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Activities for Materials and Processes Technology

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ACTIVITIES FOR
MATERIALS AND PROCESSES
TECHNOLOGY

A Research Project

Presented to

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Master of Science in Education

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by

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CHAPTER I

INTRODUCTION

Industrial Arts courses for many years have focused on industrial materials. The major purpose of these classes has been to teach the use of tools, equipment, and procedures found in processing materials, with very little consideration given to teaching about the qualities of industrial materials. With many facets of instruction constantly being reviewed and revised, Industrial Arts education was also being examined. A new Industrial Arts program was designed, Materials and Processes Technology, to give the student the opportunity to explore the variety of industrial materials and processes used in industry today.

STATEMENT OF THE PROBLEM

The problem of this study was to establish laboratory and classroom activities that deal particularly with the materials and processes technology area of Industrial Arts. These activities will reinforce instruction and give the student personal experience using the materials and processes of modern industrial technology.

RESEARCH OBJECTIVES

The purpose of this study is to (1) establish acceptable laboratory experiences that will reinforce instruction in the area of materials and processes technology; (2) suggest procedures in conducting laboratory activities and exercises, as well as in individual, group, and class projects; (3) provide additional sources for locating instructional materials, supplies, equipment, and resource information; and (4) develop a list of contacts that might help set up speakers and field trips related to the areas of study in materials and processes technology.

BACKGROUND AND SIGNIFICANCE

In the past, Industrial Arts throughout the United States has been inconsistent in its course offerings. Several programs, including the Maryland Plan, American Industry, and the Industrial Arts Curriculum Project, were developed to provide a curriculum relevant to as many students and technologies throughout the country as possible.

The state of Virginia in recent years has been creating an Industrial Arts program that will provide a series of studies at all educational levels. The program that the Virginia Industrial Service Staff has created is the Industrial Arts Curriculum K-12 (Industrial Arts Competancy Task, 1979, Table 2). It provides for learning reinforcement at the elementary level, orientation and exploration at the junior high school level, and technical and personal enrichment at the high school level.

The two semester course, Materials and Processes Technology, is being incorporated into the high school field of study. This program is designed to provide the student with the opportunity to investigate industrial materials and processes. The software needed for the program should be ready by August of 1980.

The Materials and Processes Technology program is designed to aid the teacher in the development of additional laboratory activities which will focus on the analysis of materials and industrial processes. Thus far, acceptable activities have been established by Dr. James A. Jacobs, technology students at Norfolk State University, and graduate students at Virginia State College and Old Dominion University. These activities include production of diagrams and drawings, project ideas for materials testing, equipment exercises and tests for properties of materials, and experiments dealing with industrial processes. A need for additional activities was expressed by Dr. James A. Jacobs of Norfolk State University. (Dr. Jacobs is currently working on the curriculum guide for Materials and Processes Technology.)

LIMITATIONS

This study is limited to the development of activities, field trip information, and resources for the teaching of Materials and Processes Technology (see course outline Appendix A).

ASSUMPTIONS

The activities in this study have been developed with these basic assumptions:

1. Teachers using these activities have been involved in a certification program or workshop for Materials and Processes Technology.

2. Laboratories are designed to meet the standards set forth in the facilities guide developed by the Industrial Arts Services in Richmond.

3. Teachers will follow the course outline for Materials and Processes Technology as it exists in the Industrial Arts Education Competancy catalog for Materials and Processes Technology.

4. Teachers will use the competancies established in the competancy catalog as a guide for determining student outcomes.

5. Students enrolled in the programs are in grades ten through twelve and have had some previous Industrial Arts experience.

PROCEDURES

The procedure for conducting this study will be to (1) determine what activities are needed in Materials and Processes Technology; (2) research those activities that exist in the state of Virginia; (3) establish new activities for each of the areas in Materials and Processes Technology; (4) evaluate the new activities for validity and present these activities with the suggested methods and procedures for implementation.

DEFINITION OF TERMS

The terms used in this study have the following meanings:

Combining is the process of joining materials together permanently and semi-permanently by mechanical fastening, adhesion, and cohesion.

Conditioning is the process of changing a material by finishing or treating.

Forming is the process of shaping materials, without adding or removing any of the material, by bending, casting, forging, pressing, drawing, extruding, and rolling.

Layout is the process of measuring and marking.

Macro structure is the pattern in which atoms join together in materials.

Material technology is the body of knowledge dealing with the science of industrial materials.

Micro structure deals with the atomic theory of the natural elements.

Nature of materials refers to the structure and qualities of materials that determine their individual characteristics.

Processes technology is the body of knowledge that deals with the changing of materials during production.

Separating is the process of removing or cutting pieces of material from a base material by sawing, shearing, abrading, shaping, drilling, milling, turning, and electro-chemical cutting.

OVERVIEW

In this chapter, the author has tried to set the foundation for the research study. This study is based on the need for additional experiences for Materials and Processes Technology. The research is significant because the program is in the developmental stages and a great deal of work still needs to be done toward developing laboratory activities. In establishing these basic activities, basic assumptions about the people who will be implementing the activities and the conditions of the facilities needed are made.

This study will attempt to establish new activities that are valid and easily implemented. The author intends to provide as much detail as possible about each of the suggested activities. Finally, it is hoped that these activities will be validated by people working with or interested in the Materials and Processes Technology program.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to explain the course contents of Materials and Processes Technology, give a brief history of the program, examine related programs currently in existance, and reivew plans for implementing Materials and Processes technology in Virginia. Materials and Processes Technology, which is still in the developmental stages, is designed to familiarize the student with the nature and processing of industrial materials. The program is recommended for students who have an interest in becoming technicians, scientists, or engineers.

COURSE CONTENT

Materials and Processes Technology is divided into six units. These units include an introduction to materials and processes technology, wood technology, metals technology, plastic and elastomers technology, ceramics technology, and composite materials. Each of these units are explained in the following paragraphs.

Introduction to Materials and Processes Technology is a nine week unit used to introduce the student to the terminology of materials, processes, and production technology. The unit is divided into the following sections: the nature and structure of materials, the families of materials, material testing, properties of materials, production technology, and processes technology (Gibbs, 1979). Each section includes:

1. The Nature and Structure of Materials, including the examination of the atomic structure, bonding of materials, terminology of materials science, and the micro and macro structures of industrial materials. Many unfamiliar terms that deal with material science are explained in this section.
2. The Families of Materials, dealing with the classification of materials, according to the structure, qualities, and characteristics of industrial materials. These families of materials include metals. polymeric materials (wood, plastics, and elastomers), ceramics, and composite materials. This section is only a brief introduction to each of the basic materials. Each of these materials are examined in depth later in the course.
3. Materials Testing, including dynamic, static, destructive, and non-destructive tests. (Jacobs, 1975) Materials Testing is examined as a method of determining properties of materials. Tests are introduced in relation to the mechanical properties of materials. (Gibbs, 1979)
4. Properties, including the introduction of chemical, electrical, thermal, and mechanical properties of materials. The importance of properties in choosing materials for industrial applications is investigated. (Jacobs, 1975)
5. Processes Technology, introducing the processes used in the processing of industrial materials. The processes discussed in the section are listed below. (Linbeck, 1969)

a. measuring using the American standard system as well as S. I. Metrics

b. separating, which includes sawing, shearing, abrading, shaping, drilling, milling, turning, and electrochemical cutting

c. forming, which includes bending, casting, forging, pressing, drawing, extruding, and rolling

d. combining, which includes mechanical fastening, adhesive bonding, and cohesive bonding

e. conditioning, which includes materials and procedures used for finishing and treating materials

Each of these processes will be discussed in relationship to procedures, materials, equipment, and the methods of production.

6. Production Technology, including the comparison of custom building versus mass production. The advantages, characteristics, and importance of each will be discussed. This section will also include the importance of quality control in both methods of production.

The purpose of this unit is to introduce the phases of materials and processes technology, which will be applied in detail in each of the remaining units.

Metals Technology will include a detailed look at the nature, structure, and properties of metals, the processing of a variety of metals, and the application of a variety of metals for engineering and industrial uses.

Wood Technology will include the structure of wood, its scientific classification, and the processing of wood and by-products. Individual woods will be examined in respect to their engineering and industrial application.

Plastics and elastomers will include the nature and structure of plastics and elastomers as well as the types of each, and the processing and industrial applications.

Ceramics will include the nature and structure of ceramic materials, as well as the processing and industrial application.

Composite materials will include all materials that are made up of two or more materials from different families of materials.

Each of the material units is a detailed look at its nature, qualities, and industrial application.

HISTORY OF MATERIALS AND PROCESSES TECHNOLOGY

Materials and Processes Technology as it exists in the developmental stages came about for two basic reasons. First, there is a need for a contemporary program to be taught in place of the traditional "General Industrial Arts" courses. (Hughes, 1979) Secondly, there is a need at the college level for students who are familiar with industrial materials and relevant methods for processing materials. (Jacobs, 1979)

In 1975, a curriculum council was formed in order to take a look at the total Industrial Arts program in Virginia. This council found that there was a void for contemporary high school programs to be taught in the existing General Industrial Arts labs throughout the state. Several titles were considered for this program, such as Production Technology and Industrial Materials Technology, but Materials and Processes Technology was determined to be the most original and descriptive under consideration. A great deal of work had been done through the Industrial Arts Services in contemporary programs at the junior high level concerning communications and power and transportation, but little had been done in the production area of Industrial Arts at the high school level. (Hughes, 1979)

The concept of the integration of Material Science into the Industrial Arts programs was under consideration by Dr. James A. Jacobs as early as 1969. (Jacobs, 1979) In dealing with technical programs at the community college and university level, Dr. Jacobs felt that the Industrial Arts programs could do something to contribute to the student's preparation for materials science. (Jacobs, 1979) In 1974, Dr. Jacobs presented a research proposal to the NASA Research Foundation for the purpose of developing technical materials courses for the use of educating students at the high school and college level in the area of material science. Dr. Jacobs recommended that the courses be divided into technical education packages to be made available throughout Tidewater, Virginia. (Jacobs, 1979)

In 1977, Dr. Jacobs became involved in the development of the Materials and Processes Technology program. He taught a workshop at Independence Junior High School in Virginia Beach in July and August of 1978. The workshop dealt mainly with the concept of integrating material science with the processing of materials. (Hughes, 1979)

During the Fall of 1978, Dr. Jacobs was project director for developing competancies for Materials and Processes Technology. Dr.

David I. Joyner and Dr. John Ritz of Old Dominion University were co-chairmen of the project that was responsible for developing competancies for all Industrial Arts programs in Virginia schools. This project was made possible through a grant provided by the Industrial Arts Education Service of the Virginia State Department of Education. (Old Dominion University, 1976) Competancy catalogs were distributed through workshops in competancy-based instruction in Industrial Arts Education which were held throughout the state.

The final step in the development of the Materials and Processes Technology course is the completion of the curriculum guide. The project director is Dr. John Ritz at Old Dominion University. The guide is being developed by Dr. James A. Jacobs at Norfolk State University. The curriculum guide will be completed in the spring of 1980. Materials and Processes Technology will be recognized as an Industrial Arts program as of July 1, 1980. (Hughes, 1979)

PILOT PROGRAM IN VIRGINIA

The Materials and Processes concept has been part of an effort at Churchland High School in Portsmouth to develop a contemporary program within the existing facilities. The program at Churchland includes Drafting, Communication, Graphics, Manufacturing, Materials and Processes Technology, and Wood and Metal Technology. The Materials and Processes Technology course is being taught for the second year as an experimental project. There are currently two classes of Materials and Processes Technology being taught. The course follows the description provided in the "Course Content" in this chapter. The development of the Materials and Processes competancy catalogs and expertise provided by Dr. Ritz and Dr. Jacobs have helped tremendously in the implementation of the Materials and Processes course at Churchlnad. As of September 1980, the course will be offered to students in grades ten through twelve.

At this time, all work done in Materials and Processes Technology has been done in the Tidewater area. There is a new facility for teaching Materials and Processing Technology in Fredericksburg County, Virginia. (Hughes, 1979)

RELATED PROGRAMS IN OTHER STATES

The concept of Materials and Processes Technology at the high school level has been used in only a few states throughout the country. There has been work, however, at the college and university level. Such programs include the work conducted at Norfolk State University for the courses in Mechanical/Design Technology program. (Hughes, 1979) Other programs include work done at Thomas Nelson Community College in Materials Science and Metallurgy labs (Jacobs, 1979) and programs at San Jose State College.(Bulletin No. 22, 1978) These programs and studies are aimed mainly toward materials science and material application, while existing programs at the high school level are done at a variety of levels and patterns.

Program offerings and activities related to Materials and Processes Technology were found from the following:

1. Industrial Arts in Grades Seven and Eight, a curriculum development project sponsored by the Bureau of Industrial Arts

Education, Secondary Education and the New York State Department of Education. This proposal included course content and activities that show the contemporary materials and processes concept. (Curriculum Development)

2. Curriculum Guide for Industrial Arts Education, Woods and Curriculum Guide for Industrial Arts Education, Metals, both of which include materials and processes activities in their woods and metals programs. (Mallory, 1974)
3. Manufacturing Materials and Processes, includes material testing and material processing activities for contemporary Industrial Arts programs. (Bulletin No. 22, 1978)
4. Technically Oriented Industrial Materials and Processes is probably the program most similar to that being designed in the state of Virginia. (Heggen)
5. Curriculum Guide for Plastics Education, includes course content and activities for a contemporary plastics program. (Plastics Education, 1977)
6. Manufacturing Technology programs with some related subject matter and acitivites. (Manufacturing Technology)

These programs, although they are similar, do not include the exact course content as described for Materials and Processes Technology as in this chapter.

SUMMARY

In order to have a complete understanding of the Materials and Processes Technology program, it should be clear as to why such a program is needed. It is also important to understand the stages of its development, pilot programs that exist, and related work done by other organizations.

It is the purpose of this research to determine activities for Materials and Processes Technology. These activities will be illustrated and evaluated as explained in Chapter III.

CHAPTER III

METHODS AND PROCEDURES

In order to determine activities for Materials and Processes Technology, methods and proceudres that will be used for this purpose must first be established. This chapter will include a description of the research methods, lab procedures, data collection, and evaluation procedures.

DESCRIPTION OF RESEARCH METHODS

The activities that have been researched were conducted at Churchland High School, making it relatively easy for the author to compile the information. First, a list of the major concepts under study were established. A list of possible actitivities was developed for each. Then the activity that seemed most appropriate was chosen, since there was not enough time to conduct multiple activities in each of the major units.

The activities that were developed took into consideration the amount of time required to complete it and provided complete instructions for the students. The activities were then implemented and revised as necessary. Some of the activities included in this paper were not tested because either the materials and equipment were not available at the time or because there was inadequate time to complete them.

LAB PROCEDURES

After all activites were established and descriptions written, as many activites as possible should be implemented. The students should then be provided with all necessary information, equipment, and supplies, and supervised throughout the activity as closely as possible without interferring with his completion of the activity.

Some activities will be sent to other persons interested in the program for possible implementation. Further testing will help determine if these activites are practical for implementation.

EVALUATION PROCEDURES

At the completion of each activity, it will be necessary to evaluate the activity according to the following criteria:

1. Did the activity reinforce the related concept or concepts?
2. Was adequate instruction supplied for the instructor as well as the student?
3. Are the tools, equipment, materials, and supplies readily available?
4. Is the cost of this activity reasonable?
5. What were the students' attitudes toward the activity?
6. Is the activity sound for implementation?

Once the evaluations are complete, it would be helpful to have comments from other people on the entire program.

SUMMARY

The purpose of this chapter was to establish the methods and procedures that will be used to establish activities, as well as those for evaluation of the activities that will be used in the Materials and Processes Technology program in Virginia. Chapter Four will describe the activities in detail.

CHAPTER IV

FINDINGS

Materials and Processes Technology involves multiple activities conducted by both individuals and small and large groups. The activities include written and reading assignments, experiments, exercises, research assignments, and individual and group projects. The introductory activities will largely be with small and large groups and the latter exercises conducted according to the progress of the individual student. It is important that each student be aware of the course requirements during each grading period.

In order to maintain the concept of "learning by doing," the student will be given as many experiences as possible that are related to the major concepts under study. Each activity is designed to help accomplish the goals and objectives established for Materials and Processes Technology. (Gibbs, 1979)

INTRODUCTION TO MATERIALS AND PROCESSES TECHNOLOGY

Materials and Processes Technology includes safety and operational procedures, the nature and properties of materials, materials testings, processing materials, and methods of production. The introduction is a brief overview of the major concepts to be involved throughout the course.

General safety and operational proceudres are established the first week of school. Students are given handouts, which list rules for class operation, general safety and course requirements, and are asked to read and study the information. (Appendix B) One of the class requirements is to obtain a loose leaf binder. The first handout should be included in it, as well as all other written materials used in the lcass, and brought to class each day.

Nature of Materials. To encourage the students to think about the variety of materials that are available, they should make a list of as many different materials that they can find in their homes. This list will be useful in several discussions throughout the unit.

The students' first major assignment is to read about and record various terms used in materials science. (Appendix C) After a discussion of these terms and of the atomic theory, the students will make models or drawings which represent the structure of the atom. (Jacobs, 1975, 7-9) Models may also be made of the lattice structures. (Jacobs, 1975, 13-15) Crystalization can be shown by examining the crystal boundaries formed in galvanized sheet metal. (Jacobs, 1975, 16-17) Most of this information can be reinforced through slide presentations and filmstrips.

The classification of materials may be discussed in conjunction with the students' lists of products found in their homes. The characteristics and purposes of each of these products can be brought out at this time.

Properties of Materials. Over a period of a few days, the students should define the properties of materials. (Appendix D) During class, the properties will be discussed and illustrated.

The Nature of Materials section is quite academic in nature. Most of the activities involve reading, drawing, making simple models, and individual and group experiments. The rest of the introduction, however, includes the processing of materials, product design, and production technology and involves more activity on the part of the student.

Product Design. Effective designing and planning of any product makes the processing easier. The student participates in formal and informal discussions about the processes of product design and development. The activity includes the planning of one product and involves two activities: individual and line production. One activity that has been used successfully in the past is shown in Appendix E. The students are asked to make a complete set of project plans, using the plan sheet. (Appendix F)

Production Technology. After the plans have been completed and evaluated, the students will produce the products individually using hand tool processes. When completed, the class as a whole plans a line production, using the individual plans as a guide. After the plans for line production are completed, the class will produce approximately thirty items. The line production tends to be time consuming; therefore, organization of time is very important throughout the activity.

The two to three days immediately proceeding the introduction of Wood Technology, practice exercises in measuring are helpful as many students lack experience in measuring properly. There are a series of activities on the use of metric measurement developed by Dr. Allen Bame (Bame, 1979, 13-21) that are excellent for introducing the metric system. Activities may also include a review of standard measurement.

WOOD TECHNOLOGY

Activities in each of the major areas of study will be conducted within a group. The class will be given specific assignments at the beginning of the unit. It will then be divided into four groups and each group will conduct its own activities. Within the group, there will be individual and group projects, exercises, tests and experiments, and research assignments.

Because wood is the most common material, Wood Technology is the easiest unit to teach. Activities for this unit are explained on the assignment sheet in Appendix G, with more detailed instructions listed afterwards.

Projects chosen by the teacher or the student should include the use of as many machine tools and hand tools as possible. If a student chooses projects that do not contain the processes, he may conduct exercises that involve their uses.

METAL TECHNOLOGY

More concepts in Materials and Processes Technology relate to metals than any other area. The Metal Technology unit will require more activities and time because metals are used in so many different ways. This unit comes at this point because of its complexity, the depth of material science, the variety of activities, and the new skills developed.

This unit is also completed with multiple activities being conducted simultaneously. At the beginning of the unit, there is a general introduction to the areas covered. The student is given an assignment sheet which is a brief explanation of all of the activities that he should have completed at the end of the unit. Some of these activities will need no explanation other than what is on the assignment sheet. Others will need special instructions. The instructions for each of the activities can be found in Appendix H. It is important that a schedule is established and student evaluation is conducted throughout the unit so that each student will complete as many activities as possible.

These assignments will be conducted in the same manner as those in the Wood Technology unit.

PLASTICS TECHNOLOGY

The Plastics Technology unit was limited in three ways. First, there was a lack of equipment and supplies. Secondly, there was a lack of resources for students to use. Finally, there was a shortage of time.

The Plastics Technology unit includes three activities: the use of vacuum forming equipment, construction of a project from acrylic sheets, and casting of objects using plastic resigns.

More control and direction in the first three units would provide more time in the plastics unit. Additional activities will involve injection molding, testing of plastics for properties, and research into the variety and uses of plastics.

CERAMIC TECHNOLOGY

The Ceramics Technology unit did not go beyond the planning stages because of lack of time. The construction of a miniature post out of concrete was the one activity planned. This exercise is based on the activities 38-41 in the World of Construction Lab Manual. (1970, 133-140) It should be conducted by each of the four groups. After the structure is completed. each group is to test it for hardness, stress, and impact resistance. Commercial ceramic items could be tested for comparison at the same time. Extreme safety measures should be established before the testing exercises are attempted.

CONCLUSION

These activites are only a beginning. There are still areas which can be better reinforced with more sophisticated equipment and supplies. The problems that remain will be discussed in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The greatest problem in organizing the Materials and Processes Technology program is that the realm of this program is so vast. This program could easily be part of a four year technical program.

SUMMARY

The Materials and Processes Technology program is both scientific and technical in nature. It will take much more planning and a great deal of organizing to complete the entire program and compile it into a one school year program. There are a total of six major units to be taught in the course, with subtopics that relate to each unit. Each unit should include specific production methods, testing procedures, club organization, and career awareness. Each of thses units can be crowded into six to twelve weeks or could be more adequately completed in twelve to eighteen weeks.

The most important factor in the successful organization of this program is that major concepts be introduced during the first unit and then reinforced in each of the subsequent units. Emphasis should be placed on the particular material and its design and production characteristics.

CONCLUSIONS

The activities described in this paper were established over a period of two years. The activities were formulated in an experimental program at Churchland High School. This list of activities is not complete, but those considered more relevant to the teaching of the Materials and Processes Technology program are included. There are many areas of Materials and Processes Technology that are not covered in this curriculum due to the amount of material to be taught in one year and because equipment that was needed was not available at the time that these activities were initiated.

The major problem in the operation of the program is the time elément. The program is a competancy-based program. Although competancy-based program are good, the public school systems limit the time of any class period. The study of this topic is so great that there is not enough time for the students to repeat any activity that they do not accomplish to the standard set in the time allotted. This is a characteristic that must be changed in the requirements of competancy-based education or the characteristic of public education.

RECOMMENDATIONS

It is the recommendation of the author that this program be set up as a two year program. The first year would be a prerequisite of the second. The first year course, on the other hand, would receive credit without the completion of the second.

It is also recommended that those who have been active in the development of this program become active in the promotion of the program to fellow educators. It is written from an academic stance. Other Industrial Arts poeple must be convinced that it can be taught to all students. This program can be useful to those students who intend to continue their education in a trade and especailly beneficial to those who intend to attend college and pursue an education in science or technology. (Competancy Education, 1979)

The author intends to continue to develop activities for Materials and Processes Technology program and to establish it as a major part of the Industrial Arts curriculum at Churchland High School.

APPENDIX A

COURSE OUTLINE

MATERIALS AND PROCESSES TECHNOLOGY

I. Introduction to Materials and Processes Technology
   A. Nature of Materials
      1. Structure of materials
      2. Family of materials
      3. Properties of materials
      4. Testing materials
   B. Processes Technology
      1. Design
      2. Measuring
      3. Separating
      4. Forming
      5. Combining
      6. Conditioning

II. Metals Technology
   A. Nature of Metals
   B. Processing Metals
   C. Career Opportunities in Metals

III. Wood Technology
   A. Nature of Woods
   B. Processing of Woods
   C. Career Opportunities in Woods

IV. Plastics and Elastomers
   A. Plastics Technology
      1. Nature of plastics
      2. Forming plastic material
      3. Fabricating plastics
   B. Elastomers
   C. Career Opportunities in Plastics and Elastomers

V. Ceramics
   A. Nature of Ceramics
   B. Processing of Ceramics
   C. Career Opportunities in Ceramics

VI. Composite Materials
   A. Types of Composites
   B. Use of Composites
   C. Career Opportunities

VII. American Industrial Arts Student's Association

APPENDIX B

CHURCHLAND HIGH SCHOOL
Industrial Arts Department
Rules for Class Operation

1. All students must be at their assigned stations when the late bell rings.

2. There will be a lecture or demonstration the first ten minutes of each class period.

3. There will be no talking during formal class lectures.

4. Any talking and/or misbehavior during formal class discussion will result in a zero for the day's work, or whatever is needed to prevent the disturbance.

5. All books and coats will be left in the assigned area at the entrance of the lab.

6. There will be absolutely no horseplay in the lab at any time. All students are expected to conduct themselves in a mature manner.

7. Safety glasses or goggles will be worn during all activities in the lab.

8. No one will use the outside doors without special permission.

9. Students will not use any hand tools until they have been properly demonstrated.

10. Students will not use any machine without the teacher's permission.

11. All safety regulations will be followed strictly.

12. Every accident, no matter how small, must be reported to the teacher.

13. Everyone will participate in clean-up at the end of each class period.

14. You must not leave the lab at any time during the period without permission and a written hall pass.

15. After clean-up, you will remain at your assigned work station until you have been formally dismissed.

APPENDIX B
(Continued)

16. No one is allowed in any of the auxiliary rooms (tool room, office, finishing room, balcony, etc.) without permission from the teacher.

17. All other school policies will be observed in the Industrial Arts labs.

CHURCHLAND HIGH SCHOOL
Industrial Arts Department
General Safety Rules

1. Keep the work area and the area around the machines clear of scraps.
2. Concentrate on your work; let no one distract you and do not distract others.
3. Place oily rags, stain, paint, and thinner-soaked rags in a safe metal container.
4. Immediately clean up any spilled liquids such as stain, paint, glue, finish, thinner, etc. from the floor or tables.
5. Stand on a dry surface while using all portable power tools, and never use a power tool that is improperly grounded.
6. Use a power tool when it is at its full speed, not when it is reaching its full speed or while it is coasting.
7. Do not leave a power tool until it has come to a complete stop.
8. Do not make any adjustments on a machine while the machine is in motion.
9. When it becomes necessary to touch moving parts of machines, the main switch should first be turned off and/or the plug pulled.
10. Before using any power tool, stand to one side, turn on the power, and be alert for dangerous irregularities of sound or sight.
11. Do not turn a machine on for anyone else.
12. When a helper is necessary, the operator shall control all feed speed and the helper will follow.
13. Report any unsafe, dull, or improperly operating machine.
14. Follow all safety rules concerning a specific piece of machinery that is being used.
15. Do not use compressed air to clean dust from face, hair, or clothing or any other part of the body.
16. When carrying large pieces of material through the lab, have someone help you for better control of each end.

APPENDIX B
(Continued)

CHURCHLAND HIGH SCHOOL
Industrial Arts Department
General Information

I. Course Requirements: As a student enrolled in Materials and Processes Technology, you will be expected to:

1. Come to class on time and conduct yourself in a mature manner.
2. Abide by all rules, regulations, and safety procedures.
3. Participate in all lessons, demonstrations, and class discussions.
4. Explain each of the major concepts under study.
5. Explain the processes and procedures as well as demonstrate skills in the use of tools and equipment.
6. Participate in and complete all class activities (individual and group projects, clean-up, lab maintenance, and special assignments.)
7. Take all tests and quizzes.
8. Complete all homework assignments.
9. Pay for all materials taken home as a part of an individual project.
10. Keep an up-to-date notebook which should contain all handout sheets, class notes, tests, quizzes, project plans, as well as written class homework assignments.

II. Grades: All six weeks grades will consist of the following:

A. Project: 40%. Project grades include evaluation of project construction, lab exercises, and experiments.

B. Tests: 20%. There will be at least one major test each six weeks.

C. Notebook: 20%. The notebook will be used to organize all written materials related to all class work. It will be checked periodically and graded at the end of each six weeks.

D. Daily Grades: 20%. Daily grades consist of:
   1. Written assignments
   2. Project plans
   3. Clean-up
   4. Homework
   5. Special reports

E. Extra Credit: Additional points will be added to the six weeks grade for work done above and beyond the course requirements.

III. Supplies: You will need a #2 lead pencil in class each day for drawings, plans and general classwork (an ink pen may only be used for taking notes and written tests.)

2. Notebooks: You will be required to have a notebook in class each day. It will contain project plans, lecture notes, handouts, all tests and quizzes, and notebook paper for class assignments. Every notebook will be graded at the end of each six weeks grading period. Note: This notebook should be some type of loose-leaf binder. Everyone should have a notebook by Monday, September 10.

3. Combination Padlock: Each student will share a locker with one other person. These lockers are located beneath the four woodworking tables. This locker should be used for storing notebook, pencils, and small projects.

APPENDIX C

Materials and Processes Technology

Material Science

Directions: After completing the assigned readings, explain each of the following terms in your notebook.

1. atom
2. electron
3. neutron
4. proton
5. valence electron
6. ion
7. ionic bond
8. covalent bond
9. metallic bond
10. matter
11. homogeneous
12. element
13. compound
14. mixture
15. solid
16. liquid
17. gas

(These terms were taken from Jacobs (1975, 5-9))

APPENDIX D

Materials and Processes Technology

Properties of Materials

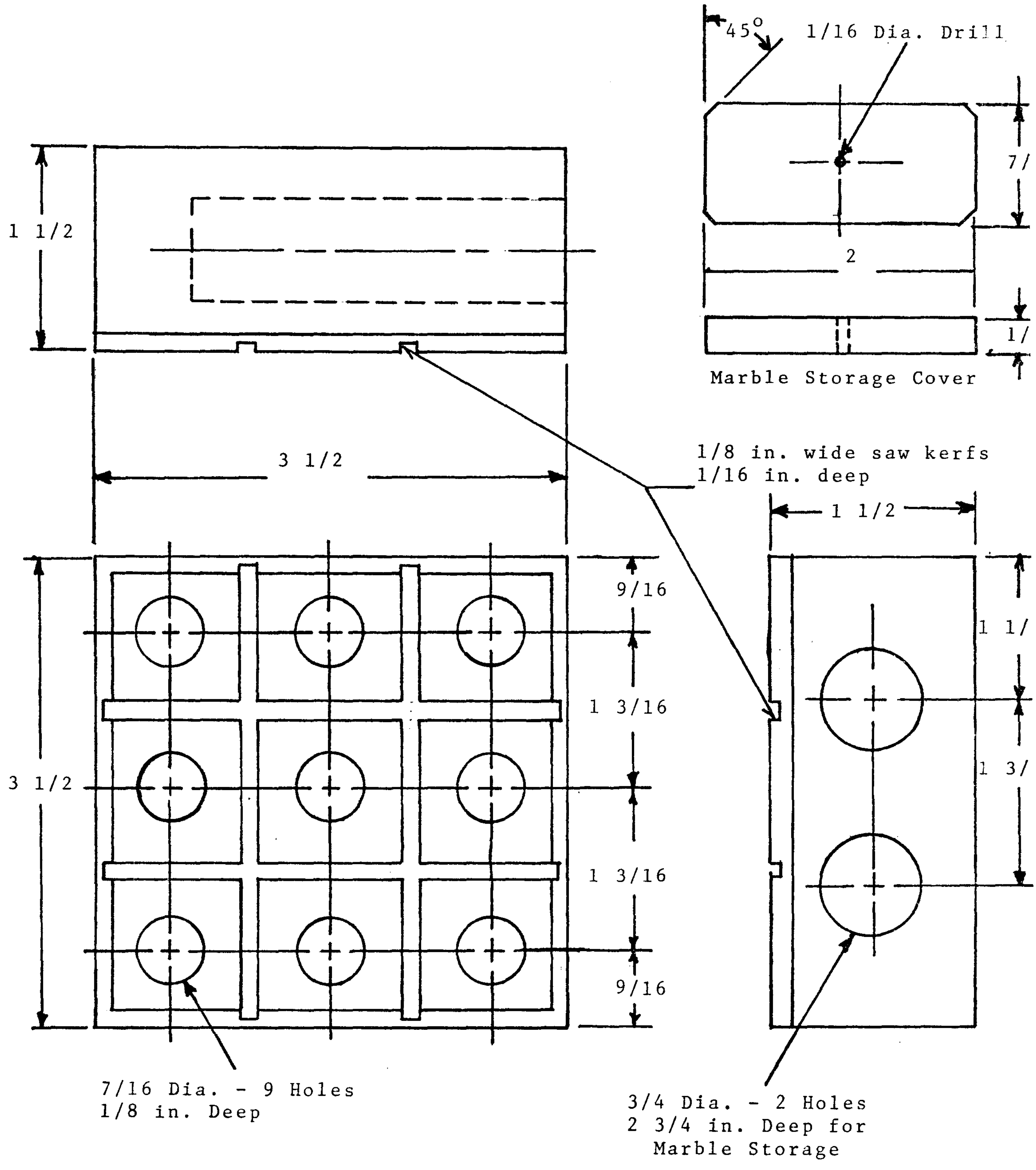
Directions: After completing the reading assignments, explain the following terms in your notebook.

1. tensile strength
2. compressive strength
3. shear strength
4. torsion strength
5. fatigue strength
6. creep strength
7. impact strength
8. ductility--plasticity
9. malleability
10. hardness--brittleness
11. destructive test
12. non-destructive test
13. static test
14. dynamic test
15. stress
16. strain
17. elastic deformation
18. plastic deformation

(These terms were taken out of Jacobs (1975, 3-14))

APPENDIX E

TIC-TAC-TOE GAME



CHURCHLAND HIGH SCHOOL
INDUSTRIAL ARTS DEPARTMENT
PROJECT PLAN SHEET

NAME: ______________________ INSTRUCTOR: ______________________

PERIOD: ______ NAME OF PROJECT: ______________________

I. Working Drawing; A working drawing is to be provided with each project and approved by the instructor before the project is begun. The drawing should be done on a seperate sheet and should include the following information:
   A. Shape of all parts.
   B. Demensions and locations of all parts.
   C. All other details that may be needed for production.

II. Bill of Materials

No. Pcs.	Part Name	Size			Material Description	Unit Cost	Total Cost
		T	W	L			

Approved: __________ Plan Mark: __________ __________

Date Started __________ Project Mark: __________ __________

Date Completed: __________ Average: __________ __________

APPENDIX F (continued)

PROJECT PLAN SHEET
(continued)

III. Procedure

IV. List of Tools

Step	Operation	Tools & Equipment

V. Stock Cutting List: To request materials, submit a list which includes;

1. Number of pieces
2. Type of material
3. Overall size

APPENDIX G

WOOD TECHNOLOGY
Assignment Sheet

Directions: Complete each of the following activities as directed below. Each member of your group will be working on the same activity at the same time. When you complete each activity, it should be submitted to the instructor for evaluation.

1. Wood and Wood Characteristics. When you are ready to start on this assignment, you will be given a chart. Complete this chart, finding the specific characteristics for each of the woods listed. When you have finished, prepare a sample of five of the woods listed. This sample should be at least two inches wide and three inches long. Each sample should be labeled.

2. Testing Wood for Properties. You will be given a list of tests that will help determine the characteristics of wood. Choose one of these tests. You may get specific instructions from the instructor. Prepare the specimens, conduct the tests, and record all findings in the spaces provided on the instruction sheet. All members of each group should be present during the testing of the materials.

3. Projects. Each student will be responsible for producing at least two projects. These projects should be suggested or approved by the teacher. You must prepare a complete set of plans before the work is started.

4. Exercises. Exercises will be conducted as needed to give you experience in working with additional processes.
   a. Turning: If you do not include turning as part of one of your projects, you will need to practice turning on the wood lathe.
   b. Wood Finishing: Each student will prepare at least three finishing samples. One should be painted, one stained, and one coated with a clear finish. Each member will use a different material for finishing their samples.

APPENDIX G (continued)

WOOD TECHNOLOGY

Wood Characteristics

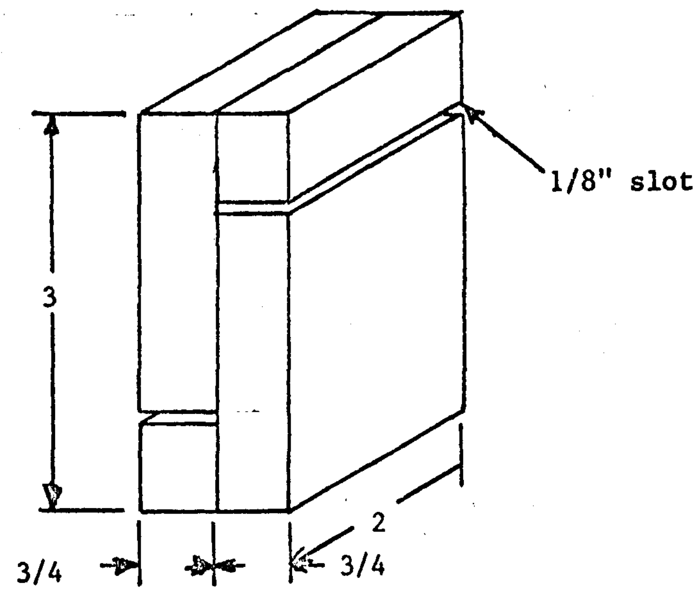
NAME	CLASS	COLOR	SPECIFIC GRAVITY	DEMENSIONAL STABILITY	WORKABILITY	STRENGTH	COMMON DEFECTS

MATERIALS AND PROCESSES TECHNOLOGY
WOOD TECHNOLOGY

Testing Adhesives

DIRECTIONS:

A. Read the drawing below, assemble four specimens as shown. Prepare two each of two different types of wood.



B. Assemble one of each type of wood with white resign glue and one of each type of wood with contact cement.

C. Test each specimen for compressive strength, and record the following information.

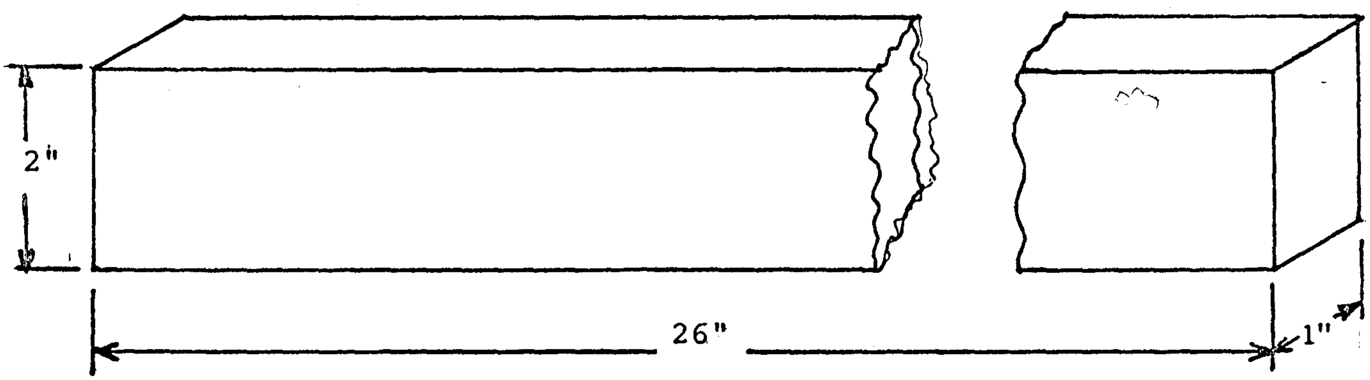
SPECIMEN	TYPE OF MATERIAL	TYPE OF ADHESIVE	MAXIMUM LOAD	TYPE OF FAILURE

WOOD TECHNOLOGY

Testing Flexural Strength

DIRECTIONS:

A. Read the drawing below,and cut three specimen from three different types of wood.



B. Material:
1. Fir
2. Mahogany

C. Directions:
1. Install flexural testing device into universal testing machine.
2. Place each specimen edge between supports, apply pressure and measure deflection every 200 lbs. (DO NOT LET IT CRACK.)
3. Place each specimen on face between supports, apply pressure and measure deflection every 200 lbs.
4. Place each specimen between supports on edge and determine maximum load.

D. Record the following:

Specimen	Materials	Test #	200 lbs.	800 lbs.	1400 lbs.	Max. Load

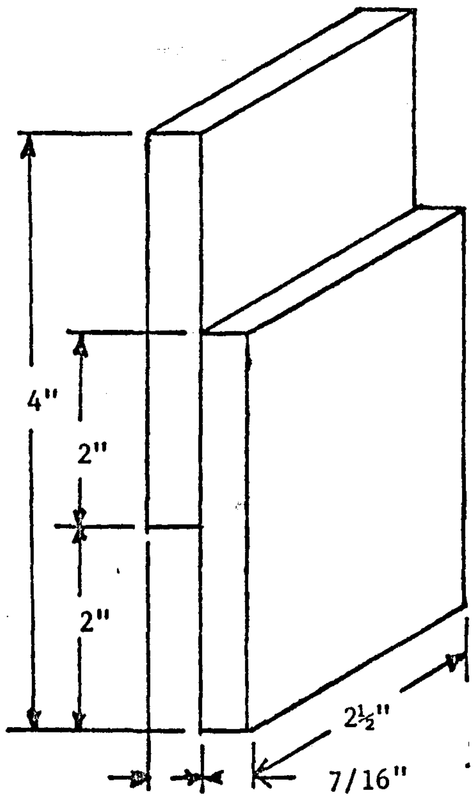
Testing Mechanical Fasteners

Directions:

A. Read the drawing below, and cut materials for three specimen.

B. Assemble one with two ½-20 bolts, one with four 3/4"x#6 FHWS, and one with four 4d finishing nails.

C. Test each specimen for shear strength and record the results in the chart below.



SPECIMEN	MATERIAL	FAILURE/PSI						MAXIMUM LOAD
		100	300	500	700	1000	1200	

D. Which method appeared to be the strongest type of fastening?

APPENDIX H

Materials and Processes Technology

Metal Technology

Directions: Perform each of the following activities as directed. Each member of your group will be working on the same activity at the same time. When you complete each activity, it should be submitted to the teacher for evaluation.

1. Metal and Metal Properties: You will complete the information requested on the instruction sheet provided. When you are ready to start this assignment, you may get the sheet from the teacher or superintendant.

2. Testing Metals for Properties: Each group will alternate using the testing equipment. Each member of the group will choose one test as described on the instruction sheet. The results for each test should be recorded and kept in your notebook. All tests should be conducted with all members of the group present. These tests and procedures will be taken from the lab manuals available in the book case. (Kazanas, 1974)

3. Projects: Project construction will include 4 of the 5 general areas listed below:
   a. Sheetmetal. A project made of sheetmetal. The construction of this project should include as many of the sheetmetal processes as possible. A working drawing will be provided by the teacher. You are to complete a set of plans as instructed, on the project plan sheet. If you would like to build something different in sheetmetal, the plans must be approved by the instructor.

   b. Band Iron. A project involving the bending, fastening, and further processing of band iron. It must include a complete set of plans. This project could be a plant hanger, house number hanger, shelf bracket, or any project which includes the bending and fastening of band iron.

   c. Machinery. A project or exercise that includes the operation of at least one machine tool that is available in the lab.

   d. Foundry. Each student should be involved in the casting of some object. This object may be a letter for a sign, part of a project, or a complete project. This activity will be done as a group effort.

   e. Welding. Each student should weld using the oxyacetylene process as well as the arc welding process. This can be done as an exercise or part of a project. This should be done as an individual or in groups of two.

APPENDIX H

METAL TECHNOLOGY

Metals and Metal Properties

Directions: Complete this exercise in outline form in your notebook. Write on the front of each page only.

I. Ferrous Metals
   A. Iron
   B. Cast iron
   C. Steel
   D. Steel alloy (at least 3)

II. Non-ferrous Metals
   A. Aluminum
   B. Copper
   C. Beryllium
   D. Brass
   E. Bronze
   F. Zinc
   G. Silver
   H. Gold

For each metal listed above, describe or explain the following:

1. Where is the metal mined or found?

2. How is it made or refined?

3. Discuss the following properties for each of these metals.
   A. corrosion resistance
   B. thermal conductivity
   C. electrical conductivity
   D. tensile strength
   E. compression strength
   F. shear strength
   G. toughness
   H. plasticity
   I. elasticity
   J. hardness/brittleness

4. Industrial uses
   A.
   B.
   C.
      Etc.

NOTE: Each of the preceeding projects may be incorporated into one or two projects if approved by the teacher ahead of time. All projects must have complete plans before the project is started.

4. Careers in Metal Technology. Make a list of at least 20 occupations that exist in the metal technology field. Choose one of these occupations and find someone who works in this occupation. Contact this person and find out some of the characteristics of his job. Such things as requirements, duties, pay, and promotional opportunities should be written into the report. It should be placed in your notebook. This person can be a family member or friend.

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