improve the production quality for consumers. Innovative inventions that have benefited humankind such as the telephone, the automobile, hospital equipment, appliances, and many, many, more are the result of production research and development. Newer, more efficient, and more cost-effective variations are continually being presented. One only has to look at the development of the pocket calculator to see a ready example of the improvement of a product due to this process. The betterment in the quality of life, health, leisure time, and safety is the direct result of the research and development process.

This module is designed to involve the students with research and development in a realistic, hands-on fashion. Informative and demonstrative lessons will be offered to show the key knowledge and skills needed to complete a development project. Brainstorming, library research skills, problem-solving, modeling, prototypes, and many other skills will be employed in this module.

Skills, knowledges, behaviors to be developed:

The student will be able to:

1. identify the procedures used in the research and development of products, materials, processes, and information.

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2. utilize mathematical and scientific principles in the solving of problems related to the research and development process.
3. manipulate laboratory tools, equipment, and materials in the development of laboratory activities related to research and development.
4. demonstrate the knowledge of how products, materials, processes, and information are conceived and improved to better the human condition.
5. demonstrate problem-solving and analytical thinking skills in solutions to simple engineering problems within the context of laboratory activities emulating the research and development process.

CONTENT OUTLINE

Production Research and Development

1.0 Inputs (Resources)

- 1.1 History of Research and Development
  - 1.1.1 Accidental/intuitive discovery
  - 1.1.2 Trial and error
  - 1.1.3 Organized R&D programs
- 1.2 Personnel
  - 1.2.1 Job classifications and opportunities
  - 1.2.2 Career preparation
  - 1.2.3 Organizational structure
- 1.3 Economics
  - 1.3.1 Budgeting
  - 1.3.2 Controlling
- 1.4 Materials and Supplies
  - 1.4.1 Availability
  - 1.4.2 Properties (mechanical, physical, etc.)
- 1.5 Technical Ability
  - 1.5.1 Knowledge
  - 1.5.2 Experience
- 1.6 Facility
  - 1.6.1 Equipment
  - 1.6.2 Location
  - 1.6.3 Size
- 1.7 Safety
  - 1.7.1 Standards
  - 1.7.2 Programs

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INSTRUCTIONS (NOTES)

2.0 Processes (Systems of R&D) 3

- 2.1 Research ("to find new knowledge")
  - 2.1.1 Identify problem
  - 2.1.2 Review information
  - 2.1.3 Plan for research
  - 2.1.4 Collect data
  - 2.1.5 Analyze data
  - 2.1.6 Develop conclusions and recommendations
- 2.2 Development ("putting knowledge to work solving problems")
  - 2.2.1 Designing
    - 2.2.1.1 Ideation/problem solving
    - 2.2.1.2 Sketches/drawings
    - 2.2.1.3 Financial feasibility
    - 2.2.1.4 Models/prototypes
    - 2.2.1.5 Re-design
  - 2.2.2 Engineering
    - 2.2.2.1 Flowcharting
    - 2.2.2.2 Procure equipment
    - 2.2.2.3 Tooling
    - 2.2.2.4 Utilize personnel
    - 2.2.2.5 Procure materials
    - 2.2.2.6 Trial run
    - 2.2.2.7 De-bug

3.0 Outputs of Research and Development

- 3.1 Innovation
  - 3.1.1 Products
  - 3.1.2 Processes
  - 3.1.3 Information
- 3.2 Impacts
  - 3.2.1 Environmental
  - 3.2.2 Economic
  - 3.2.3 Personal

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MODULE: Production Research and Development

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES*

1.1 The student will be able to analyze the differences among the research and development processes of accidential/intuitive discovery, trial and error, and organized R&D programs, given examples of the processes as they occurred throughout history. To accomplish this performance objective, the student will:

1.1.1 compare accidential/intuitive discoveries to other processes of research and development.

1.1.2 contrast trial and error to other processes of R&D.

1.1.3 appraise organized R&D programs as compared to other processes of R&D.

1.2 The student will be able to analyze the preparation and utilization of personnel as a resource for production research and development. To accomplish this performance objective, the student will:

1.2.1 identify different job classifications and opportunities common to research and development departments.

1.2.2 describe various types of career preparation required for jobs in research and development.

1.2.3 compare different organizational structures used in research and development departments.

1.3 The student will be able to assess a relationship between the need for and availability of capital and finances to the development and completion of manufacturing products, and assess the importance of economic resources to the operation of a research and development enterprise. To accomplish this performance objective, the student will:

1.3.1 identify budgeting procedures common to research and development activity.

1.3.2 outline economic controlling procedures common to research and development enterprises.

1.4 The student will be able to comprehend relationships between material properties and applications as well as analyze how materials and supplies are derived from natural resources, converted into industrial materials and procurred for a manufacturing activity, and analyze how materials and supplies are used as resources for research and development activity. To accomplish this performance objective, the student will:

*See "note" on page 7.

1.4.1 identify the availability of materials and supplies.

1.4.2 demonstrate the relationships between material properties and suitable use.

1.5 The student will be able to identify and perform applied procedures of research, development and manufacturing given a problem to solve within a laboratory setting, and identify the significance of technical ability and development activity, as an input to research given appropriate laboratory experiences and informative lessons. To accomplish this performance objective, the student will:

1.5.1 define knowledge as a necessary ingredient to successful research and development.

1.5.2 explain the role of appropriate experience to successful research and development.

1.6 The student will be able to analyze factors that influence the equipment location, and size, for an efficient research and development facility, given informative lessons by the instructor. To accomplish this performance objective, the student will:

1.6.1 demonstrate a knowledge of the specialized equipment that might be found in a research and development facility.

1.6.2 examine factors that influence the location of a research and development facility.

1.6.3 study size requirements for various research and development facilities.

1.7 The student will be able to demonstrate a knowledge of safety standards and show involvement with a safety program. The standards and the program are to be developed by the instructor on an individual basis, giving consideration to recognized federal, state and local standards. To accomplish this performance objective, the student will:

1.7.1 perform to the set standards for safety on a daily basis, 100% of the time, while working in a laboratory setting.

1.7.2 participate in the safety program on a daily basis, while working in a laboratory setting.

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INSTRUCTIONS (NOTES)

2.1 The student will be able to identify the process of research ("finding new knowledge") as a significant system in the operation of a production company and utilize the process to the extent possible while developing a laboratory activity, given appropriate informative lessons and laboratory instruction. To accomplish this performance objective, the student will:

2.1.1 demonstrate an understanding for clear identification of the problem, before research continues.

2.1.2 survey available resources to review existing information regarding the identified problem.

2.1.3 use the various procedures that might be incorporated in research planning.

2.1.4 formulate techniques that can be utilized in the collection of data.

2.1.5 demonstrate the ability to collate and analyze the collected data.

2.1.6 develop conclusions and recommendations based upon the analysis of the collected data, as it relates to the original problem.

2.2 The student will be able to utilize the processes of development ("putting knowledge to work solving problems") as it is used in production companies given appropriate informational lessons and laboratory instruction. To accomplish this performance objective, the student will:

2.2.1 design a potential product or process for production using ideation /problem-solving, sketching /drawing, financial analysis, modeling /prototyping, and re-designing.

2.2.2 engineer a product or process for a trial production run, utilizing flow-charting, procurement of equipment, tooling, personnel, material procurement, trial run, and de-bugging.

3.1 The student will be able to analyze how innovation, through research and development has effected products, processes and information, given appropriate instruction. To accomplish this performance objective, the student will:

3.1.1 identify how products are improved through research and development.

3.1.2 describe how processes are made more efficient through development.

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3.1.3 explain the significance of research to the creation of new information.

3.2 The student will be able to evaluate how the impacts of research and development have influenced environmental, economic and personal aspects of society. To accomplish this performance objective, the student will:

3.2.1 explain the possible effects that research and development may have upon the environment.

3.2.2 determine the economic impacts that research and development may have on a company.

3.2.3 analyze the influence that research and development may have upon the individual and/or community.

*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.

GENERAL INSTRUCTIONAL STRATEGIES

The writers of this curriculum offer specific instructional strategies in the section to follow but it can appear somewhat fragmented without a description of the general strategy for this 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 have the students research and develop a product, or possibly a process, and take that development to a trial-run stage. Jigs and fixtures would most likely be developed. The students would not run many products (if products and not a process was chosen), but they would get to see a few trial pieces produced.

The instructor might choose to dovetail this module with the one entitled "Production: Manufacturing". The students in the "Production Research and Development" module (20 weeks) could develop possible production runs for the "Production: Manufacturing" module (10 weeks). Certainly, in 10 weeks the students in the latter course could not have the time to fully develop a product, so the two courses could be used by the instructor as a combination, in terms of teacher preparation.

Some other general strategies would include:

1. Field trips. If there is an appropriate research and development facility in the area, many objectives could be covered by a field trip.

2. Guest speaker. If field trips are not feasible, it is highly recommended that an attempt be made to locate a suitable guest speaker. Many of the inputs to R&D could be covered with the use of a guest speaker.

3. 35mm slides. At the very least, if field trips and guest speakers are not probable, the instructor should visit an R&D facility and take slides.

4. Written responses from the students. Some of the objectives might best be covered by written responses by the students. It is recommended that these be assigned as homework so the maximum amount of laboratory time can be spent on research and development activities.

5. Research vs. development. It is defined in this module that research is the generation of new knowledge and development is putting that knowledge to work. It is recognized that not every situation will be able to have every student involved in both. It is further recognized that some of the procedures used in research are often used in development as well. It is left to the discretion of the instructor to cover these two concepts as appropriate for the individual situation and the individual problems produced by the students.

SUGGESTED SPECIFIC INSTRUCTIONAL STRATEGIES

The instructional strategies that follow are correlated with the content outline and the supporting competencies by the point-numeric coding system. Several strategies are offered for each supporting competency, and they are designated by the letters a,b,c, etc. The reader is encouraged to turn back to the Performance Objectives/Supporting Competencies beginning on page 4, and read the appropriate entry before reading the suggested instructional strategy. This will provide a more complete view of the nature and direction required by the instructor to complete the stated objectives.

The intent of offering so many strategies is to allow the instructor a choice of methods to complete the objective. Certainly, not every strategy could be employed in any one offering of this module.

1.1.1.a. The students could identify one example of accidental/intuitive discovery as a homework assignment. The instructor could then list these on the board.

b. The instructor will provide examples of accidental or intuitive discoveries to the class followed by a discussion of how those specific discoveries have affected life today.

c. The students will view selected film from the "Connections" series (James Burke) that emulate processes that were discovered.

d. Recreate the accidental discovery of the vulcanization of natural rubber by Charles Goodyear by applying heat to a natural latex rubber.

1.1.2.a. Have one student, in front of the class, use the trial and error method of connecting a bell circuit. Have the batteries and bell hidden in nondescript boxes so the student cannot tell which is which.

b. Provide the students with specifically designed experiments/activities which require trial and error testing to determine the most suitable situation. (glue testing, wood joint stress test, etc.)

c. Provide students with some emulsifiable oil ("Murphy's" oil soap) and tell them to make a D & L type hand cleaner, using hot water whipped into the mixture.

1.1.3.a. The instructor could take the students to a local company that has an organized research and development department.

b. Identify products available today and determine which method of R&D was used in their development. Observe the number of products occurring under each category and discuss the quality and societal impacts of each item.

c. A guest speaker from a R&D facility will give a presentation explaining how his company utilizes an organized process to develop new processes, products, or knowledge.

d. Make a bulletin board collection of drawings, photos, or names of many inventions that came from the organized efforts of Thomas Edison at Menlo Park.

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INSTRUCTIONS (NOTES) — ALIGN FIRST CHARACTER UNDER THIS ARROW — 6 LINES INCH

1.2.1.a. Have the students form a research and development department within the school. Each student would fill a common job classification. 10

b. Have students use the "Dictionary of Occupational Titles" as a resource to make a bulletin board and list as many jobs related to R&D as they can find on cards to be posted.

c. Design a "Line Chart" for a classroom simulation of an R&D department, listing jobs and writing a description of the job titles the students identify.

1.2.2.a. Have each student, for homework, research one job classification from the "Dictionary of Occupational Titles" and describe to the class the preparation required to obtain that particular job.

b. The students will indicate which job classifications require a high school level of preparation, a college level of education, and a graduate level of preparation.

c. Have a member of the guidance staff talk to the class about the ways of gaining preparation for work in the R&D field.

d. Bring in a counselor from a local college placement office or a R&D department to provide information on career preparation.

1.2.3.a. Using a chalkboard, have the students brainstorm possible organizational structures of research and development departments that might serve a small, medium, and large company.

b. Have the students write to one or more industries for materials which outline the staff organization.

c. Take a field trip to a R&D facility. and have a personnel representative explain different organizational structures.

1.3.1.a. In developing a class R&D project the students will prepare a budget which will outline expenditures for development, materials and fabrication of the project on a trial run basis.

b. A fiscal officer from a local company could give a lecture explaining the various factors that control the amount of financial resources that are allocated to a R&D department.

1.3.2.a. The students could develop a system to authorize expenditures for the classroom R&D enterprise.

b. Discuss the relationship between profitability and the allocation to a R&D complex.

c. Given a class R&D activity, the students will make decisions on economic or fiscal controls that will limit the scope and size of the student project.

d. Have the students make a wall chart showing the break-even point.

1.4.1.a. Have the students make up a material and supply list for a R&D project that they would like to propose and develop.

b. Divide the class into pairs or small groups and assign to each group the task of locating a specified material of acceptable quality at the lowest cost.

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INSTRUCTIONS (NOTES)

1.6.2.a. Have the students discuss why it might be important to have a R&D facility close to the production process. Have them identify instances where it not need be near the production process. 12

b. Identify any specific R&D facility and determine those reasons for its location by examining the available resources in the area. (transportation, information sources, raw materials, manpower, etc.)

c. The students will brainstorm the various factors that influence the location of a R&D facility, such as proximity to universities, markets, production processes, and others.

d. A guest lecturer could explain what factors influenced his company to operate at its present location.

1.6.3.a. Have the students identify the approximate size of a facility when given an example of a typical company.

b. Distribute a sample statistics sheet to the students containing the work force number, equipment specifications, and type of operation. Have them determine physical lab requirements based on the given information.

c. Give the students various examples of products or processes to be researched and developed. The students will list whether the school laboratory facilities are appropriate in size for the given product.

d. Given various examples of products to be developed, the students will offer suggestions and discuss what size facilities are needed for each product.

e. Design a compact R&D work lab in the corner of your basement/garage. Speculate on the products you could design.

1.7.1.a. The instructor will be the prime source of role modeling when it comes to the safe operation of tools and equipment.

b. The instructor will provide demonstrations on the care and use of tools and equipment and set the tone for a safe working atmosphere.

c. The students will demonstrate their knowledge and preliminary skill in the operation of equipment and hand tools through a series of safety quizzes and practical tests under the instructor's direct supervision.

d. Give copies of printed safety procedures to the students and discuss them. Supplement this with periodic audiovisual presentations which are widely available. As an activity, the teacher and students may work together to develop a comprehensive set of rules for the R&D activity at hand. Make sure that built-in incentives are included to insure 100% compliance of the rules.

e. Given various safety rules and specifications, the students will operate tools, machines, and equipment within the given safety guidelines.

1.7.2.a. The students could conduct monthly safety inspections, where the instructor "hides" infractions for the students to find.

b. Provide a blank chart for listing those safety procedures which are necessary for specific operations encountered during the course of the R&D experience.

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INSTRUCTIONS (NOTES)

1.7.2.c. To encourage safe working practices, grade points will be given to those students who follow safety rules and procedures 100% of the time. 13

d. Make a list of potential hazards in the lab and recommend methods of eliminating or making "as safe as possible."

e. Have a "safety professional" talk to the class about the necessity of industrial safety programs and how well they work.

2.1.1.a. Have the students submit a contract that clearly identifies a problem that needs to be solved.

b. Employ the brainstorming technique to uncover a list of potential problems/ideas that could be investigated.

2.1.2.a. Meet with each student individually to discuss possible resources for the collection of information to solve a problem.

b. Teams of students will research textbooks, periodicals, newspapers, and other available materials to gather as much background material and information that relates to the identified problems.

c. Review possible information sources with class. Have students make a priority list of contacts they will make to uncover information on the problem.

2.1.3.a. During meetings with the instructor, the student will identify a research plan to bring the problem to a final conclusion.

b. As a class project, outline a procedural plan for the research process using practices found in reference material. Delegate individuals to carry out identified parts of the plan.

c. Flowchart the "research process" indicating the key stages and time line for following a problem through to a "conclusion stage".

2.1.4.a. During meetings with students, decide how data on a problem can be collected.

b. Using a basic research textbook, the teacher could review common methods of data collection and then choose or modify a method for the activity at hand.

c. The students will brainstorm the various techniques that are utilized by research and development facilities to collect data, such as market research questionnaires, performance tests, aptitude tests, etc.

d. Student teams will be assigned one identified product and will conduct a consumer survey among the students in the school to determine opinions and criticisms of the identified product.

e. In a simulation problem, use a team approach for collecting data on stated problem. Present and compare teams' efforts in class and discuss procedures.

2.1.5.a. Have the students collate and analyze the collected data and submit a report for the instructor's review.

b. Distribute the collected data from their activity to the class. As an assignment, each student should organize the available data in a neat legible form and provide written conclusions derived from the data.

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2.1.5.c. Using flip charts students will list in priority order all the positive and negative data that has been collected regarding each identified product. 14

2.1.6.a. Have the students present their conclusions and recommendations to the entire class.

b. In class each student team will draw conclusions about the feasibility of further development of the assigned product. A presentation will be made to the class by each team. The class will then vote and recommend a particular product to be further developed.

c. Write a team report listing the conclusions and recommendations for the specified problem.

2.2.1.1.a. Have the students work individually to find a development project that they would like to see solved by a small group.

b. Engage the class in creativity exercises to demonstrate innovative ideation. The students will then review current video or printed media and select products with perceived problems. Suggestions for improving the products may then be done by brainstorming.

2.2.1.2.a. Each student (or a group) would develop sketches and drawings of their individual development idea.

b. Have each student select a product previously identified and present a graphic solution to describe the class product. A workable number of products suitable for classroom R&D will be chosen and assigned to groups for further development.

c. Make a working drawing of the proposal and develop a bill of materials from the drawing.

d. Make a series of thumbnail sketches showing ideas/possibilities for solving a selected problem/product design.

2.2.1.3.a. Each student (or a group) could submit a financial feasibility statement along with the sketches.

b. Make a cost analysis from the bill of materials by looking up cost of supplies in catalogs. Determine if quantities will lower costs.

2.2.1.4.a. Have groups of three or four work together to select one of the ideas that was expressed individually. A model would be built, and then a working prototype.

b. During a field trip to a R&D facility students could examine models and prototypes and compare them to the final product.

c. Prepare an experimental model and/or prototype.

2.2.1.5.a. Have each group of students redesign where necessary as they work on their group activity.

b. On a field trip to a R&D facility the guide could discuss the reasons why designs were changed from prototypes to the final product.

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INSTRUCTIONS (NOTES)

2.2.2.1.a. Have the class vote on which of several models and prototypes that were developed they would like to see as a class project. The entire class would get involved in the engineering of the production line for this project. Have each student develop a flowchart of the production process. 15

2.2.2.2.a. Assign one group of students to set up the equipment for the trial production run.

2.2.2.3.a. Have another group of students design the necessary tooling for the trial production run.

b. A tool and die maker could address the class to discuss the importance of proper tooling. Jigs and fixtures used in a nearby manufacturing facility could be examined by the class.

2.2.2.4.a. Have one student in charge of personnel utilization and reassignment.

b. Write up a detailed job description/operations card for each station/operation on the product line.

2.2.2.5.a. One or more students could be involved in material procurement, as needed.

b. Develop a master list of needed materials for class inspection. Assign to all students the task of seeking out sources of materials. All findings along with price, quality, etc., will be reported to the group for further investigation.

2.2.2.6.a. Conduct a trial run and produce one product for each member of the class.

b. Do a teaching "walk through" of each production job; with an on-the-spot analysis for safety efficiency, before conducting a trial run of line.

2.2.2.7.a. The class could be involved in a group discussion whenever debugging is required to brainstorm possible solutions.

3.1.1.a. Have the students make a list for homework of ten products that have improved due to research and development.

b. Give a writing assignment to each student in which a critical review is made of the produced product and improvements that could be made if done again.

c. Students will develop a list of products that have been improved over the past ten years.

d. The instructor will identify a product. The students will develop a time line which illustrates the approximate dates of the introduction of the product and subsequent improvements that have been facilitated through research and development.

e. Keep a notebook/bulletin board section for the collection of "new products". Individual reports to class on product innovation of particular interest to student.

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INSTRUCTIONS (NOTES)

3.1.2.a. Have the students make a list of ten processes that have been improved by research and development. 16

b. Each student will identify at least one commonly encountered process resulting from R&D and then report in a 5 minute class demonstration. (Example: how food is prepared at McDonald's, traffic flow patterns, etc.)

c. Students will read newspapers and periodicals to locate articles that illustrate new processes that have been developed as a result of R&D. A synopsis of those articles should be presented to the class.

d. Articles from newspapers or periodicals that illustrate an improved process as a result of R&D could be posted on a "R&D" bulletin board.

3.1.3.a. Have the students develop a list of information that has been generated by research and development.

b. The instructor will bring to the students' attention examples, such as the space program, where new information in a by-product form significantly affects the lives of all.

c. A report shall be completed by each student that illustrates a person in history whose R&D efforts facilitated the development of new knowledge in a particular field.

d. Brainstorm the possible applications of some new "breakthrough knowledge". See announcements in news reports on technology.

3.2.1.a. Have the students write for brochures from companies that explain their position on environmental preservation.

b. Students will clip and post newspaper and magazine articles which highlight both positive and negative interfaces of technology with the environment which are a result of R&D programs.

c. Guest speakers from environmental groups shall be invited to the class to illustrate how local or national research and development projects have either adversely or positively enhanced the environment.

3.2.2.a. The students could ask several companies what economic impact the research and development department has on their operation.

b. Students will regularly read business sections of newspapers and magazines to extract breakthroughs resulting from R&D which have significantly affected a business or industry.

c. Students could write for annual reports from local companies to determine what impact research and development have made on the economic well-being of the company.

d. A guest speaker could present to the class R&D products or processes that have either enhanced, adversely affected, or were dropped as being non-feasible and how each impacted the financial stability of the company.

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INSTRUCTIONS (NOTES)

3.2.3.a. Have the students develop questions on the personal impacts of working in a R&D facility, and conduct an interview with an employee. 17

b. In a general discussion, students will identify tangible results of R&D programs which have affected the lives of everyone.

c. Interview a grandparent or senior citizen and make a comparison of lifestyle of families before the advent of home television.

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Guide to Instructional Strategies Offering Interdisciplinary Correlation

Math and Science

1.1.1.d	1.3.2.a	2.2.1.3.a
1.1.2.a	1.3.2.b	2.2.1.3.b
1.1.2.b	1.3.2.c	
1.3.1.a	1.3.2.d	
1.3.1.b	1.4.2.d	

Technical Communications

	22	34	61	66
1.4.1.c	2.1.5.b	2.2.1.2.d	3.1.3.a	3.2.3.a
1.4.1.d	2.1.6.a	3.1.1.a	3.1.3.c	
1.4.2.a	2.1.6.c	3.1.1.b	3.2.1.a	
1.5.1.d	2.2.1.2.a	3.1.2.c	3.2.2.b	
2.1.1.a	2.2.1.2.c	3.1.2.d	3.2.2.c	

Careers

1.1.3.a	1.2.2.a	1.2.3.b	2.2.1.5.a
1.1.3.b	1.2.2.b	1.2.3.c	2.2.2.3.a
1.2.1.a	1.2.2.c	1.5.1.a	2.2.2.4.a
1.2.1.b	1.2.2.d	1.5.2.a	2.2.2.4.b
1.2.1.c	1.2.3.a	1.5.2.b	3.2.2.d

Human Elements

1.4.1.b	2.2.2.2.a
2.1.2.b	2.2.2.3.a
2.2.1.4.a	

Safety

1.7.1.a	1.7.2.a
1.7.1.b	1.7.2.b
1.7.1.c	1.7.2.c
1.7.1.d	1.7.2.d
1.7.1.e	1.7.2.e

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Resources

Transparencies:

A complete set on American industry available from:

DCA Educational Products
424 Valley Road
Warrington, PA 18976

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
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Film: "American Innovation - Part I The First 200 Years" (technical innovation and its impact on society)

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Indianapolis, IN 46239

Film: "Atomic Revolution in Wood"
Shows how atomic research with wood results in the development of radiated wood which is stronger and more durable than unradiated wood.
Available from:
Energy Research and Development Administration
TIC - Film Library
P.O. Box 62
Oak Ridge, TN 37830

Film: "American Innovation - Part II Facing The Third Century"
A view of science, technology and society in America's 3rd Century.
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Filmstrips:
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Periodicals:
Popular Mechanics. New York: The Hearst Corporation.
Popular Science. Los Angeles, Calif.: Times-Mirror Magazines, Inc.
Science Times: Section C. New York: The New York Times. (Tuesdays)
Technology Review. Cambridge, Mass.: Massachusetts Institite of Technology.
School Shop. Ann Arbor, Mich.: Prakken Publications, Inc. (See monthly article "Technologies Past" by Dennis Karwatka.)

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