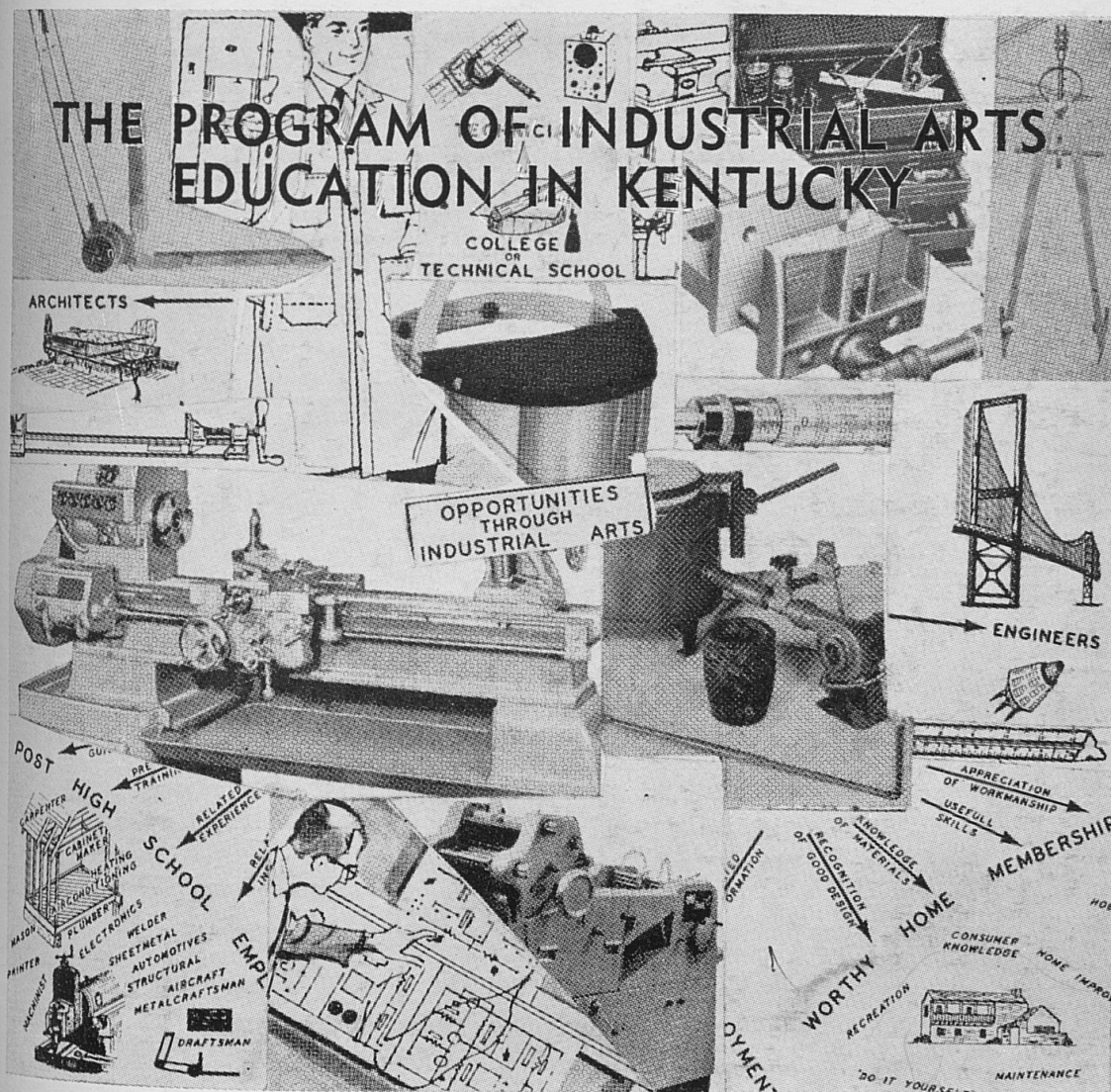


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The Program of Industrial Arts Education in Kentucky



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WENDELL P. BUTLER
Superintendent of Public Instruction

FOREWORD

About ten years have elapsed since the publication of the last educational bulletin on Industrial Arts Education by the State Department of Education in Kentucky. During that period vast changes have taken place in the phases of individual and national life involving the innumerable aspects and applications of the Industrial arts. It is timely, therefore, that the thinking, planning, and operation of this highly important portion of the educational program be brought up to date with a new issue.

I acknowledge with much appreciation the intensive work of the members of my staff and the special contributions of consultants, at both the college and local level, for the time and effort involved in preparing this bulletin. It is hoped that the material herein will be useful to the members of the profession as they strive to improve opportunities in industrial arts education for the youth of the Commonwealth.

Wendell P. Butler, Superintendent
Public Instruction

PREFACE

For some time now there has been a need for a source of reference material treating the various aspects of industrial arts education as conceived and practiced in Kentucky. This publication supersedes the 1953 handbook "Industrial Arts for Kentucky Schools," which has served well and is overdue for revision.

Industrial arts has grown from the small crowded manual training shop providing instruction in woodworking, too often located in small outbuildings or basements, to complex organizations of the comprehensive general shop as well as other types of shop organizations. For many years a transition has been taking place from a predominance of woodworking and the development of tool skills to the broad exploratory program including work representative of selected industries in Kentucky and beyond, with emphasis upon understandings, experience with tools and materials, and consumer values useful to all students.

School organization has changed in the past few years, largely due to increased school population and the fact that students remain in school longer now than a few years ago. The one industrial arts teacher program will give way to two or more teachers in this important area of education. School consolidation and the advent of the Foundation Program have done much to shape the future of the high school industrial arts education program.

This handbook is a summation of the beliefs and concepts of a number of industrial and practical arts educators. Teachers prepared in this state as well as out-of-state will find this publication useful concerning philosophy, curriculum, and teaching procedures for industrial arts education.

State Board Regulations governing certification of teachers in industrial arts may be found in the Educational Bulletin "Kentucky's New Program of Teacher Preparation—Certification." The Education Bulletin, "Planning School Plant Construction," offers information on industrial arts shops, sizes, and location. A state supervisor of industrial arts is available full time to work with school administrators in initiating a program in their school.

ACKNOWLEDGMENT

In May, 1961, The Kentucky Council on Industrial Arts Teacher Education met at Mammoth Cave, Kentucky. A committee was appointed by the Council to rewrite the Educational Bulletin, "Industrial Arts for Kentucky High Schools." Members of the committee are:

Mr. James H. Disney, Secretary to Committee	Supervisor, Industrial Arts Education State Department of Education
Mr. Charles H. Gibson, Jr.	Instructor, Laboratory School and Eastern Kentucky State College
Dr. C. Nelson Grote	Chairman, Division of Applied Arts Morehead State College
Mr. Carl Kilborne	Instructor, Berea College
Mr. Ray Lawrence	Supervisor, Industrial Arts Education Louisville City Schools
Mr. G. T. Lilly	Associate Professor Murray State College
Mr. Fred A. Martin	State Director, Industrial and Distributive Education State Department of Education
Mr. Walter B. Nalbach	Head, Department of Industrial Arts Western Kentucky State College
Dr. John D. Rowlett, Committee Chairman	Professor, Industrial Arts Department Eastern Kentucky State College

In addition to work performed by the members of this committee, we are grateful to the following people for materials, photographs, ideas, and their very fine support during this endeavor:

Mr. Rosamond Anderson	Industrial Arts Teacher Manly Jr. High School
Mr. W. A. Anderson	Industrial Arts Teacher Eastern Jr. High School
Mr. James Homer Davis	Associate Porfessor Industrial Arts Department Eastern Kentucky State College

Mr. Phillip R. Dillon	Industrial Arts Teacher Danville High School
Mr. W. Howard Huff	Industrial Arts Teacher Southern Jr. High School
Mr. Ersall Kendel	Instructor, Industrial Arts Department, Berea College
Mr. Robert E. McGowan	Industrial Arts Teacher Paul G. Blazer High School
Mr. Thomas E. Myers	Assistant Professor Industrial Arts Department Eastern Kentucky State College
Dr. H. L. Oakley	Head of Industrial Arts Department Murray State College
Mr. Rude Osolnik	Chairman, Industrial Arts Department, Berea College
Mr. Dale R. Patrick	Assistant Professor Industrial Arts Department Eastern Kentucky State College
Mr. Roger Prewitt	Industrial Arts Teacher Madison Central High School
Mr. William Sexton	Assistant Professor Industrial Arts Department Eastern Kentucky State College
Mr. Frank Shauntee	Head of Industrial Arts Department Kentucky State College
Mr. Willard E. Swinford	Assistant Professor Industrial Arts Department Eastern Kentucky State College
Mr. Ralph W. Whalin	Chairman, Industrial Arts Department Eastern Kentucky State College

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CHAPTER I

THE INDUSTRIAL ARTS PROGRAM

SOME GENERALIZATIONS

Industrial arts is a general industrial education program which contributes to the total education of all individuals. It is a laboratory type of activity that contributes to the over-all objectives of a comprehensive program of education and which cannot be duplicated in other learning situations. Provisions are made for the practical application of mathematics, science, and language arts, by bringing theory and practice closer together in a school shop environment.



A Typical Scene In An Industrial Arts Shop

Industrial arts laboratories provide opportunities for students to work in an atmosphere which encourages creativity. Ofttimes this creative activity leads to new designs of production machines and tools as well as new industrial processes. These experiences of ac-

completing given tasks through an orderly procedure make it possible for students to obtain a better concept of the technical, complex, and rapidly changing industrial environment in which they may expect to work and live.

This high school level industrial arts program is of value to students at all levels of ability and aspiration. Its laboratory organization provides an opportunity for students not only to study about American industry, but also to engage in constructive activities that make what otherwise might be superficial understandings more genuine. Intrinsic values are possessed in this area of education for all students who will be citizens in our industrial democracy. It is vocational only to the extent that through exploratory experiences a student may develop an interest in one of the numerous phases of industrial arts. His interest in electricity, for example, may bring out and assist in the development of aspirations to become a technician, an electrical engineer, or a research professor with an interest in servo-mechanisms. Thus, industrial arts is valuable to students of all ability levels irrespective of their individual vocational objectives.

PROGRAMS RELATED TO ABILITY LEVELS

The Slow Learner

Industrial arts education is for all pupils, but special emphasis may be easily directed to special groups. Teachers in this area of education can be proud of the contribution their program has made in assisting the slower student. Industrial arts subject matter has meaning that the slow learner can grasp.

Meeting individual needs is important in all educational endeavor. Here industrial arts really makes a contribution. The informal atmosphere of the industrial arts shop brings the student and teacher closer together. Thus the teacher has a chance to know his pupils intimately and to learn about their problems.

The students handle the materials they study. They learn by doing and they enjoy working with concrete materials. From early satisfaction in the proper and safe manipulation of tools and materials, they grow to enjoy and take pride in construction efforts which lead to a finished product. The manipulative therapy and manual expressions enjoyed by the student in industrial arts plays a vital role in strengthening and building confidence in the youngster who may otherwise drift along and become an early dropout.

There are very practical values in the industrial arts program for the less capable student. By far the greatest number of retarded

pupils will earn their living in adult life through the use of simple skills. Knowledge in the use of many materials and the proper and safe use of tools and equipment, together with some skill in their use, will accelerate later on-the-job training. In the environment of a *clean, well-organized, well-arranged shop*, the slow learner will have an opportunity to develop into a more industrious and conscientious citizen who will be better able to compete.

The Average Student

Exploration through investigation and experimentation is a characteristic of many average secondary school students. Their interest in the things around them are more pronounced because of their natural curiosity. Their attention is drawn to ever-increasing changes in the world about them—instructional changes and design of the small home and its furnishings. Their interest may even reach the garage where the father has a well-equipped workshop and a gasoline powermower.

The opportunity to use tools and materials in the industrial arts shop can help to satisfy these interests and desires. Here they are encouraged to develop an appreciation for workmanship and industrial processes. The acquiring of knowledge, understanding, and appreciation, as well as the development of skill in the use of industrial materials, evolves as part of their research, study, planning, and building.

With the growing demand for engineers and technicians, every opportunity should be afforded the typical high school student who shows any aptitude for this type of learning. Challenging experiences for these students and the opportunity to increase their ability to think and solve problems constitute the real function of industrial arts education.

The Gifted Student

While industrial arts is part of the general education program, there are a number of special programs in this area of education that may serve additional purposes.

Industrial arts courses are designed to meet the different interests and aptitudes of all students. Hence, these courses provide for the individual differences of the gifted students, as well as the slow learner. Gifted individuals should have educational experiences that give them insight regarding industrial progress, knowledge, and skill which make it possible for them to contribute to modern society. Opportunity should be provided for the gifted students to

enrich their educational experiences through participation in industrial arts classes. Gifted students who excel in manipulative, as well as other learning, are in a position to make ingenious application of the skills and information acquired.

For the gifted student the idea of an experimental laboratory, whether in the field of engineering or the field of art, is dominant. From this group will come the creative people, the scientist, the research engineers, the industrial designers, and inventors; thus, the desire to experiment with three-dimensional materials should be fostered.

PHYSICAL FACILITIES

Industrial arts is an organized program of educational experiences which requires a laboratory arrangement and special facilities. The stated objectives of the program will dictate the shop organization. If a broad, exploratory type of program is desired, in view of the objectives, opportunities should be offered for experiences in a variety of industrial arts areas. If the major objective is to provide a more concentrated emphasis, the subject matter is confined to a single area. This plan is commonly referred to as the unit or general unit shop. In the one-teacher program a number of different areas are taught in a single shop, this organization is the comprehensive general shop.

Factors which influence the shop organization are:

- a. The size of the school.
- b. Pupils interest and needs.
- c. Type of community.
- d. Educational background of teacher.

In the small schools where enrollment will not justify several industrial arts teachers and a series of general unit shops, the comprehensive general shop with activities in three or more unrelated areas may best meet the needs of students and serve the community. School consolidation is responsible for a small increase in general unit shops, at the same time there is no obvious decrease among the comprehensive general shop plan since these are being retained to serve the junior high schools.

Industrial arts should be part of the required curriculum in the junior high school. At this age pupil interest is high, and facilities should be available for broad, exploratory experiences. A work station with adequate materials and tools of good quality should be

provided for each student enrolled. The shop should be organized to serve the more mature needs of the students.

The senior high school, in the smaller community, will probably have one comprehensive general shop. The larger schools with more than one teacher are moving toward several general unit shops. In either organization, the facilities can be provided for beginning and advanced activities. Students in the senior high school will look for offerings with greater depth and complexity, with a degree of concentration in one area. Equipment, activities, and classroom procedures will more nearly reflect the practices found in industry.

Laboratory organizations for teaching industrial arts fall into three major types.

The Unit Shop

The industrial arts shop with facilities for only one area of instruction, such as, cabinetmaking, machine shop, or sheet metal, is a unit shop. The real purpose of this type of organization is to provide a concentration in one area. The limited scope is the chief objection to this type of shop. This type of organization requires a separate shop for each area being taught in industrial arts.

The Limited General Shop or the General Unit Shop

The limited general shop is so equipped to provide instruction in two or more sub-areas within the same area. For example, general metalworking would include sub-areas; such as, art metal, sheet metal, bench metal, welding, foundry and metal machining. In the graphics arts shop, sub-areas may include silk screen printing, linoleum block printing, book binding, photography, and general printing. In the woodworking shop, sub-areas may include patternmaking, cabinetmaking, furniture reproduction, upholstery, design, wood finishing, and other activities related to the wood industry. A more varied program of instruction is possible under the limited general shop plan.

The Comprehensive General Shop

This plan is organized to provide experiences which have been selected from a wide variety of activities in three or more unrelated areas of industrial arts. These activities are usually taught by one teacher in one shop. The activities common to this type of shop organization are drawing and planning, woodworking, electricity, metalworking, and crafts.

BUDGET

While little has been said about the budget for the industrial arts shop, it is a very important item. No one would expect the industrial arts shop, with an initial investment of several thousand dollars, to go on indefinitely without an occasional need for some machine parts replacement or the replacement of a worn-out hand tool, etc. When we consider a maximum class load for one day going through the industrial arts shop, a considerable amount of strain and wear is brought to bear on the equipment and hand tools.

Capital Outlay

The Industrial Arts Department, as part of a modern school plant, will be in a better position to function properly if accurate records are kept. These should be in the form of inventories of everything in the shop which belongs to the school board. All equipment should be protected by insurance.

A report should be prepared by the industrial arts teacher, toward the end of the school year, with information as to condition of each piece of equipment. If replacement parts are needed for machines, a new bench or certain hand tools are needed to replace broken or worn-out tools, a list should be prepared by the teacher in the form of a requisition. This request should have the approval of the principal and should list only those items which, understandably, will become the property of the school board. This requisition for permanent type items would be directed through the principal's office to the superintendent, who would present it to the board.

Supplies

A general operating budget provided by the board of education to strengthen the industrial arts program is needed in areas of the state. A sum of money, based on enrollment in the classes, is an admirable approach to this problem. This amount set aside by the school board, and the sum made known to those concerned, should be available for purchasing supplies as they are needed. The supplies needed in an industrial arts program should be anticipated by the teacher as far in advance as possible, and a purchase order placed with the Board of Education for such supplies.

Many teachers, with the help of their principals, have succeeded in establishing a revolving fund within their school for industrial arts supplies. This fund, when established, will enable the teacher to make purchases any time during the school year.

Any income which the Industrial Arts Department may have, including fees, sales of projects, etc., would be placed in this revolving fund. This will necessitate some bookkeeping and receipt writing on the part of the teachers or someone in the principal's office.

Many advantages can be seen in planning the program to operate within a budget. Some of these are:

- a. The teacher would limit buying to those items needed and within the departmental budget.
- b. Purchases could be made toward the end of the school term for the following term.
- c. More responsibility would fall upon students to accept budgetary spending and help eliminate waste.

Library

Study habits are changing in today's schools. Fewer students are assigned to the one-hour study hall for reading or preparing for an examination. Planning rooms are frequently a part of the industrial arts shop layout and are being utilized for a shop library among other things.

A selection of good books for the shop library can best be made by the industrial arts teacher. It is also true that these books, periodicals, and magazines will be used more if they are available and students can have ready access to them during the class period.

Many favorable changes in the instructional program over the past few years can be traced directly to the availability and use of good reference and text books for industrial arts.

The planning and drawing room adjacent to the industrial arts shop, should be equipped with good reading materials, texts, and reference books to cover all the areas being taught at a particular school.

SAFETY

The task of the shop teacher in education for accident prevention is that of promoting and forming desirable attitudes toward safe practices on the part of the students. The formation of such attitudes, like any other attitude formation, must be based upon sound psychological principles. It results from the actual participation of the student in activities designed to show the reason for safety emphasis and to indicate desirable safe procedures in the carrying out of these activities.

Accident prevention should be taught as an integral part of the course. It should be so tied up with the general shop work that it loses its identity as safety instruction as such.

Once the job of safety instruction has been started and safe practices initiated and developed, the safety program is well on its way. Such procedure will do much to establish the desired outcome of safety consciousness and a wholesome attitude on the part of the student toward the whole accident prevention effort.

Some of the responsibilities for school shop accident prevention may be assigned to instructors. In some cases the actual carrying out of administrative safety provisions is done by the instructors in charge of the shop. Other safety provisions must be initiated by the instructors. These may include:

- a. Maintain the shop in safe working condition. This may include rearranging for safer operation, building suitable guards, and *setting up good housekeeping conditions*.
- b. Provide adequate safety instruction in the shop courses. Such instruction is most effective when it is given as a part of the total shop program, being emphasized as the occasion arises.
- c. Lead the students in shop accident prevention. Obey all safety rules and regulations adopted in the shop. *Be a good example.*
- d. Formulate regulations for the safe operation of the shop program.
- e. Follow through consistently on safety instruction to see that students do not digress from safe practices and procedures.

"Teacher Liability in School-Shop Accidents," by Denis J. Kigen, is a very fine book for the industrial arts library. In addition to the up-to-date information, the bibliography includes an excellent list of books, pamphlets, and periodicals on this subject. This book is available from Prakken Publications, Inc., Ann Arbor, Michigan.

CHAPTER II

THE MEANING AND FUNCTION OF INDUSTRIAL ARTS

INTRODUCTION

A static civilization can not long endure. Each society is faced with extinction or drastic transformation unless its institutions are effective in preparing successive generations to enhance and expand those ideals and values cherished by that society. Furthermore, a prerequisite for effective citizenship is an understanding of those elements in the culture that are so pervasive that their influence is felt by all, irrespective of occupational pursuits. To the extent that members of a given society grasp the significance of these dominant elements, and understand the impact which they have not only on their livelihoods but also on the direction their lives may take, then to this extent are they in a position to act as informed citizens.

The culture in which we live is tempered by the magnitude of its industrial dimension. Our citizens are dependent not only on the products of American industry, but a majority of them earn their livelihood in industrial or related occupations. Should our schools fail to provide adequate programs for the development of realistic understanding of the industrial society in which we live, they will do so at the risk of developing citizens who will be unprepared to meet the challenges thrust upon them.

INDUSTRIAL ARTS DEFINED

Industrial arts is a phase of general education which includes the study of industry, its organization, materials, processes, products, occupations, and those basic problems common to a changing technological society. Industrial arts is the general education phase of industrial education and is considered to be of value to all boys and girls. The other phases of industrial education have different purposes, which are vocational in nature, and will be discussed elsewhere in this chapter.

A modern and purposeful industrial arts program provides opportunities for students to develop habits, attitudes, and abilities desirable for all citizens of an industrial society, regardless of occupational pursuits. It is concerned with providing experiences for students which will enable them to understand the industrial and technological elements in their environment, to develop interest in and knowledge of

modern industry, to develop the ability to select and use intelligently the materials and products of industry, to find effective means of expressing their natural urge for creative and constructive activity, and to develop skill in solving problems.

THE GROWTH AND DEVELOPMENT OF INDUSTRIAL ARTS

Technical school shop work, then known as "Manual Training," was first introduced into American high schools around 1880. The subject matter content was limited in scope with primary emphasis on development of manipulative skills. The program was generally confined to high school in large cities, and the work was considered by many to be essentially vocational in character.

By the turn of the century, due to the influence of the arts and crafts movement plus a growing concern for a more functional school shop program in harmony with the prevailing philosophy and purpose of general education, the name was changed from "Manual Training" to "Manual Arts." Although this move brought about certain desirable changes in the school shop program, chief of which was the substitution of individual student projects for abstract graded exercises, there remained considerable confusion both among educators and lay citizens concerning the character and purpose of the program.

It was not until after World War I that substantial progress became apparent. With the enactment of the Smith-Hughes Act in 1917, creating federally reimbursable vocational programs of less than college grade in agriculture, home economics, and trade and industrial education, new and modern concepts began to evolve concerning school shop work for general educational purposes. Thus around 1920, the term "Industrial Arts" replaced that of "Manual Arts." This change resulted in a move to revitalize the school shop program in line with general education needs of young people destined to live in a predominantly industrial society. Consequently the objectives of the program were clarified and refined, school shops and laboratories were modernized and expanded, and the subject matter was broadened and enriched.

As evidenced in most attempts to bring about desirable change in educational patterns, progress in the field of industrial arts education has not kept pace with needs. Even so, considerable gains have been made. A vast majority of the more modern public junior and senior high schools in the nation include industrial arts in their instructional programs. In some states, the state of Utah as an example, industrial arts is offered in every public junior and senior high school.

In numerous instances, industrial arts is offered in elementary schools, especially for grades five and six. Below the fifth grade, industrial arts is usually correlated with artcraft activities.

Although significant advances have been achieved in developing modern and functional industrial arts programs in the American schools, especially during the past two or three decades, much remains to be done if the needs of our young people are to be adequately met. Moreover, as industrialization and the population growth continue to mount and an ever increasing percentage of our citizens shift from rural to urban centers, coupled with the fact that the schools continue to be assigned more and more functions formerly provided for in and around the home, the need for industrial arts education becomes more imperative.

In Kentucky, a state that is rapidly becoming industrialized, great gains in industrial arts have been realized in recent years. Previously, industrial arts programs were confined chiefly to the larger city junior and senior high schools. But with an accelerated program of consolidation, practically every new junior and senior high school in the state has included industrial arts in its curriculum. In all probability, due in part to state requirements for accreditation of schools plus the growing recognition of need for this work, every public junior and senior high school in Kentucky will soon provide a diversified program in industrial arts. This is a worthy and attainable goal. It can and must be accomplished if succeeding generations are to be prepared to live effectively in an ever increasing industrial and technological society.

OBJECTIVES OF INDUSTRIAL ARTS

As is true for all educational goals, industrial arts objectives must be based upon a sound philosophy of education. These objectives, expressed in terms of behavior changes, serve as goals to be attained, guides for the selection and organization of subject matter, the basis for determining teaching method, and as standards for evaluation. It should be noted that many of the objectives for general education are common to the various subject fields. Thus, industrial arts must contribute to this common educational purpose and, at the same time, emphasize those objectives that are somewhat unique to this particular field.

A sound program of industrial arts offers opportunity to student and teacher alike for achievement of the objectives that follow. These

should be considered as the major or overall objectives for industrial arts and not the specific objectives for a particular course.

1. To develop in each pupil an appreciation of industry, its vocations, processes, raw materials used, products manufactured, and its economic and social significance to our way of life.
2. To develop in each pupil an appreciation of good design, materials, craftsmanship, and the ability to select, care for, and use industrial products wisely.
3. To develop the ability to do creative thinking and to analyze and solve both tangible and non-tangible problems in a systematic and economical manner.
4. To develop in each pupil a feeling of pride in his ability to do useful things and to acquire wholesome avocational interests that will project into adult life.
5. To develop in each pupil an awareness of the dignity of work and the habit of safe and efficient performance of work practices of everyday living.
6. To develop in each pupil an understanding of current graphic representations and the ability to express ideas by means of drawings and sketches.
7. To acquire technical and related knowledge and develop desirable basic skills in a variety of industrial areas.
8. To explore numerous vocations for the purpose of extending understanding and to provide information concerning occupations and opportunities for self-realization.

THE RELATIONSHIP OF INDUSTRIAL ARTS TO GENERAL EDUCATION

A major purpose of general education is to enhance, expand, and transmit those desirable elements of our culture to succeeding generations. It is, therefore, essential that those charged with this responsibility be endowed with a high degree of understanding of the culture they desire to pass on. The American way of life, although embedded in a highly industrialized and technological environment, is characterized by its democratic principles. In view of this fact, it would seem that the subject of industrial arts should be an integral part of the school curriculum of a democratic industrialized nation whose destiny depends upon an enlightened citizenry.

A further purpose of general education is to develop common values, skills, understandings, and appreciations based upon the

fundamental precepts of democracy. These values, skills, appreciations, and understandings serve a social-integrative function and center around the common core of enterprises shared by most citizens. Furthermore, except for our democratic precepts and structure, the magnitude of our industrial dimension, supported by science and technology, has been and will undoubtedly continue to be the most pervasive influence on the American way of life. Thus industrial arts, which is concerned with the study of industry and its related problems, fits well within the scope of general education since industry, in large measure, has become the mainspring of our cultural enterprises.

THE RELATIONSHIP OF INDUSTRIAL ARTS TO VOCATIONAL AND TECHNICAL EDUCATION

There exists a close kinship between certain aspects of industrial arts and the vocational phases of industrial education in much the same sense as other facets of general education relate to all vocational fields. Chief among these are subject matter, methodology, and laboratory facilities. But the objectives for and the groups served by these two types of industrial education programs are vastly different.

Industrial arts instruction is broad in scope and is concerned primarily with those general educational aspects of industrial education needed by all boys and girls, irrespective of their individual vocational objectives.

The vocational phases of industrial education are more limited in scope and specific, with chief emphasis on the development of vocational skills, attitudes, and technical knowledge. More complete descriptions of vocational-industrial education and vocational-technical education follow.

Vocational-Industrial Education

Vocational-industrial education (frequently referred to as trade training) is primarily concerned with preparing youth sixteen years old and over for industrial employment, or to provide needed additional training for adults who have already entered an occupation and desire to further advance themselves.

Vocational-Technical Education

Vocational-technical education is designed for youth over sixteen years of age and adults who desire to enter industry as technicians, laboratory workers, inspectors, supervisors, or engineering aids. This type of training is generally offered on the post-high school level.

CHAPTER III

THE INDUSTRIAL ARTS TEACHER

Many desirable learning experiences and behavior changes are brought about in the student under the guidance of a good industrial arts teacher. Lasting impressions are made as the student satisfies the curiosity or urge to build something in the shop and has been successful in securing information and discussing his problems with a qualified, well trained teacher.

The teacher helps the student gain first hand experiences with tools, materials and machines which may become an important part of his life. The industrial arts teacher is a most important person in



Teacher Assists Young Drafting Student

their lives as he helps them develop basic skills and in his teaching routine, creates a shop atmosphere favorable to the student and conducive to learning.

COMPETENCIES

A program of industrial arts teacher education should seek to develop the following in each person preparing to enter this subject matter area of the teaching profession:

1. Ability to determine the extent and nature of community needs, whether they be social, vocational, recreational or civic, and to organize accordingly an effective industrial arts curriculum in terms of a total comprehensive program of education.
2. Ability to co-operate with his associates and administration officials in developing the best educational program that existing conditions and limitations permit.
3. Ability to develop objectives of the industrial arts program and plan and present instruction in order to achieve those objectives.
4. Ability to practice long term planning in developing the industrial arts program based on sound and discernible educational trends and needs of the community.
5. Ability to plan the industrial arts laboratory, select equipment and direct its installation in conformance with sound principles of school planning, economical use of materials, and the best utilization of space.
6. Ability to determine the type and quality of laboratory supplies, economize on their purchase, and organize, store and dispense in an efficient manner.
7. Ability to devise an adequate financial plan for the purchase of annual supplies and equipment.
8. Ability to select and develop effective instructional devices that will expedite learning.
9. Ability to experiment with and practice elementary research procedures in discovering and using new industrial materials and techniques, new projects and problems and new methods of instruction.
10. Ability to organize and maintain safety tested instructional facilities in a manner that will promote efficiency and provide a wholesome democratic atmosphere.

11. Ability to organize and direct student personnel in a manner that will cause them to develop a co-operative attitude and a sense of responsibility in a wholesome democratic atmosphere.
12. Ability to develop a safety consciousness on the part of the student that will enable him to avoid accidents in the school and in other life activities.
13. Ability to demonstrate skilled performance and technical understanding as a craftsman-teacher in a wide area of industrial activities.
14. Ability to maintain a propriety in his daily habits that will result in maintaining the respect of his students, colleagues, and school patrons.
15. Ability to understand and practice wholesome human relations with pupils which indicate an understanding of the complex problems relative to human growth and development.
16. Ability to develop enthusiasm for learning and to maintain a classroom morale which reflects the influence of an effective teacher with the ability to motivate students to learn.
17. Ability to direct pupils in a study of occupations and industrial problems, so as to contribute to their social understanding and enable them to make a more intelligent vocational choice in the future.
18. Ability to direct students in the various instructional areas in a manner that will enable them to develop individual interest patterns that will contribute to the objective of self-realization.
19. Ability to determine student achievement and evaluate the quality of his own instruction.
20. Ability to understand and implement problems and practices relative to his program, the school, community, nation and society in general, indicating an educational background commensurate with the qualifications and position that he holds.
21. Ability to interpret his area of education to the school and community through the various media of communication available.
22. Ability to grow professionally through continuous in-service-education.

CHAPTER IV

THE INDUSTRIAL ARTS CURRICULUM ASSUMPTIONS

The following assumptions have been adopted from a report of Dr. M. Ray Karnes* which was presented as a paper entitled "Tentative Assumptions" to the joint Illinois-Indiana Conference on Industrial Arts Education held on May 4, 1957.

- I. *With reference to social, economic, and technological developments, it is assumed that:*
 - A. Technological change in industry will continue at an accelerating pace.
 - B. The economy will continue to expand with an accompanying rise in the standard of living for an increasing proportion of the population.
 - C. An increasing proportion of the total labor force will be employed in business, industrial and service occupations.
 - D. A decreasing proportion of the total labor force will be employed in occupations presently classed as unskilled and semi-skilled, and an increasing proportion in professional, semi-professional, managerial, technical and highly skilled pursuits requiring the higher levels of preparation.
 - E. An increasing proportion of women, both single and married, will enter employment, with less and less distinction being placed between occupations for men and for women.
 - F. Even though the number of people in the labor force will continue to increase, national security and the nation's economy will demand increased productivity per capita.
 - G. The number of working hours will continue to decrease with an increased amount of available time to the individual.
 - H. An increasing proportion of the total labor force will experience an increasing need for technical and applied science competencies.
 - I. The increased complexity of our society will demand a greater knowledge on the part of each consumer of goods and services.

* Dr. M. Ray Karnes, Professor and Chairman, Department of Industrial Education, University of Illinois.

- J. Medical science and changing conditions under which people live and work will further increase the life span. This will tend to bring about:
1. An increase in the total population.
 2. An increase in the number of years the individual attends school on a full-time basis.
 3. An increase in the number of years the individual could participate actively in the labor market.
 4. An increase in the age at which full-time employment begins.
 5. An increase in the number of years remaining after retirement.
- K. Communication in its broadest sense will become increasingly important as a basic characterization of the evolving industrial-technological society. Some aspects of communication which are likely to accelerate are:
1. Geographic and occupational mobility of people.
 2. Exchange of goods, services, information and ideas.
- II. Educational planning must go beyond observable social, economic, and technological trends and be grounded in a philosophic frame of reference if it is to be effective. Fundamental to the planning and conduct of a program of education which is right for the people of a democratic society are certain basic precepts of democracy. *With reference to the tenets of democracy and their implications for education, it is assumed that:*
- A. Democracy is more than a form of government; it is a way of life.
 - B. The individual is of supreme worth; the state exists only in the interest of individual welfare.
 - C. Individuals deserve and shall enjoy that maximum degree of freedom which knows as its only limits the self-imposed and the public restraint which prevents one individual from encroaching upon the freedom of others.
 - D. There shall be only one class of citizenship, and each individual shall enjoy to the fullest the rights and privileges which he earns by meeting the responsibilities which go with citizenship.
 - E. An educated, enlightened citizenry is essential to a democratic form of government and a democratic way of life.

Every individual is entitled to, and shall have available to him, that amount and that level of education commensurate with his ability to profit from it.

- F. Education shall be made available to all as a public responsibility. At the same time the people shall be free to pursue education in private institutions, and individuals and groups shall be encouraged to maintain such institutions.

III. *With reference to the school, the pressures which will be exerted upon it, the problems with which it will be confronted, and the changes it will undergo, it is assumed that:*

- A. Enrollments, lay interest, and attacks upon the schools will increase which in the end will result in improvements and increased financial support.
- B. The small schools with low enrollments and limited course offerings will continue to decrease in number.
- C. As schools become larger and more complex, the school will follow the pattern of industry in that more consultants, supervisory personnel, and other special staff members will be required.
- D. The manpower needs of the nation will become such an urgent problem that the public will demand that ways and means be devised to get the highest possible percentage of pupils with ability to profit from the training into and through college or a technical institute.
- E. Strong pressures will be exerted upon the school for more efficient and economical means of operation and the problems of obtaining funds for existing and new programs will become increasingly more difficult without Federal aid.
- F. With a social and economic complexity calling for breadth of education and with employment conditions demanding specialization and depth, the counter-balancing of pressures between general and specialized education will continue.
- G. A major development will be the establishment of numerous new junior and four-year community colleges and a variety of programs in vocational-technical institutes on an area basis.
- H. Adult education, both for general and for vocational purposes, will continue to expand.

- I. The problem of obtaining staff, both in the elementary and secondary departments which compete directly with industry for professional personnel, will become much more difficult before an adequate supply of teachers and other professional school personnel will be available.
- IV. *With reference to industrial arts at the elementary, secondary, adult and college levels, it is assumed that:*
 - A. There will be a continued growth and expansion of industrial arts at all levels. As growth occurs, major changes will be made both in definition and interpretation of objectives and in content and activities selected to achieve objectives.
 - B. The problem of defining and interpreting objectives which are valid and appropriate for industrial arts will receive increasing attention, both by industrial arts personnel and by other groups. Objectives and emphasis in industrial arts at the secondary level will move toward the central purpose of educating people with reference to the industrial aspect of the culture, with the result that fewer claims will be made to the effect that industrial arts makes major contributions to all of the objectives of general education.
 - C. As the trend toward the movement of the vocational-industrial programs to the post-high school level continues, and as secondary schools grow larger and more comprehensive, advanced industrial arts offerings at the *senior* high school level will experience further growth and development.
 - D. The national interest in the problem of providing an adequate supply of personnel with advanced preparation, particularly in engineering and the sciences, may lead to an increase in the difficulty of getting the bright pupil who is college bound to enroll in industrial arts classes, unless rather drastic adjustments are made in the industrial arts program to make it more challenging and more beneficial to the bright pupil.
 - E. The concentration of industrial arts enrollments at the junior high school level and the increase in school size are two trends which will focus attention upon the adequacy of the industrial arts program in the junior high school.

Careful research and evaluation will reveal that there are major weaknesses in the exploratory program of the multi-shop junior high school, whether the pupil be rotated through a series of general unit shops or remains in one of a series of identical comprehensive general shops for an extended period of time.

- F. The general shop concept, historically, is tied to two considerations: (1) The need which arises in the small school in which only one shop and one industrial arts teacher can be provided, and (2) The assumed need for broad exploration as an emphasis in the introductory phase of industrial arts. Experience and experimentation with the general shop pattern and with the exploration emphasis will lead to further experiments with: (1) Introductory industrial arts programs in which breadth and exploration are not the major emphasis, and (2) The general shop pattern of organization in programs designed for the most mature, experienced, and competent industrial arts pupils of the large senior high school.
- G. As industrial arts programs expand and develop, and as the typical school grows larger, there will be need for an increased number of industrial arts personnel to fill such positions as local supervisor, curriculum specialist, physical plant specialist, consultant to elementary school personnel, consultants for industrial arts in the adult program, teacher educators in the field of industrial arts, specialists in research in industrial arts, etc.
- H. As new media and new processes result from technological advancement, industrial arts teachers will become more and more inclined to explore possibilities for incorporating them in the industrial arts offerings.

CURRICULAR PRINCIPLES

Schools in Kentucky are diverse in nature, and they vary in size, curriculum and the type of community served. Likewise, the industrial arts programs and their facilities vary from community to community. Regardless of these differences, each school should provide the program of industrial arts that best meets the needs of all the students in that particular community. An effective industrial arts program is adaptable to future changes, and it reflects, in its scope, the accepted philosophy and objectives.

The embodiment of the following specific curricular guides should aid in realizing an effective program of industrial arts on the secondary level:

1. *ALL STUDENTS*—boys and girls, of different abilities, and of different interests should have some experience in the industrial arts laboratories.
2. A junior high school industrial arts program, whether in a large or small school, should provide students basic understanding and broad exploratory experiences rather than a field of specialization.
3. It is recommended that only one Carnegie unit of credit for any one subject area be offered in the industrial arts program except in instances where local conditions justify a departure from this general recommendation.
4. The length of the senior high school class should be for one period duration, meeting each day during the school week. The junior high classes may meet fewer hours, depending upon the school organization, but not less than two hours per week.
5. A special effort should be made to aid students in discovering their interests, aptitudes and abilities.
6. Vocational guidance is a recognized function of industrial arts, and students should gain experiences that may later aid them in selecting and succeeding in an occupation of their choice.
7. Industrial arts is a laboratory for guided learning experiences, and regardless of students' future plans, industrial arts experiences should be an integral part of their total education.
8. Junior high school industrial arts should utilize different media in succeeding years rather than more advanced work in the same media.
9. Schools with one or two industrial arts teachers should have a comprehensive general shop, while those schools with several industrial arts teachers should consider the general unit type of organization with students being rotated through the shops.
10. While emphasis should be placed on achievement equivalent to the individual's ability, and although manipulative skill is a factor in industrial arts instruction, it is not the dominant objective in this area of study. Others deserving perhaps equal emphasis are: appreciation of industry, consumer

competence, leisure time interests, problem solving and opportunities for experience in areas of work where self-realization is possible.

11. Each industrial arts course should be organized in terms of educational objectives that are attainable through planned and systematic instruction. Students should be permitted to exercise their own initiative and judgment in selecting projects and problems as long as these selections contribute to the realization of course objectives and are consonant within the abilities of the students.
12. Industrial arts activities should be of a type that experience in them by the student may contribute to the development of the ability to solve problems and successfully pursue investigation and experimentation. Whereas meaningful repetition may be necessary in developing some skills to a high order of perfection, most levels of skill development compatible with industrial arts objectives may be attained without over-emphasizing this technique.
13. The development of skill in industrial arts instruction is always a factor, but the degree to which it is developed should not dominate or over-shadow over established industrial arts objectives.
14. The industrial arts program should include a study of many selected occupations.
15. Adequate written instructional material dealing with both general and technical information should be available for student use.
16. Examples of recent and appropriate industrial material should be utilized in the industrial arts instruction.
17. The tools, equipment and materials of the industrial arts laboratory should be selected on the basis of their contribution to the achievement of established industrial arts objectives.
18. The senior high school industrial arts program should include a broad offering of subject matter areas and yet permit a degree of specialization where specific student interests and needs are indicated.
19. The comprehensive general shop in the senior high school, in a one or two teacher program, should provide facilities for broad and advanced laboratory experiences with an opportunity for the student to select activities in which he shows aptitude and interest which may assist him in identifying his future life's work.

20. Senior high school industrial arts should provide opportunities for greater use of precision tools and the safe operation of power equipment.
21. Industrial arts should provide opportunities and challenging situations for integrating English, mathematics, science, design, economics and sociology within the industrial arts content.
22. The pursuit of vocational interests should be strongly emphasized in the industrial arts activities.

INSTRUCTIONAL LEVELS

The following guide was taken from the educational bulletin "Accrediting Standards and Courses of Study for Kentucky Elementary and Secondary Schools."

Subjects	GRADE												Maximum Units of Credit*	Recommended Length of Course
	1	2	3	4	5	6	7	8	9	10	11	12		Year
Introductory Industrial Arts.....							x	x	(Suggested)					
General Shop									x	x			1	1
General Drafting									x	x	x		1	1
General Woodworking									x	x	x		1	1
General Metalworking.....									x	x	x		1	1
General Electricity									x	x	x		1	1
Power and Transportation									x	x	x		1	1
Graphic Arts									x	x	x		1	1
General Plastics									x	x	x		1	1

*Applies to grades 9-12 only.

MINIMUM COURSE OFFERINGS IN INDUSTRIAL ARTS IN UNITS PER YEAR

Type of School	6 year H. S.	4 year H. S.	Senior H. S.	Junior H. S.
Comprehensive	5	3	3	3
Standard	2	2	2	2
Provisional	1	1		
Prov.—Emergency	2*	2*		

*Two units in either Industrial Arts, Vocational Agriculture, or Business Education.

Industrial arts is the general education phase of industrial education and is considered to be of value to all boys and girls.

Introductory Industrial Arts

It is recommended that industrial arts be established on a separately organized basis beginning in the seventh grade. The term "separately organized" meaning that specially designed facilities should be provided to meet the activity requirements of the course and also that the instruction should be conducted by a qualified industrial arts teacher.

Administratively, the Introductory Industrial Arts course can be set up in one of several ways: (1) The subject may meet on a full time basis (five periods per week) during either the seventh or eighth grades or during both, (2) the subject may meet on a half-time basis, alternating periods during the school week with another half-time subject in the curriculum. This would be equivalent to two and a half hours per week. In this instance, the subject would be pursued continuously through the seventh and eighth grades, and (3) students may be assigned to industrial arts for a semester at a time (five periods per week) during the seventh and again in the eighth grade. Where large numbers of students are to be served, this method will probably be more expedient insofar as the organization of the industrial arts department is concerned, since the over all student load for a given time is less, therefore, less facilities are required for the storing of materials and projects.

Although Introductory Industrial Arts is pursued through two grades, it is usually treated as one course in content. This is accomplished by taking half of a designated number of units (usually four to eight) during the seventh grade and taking the other half of the units during the eighth grade. Being introductory in nature, the units included in the course should deal with the elementary phases of industrial arts and those crafts that are applicable to the maturity of seventh and eighth grade students.

General Shop

This course is intended to introduce exploratory industrial arts at the high school level. It has been defined as a course having units of instruction in three or more unrelated areas of instruction. For example, a metals unit, a woods unit, and electricity unit, etc. With the exception of General Drafting, this course should serve as a prerequisite to the other industrial arts courses in the high school curriculum. Consequently, grade placement wise it should predominantly serve students in the ninth and tenth grades. If many eleventh and twelfth grade students elect to take this one course in industrial arts, a separate section of the course should be organized in order to maintain some degree of homogeneous grouping.

General Drafting

This course will serve most effectively as an elective for students in the eleventh and twelfth grades. For those students whose vocational plans include collegiate preparation for one of the mechanical professions, General Drafting may be their only elective from the industrial arts curriculum. In this case, General Shop, the introductory high school course, should not be required as a prerequisite. *General Woodworking, General Metalworking, General Electricity, Power and Transportation, General Plastics, and Graphic Arts:* These courses are essentially second year courses in the industrial arts curriculum. For the student, this type of course affords him the opportunity to elect a degree of specialization above and beyond the exploratory unit experienced in the course in General Shop. The second year courses are differentiated from vocational training in that they continue to be exploratory in nature, offering a wide range of activities even though they are confined to one general classification of material. Thus a General Metals Course will provide experiences in sheet metal, machine tools, foundry, welding, etc.

CHAPTER V

PLANNING AND EQUIPPING INDUSTRIAL ARTS LABORATORIES

Determining the program. A clear understanding should exist concerning the purpose and function of the industrial arts program as an integral part of the total school endeavor preparatory to laboratory planning. Subject matter areas and courses must be identified before planning can be intelligently practiced or equipment purchased. It is obvious that the tools used in the various learning experiences in the laboratory cannot be determined before decisions are made relative to what experiences are desirable and educationally significant. Permitting equipment to determine the curriculum is educationally indefensible.

Guiding principles and procedures to observe in planning.

1. Determine the purpose and function of the industrial arts program.
2. Determine the courses to be offered and outline the major instructional areas.
3. Estimate present and future community needs.

4. Determine the approximate number of students and the grade levels to be served.
5. Consider the possibility of evening classes.
6. Secure an estimate of the funds available.
7. Prepare a scale drawing with major equipment located and power specifications indicated.
8. Check plans for the observance of all safety and fire regulations.
9. Consult with and secure the approval of the proper administrative officials.
10. Check preliminary and final architectural plans.
11. Secure approval in the State Department of Education.
12. Check the building as it progresses.
13. Plan thoroughly, consult with State Department and college faculty, reduce change orders to a minimum.

THE INDUSTRIAL ARTS LABORATORY

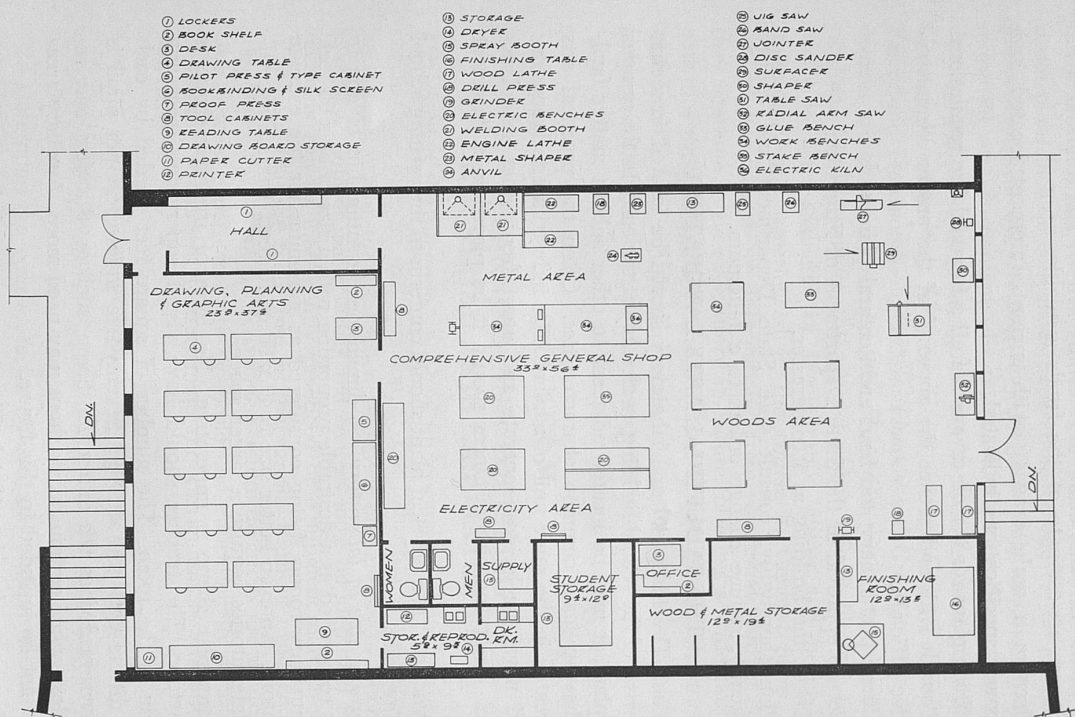
Location. The industrial arts laboratory should be located in a first floor wing of the school building, preferably at the end. In the campus type plant, it may be located adjacent to other subject matter facilities having some common characteristics. Often the practical arts are located in the same unit of a plan. The industrial arts laboratory should never be located separate and apart from other school activities. Under no circumstances should it be placed in a basement room.

Construction. The physical plant should conform to the existing school building code.

Proportion, size of laboratory. A dimensional relationship of one to two is recognized as a desirable proportion with a size of 30 x 60 feet, plus auxiliary rooms, being considered as minimum for the average laboratory. An even better size is 40 x 60 or 70 feet. Certain specialized laboratories require a larger space.

A rectangular shape is imperative. No form of irregular shape is satisfactory. The teacher should have visual supervision from any position in the room. The number of square feet needed by each pupil differs with the activity. Seventy-five square feet per pupil is usually regarded as the minimum. Some, such as, drawing, may require less, while certain heavy shops may need more. Auxiliary areas should not be included in this figure.

Lighting, natural and artificial. The very nature of the activities in which students are engaged requires that lighting, both natural and



MODEL LABORATORY SCHOOL
EASTERN KENTUCKY STATE COLLEGE
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artificial, be better than in the average classroom. The total window glass area of the room should equal at least one fourth the floor area. In order to have the intensity of light needed across the room, the top of the window glass should extend to within at least six inches of the ceiling.

Artificial lighting should be of an approved type, indirect or semi-indirect, incandescent or fluorescent fixtures, and not less than 50 foot-candles on the location where accurate work is being done. The Pennsylvania bulletin has made recommendations regarding artificial lighting.

"Artificial lighting for shops in general should produce 30 to 40 foot-candles of light on the work. Lighting for mechanical drawing and other activities where precision work is being carried on should produce 50 candles, or more, light on the work."¹

Power, water, and gas. Most shops should be equipped with electricity, water, and gas. Some laboratories do not need gas, but all need electricity and water outlets.

The locked master power panel should be located in a place where the instructor will have full control over it. Machines connected to light circuits are hazardous; and each should be on a separate circuit with individual safety switches.

Heating and ventilation. An automatic heating system should maintain even room temperature. While room temperature is sometimes too high for students who are engaged in physical activity, it is necessary in order to use most wood adhesives. The ventilation system should be such as to frequently change the air according to modern standards of school construction. Dust from machines should be removed through an exhaust system.

Floors. Most modern school buildings are constructed using reinforced concrete, and for that reason there will usually be a base or sub-floor of concrete. However, most laboratories should have a covering over the concrete. Several excellent types of floors are available and appropriate. Asphalt and rubber tile, cork, and several composition materials are satisfactory. But certain heavy shops require a different treatment.

Ceilings. Ceilings should be approximately twelve feet high and acoustically treated.

¹*Industrial Arts in Pennsylvania*, Bulletin 331, Department of Education; Harrisburg, Pennsylvania, 1951.

Walls. All walls should be treated with glazed tile or epoxy resin to a height of four or five feet.

Doors. There should be two exits to the shop with one of such size as to admit any machine, equipment, or project that may be necessary to move in or out of the building. Double doors should be used at the main and rear entrance, with a removable mullion at the rear door. Overhead doors should not be used. They utilize greatly needed wall space and are difficult to weather-proof.

Windows. Most of the outside wall area above sill height should contain windows. The type should be such that ventilation can be controlled and draft, blowing rain, or snow avoided. The awning window is ideally suited for this purpose.

Painting and decorating. The laboratory should be as attractive as any other room in the school. Great advancements have been made in the development of color schemes that take into consideration such factors as health, safety, efficiency, eye fatigue, and psychology. Many industrial firms that manufacture paint offer their services free, including recommendations concerning color schemes for the laboratory.

Chalk-board, bulletin board, display cabinet. A chalk board is needed near the demonstration center with ample board area in the drawing room for illustrations. The bulletin board is an excellent instructional aid, and a space should be provided for one near the entrance or the drinking fountain, with another in the planning area. Every shop should have a display cabinet, preferably opening on the corridor, for exhibiting the work done by the students and for displays of interesting industrial materials.

AUXILIARY ROOMS AND AREAS

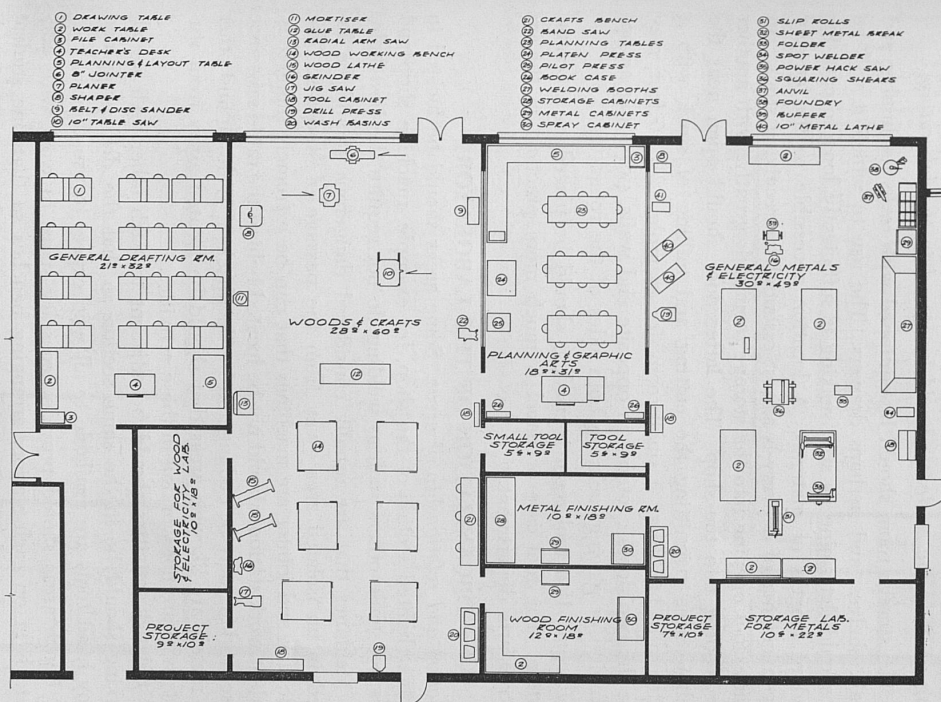
Planning center and library. A planning center and library are absolutely essential for all effective industrial arts programs. One corner of the shop may be used, although an adjacent room separated by a glass partition is more appropriate. It should be equipped with planning tables, book and file cases, and the instructor's desk.

Finishing room. A separate room is needed for finishing, equipped with sink, steel supply cabinet, shelves for articles being finished, a table, and a spray booth, if finishes are to be sprayed. Explosion-proof lights, motors and switches are essential, as well as an exhaust for spraying.

Supply or storage room. Many materials and supplies are necessary and provision should be made for them in a separate auxiliary room

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INDUSTRIAL ARTS LABORATORY
 CLARK COUNTY HIGH SCHOOL
 WINCHESTER, KENTUCKY

where they may be kept classified and dispensed in a systematic manner. Lumber and other materials should not be stored in the shop area. The wall space is needed for other purposes; it is most difficult to keep control of materials under such circumstances and the shop will often be disorderly and unsightly. *Only those materials being used by the students should be stored in the laboratory.*

The storage room should be equipped with racks for lumber and metals, shelves, and perhaps drawers. The use to which it will be put should determine its size, making it sufficiently long to care for standard lengths of material. A location accessible to the outside for convenience of delivery is almost essential for receiving stock. An outside door opening into the storage room aids greatly, with another door leading into the shop. The latter door should open near the machine area permitting the cutting and milling of stock with a minimum of handling. A small room, for example, 12 x 16 feet, may have the two doors centered in opposite end walls, providing an opportunity for placing racks on both sides of the room.

Tool room. If a tool room is used, it should be placed in a central location. The tool case or panel is much more practical in the industrial arts department.

ORGANIZATION OF THE LABORATORY

Location and relationship of areas. Some areas should be located in the best lighted section of the shop, for example, machine shop and drawing, while others such as welding do not require the best light.

Machines that are usually considered dangerous should be located in an isolated area away from the passage of students. The table saw and jointer are machines that can be extremely dangerous. Student work stations should not be located behind the table saw since those working may be endangered by "kickbacks". Welding and other hot metals are likewise areas that should be located away from students who are not working in these activities.

Related activities should be adjacent to each other. All metal-working should be in the same section so that the drill press and many hand tools are available to all who expect to use them.

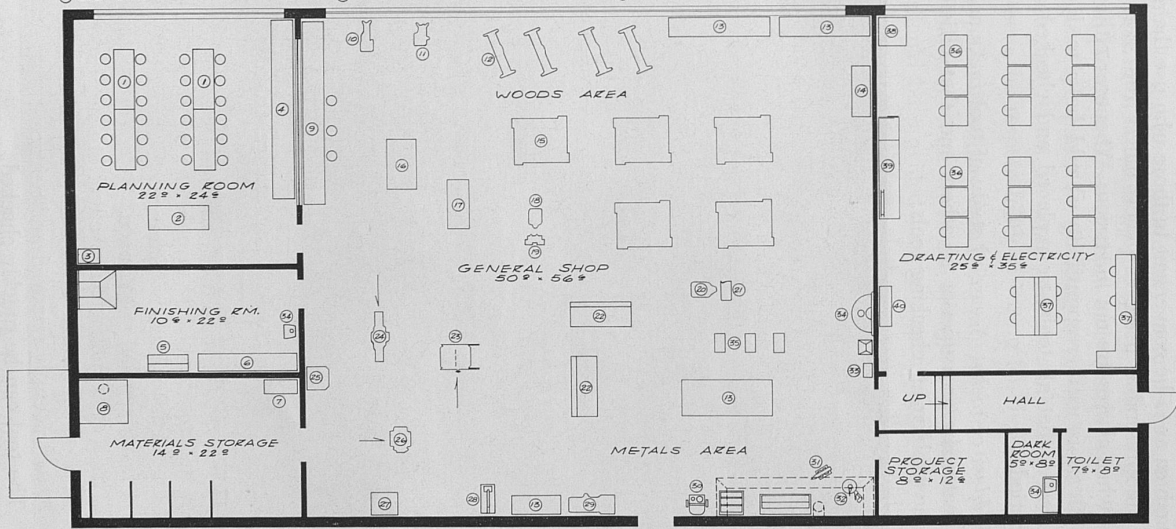
Bench areas should provide necessary space to work with adequate light on each station, arranging benches so that one student does not work in the shadow of another. An assembly and glue bench should be placed adjacent to the bench area for the use of all students. A steel plate makes an excellent top for gluing. Benches of the cabinet type with lockers and doors are desirable.

- ① PLANNING TABLES
- ② TEACHER'S DESK
- ③ FILE CABINET
- ④ GRAPHIC ARTS & SILK SCREEN
- ⑤ METAL STORAGE CABINET
- ⑥ FINISHING TABLE
- ⑦ AIR COMPRESSOR
- ⑧ DUST COLLECTION SYSTEM
- ⑨ CRAFTS BENCH
- ⑩ VIG SAW

- ⑪ 14" BAND SAW
- ⑫ WOOD LATHES
- ⑬ WORK BENCHES
- ⑭ TOOL CABINETS
- ⑮ 4-STATION WOOD BENCHES
- ⑯ GLUE & CLAMP BENCHES
- ⑰ SHOP SMITH
- ⑱ 14" DRILL PRESS
- ⑲ GRINDER
- ⑳ 17" DRILL PRESS

- ㉑ BUFFER
- ㉒ TRANSPORTATION BENCHES
- ㉓ TABLE SAW
- ㉔ JOINTER
- ㉕ WOOD SHAPER
- ㉖ PLANE
- ㉗ RADIAL ARM SAW
- ㉘ METAL SHAPER
- ㉙ METAL LATHE
- ㉚ ARC WELDER

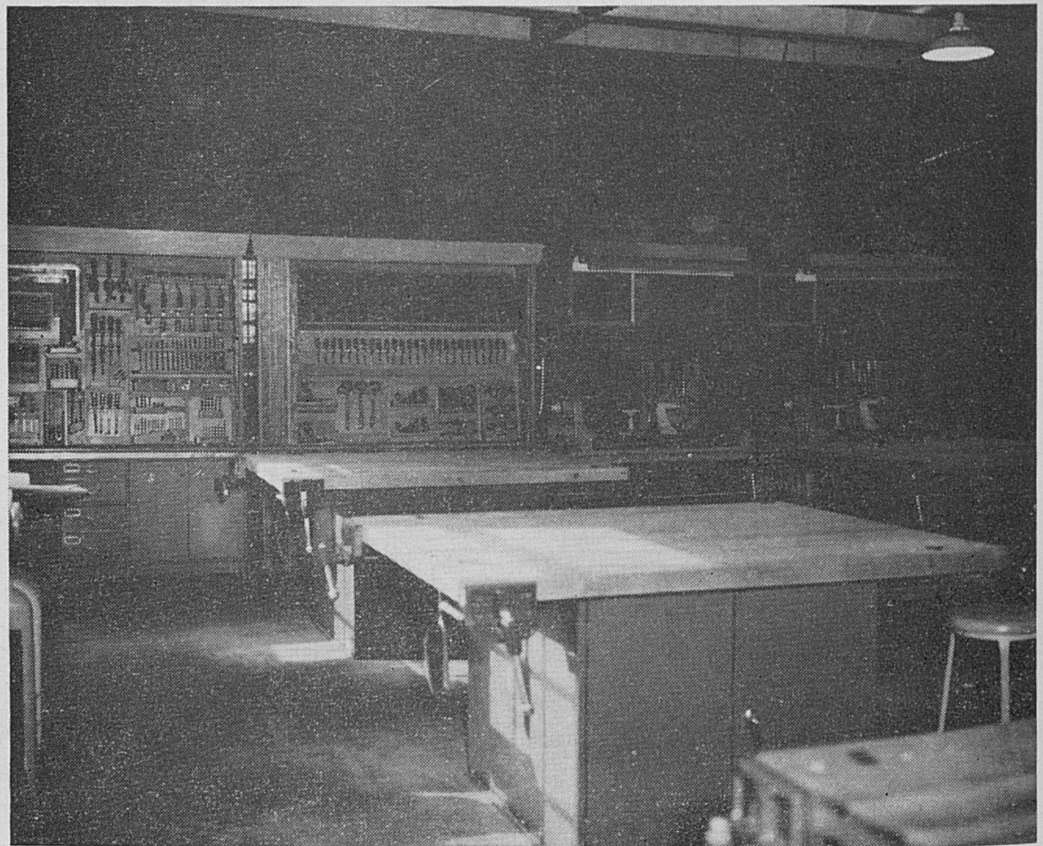
- ㉛ ANVIL
- ㉜ MELTING FURNACE
- ㉝ FOUNTAIN
- ㉞ WASH BASINS
- ㉟ SHEET METAL STANDS
- ㊱ DRAWING TABLES
- ㊲ ELECTRIC TEST BENCHES
- ㊳ DRAWING BOARD STORAGE
- ㊴ PAPER CUTTER & DEVELOPER
- ㊵ MAGAZINE STAND



INDUSTRIAL ARTS LABORATORY
DANVILLE HIGH SCHOOL
DANVILLE, KENTUCKY

Hand tool storage. Tool cabinets or panels should be placed near each area so as to be convenient to those who use them. Locked tool cases are preferable to open panel, unless the shop can be kept locked when classes are not in session. Whenever either of the above tool systems is used, responsibility should be placed upon the students to see that all tools are replaced and checked at the end of each period.

Tool holders or racks. A careful study of tool racks and holders will show that some are superior to others and that efficient ones help solve the problem of checking tools.



Well-organized Tool Storage Cabinets

Some characteristics of a good tool holder are:

1. A tool can be placed in only one position, the correct one.
2. It presents a good appearance.
3. It is economical with space.
4. It is a safe holder, sharp edges are not exposed.
5. The tool, including cutting edge, is protected.
6. A tool is easily removed and replaced.
7. The tool can be quickly checked.

Checking tools. Numerous systems have been devised for checking tools, but probably the most satisfactory is to permit students free access to all tools in the case or on the panel, with the policy established that each person will return those tools that he uses. The class can easily check each panel by glancing over the tools. Complete freedom to use and return all tools enables students to save time, and it gives them the responsibility of caring for the shop.

Storage of supplies. Facilities should be provided for the storage of not less than one year's supplies in the storage room. However, additional space should be provided for the dispensing of daily supplies, such as, sandpaper and emery cloth, screws, nails, finishing materials, and others, that are in constant demand by students. Cabinets with small drawers and shelves are satisfactory, with another cabinet place in the finishing room for those items needed there. Some supplies, screws and nails, for example, should be made available to all students without restrictions, while others, such as, coated abrasives, should have their distribution controlled.

Storage of projects. A room equipped with shelves and lockers should be provided for the storage of student materials and projects.



Well-arranged Equipment With Open Aisles

Aisles of travel. Aisles of travel should be kept open for student passage. Students should not pass through machine or other work areas where workers will be distracted or safety practices violated. The aisles should be not less than four feet in width, and, if greatly traveled, a foot should be added. The aisles may be painted a prominent color to indicate their location.

Congested areas. Entrances, exits, and the space around tool panels or the tool room should be large enough to avoid crowding. A minimum space of five to six feet in width is advisable.

Mats. Safety mats should be placed around all hazardous equipment where there is danger of slipping.

First aid equipment. The first aid kit with all the essential medical supplies for giving first aid to the injured should be located near the teacher's desk.

Fire extinguishers. There should be an extinguisher for each of the various type of fires, namely, class A, B, and C, and they should be located in prominent places.

THE PURCHASE OF EQUIPMENT AND SUPPLIES

The purchasing of equipment and supplies should be done in a business-like manner with an established budget. A school is big business, often having a budget of hundreds of thousands, or even millions, of dollars, and the industrial arts department is a rather expensive part of the school system. A budget is simply a financial plan for spending the money allocated the department. It need not be made in minute detail, but it should cover the main categories of supplies.

Dispensing supplies. The question sometimes arises: What percent of the total supply budget should the teacher be expected to return to the school from the sale of materials to students? Costs should not be excessive, although each student takes home a project of greater value than the materials used to construct it. It is not unreasonable to expect the industrial arts department to return seventy-five per cent of the total amount spent for supplies. Waste always exists in cutting small bills of material and some supplies are used for various purposes in the school that are often difficult to account for in every detail.

Each student should prepare a bill of material after completing his plans. When the bill of material is secured, each student should

pay the office and bring a receipt by the end of a certain period, whereupon the teacher marks it as paid in his book.

The instructor should provide himself with a large ledger in which he will keep a roll of each class and a detailed account of materials used by each student with the name and cost of each project. The bookkeeping should always be up to date.

SELECTION OF EQUIPMENT, MACHINES, AND TOOLS

Serious errors may be made in purchasing industrial arts equipment, including machines and tools, unless certain factors are considered:

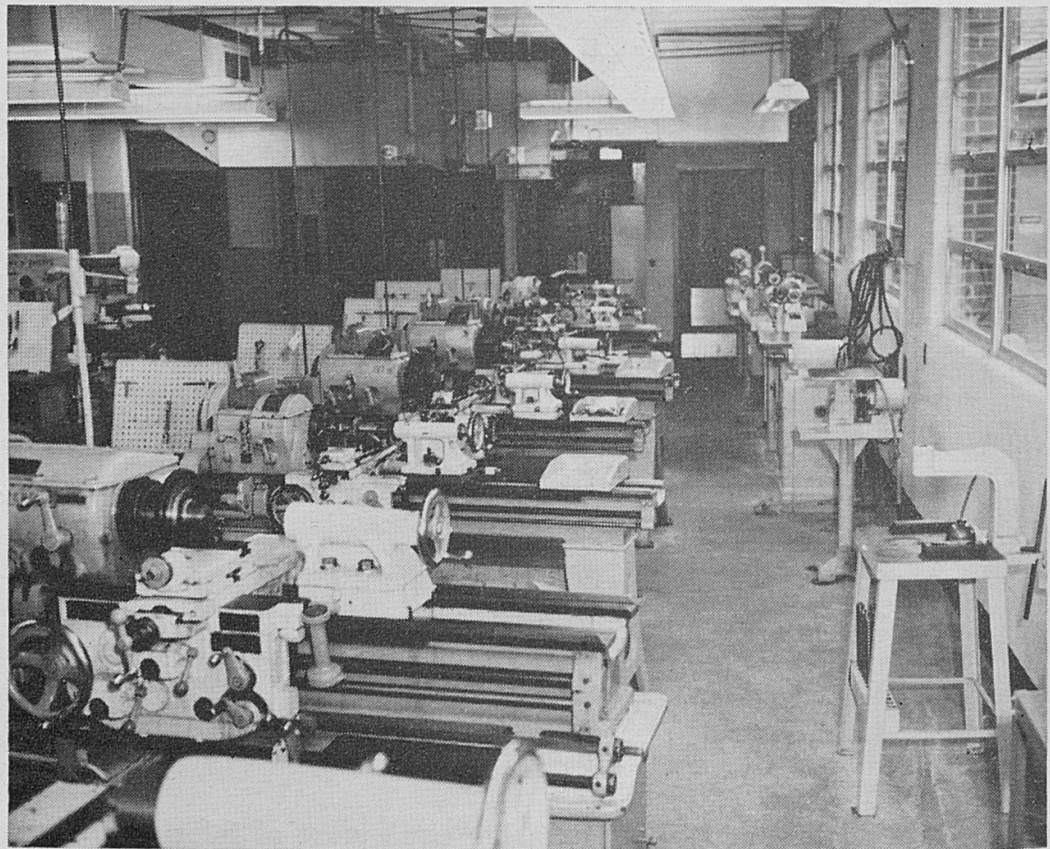
1. *Objectives of the program.* The equipment needed in a junior high school laboratory, where emphasis is basically exploratory in nature, would not be the same as in a senior high school shop of a more specialized type.
2. *Courses offered and subject matter within courses.* Equipment selection is based upon what is to be taught.
3. *Size of classes.* Quantity of benches and hand tools to be purchased depends upon the number of students to be enrolled in each class.
4. *The grade level and age of students.* Certain equipment is not suitable for immature students to use or operate, and other items are more appropriate to their needs. Table saws, jointers, and shapers are made for adults, or those approaching adulthood, and are dangerous for youngsters to operate.
5. *Present and future needs.* Not only present needs should be considered in purchasing, but an effort should be made to plan for the future or the physical plant will quickly become out of date.
6. *Trends and practices in industrial arts.* Planning and purchasing should be preceded by a thorough study of present day practices and trends in this field.
7. *Availability of funds.* Obviously, more equipment cannot be purchased than available funds permit. Under circumstances where funds are limited, essential basic equipment should be purchased, but the total program should be planned with the understanding that equipment will be secured periodically as financial resources permit.
8. *Design and quality.* Purchasing equipment of inferior quality is never economical in the school. The very best should be

purchased for learners. It should be of modern design and pleasing to the eye. Only specific or single purpose machines should be purchased. The combination machine is both inefficient and dangerous in the school shop. Benches and machines with enclosed bases present a better appearance and are easier to clean around. The open type should not be purchased if the enclosed base can be secured. All equipment should be mounted on individual floor type bases.

9. *Safety.* This is one of the more important factors to consider. Machines with open belts and other unguarded moving parts should not be recommended. Motors should be equipped with overload type switches. Safety is built into many machines, and those are the ones to select for the school shop.

SELECTION OF MACHINES AND EQUIPMENT

No one company manufactures the best machinery. A certain firm may build a greater number of what appears more nearly to meet school shop needs than any other, but seldom are all of its machines the best that can be secured.



Equipment Adequate for Purpose Intended

One company may manufacture one of the best screw cutting lathes for a high school general shop, while another firm builds the best lathe for a more specialized metalworking program. One company may build a better drill press, another a better shaper. Those selecting equipment must know machinery, its characteristics, assets, and limitations, so as to be capable of selecting the best for a particular shop.

Machinery should not be considered that is too small, does not have the needed capacity, is underpowered, or will not withstand the wear and tear of student use. The purchase of such machinery is poor economy.

Neither should heavy and costly machinery be selected that is entirely beyond what is needed to perform effectively those operations planned for the program. It is poor practice to select a 16-inch variety table saw when a 10-inch saw would serve as well, or to select a 17-inch heavy duty screw cutting lathe when a 10-inch machine would meet the instructional needs of the students.

The following specific factors should be kept in mind when selecting machinery:

1. Purpose of machine in relation to course objectives.
2. Range of operations that may be performed.
3. Capacity of machine.
4. Design and construction.
5. Drive, horse power, phase.
6. Type of bearings.
7. Adjustments.
8. Accessibility of parts.
9. Guards, safety features.
10. Floor area covered.
11. Reputation of manufacturer.
12. Cost.

Machinery is purchased for school shops to withstand years of use. It is not uncommon to find machines in many departments that have been in use for twenty or more years. For this reason alone, wise purchasing must be practiced.

Construction by the teacher. Work benches, lockers, and other equipment should be purchased. It is inadvisable to expect the teacher or other school personnel to build these. The instructor is far too involved with teaching duties to give him this burden, and seldom is the product of the quality needed in a new school. It is not too much

to expect the teacher to build tool holders for the tools and other essential items that cannot be readily purchased.

Bench and drawing table design. Work benches should be of the enclosed type, providing storage space in the metal base. Tops are usually of edge-grain maple. Four station woodworking and craft benches are recommended. The two station drawing table with drawers for storage between the stations is appropriate for most drafting rooms. These may be purchased with the bases made of either wood or metal.

Orderliness in the laboratory. The industrial arts laboratory should reflect habits of good housekeeping and the efficiency essential for effective instruction. A poorly organized and disorderly laboratory is generally indicative of an indifferent teacher and poor instruction. A well organized laboratory contributes to the development of high morale and a wholesome learning environment.

CHAPTER VI

PROBLEM-SOLVING, CREATIVITY AND DESIGN

Developing skills

The development of skills in problem solving and design as a direct result of industrial arts experiences will approach reality only when teachers gain insight into the implications of this objective and structure learning accordingly. The frequency with which this topic has appeared on the programs of national and state industrial arts conventions, and the increase in the number of articles devoted to this subject in professional journals indicates that at least a segment of the profession is willing to re-evaluate the traditional usage of the project in terms of its adequacy in developing these important skills. If it is correct to assume that students become proficient in these skills only to the extent that they are given both the encouragement and opportunity to practice them, then it follows that the development of an industrial arts project should be such that skills in problems solving and design are fostered as are those of a manipulative nature.

Problem-solving

The intellectual resources of a student are perhaps most fully operative when they are focused on the solution of a problem that is challenging and which has a personal importance to him. To be challenging there must be both the possibility of success and failure, but with the probability of success being greater if sufficient effort, both physical and mental, is put forth. For example, an advanced

woodworking student would feel little challenge or incentive to construct a set of bookends which, at the seventh grade level, may be of ample difficulty for a beginning student. On the other hand, a project which demands a skill level of a much higher order than that possessed by a student is unchallenging because the probability of success is unreasonably low. It is true that such a project may present a momentary challenge to a beginning student, but when failures, during the course of its construction, become compounded as a result of inadequate skills both the challenge and motivation to persist depreciate. The industrial arts project, then, should be regarded as a *problem to be solved*; as a physical object that, when completed, will be an adequate solution to a problem that is of personal importance to the student.

For a great many years scholars in psychology and related fields have made analyses of the problem solving process. A number of generalized models have been proposed; patterns of thinking and acting that are applicable whether one is attempting to follow a road map across a strange city to a given destination, or designing a table on which beverages, magazines, and ash trays will be placed, and which will be located in front of a couch. Perhaps the most famous and influential of all descriptions has been the five step analysis developed by John Dewey:¹ 1) becoming aware of the problem, 2) clarifying the problem, 3) proposing hypotheses for solution of the problem, 4) reasoning out the implications of the problem, and 5) testing hypotheses against experience. Although Dewey describes the model as a sequential enumeration of the steps involved in critical thinking, both Thorndike² and Russell,³ in addition to others, interpret the analysis as a description of the problem solving process. Applied to project development, the analysis may be illustrated in the following manner:

1. *Becoming aware of the problem.* The student becomes conscious of a problem which may be solved by the construction of a project in industrial arts. For example, his books may be in a state of disorder on his desk at home. At his parent's insistence, through his own initiative, or as a result of the instructor's suggestions in regard to appropri-

¹Dewey, John, *How We Think*, Boston: D. C. Heath, 1933.

²Thorndike, R. L., "How Children Learn the Principles and Techniques of Problem Solving." In N. B. Henry (Ed.), *Learning and Instruction*. The Forty-ninth Yearbook of the National Society for the Study of Education, Part 1. Chicago: University of Chicago Press, 1950.

³Russell, David, *Children's Thinking*, New York: Ginn, 1956.

ate projects for the course the student may choose to develop a project

that will store his books in a neat, orderly, and usable manner.

2. *Clarifying the problem.* This stage involves a clear cut statement of the problem to be solved. In addition, a criteria which the proposed solution must satisfy is developed. For example, the solution to the book storage problem should:

- (1) enable titles to be easily observed
- (2) accommodate books of different sizes
- (3) be durable in terms of its function
- (4) enable the reader to secure and replace books with a minimum of effort
- (5) be easy to clean and maintain
- (6) reflect an intelligent choice of materials
- (7) have a contemporary form that reveals its function and is aesthetically pleasing
- (8) be appropriate in terms of difficulty, to the skill and intellectual resources of the student

The above criteria are not exhaustive. However, they do illustrate the pattern of thinking that may be exercised in problem solving. The development of criteria will logically lead to research in regard to possible materials, finishes, and construction techniques. In addition, the student will study illustrations in books, magazines, catalogs, and newspapers to observe *how others* have solved similar problems. Visits to homes, offices, and stores to study similar solutions is a type of research not to be undervalued.

3. *Proposing hypotheses for solution of the problem.* Alternate solutions to the problem of storing books should be developed at this point. Consideration would be given to such solutions as 1) bookends, 2) a book rack, and 3) a bookcase. These would be developed as freehand sketches with as many feasible solutions as possible.

4. *Reasoning out the implications of the problem.* The student commits himself to a tentative solution to the problem. A decision is made, for example, to use a bookcase in preference to other solutions because the surface of the desk is of an inadequate size to use bookends. Additional research is employed in regard to the final form of the bookcase. Books of various sizes are measured, and shelves are spaced accordingly. A final plan of the project is completed and a model is constructed if time permits.

5. *Testing hypotheses against experience.* The completed bookcase is evaluated in terms of the criteria established in 2). If it meets the criteria the hypothesis is confirmed.

When a student becomes actively involved in the problem-solving process a level of tension is produced which serves as a strong source of motivation. When the problem is solved the tension is reduced with a resulting psychological satisfaction or pleasure. There is nothing mysterious about this process. A fisherman experiences it each time he hooks a game fish and, after a difficult battle, leads his catch into the landing net. Is it possible to structure learning in the industrial arts laboratory in a manner such that a similar level of tension, motivation, and ultimately satisfaction will be a part of the total educational experience? The answer will likely be in the affirmative when teachers begin to regard projects as *solutions to problems* that are important to students, and when students are given practice and guidance in preparing tentative solutions on paper followed with a final solution using one or more industrial arts media.

Design

Design is a special form of problem-solving involving both technical and aesthetic considerations. It is neither a synonym for decoration nor a set of rules to be arbitrarily applied. In essence, contemporary design is a *method* that is characterized by the intelligent use of modern materials and processes in solving problems related to persistent human needs in a manner such that the finished product meets a defined need, and is aesthetically satisfying to those who see and use it. More specifically, contemporary design may be understood in terms of the following:

1. *Anatomical consideration.* Contemporary designers design for human beings. Out of this emphasis have come for example, chairs such as those by Saarinen, Eames, and Wegner which admirably support the occupant without disregarding the aesthetic.

Many of the projects developed in the industrial arts laboratory will be used by students or members of his family. For example, a student may wish to construct a study table for a younger brother. An adequate design solution for this type of problem must take into account the physical size of the person who will use the table.

2. *Function.* The oft-quoted phrase, "form follows function" is of prime consideration to the designer. However, functional adequacy is no guarantee of good design. It is, however, an essential that must be satisfied.

3. *Freedom.* The contemporary designer refuses to be bound by arbitrary rules that limit rather than free the exercise of intelligence.

Proportion, balance, color harmony, and other desirable design qualities, however, are not disregarded.

4. *Experimentation.* Experimentation is basic to contemporary design. One needs only to trace the development of the Eames plywood chair to comprehend the emphasis placed on experimentation by contemporary designers. They do not expect, and seldom achieve, a satisfactory solution in their initial attempt to solve a design problem. They develop many alternate solutions utilizing a wide range of materials and construction techniques before arriving at a final product design, and this is considered final in only a tentative sense.

5. *Contemporary orientation.* The contemporary designer is sensitive to the manner of living in the particular culture for which he designs. Like the artist, he is somewhat of an interpreter of the passing scene. This generation has adopted an informal manner of living that gives the contemporary designer a sense of direction and purpose. Conversely, our manner of living is being made more pleasurable by the men who have their eyes on the present, as well as the past achievements of man.

6. *Problem-solving.* Some have suggested that both the strength and weakness of contemporary design is its intellectual approach. If by intellectual is meant the application of intelligence to develop products that better meet human needs (including the aesthetic) then this is without question a strength, but it is difficult to locate the weakness.

The youngsters who enroll for course work in industrial arts will usually have had considerable problem solving experience in their non-school activities. For example, a boy who designs and constructs a kite, snow fort, tree house, or a device for trapping small, wild animals, unharmed, has used, in gross form, the problem solving process that is basic to design. Additional practice in problem solving of a more refined order in relation to project development will strengthen these nascent skills.

Contemporary forms. The forms which contemporary products may take are virtually limitless. Without disregarding design qualities such as proportion, stability, balance, and pleasing division of masses, the contemporary designer continually seeks new forms that reflect the spirit and progress of our culture. Many of the new forms found in contemporary furniture may be traced to developments in modern architecture and painting.

Simplicity is characteristic of contemporary forms. Elaborate surface enrichment, typical of another era and culture, has been replaced by an emphasis on the natural beauty of materials.

Honesty in the use of materials is another attribute of contemporary forms. Wood is finished in a manner such that its inherent beauty will be emphasized. Metal is not disguised to resemble another material. In addition, the contemporary forms are themselves examples of honest approaches to the solution of design problems. Butter churns, quaint though they be, do not appeal to contemporary designers, as they do to some as ideal lamp-bases. A contemporary designer insists that the form of his solution reveal its function. Thus, lamps with bases resembling water pumps, dogs, assorted fowl, coal scuttles, or wash kettles, to mention a few, have no perceptible relationship to the problem of lighting for which the lamp is a solution.

The industrial arts teacher needs only to open his eyes to the world around him and he will find unlimited examples of contemporary forms adaptable to projects at all levels of difficulty. Through guidance and instruction his students may develop an understanding of, and an appreciation for these forms to the extent that their projects will reflect a quality long desired, but too infrequently achieved in the industrial arts laboratory.

Implication for project development in industrial arts

To provide educational experiences leading to the complementary competencies of skills in problem solving and design the following suggestions seem worthy of consideration:

1. Do not expect beginning and even some advanced students to master and demonstrate the competencies within a brief period of time. Skills of this nature are learned, and the development of creative talents may be a slow process.
2. Methods of project selection in industrial arts have often been classified into the trichotomy of 1) required projects, 2) limited selection, and 3) free selection. A required project, of a duration of five to six class periods, is psychologically sound for *beginning* students. It should remain foremost in the minds of industrial arts teachers that most students are highly motivated when they initially enter an industrial arts program; they expect to work with tools and materials and nothing should be permitted to dull this interest. A required project, of good design, will enable students to begin productive work at the first or second class meeting. From the standpoint of design, students will begin to see *possibilities* for using materials and tools to solve problems. It is absurd, although it may be found in practice, to insist that students "plan" or

"design" projects before initial and exploratory experience with tools and materials.

The "limited choice" plan of project selection from categories of predesigned projects is a natural step to be taken after the completion of the required problem. The degree of freedom permitted at this stage lays the groundwork for genuine creative opportunities.

"Free selection" enables the student to move ahead, with the teacher's guidance, in the identification of problems, developing design solutions which have possibilities of solving the problems, and finally, of completing the projects. A plan which one of the authors used for two years with seventh grade students incorporated an individual notebook of problems and proposed solutions which was submitted for evaluation each week.

3. Encourage students to use materials honestly and intelligently. Plastics, for example, should not be used for a project unless it is the most logical material when compared with wood, metals, leather, and other industrial arts media.
4. Insist that students capitalize, in their project designs, on the unique and distinguishing characteristics of a given material. For example, a thermoplastic may be blown, stretched, or formed. Project designs involving thermoplastics should demonstrate one or more of these qualities.
5. Reward, through praise and marks, evidence of creativity.
6. Insist that students follow a systematic plan of procedure accompanied by a working drawing of a quality appropriate for the grade level.
7. Require a level of craftsmanship suitable to the ability and grade level of the students.
8. Provide, in the related library, copies of such magazines as *Interiors*, *Industrial Design*, and *Craft Horizons*. In these publications students may study the solutions of leading designers.
9. Set an example, as a teacher, of project development and construction of a high order.
10. Provide for a continuous display of projects including: 1) a statement of the problem to be solved, 2) the design analysis, 3) sketches and plans depicting various solutions to the problem, and 4) evidence of research related to the problem.

11. Provide a display of photographs and clippings representing contemporary design solutions. A bulletin board will adequately serve this purpose.
12. Provide instruction related to new materials and new processes so that students may have the advantage of incorporating these in developing projects.
13. Encourage experimentation so long as it is planned, orderly, and purposeful.
14. As a teacher, earnestly test the hypothesis that all students are capable of developing and applying problem solving and design skills to a lesser or greater degree. Progress and adaptiveness, however, should be viewed on continuum rather than in terms of absolutes. As the contemporary designer does not expect perfection to result from his initial efforts, it follows that the industrial arts teacher can be no more optimistic. Some students will develop designs, as they always have in the past, that will not measure up to the instructor's expectations. However, when students are given the opportunity to develop their own designs, when they recognize that the instructor respects their ideas and judgments, and when they are encouraged, even required, to exercise their intelligence as they design and construct projects, the probability of realizing the objectives which justify the existence of our programs will be greatly enhanced.

See Appendix for reference books.

CHAPTER VII

THE COMPREHENSIVE GENERAL SHOP

A GENERAL STATEMENT OF PURPOSE

It should be understood that individuals have a more complete concept of American culture if they have an understanding of American industry.

The purpose of the general shop in the industrial arts program is to teach students the basis of our American industrial society through the media and equipment of various industries. The individual can gain this concept if he actually uses industrial procedures in the general shop. In fulfilling the purpose of the general shop, individuals

should be taught how to think creatively, develop their own ideas, plan work effectively, and solve problems by using equipment and materials.

To further analyze the purpose of the general shop, individuals should develop an understanding of how industry solves a problem (develops a product) by using machinery and equipment from many different areas (not just one area) and by using a number of various materials in one product. Individuals should be taught how to work cooperatively with one another through planning, designing, and executing a problem by the group. A degree of skill and craftsmanship should be developed not only in relation to working with materials, but in relation to planning, problem solving, and creative thinking. Other purposes of the general shop would include developing hobbies and leisure time activities, the ability to distinguish between quality and inferiority in design and workmanship, and a greater ability to select a good occupation.

If the purposes of the general shop are fulfilled, students will have a greater appreciation of our American culture.

INSTRUCTIONAL AREAS

Seventh Grade Level

A. *Drawing and planning* is a vital part of the general shop program at the seventh grade level. Rather than being taught as a unit within the general shop, separate and apart from other activities, drawing and planning should be an integral preparatory phase of each student's entry into individual areas of instruction included in the program. As such, students will be engaged in drawing and planning activities in each area prior to the performance of other activities within the area. Individual teachers may wish to simultaneously instruct all students on such things as basic principles of design, techniques of freehand sketching, principles of multi-view drawing, types of pictorial drawings, etc. However, the bulk of the drawing and planning activities should be performed as the need arises. This will primarily consist of students preparing to enter initial areas of instruction or rotate from one area to another. In this context, drawing and planning will be an on-going part of the program in which the participation of each student will be determined by his or her individual needs.



A Drawing and Planning Group of a General Drafting Class

Fundamental understandings and manipulative techniques to be developed:

1. Basic principles or design.
2. Technical sketching.
3. Use of basic drafting tools and equipment.
4. Methods of graphic representation.
 - a. Multi-view drawing
 - b. Pictorial drawing
 - (1) Isometric
 - (2) Oblique
 - (3) Perspective
5. Preparation of bill of material and computation of material costs.
6. Plan procedure.

Safety

Hazards to personal safety are not as prevalent in drawing and planning activities as in most other areas of the general shop program.

Improperly used, however, a pencil point, compass point, or divider point may become a dangerous weapon. Instances where severe injury has resulted from improper use of these instruments have been recorded. Proper instruction in the correct and safe use of all equipment used in the drawing and planning phase of the program is essential.

B. Introduction to Woodworking

As a result of this area in the general shop the students should:

1. Understand the importance of woodworking.
2. Understand the course requirements and develop the competencies and understandings expected.
3. Understand the shop management and safety practices.

In meeting these objectives students should understand:

1. Woodworking industries and occupations.
 - a. cabinetmaker
 - b. carpenter
 - c. patternmaker



A Woodworking Area of the General Shop

- 2. Woodworking as a hobby
 - a. economy
 - b. relaxation
 - c. consumer values
- 3. Impact of the woodworking industries on society
 - a. functional qualities of wood
 - b. common woodworking industries
 - c. wood products
- 4. General Information
 - a. Conservation of our forests.
 - b. Methods of lumbering.
 - c. Seasoning and storage of lumber.
 - d. Common native woods.
 - e. Usage of lumber.



Student at the Wood Turning Lathe

- f. Woodworking hand tools.
 - g. Elementary woodworking machines.
 - h. Woodworking abrasives.
 - i. Woodworking finishes.
5. Instructional Content
- a. The design of the project should be such that the projects are attractive, practical, and structurally sound.
 - b. A freehand sketch should be made of the project approved by the instructor.
 - c. A plan of procedure should be made showing the steps in sequence for construction.
 - d. Using the information of the working drawing, a bill of materials should be made listing all woods, hardware, total board feet, and total cost.
 - e. The design should be transferred to the stock and all joints properly located by use of the measuring and layout tools.
 - f. The cutting tools should be used to bring all stock to finished size, joints cut for assembly, and all surface blemishes removed.
 - g. A trial assembly should be made followed by the application of glue and the final assembly.
 - h. Stains, fillers, and varnishes should be properly mixed and applied with adequate drying time for each.
 - i. Brushes should be cleaned and stored for later use.
6. Safety
- a. The shop should be clean and well organized with all points of possible danger clearly marked.
 - b. Auxiliary rooms for finishing and storage of supplies should be kept clean and orderly.
 - c. All tools and equipment should be kept in good working condition with guards and other safety features in proper function.
 - d. Finishing materials should be kept in appropriate containers and stored in fireproof metal storage cabinets, with provision made for the storage or disposal of oily waste materials.
 - e. Horseplay or any other unnecessary activity which might lead to injury should not be tolerated.

- f. A first aid cabinet should be available and properly supplied to care for minor injuries.
- g. Fire fighting equipment should be available to combat all types of fire.

C. *Introduction to Metals*

There are certain exploratory activities, related technical knowledge and guidance information that will help the junior high school youth to comprehend the role of metals in our industrial society.

Study and experience in general metals will introduce a junior high school boy or girl to a better understanding of the materials and processes of the industrial society in which he will live and make a place for himself. While industrial arts at this grade level is basically for purposes of general education, the following outline will note the singular and unique contributions of experiences in metal work.

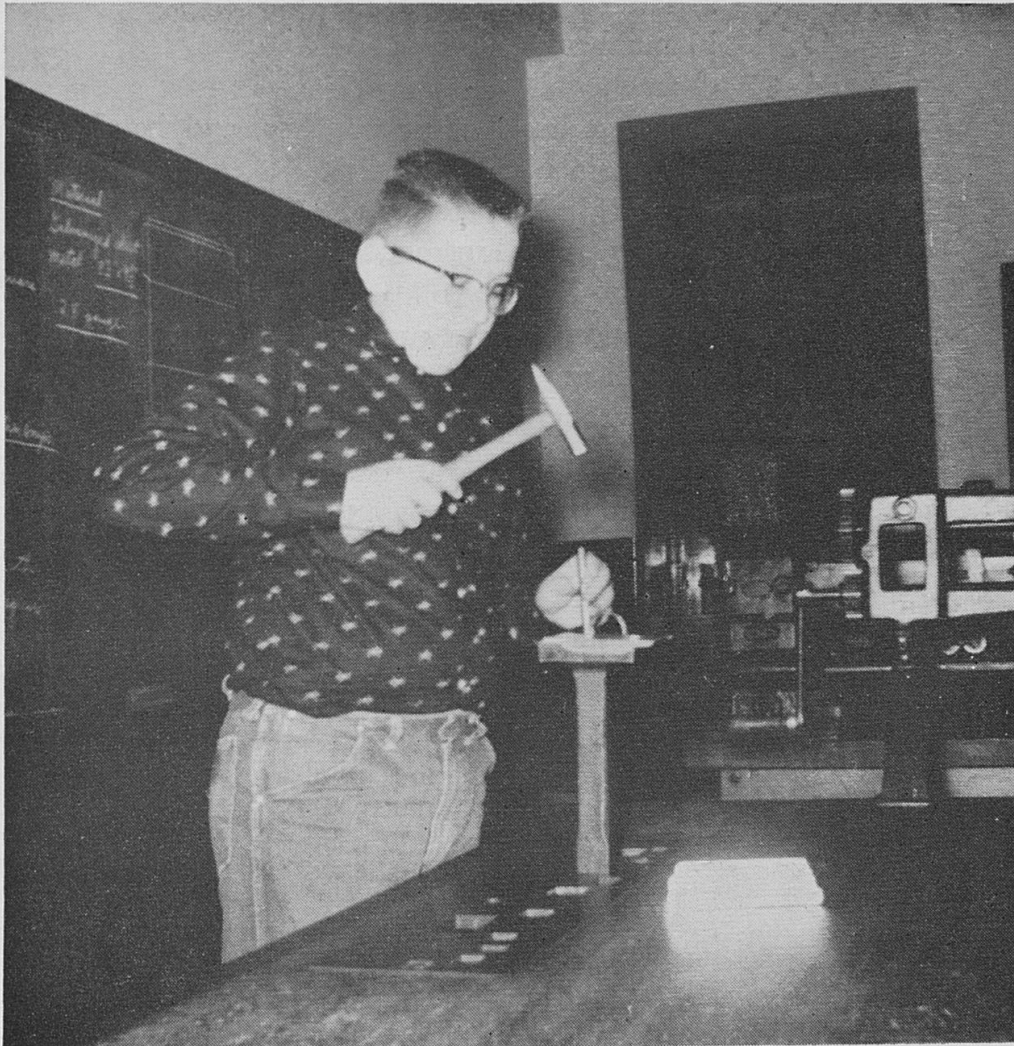
1. Instructional content

a. General information

- (1) the history of metals and man's progress
 - (a) copper—man's oldest and most versatile metal
 - (b) the story of iron and steel
 - 1) the blast furnace, open hearth and Bessemer processes
 - 2) shapes and sizes of wrought iron, mildsteel and tool steel
 - 3) hot rolled, cold rolled, bar and sheet steel
 - (c) aluminum—the wonder metal of this era
 - (d) new, exotic-heat resistant metals for the space age
 - (e) the science and metallurgy of metals
 - 1) sources of raw materials
 - 2) characteristics and properties of metals
 - 3) refining of metals
- (2) consumer metal products
 - (a) home construction
 - (b) machinery and automobiles
 - (c) home utilities and equipment
 - (d) jewelry and silverware
 - (e) industrial construction
- (3) safety and hygiene for metal workers
 - (a) correct tool use for safety
 - (b) how to treat cuts and abrasions

- (c) care for burns from welding or soldering
- (d) rules for handling acids
- (e) fume poisons from fluxes or natural gas
- (f) how to use every machine safety
- (g) health in metal industries
- (h) develop personal and group safety mindedness
- (4) guidance in social-economic considerations
 - (a) labor cost in manufacturing a product
 - (b) the history of tools, past and present
 - (c) the story of mass production
 - (d) costs of tools and equipment
 - (e) the economy and satisfaction of doing a job yourself
- b. Skills
 - (1) planning the general metal project
 - (a) consideration of design and construction elements in selecting a project
 - 1) study the design and method of fabrication of this item as it is now on the market
 - 2) approach sketching and designing creatively, with the limited manipulative skills in mind
 - 3) design the projects within the limits of the equipment available
 - (b) make a working drawing of project to be constructed
 - (c) plan the construction procedure and the sequence of assembly
 - (d) make a list of material requested and figure the entire cost including finishing materials and extra shop supplies
 - (e) check materials received against bill of material request, and drawing for dimensions, kind, quality and quantity
 - (f) store material property in suitable locker
 - (g) proceed with construction of project according to working drawing specifications; keep in mind quality of workmanship, quantity and time element
 - (2) present industrial related material
 - (a) industrial films
 - (b) field trip orientation
 - (c) technical magazines
 - (d) use machine operating manual

- (e) secure technical library from some industries
- (f) have general tool and material supply catalogues available
- (g) display charts, diagrams, and bulletins
- c. Methodology: bench metalwork, forging and heat treating practice



A Junior High Metal Working Student

- (1) bench metal
 - (a) measuring and lay-out
 - 1) secure correct gage of sheet metal
 - 2) become acquainted with good measuring tools
 - a) steel rules
 - b) circumference rule
 - c) combination squares

- 3) mark locations and lines using
 - a) layout fluid
 - b) scribe and prick punch
- 4) use proper wing dividers or trammel
- (b) drilling, punching and reaming holes
 - 1) twist drill sets and gages
 - a) letter
 - b) number
 - c) fractional
 - 2) solid punches, hollow punches, and hand sheet metal punch
 - 3) hand drill and portable electric power drill
 - 4) reaming; pipe reamer, countersink, and hand reamer
 - 5) see section on power machinery—bench or pedestal drill press
- (c) forming wrought iron
 - 1) simple bending with wrench or pin block
 - 2) machine bench vise or metal former vise and roll
 - 3) operating the Di Arco #2 bending machine
- (d) shaping metal with cutting tools
 - 1) cold chisels—flat, cape, round (nose) and diamond point
 - 2) sawing
 - a) hand hack saw and blade selection
 - b) jewelers saw and blade selection
 - c) sawing technique—stance, stroke-speed and pressure
 - 3) filing metal
 - a) kinds and sizes of files
 - 1 select the right file for the job
 - b) how to use and care for files
 - 1 clean file with file card
 - 2 cross-filing—quick and accurate
 - 3 drawfile for smooth surface
 - 4 safety note—keep handle on file
 - 4) abrasives
 - a) kinds and sizes of abrasive grain
 - 1 natural minerals emery, sandstone, and rottenstone

- 2 artificial abrasives are alundum, carborundum, crastolon and aloxite
- b) selecting the right abrasive sheets for the job of polishing on metal
- c) how to tear strip abrasive sheets
- d) use crocus cloth for high polish
- (e) shaping metal by forging
 - 1) the anvil and simple forge practice
 - 2) forging temperatures and forging tools
 - 3) safety related to forging; goggles, gloves, etc.
 - 4) ornamental iron work scroll, flats, bends, etc.
 - 5) learn to strike with forge hammer, use tongs and anvil accessories; flatter, fuller, etc.
- (f) heat treating metals—simple metallurgy terms
 - 1) normalizing—annealing
 - 2) hardening—critical temperatures
 - 3) tempering—visual temper colors
 - 4) case hardening—surface hardening
 - 5) temper small tools—scriber, chisel and punch
- (g) fastening metal with threaded devices
 - 1) sizes and uses of the tap and die set and accessory tools
 - 2) technique of cutting a thread with a tap or die
 - a) cutting oil required
 - 3) selecting bolts, screws, nuts and washers
- d. Methodology: sheet metal and art metal projects
 - (1) developing and laying out a pattern
 - (a) refer to bench metal lay-out work
 - (b) learn to gage thickness of sheet metal
 - 1) use American Standard gage for non-ferrous metals
 - 2) use United States standard gage for all ferrous metals
 - (c) make out a bill of material for each project
 - 1) refer to materials price list for cost
 - (2) methods of cutting sheet metal
 - (a) types of hand snips and shears
 - (b) demonstrate cutting of inside and outside curves
 - (c) squaring shear operations
 - (d) demonstrate methods of cutting heavy gage metal

- (3) punching sheet metal and drilling holes
 - (a) hand punch holes 1/16 to 3/8 inch diameter
 - (b) use hollow punch for larger diameters or for an opening into a surface
 - (c) special grinding of twist drill for sheet metal
 - (d) drilling holes with portable electric or drill press
- (4) bending and forming sheet metal
 - (a) set seams by hand with wood mallet or setting hammer
 - (b) set seams with hand seamer
 - (c) bend sheet metal with angle iron, blocks or vise
 - (d) bending and forming metals over sheet metal stake
 - 1) hollow mandrel
 - 2) square
 - 3) hatchet
 - 4) blow horn
 - 5) creasing
 - 6) copper smith square
 - 7) beak horn
 - 8) candle mold
 - 9) needle case
 - (e) bending and forming sheet metal with machines
 - 1) demonstrate operations performed with the bar folder and cornice brake
 - 2) form cylinder with slip roll forming machine
 - 3) advantages and versatile use of the box and pan brake
- (5) operating the sheet metal rotary machine
 - (a) the general shop combination rotary machine
 - 1) equipment: proper wrench for machine and following sets of rolls:
 - a) beading
 - b) crimping
 - c) burring
 - d) wiring
 - e) turning
 - (b) the unit type rotary machine; this machine is less expensive if several work stations are needed
- (6) techniques of fastening sheet metal
 - (a) seaming (see Item (4))
 - (b) soldering



A Junior High Metal Working Student

- 1) composition of solder alloys
 - 2) purchase in following forms: bar solder, wire solder, acid core, rosin core or solid
 - 3) soldering flux and uses
 - 4) heating and tinning soldering coppers
 - 5) soldering techniques and procedures
 - 6) air gas soldering torch and equipment
 - 7) silver soldering and brazing
- (c) riveting sheet metal
- 1) variety and weight of sheet metal Tinnens rivet
 - 2) ornamental and special purpose rivets
 - a) soft iron, copper, brass and aluminum
 - b) round head, split rivets, truss and countersunk

- 3) special rivet setting tools
 - a) hand rivet setter and riveting hammer
 - b) pop-riveter or equal for difficult locations
- (7) art metal: forming for surface decoration and utility
 - (a) vitreous enameling jewelry like surfaces
 - (b) hand tooling metal foil
 - (c) decorate surfaces with abrasives, wire wheel, satin finishes, swirl or spot finish
 - (d) panel project areas with perforated, embossed or expanded metal
 - (e) raise surface decoration with chasing tools and hammer
 - (f) etch surfaces with Safe-T-Etch or similar harmless chemical
 - (g) peen or planish or matt finish metal to give hand wrought appearance
 - (h) use doming, fluting, and horning to enhance beauty
 - (i) contour saw or pierce and saw designs with jeweler saw
 - (j) finish plain metal surfaces with protective coating for natural beauty
 - (k) antique surfaces with chemicals and apply protective finish

TYPICAL METALWORK PROJECTS

Junior High School Level

General metalwork projects usually require several elements or operations from various areas of the metal shop. In selecting a project to build a student will depend on former experiences and desired new experiences. Each project selected should meet the needs of the individual, construction should be within the range of his skill, and within the capacity of the shop equipment and the materials available.

D. *Introduction to Plastics*

I. Instructional Content

a. General Information

Because of the dwindling supply of some of our natural resources, synthetics will gradually replace their use in many products. One of these synthetics is plastic, which is becoming one of our largest and most important in-

Suggested Projects

	Wrought Iron	Art Metal	Spinning	Sheet Metal	Bench Metal	Machine Lathe
Candy dish		X	X		X	
Candle holder		X	X		X	X
Cigarette box		X	X	X		X
Coasters		X	X			X
Desk name plate		X		X	X	
Door knocker	X	X			X	
Jewelry box		X	X	X		
Letter opener		X			X	
Magazine rack	X	X		X	X	
Paper weight		X				X
Small tools	X				X	X
Serving trays		X		X	X	
Waste paper basket	X	X			X	

dustries. Various articles, such as, toys, appliances, tools, furniture, and even automobiles, are being manufactured from some type of plastic.

A general shop designed to give students a wide variety of experiences in various industries should include an area in plastics. Although plastics of many types are impractical to use in the shop, just as many more can be used with successful results. With the increase of experimentation and research being conducted by the various individual classroom teachers, some of those plastics not now being used may be found adaptable in the future for industrial arts use.

There are two broad categories of plastics. Thermosetting is formed and set with the addition of a catalyst. Thermoplastic is formed by heating and may be reformed by reheating as many times as necessary. Acrylic plastic, an example of a thermoplastic and more commonly called by the trade names Lucite and Plexiglas, is well adapted to general shop use. A wide range of colors, shapes, and

sizes, and the need of few additional tools make acrylic an excellent medium through which general shop students may become acquainted with plastic. Polyester resin, an example of a thermosetting plastic, when mixed with a catalyst and used in conjunction with fiberglass material, can be molded to form almost any contour. Its use in general shop in the making of bowls, trays, and many other useful articles proves to be very rewarding to those students who have the opportunity to use it.



Students Working on a Mold

b. Skills

The following is a list of those skills or abilities that a student taking general shop is capable of learning in regard to plastic.

- (1) A student should be able to distinguish different types of plastics.
- (2) A student should develop skill in the use of acrylic plastics by knowing how to saw, drill, file, glue, form, and bend to various shapes.
- (3) Opportunities should exist whereby a student may become familiar with the various molding techniques in the use of the thermoplastics. Vacuum molding and pressure forming can be easily duplicated and used in the general shop.
- (4) A student should develop a degree of proficiency in the use of one of the thermosetting plastics. The laying-up of objects with the use of polyester resin and fiberglass provides unlimited opportunities in this category.



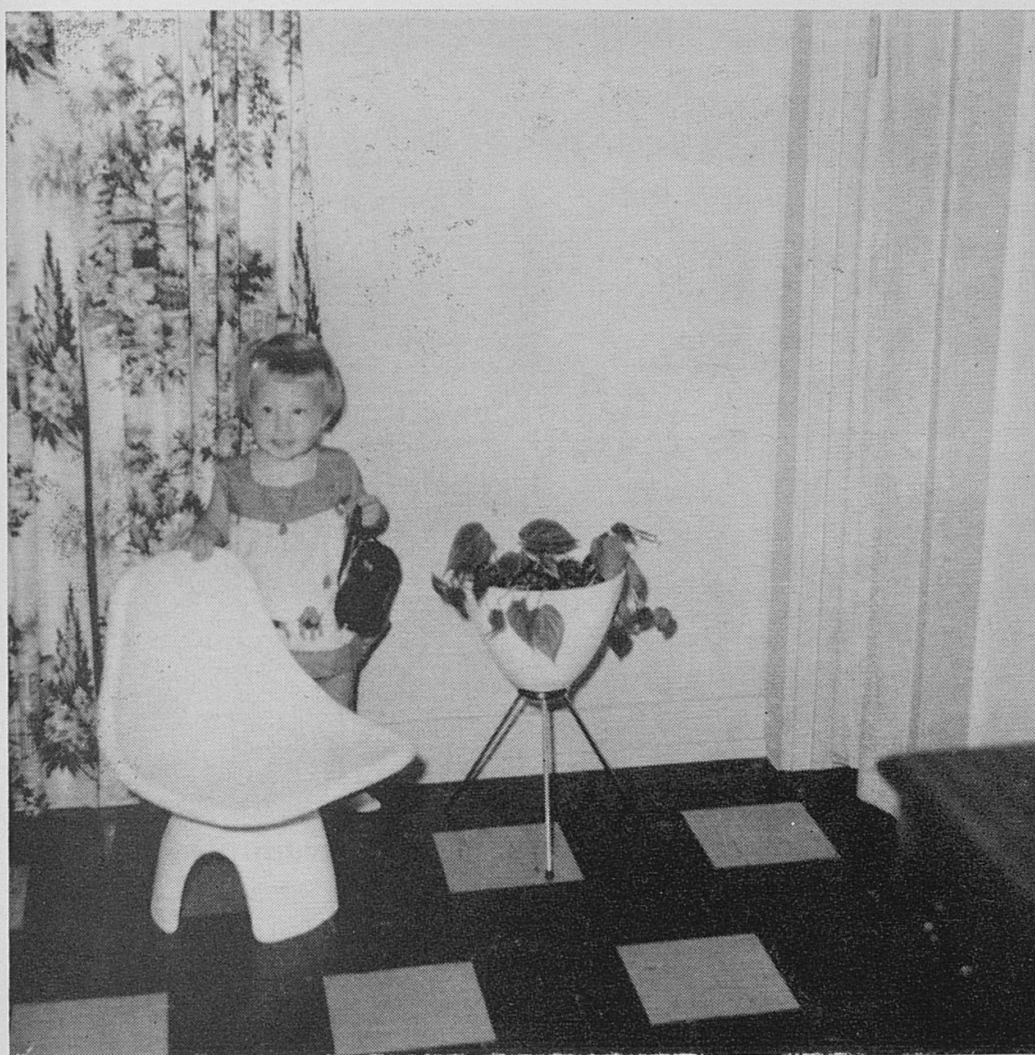
Work Continues on the Mold

- (5) Individual skills in mold construction should be promoted to the extent that the student maintains his personal interest. Many of those objects to be fabricated in the general shop should be put up on pre-made molds.
- (6) Opportunities should be provided whereby a student may use the contact molding methods, both positive and negative, and the matched die molds in the use of constructing small useful projects from the thermosetting plastic.
- (7) Skill in the conservative use of materials should be emphasized in the use of all types of plastics.

c. Safety

As in all industrial arts fields, safety is of the utmost importance. First and foremost in our thinking should be the concern of safety for those students who participate in general shop. The following rules are only suggestions, leaving the specific application to be determined by the individual classroom teacher.

- (1) Asbestos gloves should be required when handling or forming hot acrylic plastics.
- (2) Acrylic plastic should be heated by heat lamps or electric hot plates, not in open flames.
- (3) All plastic materials should be stored in a fire-proof container.
- (4) Any catalyst that needs to be stored should be kept in a very cool place or in a refrigerator.
- (5) Only premeasured amounts of catalysts should be available for the student's use.
- (6) While working with a thermosetting plastic, such as, polyester resin, which gives off volatile fumes, ventilation should be provided.
- (7) If excessive sanding is needed where fiberglass has been used, protective clothing should be available for the student to use. This should include gloves, shop coat, goggles, and a respirator.
- (8) Competent demonstrations on all procedures and methods should be given by the teacher before a student is allowed to proceed on his own.



Young Lady Admires Fiberglass Chair

Eighth Grade Level

A. *General Drafting* in the eighth grade should be an extension of the exploratory experiences of drawing and planning in the seventh grade with a progression in content from broad understandings to more specific experiences in which a greater degree of skill and knowledge is acquired. Elementary experience in drawing and planning prior to this level is recommended but is not considered to be a prerequisite.

Emphasis should be placed on industrial arts drafting as a means of expression and communication with direct relation to the problems of daily living. It should not be treated as an area separate from other activities but as an integral part of almost every phase of our complex society. Technical, general, and occupational information should be provided.

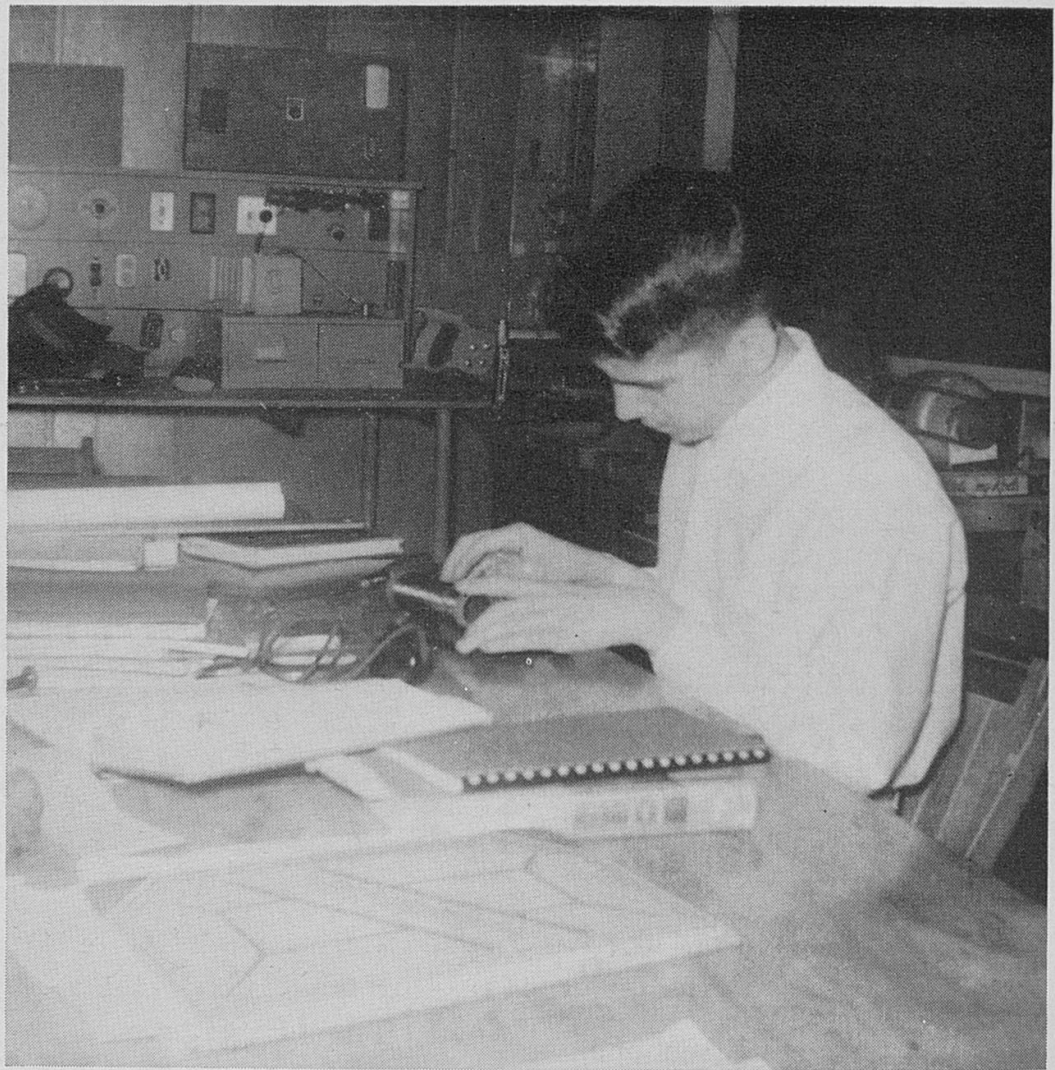


Teacher Discusses Problem with Student

At this level attention is given to the development of accuracy, skill, judgment and techniques. Once the concept of drawing as a graphic language has been established the student will more willingly spend the time necessary to develop this skill by which he can more easily express his ideas and work out his problems in the shop or laboratory. A definite block of time should be provided in which the entire class is given instruction in the skills and information necessary for them to select, design, plan, and reproduce appropriate drawings. The actual amount of time may vary according to the organization of the individual school but four to six weeks is suggested as an example.

It is obvious that no single set of experiences could be set up to meet all of the situations that might arise, or to satisfy all the needs of a single class. There can be no substitute for careful planning and guidance by the teacher with consideration of the specific needs of his group and the individuals therein. The following experiences and activities are suggested as basics for drafting at this level:

1. Implementation of basic design principles
 - a. Values of traditional and contemporary design
 - b. Designing projects involving a variety of materials
 - c. Design as a consumer value
 2. Technical sketching
 - a. Freehand representations of projects
 3. Correct use of drafting tools and equipment
 4. Geometric construction
 5. Methods of graphic representation
 - a. Multiview drawings
 - (1) selection of views
 - (2) dimensioning and lettering
 - (3) auxiliary views
 - (4) sections
 - (5) surface development
 - b. Pictorial drawings
 - (1) isometric
 - (2) oblique
 - (a) cavalier
 - (b) cabinet
 - (3) perspective
 - (a) parallel
 - (b) angular
 - (4) pictorial dimensioning
 - (5) pictorial sectioning
 6. Reproduction processes
 - a. Whiteprints
 - b. Blueprints
 - c. Safety
 - (1) hazards from fumes and chemicals
 7. Preparation of bill of materials and plan of procedure
- B. *Introduction to Electricity*
1. What is electricity?
 - a. Electron theory
 - (1) static electricity
 - (2) current electricity
 - b. Magnetism
 2. General electrical safety
 - a. Handling electric wires and circuits safely
 - b. Electrical dangers and hazards in the shop and home



General Shop Student Working on Electrical Project

3. How is electricity produced?
 - a. Chemical action
 - (1) primary cells
 - (2) secondary cells
 - b. Mechanical generation
 - (1) direct current
 - (2) alternating current
 - c. Unusual methods of producing electricity
 - (1) heat
 - (2) light
 - (3) piezoelectric
 - (4) atomic

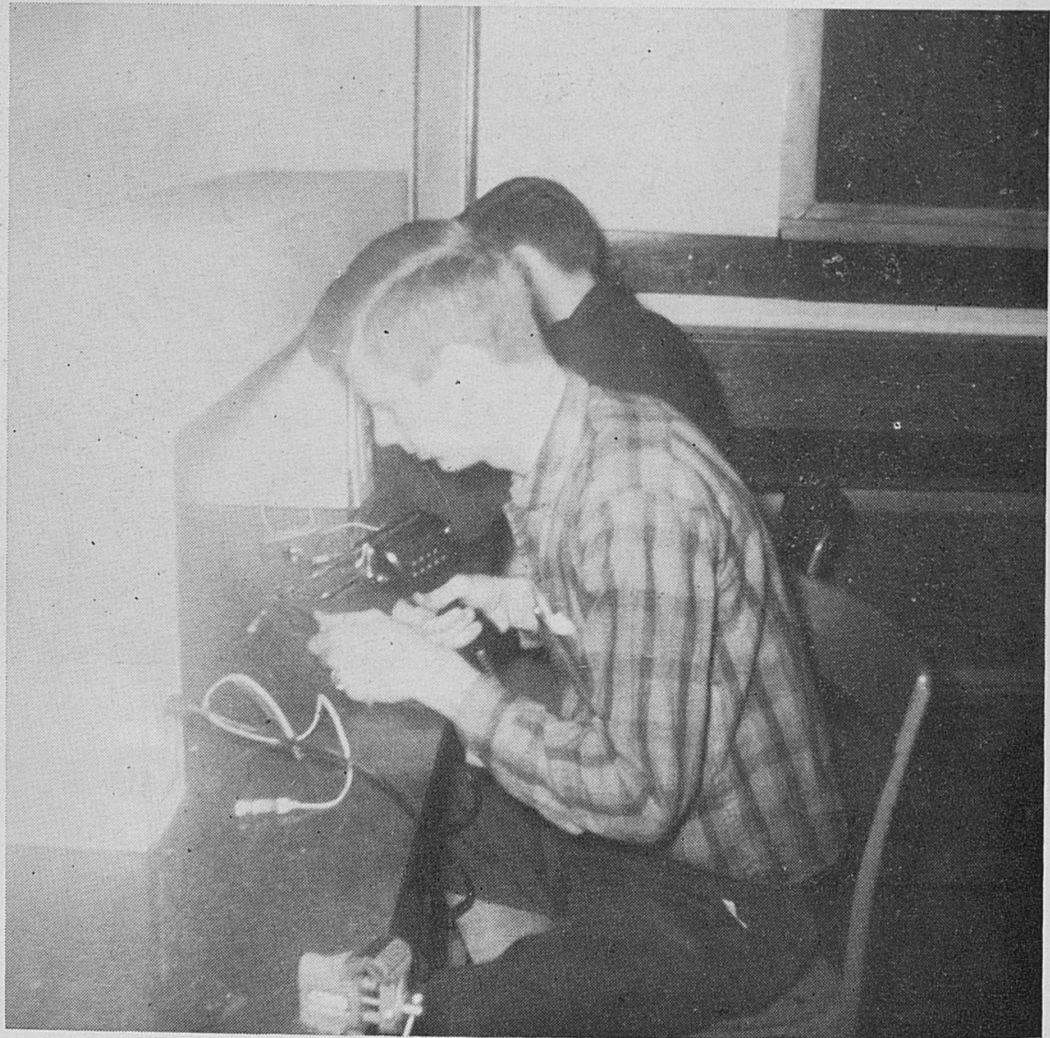


Student Working in Electricity Area

4. Electric circuits, uses and measurements
 - a. Common circuits in the home
 - (1) series
 - (2) parallel
 - (3) combination
 - b. Electrical measurements
 - (1) voltage
 - (2) current
 - (3) resistance
 - (4) wattage
 - c. Switches and associated circuits
5. Effects of electricity
 - a. Lighting
 - b. Heating

- c. Chemical
- d. Magnetic
- 6. Communications
 - a. Telephone - Telegraph
 - b. Radio
 - c. Television

It is noted that safety should be stressed in all phases of the unit as well as in the major safety unit, and the student should use low voltage (0-50 v. a-c d-c) in this unit.



Students In Electricity Area

Understandings and manipulative techniques the student should learn in this electrical unit.

1. Have an understanding of the following electrical terms
 - a. Electrons, protons, neutrons
 - b. Voltage, resistance, current



Students Work on Electrical Projects

- c. Wattage, voltage drop, current drop
- d. Magnetism, electromagnetism
- 2. To know the correct usage of the following test equipment
 - a. Voltmeters
 - b. Ammeters
 - c. Ohmmeters
 - d. Wattmeters
 - e. Kilowatt-hour meters
- 3. To become familiar with basic electrical symbols and recognize the component it represents.
- 4. To be able to connect batteries, components and circuits in series or parallel and know the limitations and advantages of each method of wiring.

5. To know the difference between AC and DC and applications of each.
6. To know how electricity is produced by chemicals, mechanically, by heat, and light.
7. To know the effects of electricity such as heat, light, electromagnetic and chemical.
8. To be able to connect a circuit that is electrically safe.
9. To have an understanding of common electrical devices such as the: relay, thermostat, electric iron, electric lighting devices, safety and overloading devices, and common communication equipment.
10. To be familiar with the common conductors and insulators of electricity and the limitations of each.
11. To be able to solder conductors appropriately.

C. *Introduction to Graphic Arts*

1. Importance and scope of graphic arts industry
 - a. Local
 - b. State
 - c. National
2. Processes of graphic arts reproduction
 - a. Relief printing
 - b. Lithography
 - (1) stone
 - (2) photo offset
 - c. Itaglio
 - d. Silkscreen
3. Graphic arts area of general shop
 - a. Areas and processes to be experienced
 - b. Names and uses of material and tools
 - c. Safety rules and practices

Composition

1. Layout of California job case
2. Spaces and quads
3. Composing stick
4. Setting type
 - a. Holding stick
 - b. Placing characters in stick
 - c. Spacing and justification
 - d. Using leads and slugs
 - e. Correcting errors

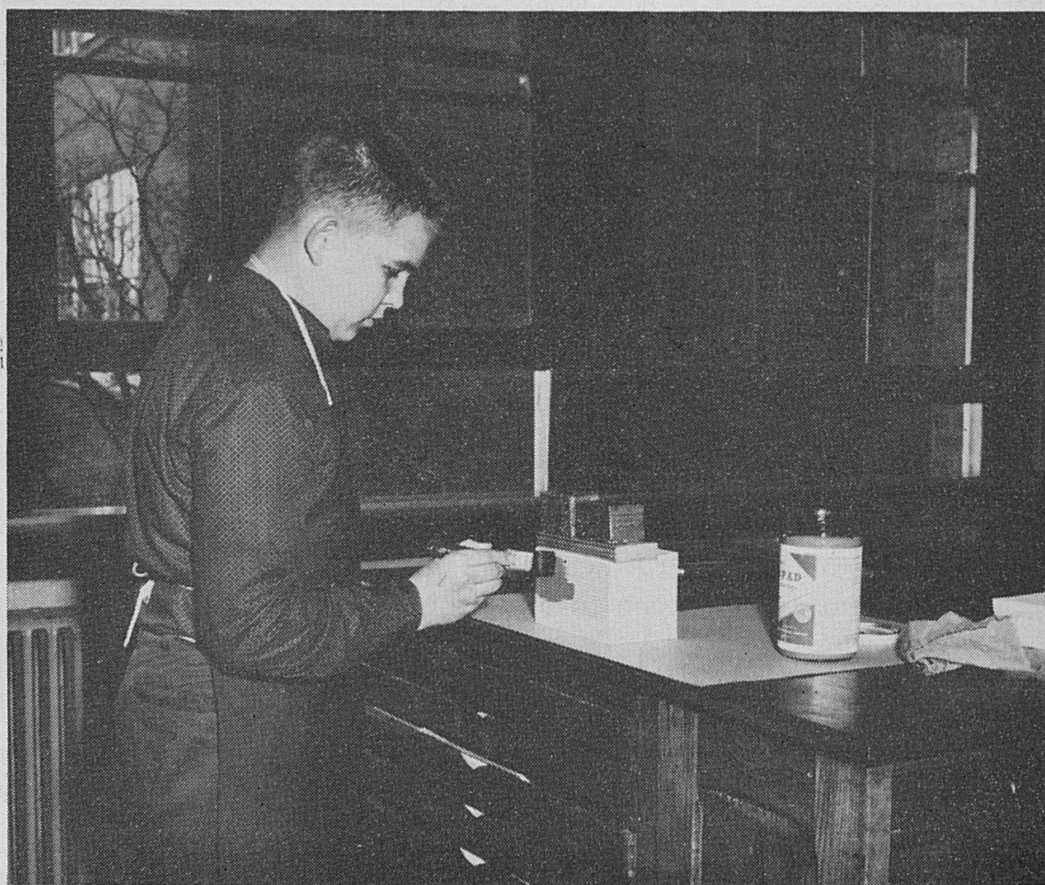


Junior High School Students in Graphic Arts Class

5. Handling type forms
 - a. Use of galley
 - b. Tying type form
 - c. Transferring type to and from imposing table
6. Proofing
 - a. Operating proof press
 - b. Standard proof marks
 - c. Cleaning type
7. Distribution of form
 - a. Identifying type
 - b. Distributing type
 - c. Distributing spacing and other material
8. Printer's point system
9. Type
 - a. Type metal
 - b. Height of type
 - c. Sizes of type
 - d. Font of type

Locking up forms

1. Materials used
 - a. Imposing table
 - b. Type form
 - c. Chase
 - d. Furniture
 - e. Quoins
 - f. Quoin key
 - g. Reglets
 - h. Type planer
2. Positioning type forms in chase
3. Chaser method of lockup



Junior High Graphic Arts Student

Operating platen press

1. Safety practices
2. Change type pan and packing material
3. Ink press
4. Make impression
5. Set gauge pins

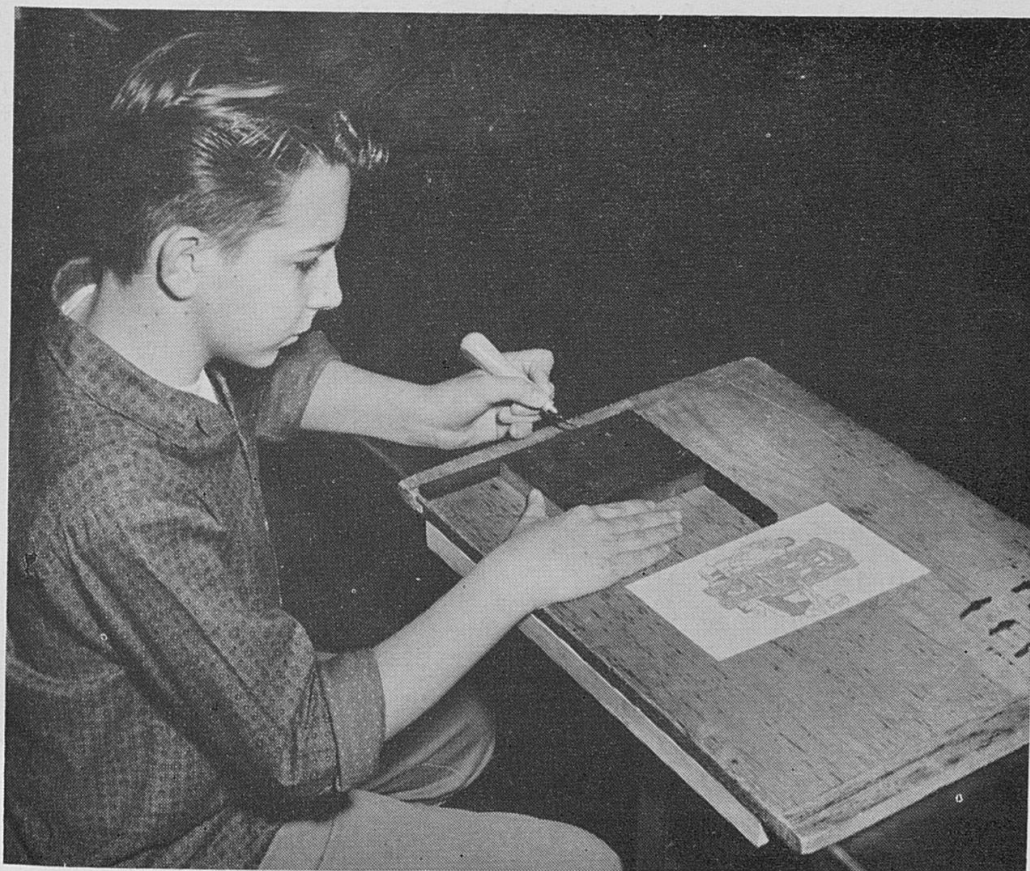
6. Regulate packing for proper impression
7. Underlays and overlays
8. Feeding the press

Stockroom binder

1. Safety practices
2. Estimating stock
3. Counting stock
4. Cutting stock
5. Jogging stock
6. Padding stock
7. Folding
8. Stapling

Linoleum-block cutting

1. Make design
2. Transfer design to block
3. Cut out non-printing areas of design
4. Lockup design and print design



Student Works on Linoleum—Block Job

Screen process printing

1. Make design
2. Make stencil
 - a. Blockout
 - b. Paper
 - c. Lacquer film
3. Adhere stencil to screen
4. Select ink
5. Print copies
6. Dry prints
7. Clean screen and squeegee

Paper and papermaking

1. Early methods
2. Materials used in paper making
3. Modern paper mill
4. Uses of paper
5. Making paper in the classroom

Printing inks

1. Development of printing inks
2. Methods of manufacture
3. Ingredients of printing inks
4. Use and care of inks
5. Coloring printing

Suggested projects

Personal card	Stationery
Grocery shopping list	Memo pads
Important telephone numbers	Bookmarks
Personal napkins	Desk blotter
Writing kit	Scratch pad
Autograph book	Book jacket

D. *Introduction to Power Mechanics*

1. Instructional content
 - a. Power machines
 - (1) simple basic knowledge of types and scientific principle of operation of power machines
 - (a) small one-cylinder gasoline engines—lawn mowers, boat engines, go-karts, scooters, etc.
 - 1) four-stroke cycle
 - 2) two-stroke cycle
 - (b) automotive gasoline engines—four-stroke cycle

- (c) diesel engines
 - 1) four-stroke cycle
 - 2) two-stroke cycle
 - (d) electric motors
 - 1) alternating current
 - 2) direct current
 - (e) propellor-driven aircraft
 - (f) jet engines
 - 1) ram jet
 - 2) turbo-jet
 - 3) turbo prop
 - (g) rockets
 - 1) liquid fuel
 - 2) solid fuel
 - (h) other experimental types of power machines such as turbine engines, fuel cell, nuclear and solar engines
- b. Small gasoline engines
 - (1) engine parts and functions
 - (2) engine adjustments and operation before disassembling
 - (3) fuel system
 - (4) electrical system
 - (5) lubrication system
 - (6) cooling system
 - (7) disassemble and reassemble engines
 - (a) use instruction sheets, engine manuals, and have teacher demonstrations at critical points along the way
 - (b) remove and replace parts in proper order
 - (c) inspect for worn or damaged parts
 - (d) engine measurements
 - (8) engine adjustments, testing, and operation after assembling unit
- c. Related information and reports
 - (1) power machines industries
 - (2) labor and management
 - (3) occupational opportunities in power mechanics
 - (4) new developments of interest to the student in the field
- 2. Skills (basically exploratory rather than to develop skills)
 - a. Use of hand tools and engine repair tools
 - (1) hammering tools

- (2) adjusting tools
 - (3) measuring tools
 - b. Use of special gasoline engine tools and machines
 - (1) feeler gauge
 - (2) piston ring compressor
 - (3) piston ring installing tool
 - (4) cylinder hone
 - c. Small engine disassembly and assembly
 - (1) carburetor adjustments
 - (2) ignition adjustments and timing
 - (3) piston rod, bearings adjustments
 - (4) cleaning, inspecting and measuring for worn or damaged parts
 - (5) replacement of gaskets
 - (6) torqueing and tightening head bolts, etc.
 - (7) use of compression gauge
 - d. Servicing and trouble-shooting small gasoline engines
 - (1) oil
 - (2) fuel
 - (3) air cleaner
 - (4) spark plug and ignition
 - (5) operation and adjustment of engine
- 3. Typical projects and special interest activities
 - a. Make name plates for family car
 - b. Build simple go-kart or scooter
 - c. Repair own bicycle
 - d. Minor overhaul and cleaning of family lawnmower after shop demonstration by instructor
 - e. Build Derby racers (no engines)
 - f. Technical reports on some phase of automotive or transportation industrial production
 - g. Reports on the occupational opportunities in the automotive and related industries
 - h. Group projects to promote safe pedestrian and driving habits
 - i. Oral reports on go-karts, turbine engines, sport cars, foreign cars, etc., that are of special interest to the students
- E. *Introduction to Crafts*
 - 1. Units of instruction
 - a. Introduction

- (1) various craft media
 - (a) woods
 - (b) metals
 - (c) ceramics
 - (d) fabrics
- (2) woods
 - (a) industry
 - (b) products, raw materials, methods of manufacturing, and properties
- (3) metals
 - (a) industry
 - (b) products, raw materials, methods of manufacturing, and properties
- (4) ceramics
 - (a) industry
 - (b) products, raw materials, methods of manufacturing, and properties
- (5) fabrics
 - (a) industry
 - (b) products, raw materials, methods of manufacturing, and properties

Design as related to various craft media

- 1. Elements of design
 - a. Line
 - b. Form
 - c. Space
 - d. Color
 - e. Texture
- 2. Principles of design
 - a. Rhythm
 - b. Movement
 - c. Function
 - d. Proportion
 - e. Contrast
 - f. Balance
 - g. Harmony

Laboratory project

- 1. Student chooses one of the above four areas
 - a. Plans project
 - b. Lists procedure and makes rough sketch of project

- c. Makes bill of material
 - d. Selects material
 - e. Transfers design to material
 - f. Demonstration of basic tool processes and student may begin project
 - g. Complete work on project
 - h. Prepare project for finishing
 - i. Finish project
2. Correlating related information to progress on project
- a. Knowledge of material
 - b. Types of construction
 - c. Kinds of finishes
 - d. Possible uses of project as related to their own home
 - e. Basic consumer knowledge of comparable items on the commercial market
 - f. How hand crafted items can be made commercially
 - g. Shop safety

CHAPTER VIII

GENERAL DRAFTING—SENIOR HIGH SCHOOL

PURPOSE

General industrial arts drafting is considered to be a vital part of the general education of all students. The broad and varied content of a unit in general drafting has application to the immediate and future interest of both boys and girls. The need for a common understanding in the graphic expression of ideas and problems is becoming increasingly important in our contemporary society. Drawing not only serves as the "language of industry" but functions in the study and application of mathematics, science, social studies, and language arts. Graphic presentations in the form of schematic diagrams, charts, graphs, and illustrations are becoming of great importance in presenting statistical data in textbooks, research papers, reports, magazines, and newspapers. The boys and girls of our present society would be seriously handicapped if they had no opportunity to learn how to make and use the many tools of graphic communication in their daily lives.

A clear distinction should be made between drafting in the industrial arts as a phase of general education and vocational drafting. In keeping with the overall objectives of industrial arts, general drafting

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makes a contribution that should be of value to all students in a more satisfactory adjustment to the problems of daily living. It is not intended to develop highly specialized skills of a vocational caliber. However, industrial arts drafting may well serve as a focus for the interest and abilities of many students to the extent that they may more intelligently choose a technical, engineering, or related profession. Within this frame of reference, industrial arts will have certain vocational implications.



A General Drafting Class at Work

At the senior high school level a unit of drafting should be organized to be offered for one full year, or two semesters. It should be an elective course, open to both boys and girls, with no prerequisites required. If the school is large enough to offer several sections of drafting it is desirable that groupings be made according to age or classification but this is more a matter of teaching efficiency than of necessity. One hour of elective credit toward high school graduation is granted upon satisfactory completion of the course.

The various phases of drawing should be so organized that the student will have an opportunity to explore each area during the

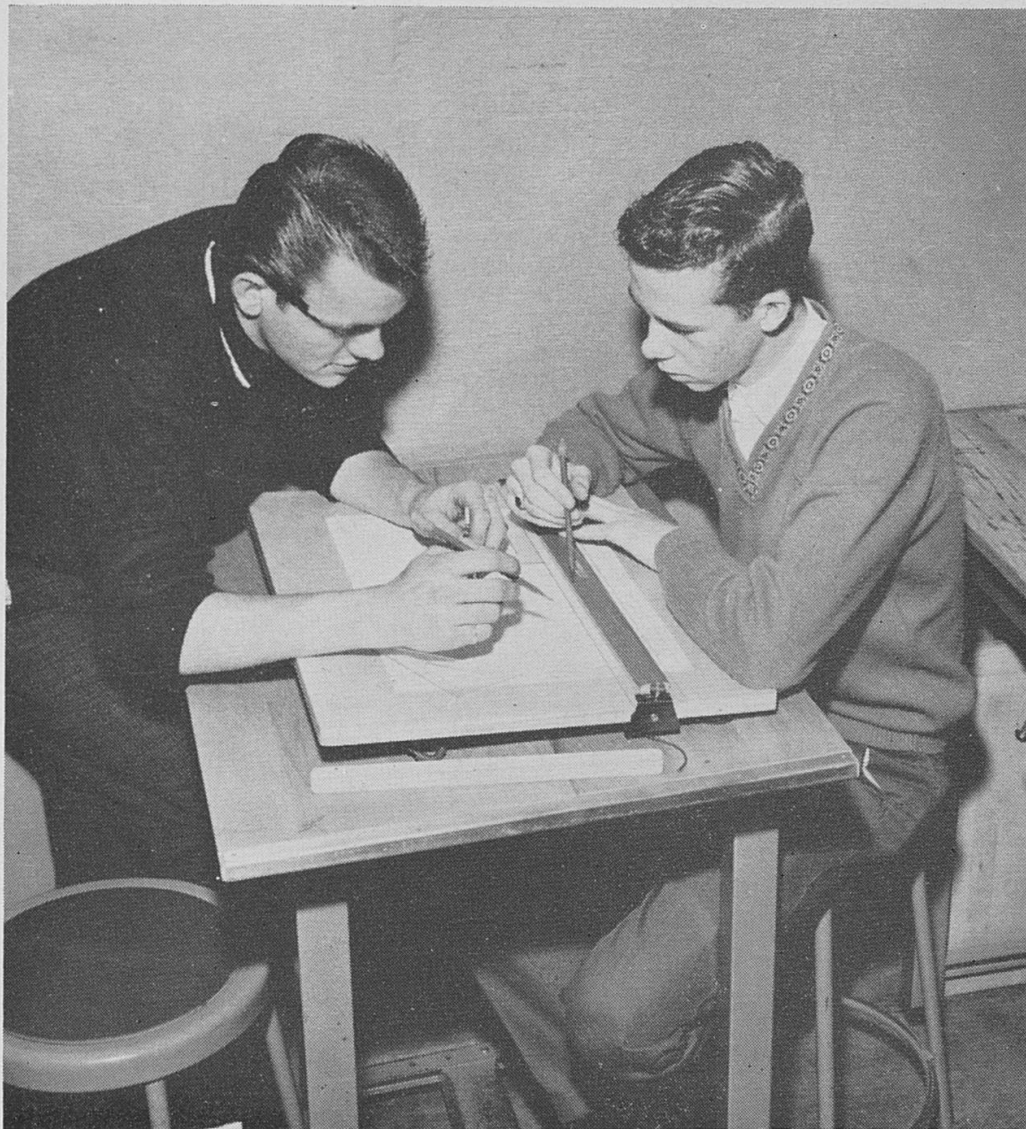
school year. Additional emphasis may well be placed on certain phases of the work dependent upon the student's needs and interests and community resources. If there is a predominate industry within the community its drafting peculiarities may well be given more emphasis but not to the complete exclusion of all other areas. The most generally accepted plan is to devote the first semester principally to general technical drafting and several subareas and the second semester to architectural drawing and its related areas. A more detailed outline of this plan will appear later in this chapter.

Emphasis should be placed on the problem-solving approach in acquiring technical knowledge and skills. Accuracy and neatness are stressed. Problems should be carefully selected and analyzed to be sure that they contribute to the objectives of the course. Copying plates and meaningless objects should be avoided. The drawing problems should be closely related to practical application in the shop or other realistic situations. The students need for understanding the principles of drawing becomes particularly acute when the object has direct personal meaning for him.

Related information should be given strong emphasis as it applies to all phases of the student's work. Occupational opportunities should be presented as an aid in helping the student make an intelligent choice of vocation. Pamphlets, technical publications, newspaper articles, magazines, and current items should be made available to the students for updating or rapidly changing information. A good current textbook should be used so that all students will have a common source of reference. Additional references should be available in the classroom and school library.

Intensive use of the many visual aids available should be made in a meaningful and interesting manner. Liberal use of films, film strips, overhead and opaque projectors, chalkboards, bulletin board displays, slides, pictures, mock-ups, models, field trips, commercial exhibits, and other such activities help vitalize and stimulate the interest and understanding of pupils.

Last, but by no means least, a continuous program of evaluation should be conducted. It should not consist only of periodic tests to terminate each grade period for the sole purpose of determining a letter grade, but should be a meaningful evaluation of each drawing and activity as a technique in improving the skill of the student and enabling him to improve his own judgment of values.



Problem Solving In General Drafting

METHODOLOGY

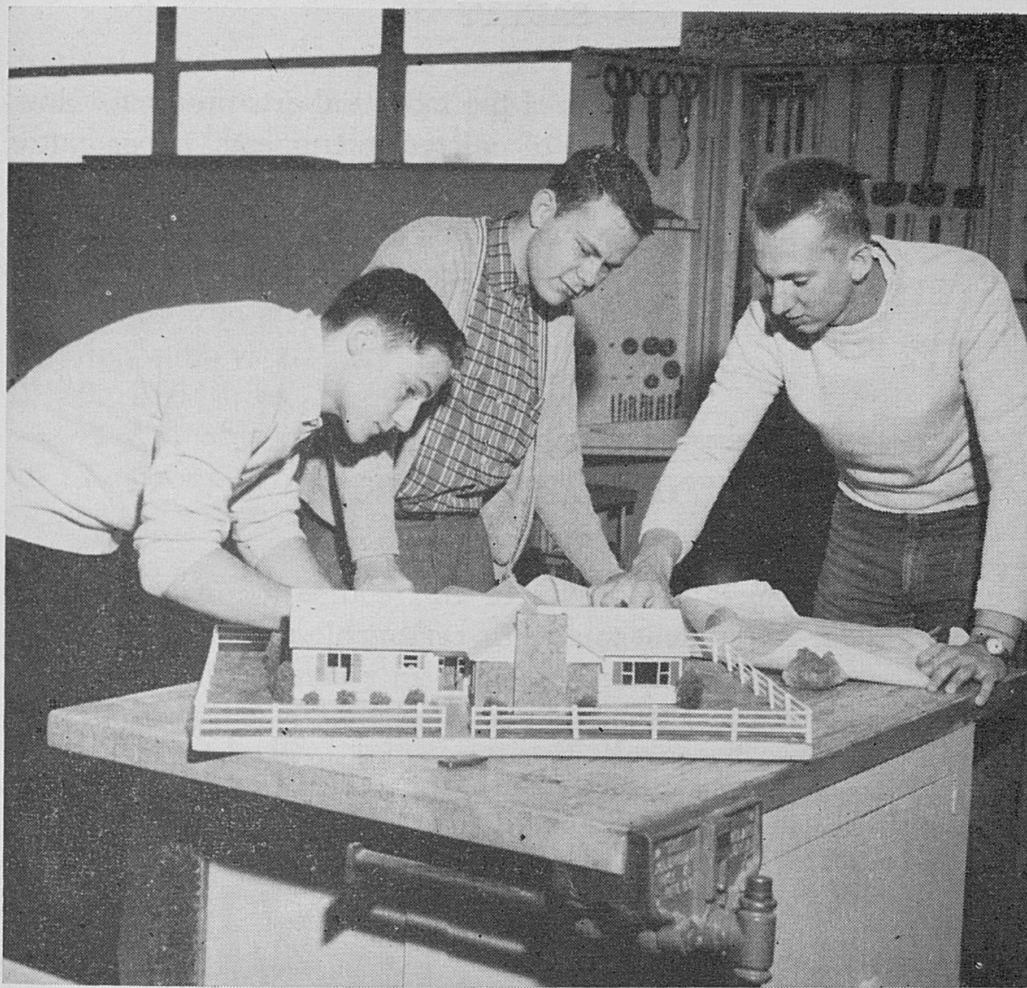
Technical Drafting

1. Introduction to technical as a universal graphic language
 - a. Purposes
 - b. History
 - c. Opportunities
2. Technical sketching
3. Use of drafting tools and equipment
4. Lettering
5. Technical geometry
6. Multiview projection

7. Dimensioning
8. Sectional views
9. Auxiliary views and revolutions
10. Pictorial drawing
 - a. Isometric
 - b. Oblique
 - (1) cabinet
 - (2) cavalier
 - c. Perspective
 - (1) parallel
 - (2) angular
11. Surface development and intersections
12. Production illustration
13. Working drawings
 - a. Patent drawings
 - b. Detail drawings
 - c. Assembly drawings
14. Threads and fasteners
15. Cams and gears
16. Map drafting
17. Inking techniques
18. Charts and graphs
19. Reproduction of drawings
 - a. Positive prints
 - b. Intermediates

Architectural Drafting

1. Introduction to the purposes, history, and opportunities
2. Architectural lettering styles
3. Types and styles of architecture
 - a. Traditional
 - b. Contemporary
 - c. Height and plan types
4. Planning the house
 - a. Selection of site and lot
 - b. Location of house on lot
 - c. Excavation considerations
 - d. Utilities and services
 - e. Arrangement of main areas of the house
 - (1) eating
 - (2) living
 - (3) sleeping



Building Models In The Drafting Class

- f. Storage
- g. Foundation
- h. Framing
- i. Interior finishes
- j. Exterior finishes
- 5. Architectural symbols
- 6. Plans
 - a. Floor
 - b. Basement and foundation
 - c. Elevations
 - d. Roof framing
 - e. Plot
 - f. Details
 - g. One-point perspective (interior feature)
 - h. Two-point perspective (exterior)

SAFETY

Safety hazards, as previously stated, are not as prevalent in drawing room as in many other areas of the industrial arts program. However, instruction in the safe use of pointed instruments, paper cutter, etc., should be planned. Incorrect use of these or "horseplay" could result in a serious accident.

See Appendix for equipment list and reference books.

CHAPTER IX

GENERAL WOODWORKING— SENIOR HIGH SCHOOL

PURPOSE

The chief general objectives of this course are to provide an opportunity for the student to acquire reasonable proficiency in working with wood and to help him develop an understanding of the materials used and the techniques of good design and construction associated with woodworking.



A Typical Scene In a General Woodworking Class

METHODOLOGY

In this course students should be provided the opportunity to participate in activities involving production methods and processes. Emphasis is placed on related technical information and the practical application of mathematics, science, and language arts.

1. Demonstrations of techniques and procedures
2. Discussions of informational topics
3. Written and oral reports on informational topics
4. Audio-visual aids
5. Field trips
6. Individual projects
7. Group or production projects

INSTRUCTIONAL CONTENT

General Information

Woodworking at this level should be student centered, with every effort being made to develop interest in good craftsmanship and to encourage better understanding of the place of wood in modern technology. To promote student interest, their participation should be utilized in such areas as selecting and planning projects, setting up shop routines, and in the development of policies and the utilization of personnel within the shop.

Special attention should be given to new techniques in such areas as laminating, veneering and bending; and improved processes in the conventional phases should be adopted, where applicable. At the same time, the program should keep abreast of new materials, such as, laminates, adhesives, abrasives, and finishing materials. In addition, the construction, styling, and designing of projects should also reflect advances in technology.

The use of shopworn, teacher-imposed exercises and projects is not desirable, since they do not serve to motivate student initiative, nor can they avoid the tendency to become stereotyped and typical of obsolete materials and techniques. The teacher must, therefore, be very careful that his students' projects are not characterized by the repetition of features which have long been outmoded.

Skills

Although the development of skills is not the primary objective, a very worthwhile outcome should be the attainment of reasonable levels of manipulative competence. It is not the intention of this section to deal specifically with operational content, but rather to suggest general areas in which the student should become proficient.



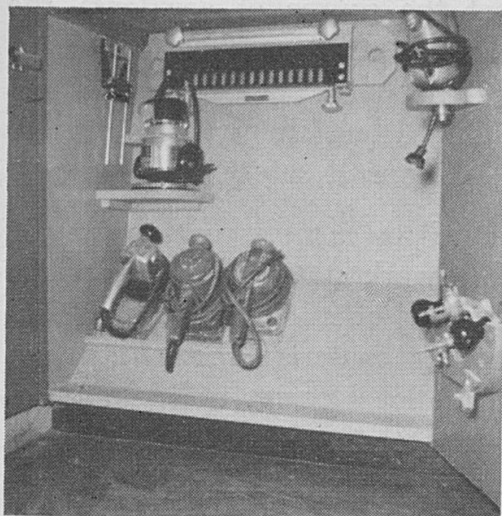
Students At Work In a General Woodworking Class

Reasonable ability in the use of the common hand tools, if not previously acquired, should be stressed. However, any correlation with modern technology demands that emphasis be placed upon the milling, shaping, and joint cutting operations that can be performed with power equipment. These would include, for example, reducing stock to dimension, cutting mortises and tenons, rabbets, dadoes, miters, boring holes, shaping edges, and making glue joints.

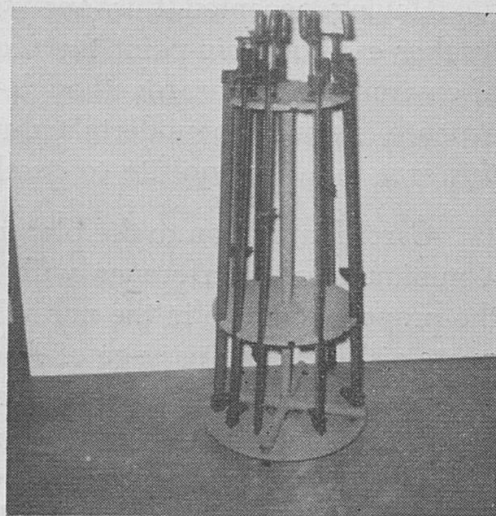
The student should be able to do simple face plate turning, in addition to turning between centers. As previously mentioned, laminating and bending should be introduced, in order for the student to realize their potential as a modern use of wood. Of particular importance in modern woodworking, also, is the comparatively recent introduction of small power tools, such as, the router, saber saw, and electric drill combinations. Since these are within the range of availability of the public in general, an understanding of their possibilities and the development of acceptable skills in their use may well be

considered an important function of the woodworking course at the secondary level.

The application of finishes, both of the more conventional types and with the use of some of the many new, quick-drying materials, can well be included as a desirable skill. If facilities permit, spray finishing may be included, but it is not advised unless fully adequate provisions are made. The finishing process should be thought of as including stains, fillers, abrasives, and polishes normally associated with finishing; and such materials as chemical bleaches, used in the treatment of contemporary furniture, may also be considered as important.



Electrical Tool Storage



**Cabinet Clamp
Storage Rack**

SAFETY

No single topic in the school shop is of equal importance with that of safety. The teacher's success in developing a safety program will have far reaching implications, beyond the immediate value of the physical welfare of his students. Although safety is broadly applicable to facilities and equipment, by far the most important connotation is that which concerns the student.

To assist the teacher in adopting an objective approach to the problem of safety, he might well keep in mind the following observations:

1. Safety is the teacher's responsibility.
2. Accidents don't just happen, as a rule.
3. Accidents, in general, are preventable.
4. Any accident should be carefully studied, with the purpose of determining its cause and applying this knowledge to future situations.

Most experienced teachers recognize that the causes of shop accidents fall into two categories:

1. Unsafe human behavior

This includes deliberate carelessness, inattention to safe procedures, playing, use of improper tools and equipment.

2. Unsafe environment

Improper arrangement of equipment, poor condition of tools and equipment, sub-standard lighting or ventilation, and crowded working conditions fall in this category.

Having accepted this analysis of the source of accidents, the teacher can then pin-point the problems in his own shop. Correction of environmental hazards, though involving some additional work and expense, should be undertaken without delay. Remedial action in this area is a prerequisite to good conditions of safety.

Careful attention to the placement of power tools, so as to provide a minimum of interference with other work stations, allowance for the proper sequence in the normal handling of stock, and leaving adequate aisles for the passage of students and materials should be given priority in planning. Assistance from the local power utility can usually be had in ascertaining the proper intensity of artificial lighting, where the teacher is confronted with such a problem. Dull tools can be sharpened, and improperly adjusted or poorly functioning equipment can be put in proper working order.

Correction of behavior problems is more difficult of solution, since the human factor is involved. However, proper attitudes toward safety can be developed by associating safety instruction with proper operating procedures. This method places the positive connotation upon safety, rather than the negative approach characteristic of those who conceive of safety as a code of prohibitions. Rather than to constantly dwell upon rigid rules that usually consist of a compilation of "don't," every effort should be made to approach the student with a frank appraisal of his importance in the safety program. See Appendix for equipment list and reference books.

CHAPTER X

GENERAL METALWORKING— SENIOR HIGH SCHOOL

PURPOSE

Metalworking industries and their products play a most important part in the lives of all of us. Through metal products our homes have become more convenient, safe, and sanitary. Our transportation has become more luxurious and convenient with modern automobiles, streamline trains, and jet airplanes.

Metals, metal alloys, and surface treatments of metals have played a most important part in our modern industrial and cultural development. We still look to iron and steel for strength, durability, and furniture design, with modern processing and surface treatments. We look more and more to the many non-ferrous metals, such as copper and its alloys, lead, aluminum, zinc, nickel, tin, and magnesium for resistance to corrosion, alloying, beauty, and useful industrial and medicinal compounds.

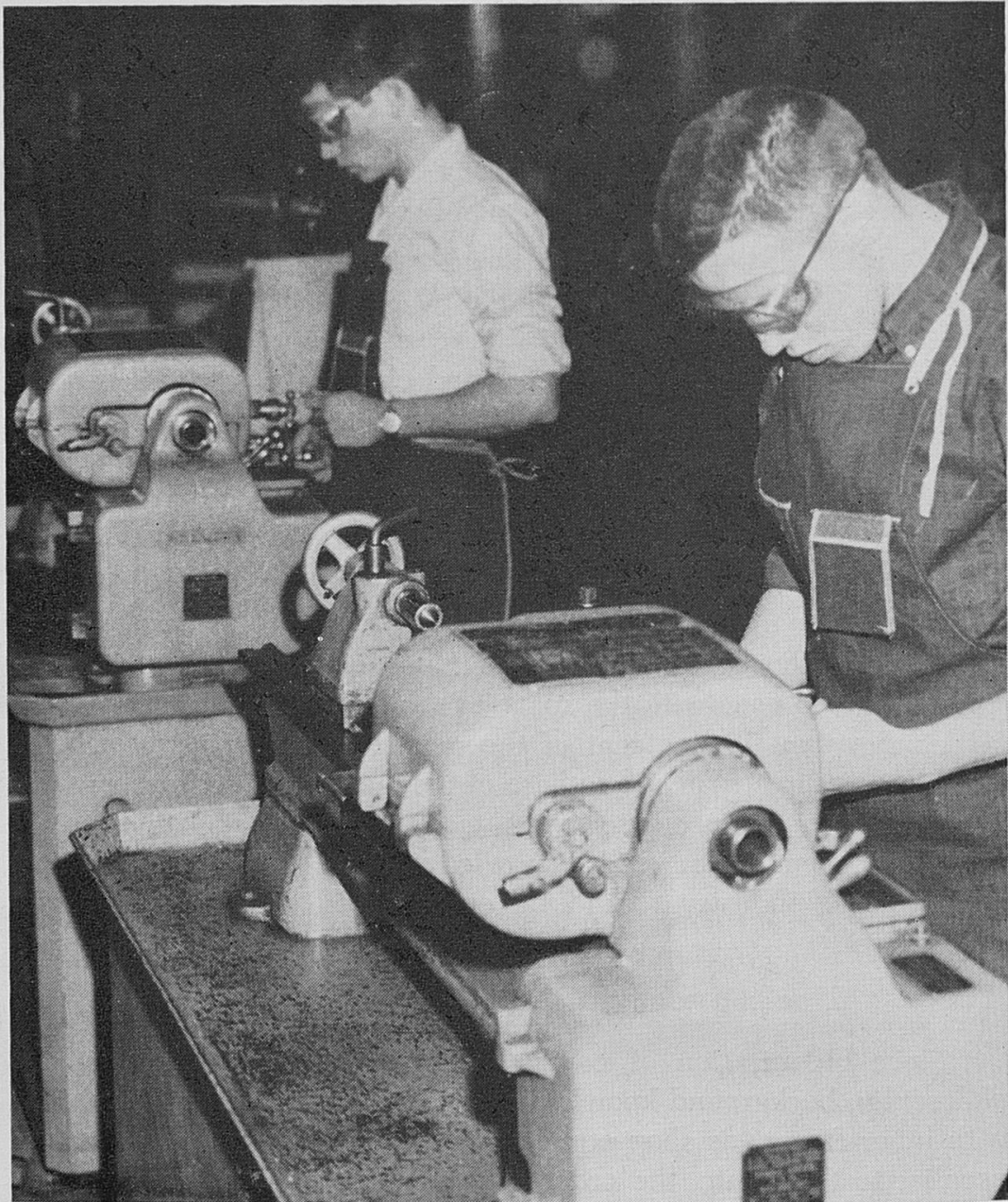
A basic knowledge of physical and chemical properties of commercial metals, combined with the basic metalworking skills will help the potential consumer to be an intelligent user of metal products. The skills will also enable the consumer to maintain and repair these products.

When we view the future with our vast mining resource, huge metal refining plants, and scientific developments in new uses of metal alloys, thousands of new and interesting jobs must develop if we are to keep pace with the space age and modern consumer needs. With more than 10 per cent of the people of our country engaged directly or indirectly in some phase of the metalworking field, increasing numbers of engineers, scientists, technicians, and skilled craftsmen will be needed. Basic skills, knowledges, and interest in the vast metalworking industry should be encouraged in junior and senior high school.

METHODOLOGY

Since organization of course content differ depending on the philosophy, background knowledge, and method of the teacher, along with other factors as shop equipment, operating cost, and objectives peculiar to the locale, the order and stress of emphasis may vary in presenting the following topics:

1. Planning (drafting, print reading, estimates, etc.)
2. Accurate measurements (to limits) and layout (on stock and transfer of patterns).
3. Design (basic principles peculiar to metal products and physical properties of the stock).
4. Tools and tool processing (both hand and machine).
5. Fitting, assembly fasteners, and assembly (custom and production).
6. Treatment of metals (heat, alloys, and chemicals).
7. Safety.



Students In A General Metalworking Class

Some textbooks and metalworking teachers as well, suggest special lessons on such topics as planning, study of metals, design, and safety as beginning lessons of the course. Others suggest brief preliminary discussions on some or all of these topics, and that they be introduced again along with other general informational items. Still others omit the design and much of the planning assuming that this information is covered in other courses. In some cases special safety notes are pointed up in red print or by picture inserts.

There are definite problems in planning, design, and safety that should be considered in teaching metalwork. Some time could be well spent with these topics as preliminary assignments. There is no doubt about the importance of the safety problem. The following safety guides should be noted, posted, and followed:

Proper dress:

1. Roll up your sleeves above the elbows.
2. Remove your tie or tuck it in your shirt.
3. Remove wrist watch, rings, and other pieces of jewelry.
4. Keep your hair cut short or wear shop cap.
5. Wear shop coat or apron to protect clothing.
6. Wear special protective clothing when working with hot metal.
7. Wear special goggles or face shield when drilling, grinding, buffing, or when there is danger of flying chips.
8. Wear special goggles or shield when welding.

When working with tools:

1. Do not use a tool until you have had a demonstration.
2. Report any defective or broken tools that you find.
3. Avoid using dull tools.
4. Avoid using tools with loose handles.
5. Never use files without a handle.
6. Avoid using chisels, punches, etc., with mushroom heads.
7. Never carry sharp tools in your pocket.
8. Always handle tools, stock or projects with sharp points down, or wrap edges with protective covering.
9. Avoid wet hands when using portable electric hand tools, and make sure this equipment is grounded. Check for faulty cords, plugs, and switches.
10. Do not use these tools around inflammable gases or vapors.
11. Avoid wet spots, plumbing, or other grounded objects while using electrically powered tools.

Other safety notes peculiar to the operations should be pointed up and not listed along with other informational items. Safe handling of tools and materials is one of the major objectives of industrial arts.



Welding In A General Metalworking Class

INSTRUCTIONAL CONTENT

Designing and Planning

Make and read a working drawing.

Study principles and elements of design and select a project.

Create a design.

Learn about working qualities of metal that affect design.
Apply drafting fundamentals and principles.
Learn about types of assembly that affect design.
Use proper abbreviations and symbols on drawings.
Make a plan of procedure.
Make a bill of material.
Make an analysis cost.
Measure and divide spaces with rule.
Measure with micrometer.
Use of steel square, combination.
Measure with outside calipers.
Measure with inside calipers.
Locate centers with hermaphrodite calipers.
Transfer dimensions with dividers.
Gauge parts with gauges and indicators.
Measure angles with protractor.
Measure with a vernier.
Make a simple layout on metal.
Make a layout on paper and transfer it to metal.
Layout by parallel line development.
Layout by radial development.
Develop a pattern.
Scribe arc with divider.
Layout with prick or center punch.
Apply layout dye or coating.
Select design for decorating.
Layout with trammel points.

Cutting

With hand tools, including hack saw, cold chisel, jeweler's saw, tin snips.
With lathe, shaper, milling machine, broach.
With squaring, ring, circle, and bench shear.
With power hack saw, band saw, and jig saw.
With acetylene torch.

Drilling

Drill holes with hand drill.
Drill holes with drill press, lathe, milling machine.
Punch holes with solid or hollow punch by hand.
Bore holes with drill press, lathe, milling machine.
Ream holes with drill press, lathe, milling machine.
Ream with hand reamer.

Bending

- By hand when cold.
- With machines.
- By bending when heated.
- Form with bending jig.

Shaping and Forming

- Form to shape by hand when cold or hot.
- Use sheet metal machines, such as forming rolls, bar folder.
- Fold hems or seams with hand seamer.
- Form to shape by hand when heated.
- Groove with hand groover.
- By pouring into molds.
- By spinning.
- With machines, such as lathe, shaper, milling machine.

Heat Treating

- Annealing.
- Hardening.
- Tempering.
- Case hardening.
- Identify metal by spark test.
- Normalizing.
- Use hardness tester.

Smoothing Metal

- With files, scrapers, burnishers.
- With grinding wheels.
- With abrasive materials.

Cutting Threads

- With taps and dies by hand.
- With taps and dies on drill press, milling machine, lathe.
- Remove broken tap or drill.
- Cut external or internal threads on lathe.

Assembling Metal Parts

- By soft soldering.
- With rivets.
- With seams.
- With metal screws.
- By brazing.
- With bolts and machine screws.
- With joints.

By acetylene welding or cutting.
By hard soldering.
Assemble fittings.

Decorating Surfaces

By peening and planishing.
By chasing, doming, fluting.
By etching or engraving.
Knurling.
Spot finishing.

Finishing

By polishing, buffing.
By painting with paint, enamel, varnish, lacquer, wax.
By color with heat.
Clean metal with acid.
By spraying.
Clean a solder surface.

Cleaning and Caring for Tools and Machines

Clean and tin soldering copper.
Sharpen hand tools, such as punches, cold chisels, drills.
Regulate and adjust machines.
Clean and lubricate machines.
Sharpen cutting tools for machines, such as tool bits for lathe, shaper, milling machine.
Regulate and adjust hand tools and equipment.
Clean and oil tools.
Repair mold.
Temper sand.
Repair and replace belts.

Sources of Metals

Geographical location of raw materials.
How they are mined and extracted.
How they are shipped to processing plants.

Refining of Metals

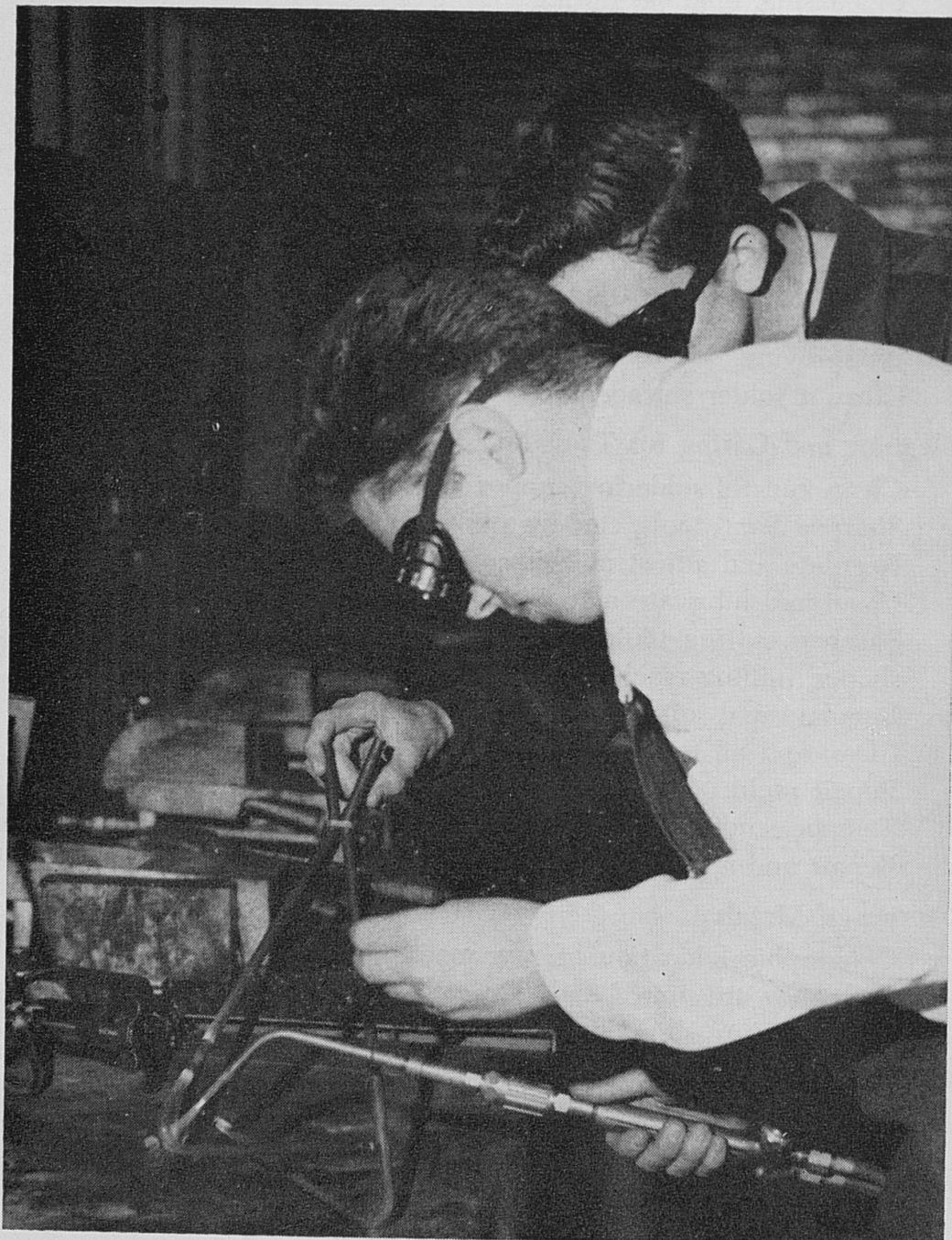
How metals are refined and produced.
How steel is made.
How copper and its alloys are refined and manufactured.
How aluminum is refined and produced.
How tin and tin plate is manufactured.
How wire is made.

Characteristics

Comparison of color, cost, working qualities, characteristics, identification.

Properties of metals.

Common kinds and shapes.



Brazing In General Metalworking Class

Consumer Uses

Where metal is used in home construction, home utensils, appliances, scrap, commercial construction, transportation (automobiles, airplanes, ships, trains).

How metal is purchased, cost (sheets, angles, shapes as pipe, rivets, etc.).

Occupational Information

Opportunities.

Wages and working conditions.

Fields of metalworking.

Number and kinds of workers in each field.

Kinds of manufacturing concerns.

Occupational requirements.

Trade publications.

Apprenticeship system.

Purchasing and caring for tools, materials, and machines for home metal workshops, including repair and hobby activities.

History and Development

Metalworking processes.

Tool development (machine and hand tool).

Metals.

Industrial Techniques

Mass production methods.

Uses of jigs and fixtures.

Industrial design drafting procedures.

Machine tool manufacture.

New machines and processes.

Principles and Processes

Principles and characteristics of heat treatment.

Speeds and feeds.

Related advanced mathematics.

Theory of metal cutting.

Types and Uses of Hand Tools

Cutting tools.

Layout and measuring tools.

Assembly tools.

Forming tools.

Striking tools.

Holding devices (vices, chucks, etc.).

Types and Uses of Machine Tools

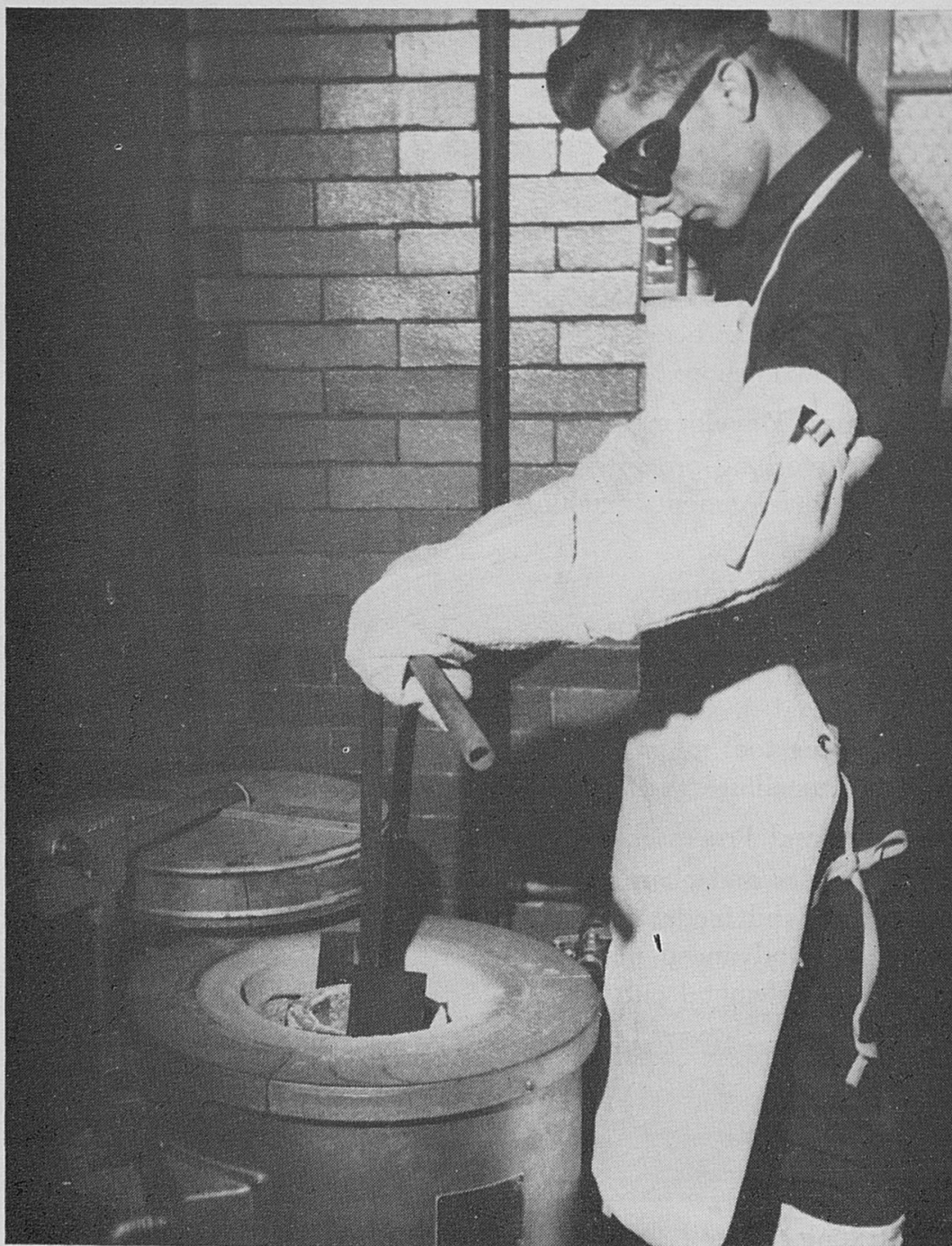
Welding

Welding practices and procedures.

Types of welding rods and electrodes.

Types of welders.

Types of torches and their application.



Working In Foundry—General Metalworking

Foundry

Foundry practices and procedures.
Types and sources of molding sand.
Casting metals and alloys.
Types of patterns.

Sheet metal

Types of sheet metal and assembly procedures.
Uses of templates and patterns.
Methods of forming irregular shapes.
Soldering procedures.

Plumbing Procedures and Practices

Forging Procedures and Practices

Machine Shop Operations

Kinds and uses of threads and gears and how they are machined.
Methods of cutting tapers.
Grinding, sharpening and polishing procedures.
Knurling practices and procedures.

Related Drafting Procedures

Types of sheet metal development.
Principles and fundamentals of metal drafting.

Footnote

We are grateful for the assistance offered by the industrial arts teachers listed below in checking topics, tools, and reference materials for this chapter:

Mr. Talmage L. Hendrick
Male High School
Louisville, Kentucky

Mr. James Pearce
Jessamine County High School
Nicholasville, Kentucky

Mr. G. T. Malbone
Southern Jr. High School
Louisville, Kentucky

Mr. Roger W. Prewitt
Madison Central High School
Richmond, Kentucky

CHAPTER XI

GENERAL ELECTRICITY—ELECTRONICS

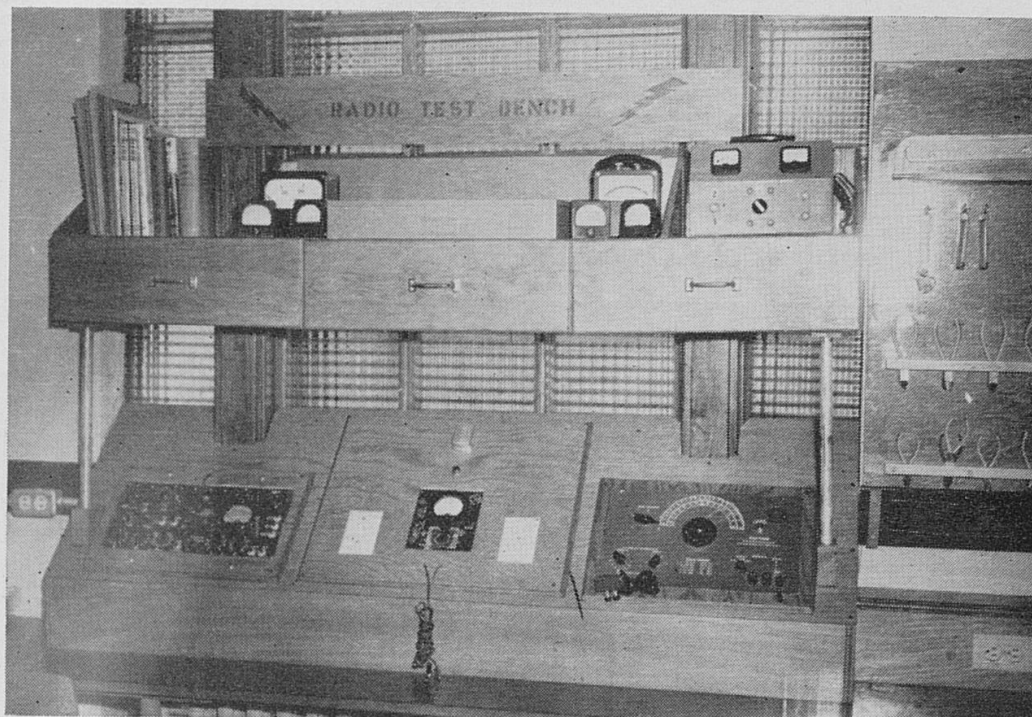
SENIOR HIGH SCHOOL

PURPOSE

The development of tool and machine skills is stressed in the use of materials and processes covered in the subareas of magnetism, light, heat, elementary electronics, appliance repair, power sources, power transmission, and basic circuits. Emphasis is placed on developing safe work habits in the shop and their relationship to everyday living in school and community. Technical abilities and interests are discovered and occupational information is provided.

METHODOLOGY

1. Conventional teaching methods are employed in the teaching of electricity-electronics as they would in any area of industrial arts. The most appropriate method of instruction for the particular unit is left to the individual instructor. Visual aids should be included in all lectures and discussions to enhance the lecture as much as possible.
2. Rapid circuit wiring devices and "breadboarding" should be used as much as possible to accelerate the program.
3. The unit assignment sheet should be used in order to allow a great deal of personal investigation by the student. The teacher must prepare the unit sheets well in advance and thoroughly test it before assigning. Close supervision by the teacher must be carried on at all times in order to maintain equipment and ensure safety to the student. Not more than two students should be allowed to work on one assignment sheet for a particular unit at one time. After one assignment is completed the student should move to a new unit assignment.
4. Appropriate films, charts, and instructional aids should be incorporated into the presentation of the different units whenever possible.
5. Adequate shop library facilities should be provided and maintained for personal student investigation.
6. Low voltage AC or DC should be used at all times except in a case where the understanding of the unit would be hindered if a lower voltage is used.
7. Students' project should possess a high degree of quality and craftsmanship.



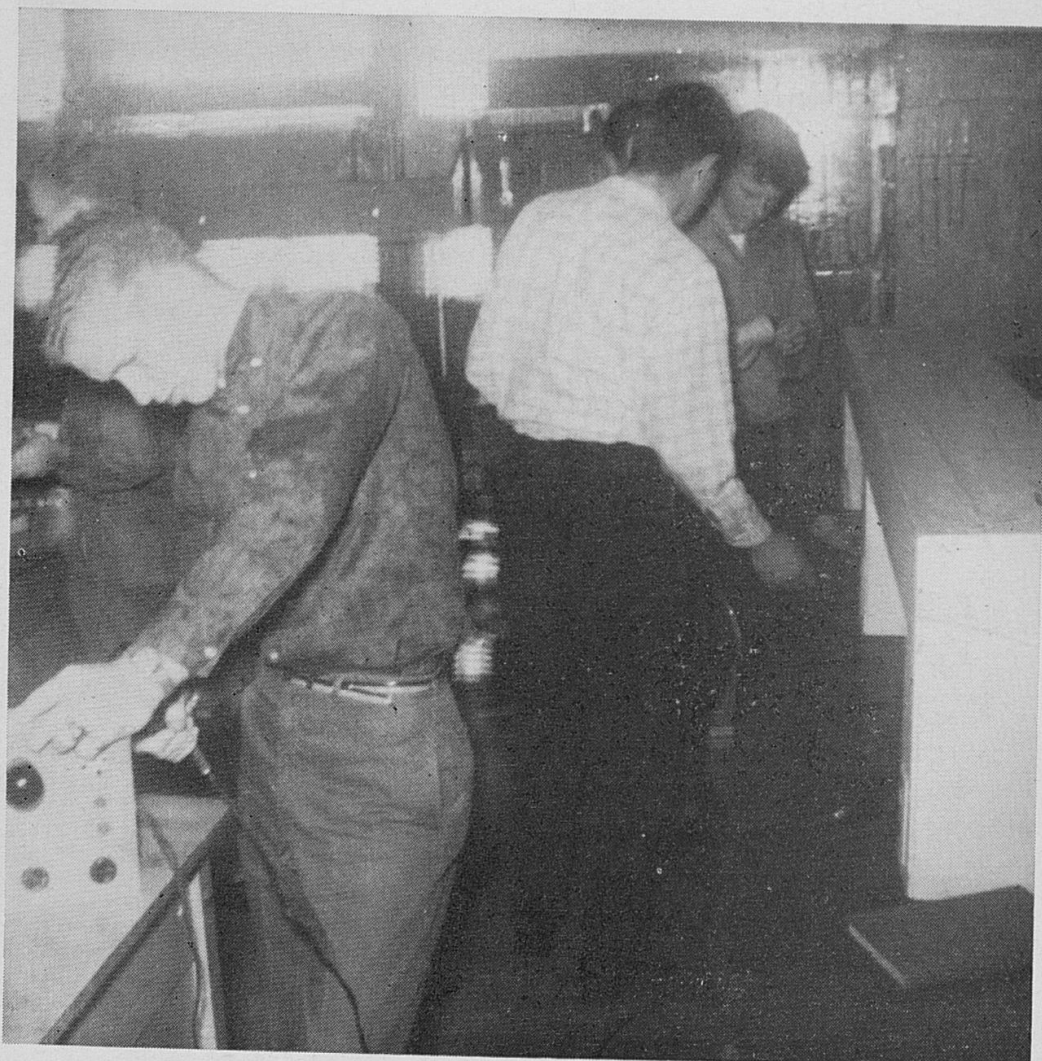
A Radio Test Panel In General Electricity

INSTRUCTIONAL CONTENT

Following is a proposed outline for a unit in general electricity.

1. What is electricity?
 - a. Electron theory
 - (1) electrons—protons—neutrons
 - (a) current electricity
 - (b) static electricity
2. General electrical safety
 - a. Safety procedures for the shop
 - b. Potential dangers of electricity
 - c. Working with electricity safely
 - d. General first aid procedures
3. Permanent magnetism
 - a. Molecular theory of magnetism
 - b. Magnetic properties
 - c. Magnetizing and demagnetizing materials
4. Producing electricity
 - a. Methods of producing electricity
 - (1) direct current generators
 - (a) thermocouples
 - (b) chemical effects

- (c) photo electricity
- (d) mechanical generators
- (2) alternating current generators
 - (a) mechanical generators
 - (b) piezoelectric effect
- b. Analysis of AC and DC



Students In General Electricity Class

- 5. Measuring and computing electrical units
 - a. Direct current
 - (1) voltage
 - (2) resistance
 - (3) current
 - (4) wattage

- b. Alternating currents
 - (1) voltage
 - (2) resistance
 - (3) current
 - (4) wattage
 - (5) inductance
 - (6) capacitance
 - (7) reactance
 - (a) capacitive
 - (b) inductive
- 6. Circuit analysis
 - a. Series circuits
 - b. Parallel circuits
 - c. Combination circuits
- 7. Electrical applications
 - a. Heating electrically
 - b. Lighting with electricity
 - c. Magnetic effects
 - (1) electromagnetics
 - (2) transformers
 - d. Electroplating
 - e. House wiring
 - (1) distribution systems
 - (2) entrance equipment
 - (3) switches and control circuits
 - (4) outlets, receptacle and fixture wiring
 - (5) splicing and connection devices
- 8. Common electrical appliances
 - a. Principles utilized by common appliances
 - b. Maintenance and repair procedures
 - c. Purchasing appliances wisely
 - d. Using appliances safely
- 9. Electronic principles
 - a. Vacuum tubes
 - (1) basic principles and characteristics
 - (a) diodes
 - (b) triodes
 - (c) tetrodes
 - (d) pentodes
 - (e) multielement tubes



Applying Electrical Theory

10. Applications of vacuum tubes
 - a. Detection
 - b. Amplification
 - c. Rectification
 - d. Oscillation
 - (1) common vacuum tube circuitry
 - (a) radio receivers
 - (b) transmitters
 - (c) television
 - (d) high quality audio reproducers
 - (2) service and repair procedures and principles
 - (a) semiconductors
 - 1) diode and transistor principles

- 2) applications of semiconductors
 - a) detection
 - b) amplification
 - c) rectification
 - d) oscillation
- 3) common transistor circuitry
- 4) transistor servicing techniques

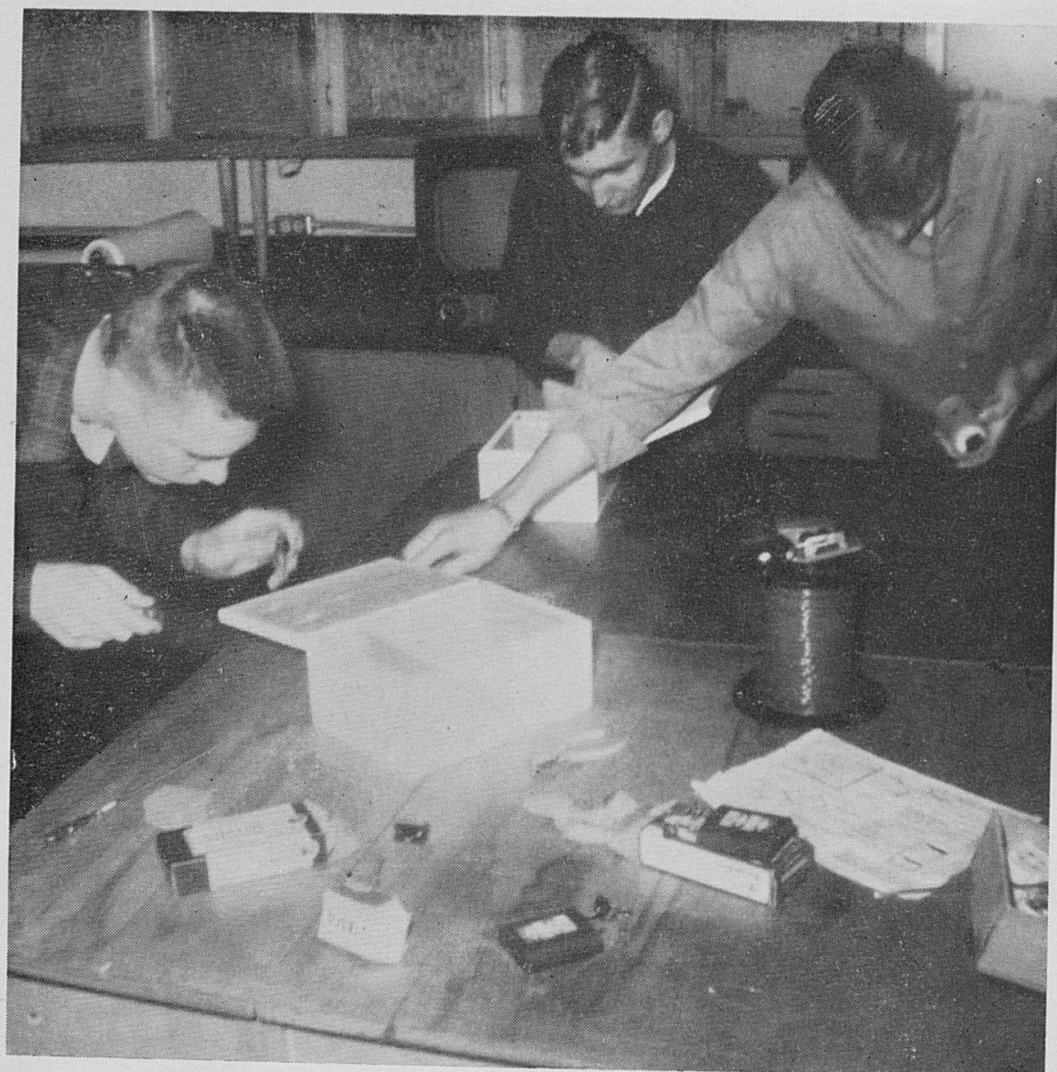
General Information

1. To have an understanding of the following terms and be able to compute them with certain known values.

current	impedance
resistance	reactance
voltage	capacitance
wattage	inductance
conductance	
2. To have an understanding of the following terms in relationship to magnetism:

retentivity	magnetic field
permeability	polarity
diamagnetic	reluctance
3. To understand how electricity is produced chemically, mechanically, by heat and light.
4. To know the correct usage of the following instruments:

voltmeters	tube testers
ammeters	signal tracers
ohmmeters	signal generators
wattmeters	oscilloscopes
kilowatt-hour meter	
5. To become familiar with basic electrical symbols and recognize the particular component they represent.
6. To be able to connect and recognize components in series and parallel and know the limitations of each circuit type.
7. To be able to connect a circuit that is electrically correct and safe.
8. To understand the potential dangers of electricity.



Problem Solving In The Electrical Shop

9. To understand the basic operation of the following electrical devices:

circuit breakers
motors
electromagnets
transformers
bells and buzzers
generators
radios
televisions
meters
telephone
code oscillator
fluorescent lamps

welders
toasters and hot plates
electric irons
electric clocks
electric ranges
phonographs
auto ignition systems
speakers and earphones
transistors
vacuum tube
tape recorders

10. To be able to differentiate between AC and DC and recognize the limitations and applications of each.
11. To be familiar with common electrical conductors and insulators and recognize the limitations of each.
12. To be able to perform minor repairs of common household appliances.
13. To be able to splice and connect conductors by the most appropriate means for common electrical circuits.
14. To be able to connect and understand house wiring circuits.
15. To understand static electricity and its applications.
16. To be able to magnetize and demagnetize metals.
17. To understand the following functions of vacuum tubes and semiconductors. Amplification AF, RF, IF, Video (1) Detection (2) Rectification (3) Oscillation
18. To understand basic transmitting and receiving principles of radio and television.
19. To be able to construct radio circuits and place components correctly in circuits.
20. To understand what is meant by circuit overloading and know what is necessary to prevent overloads.
21. To understand how electricity can produce the following effect. (1) heat (2) light (3) magnetic (4) chemical
22. To know how to plan an electric circuit.
23. To understand the transformation of energy from power plant to the home.
24. To recognize the uses and characteristics of AC and DC motors and generators.
25. To know how to select proper electrical devices for the job.
26. To know how and what to look for in purchasing electrical appliances and devices.
27. To know how to care for and operate common electrical devices.
28. To be able to read schematic diagrams of radio and television sets.

SAFETY

The average person is usually afraid of electricity due to his lack of knowledge along these lines. Electricity is perfectly safe when handled properly and with respect. It should be the aim of every

electricity instructor throughout the state of Kentucky to incorporate safe practices and procedures within his instructional content and strive continuously to make his laboratory a safer place in which to experiment and learn.

Below are listed a few basic points in relation to practices and procedures pertaining to the electricity laboratory. These points are to be used, simply, as a guide to the instructor in order that he might operate and maintain a safe and orderly laboratory in which to learn. These points, as stated, are basic and should be added to and expanded by the instructor as determined by his individual situation and needs.

1. Correct procedures and practices should be taught in all areas, throughout the entire year.
2. The instructor should be certain that the student understands the function and purpose of all equipment before the student is permitted to use this equipment.
3. The instructor should never permit the student to use badly worn or broken electrical equipment.
4. The laboratory should always be kept **clean** and **dry** at all times. **Water and electricity do not mix.**
5. The student should understand completely the effects of electricity before attempting to experiment. Electricity can and does produce heat. Severe burns can be the result of a poorly informed or instructed student.

Safe practices and procedures should be observed by the instructor at all times while presenting his instructional content and while working with the students. **The student, while experimenting, will be only as safe as his instructor.**

CHAPTER XII

GENERAL POWER MECHANICS— SENIOR HIGH SCHOOL

PURPOSE

The fundamentals of power mechanics are provided through a variety of experiences and activities. The correct and safe use of tools and machines is emphasized. The development of tool and machine skills is stressed in the use of materials and processes covered in the subareas of small gas engines, electrical systems, fuel systems, and accessories. Attention is given to the development of skill, accuracy,

judgment, and craftsmanship. Shop activities correlated with class discussion, demonstrations, and study provide for the practical application of mathematics, science and language arts.

1. Basic understanding of automobiles, airplanes and other power machines as well as other sources of power and means of transmitting power such as hydraulics and pneumatics is a fundamental educational need of our technological society. In a broad sense, power mechanics provides an opportunity to apply selected principles of physics.
2. Discovery of interests and technical abilities to guide students toward life's work.
3. Some technical skill.
4. Knowledge and application of fundamental scientific and mathematical principles.
5. Learning in a problem-solving, planning, learning situation.

METHODOLOGY

Man has done much to utilize various sources of power to assist him in his work; tilling the soil, cutting the lawn, and providing the means of personal transportation for masses of people.

1. Students study textbooks, instruction manuals, laboratory guide sheets, etc. before teacher gives laboratory lessons and demonstrations. Students must read, learn to follow written instructions and learn how to reason to get the most from power mechanics.
2. Instructor's lessons, lectures and demonstrations with laboratory engines, mock-ups, cut-away parts, charts, etc. follow student reading.
3. Students work on laboratory units from detailed instruction guides or service manuals in an orderly manner.
4. Students work on "live" units of their own or others **only** after proper demonstration and actual performance on laboratory engines are successfully demonstrated.
5. Movies, transparencies, charts, cut-away parts, organized laboratory guide sheets, instruction manuals of all power units and a good shop library are absolutely essential for an ideal learning situation.
6. Normal interest of high school students to understand automobiles and other power machines makes it an ideal course as far as student motivation is concerned.

7. Simple research experiments on the comparable qualities of fuel, oils, etc. are possible.
8. Related information, reports on lubrication oils, fuels, production, labor relations, corporate management, etc.
9. In general, emphasis should be on scientific trouble-shooting and testing procedures and mechanical skills only after fundamental principles, parts adjustments and operations of power units and accessory parts are at least familiar to the students.
10. Senior high school students should be expected to learn more complex machines and operations as well as make precise measurements and adjustments with laboratory tools and equipment to close tolerances as in industry.

INSTRUCTIONAL CONTENT

General Information

1. Basic knowledge of types of power machines
2. Understanding of basic principles of internal combustion gasoline engines
 - a. Fuel
 - b. Combustion
 - c. Basic engine parts
 - d. Engine operation
3. Principles of diesel engine operation
 - a. Air induction
 - b. Compression
 - c. Fuel metering and injection
 - d. Ignition
 - e. Combustion
 - f. Engine cycles
4. Comparing gasoline and diesel engines
 - a. Fuel
 - b. Compression ratio
 - c. Air-to-fuel ratio
 - d. Fuel economy
 - e. Engine structure
5. Gasoline engine operation and repair
 - a. Engine construction and parts
 - b. Precision measurements and performance
 - c. Lubrication systems
 - d. Cooling systems

- e. Fuel systems
- f. Electrical systems
- g. Engine, fuel, and electrical testing and trouble-shooting
- 6. Jet engines
- 7. Hydraulics
- 8. Pneumatics
- 9. Technical and related research reports

Skills

1. Use of engine repair tools and machines
2. Use of precision instruments and measuring tools
3. Skill in repairing and servicing small engines such as lawn-mower, outboard motor, etc.

SAFETY

1. Personal safety
 - a. Attitude of students
 - b. Smart people are safety-minded
 - c. The laboratory is a place for serious work and not a play room
2. Be certain that all tools, machines and equipment are in safe condition and are used properly
3. Power mechanics safety
 - a. Prevent falls of students by keeping loose tools, parts, oil, etc. off the floor
 - b. Use car stands properly under cars at all times
 - c. Be careful of fire, heat and moving parts when engines are started
 - d. Radiator caps on boiling radiators are dangerous
 - e. Compressed air is not to be played with
 - f. Carbon monoxide gases coming from exhaust systems are poison
 - g. In electrical work watch for short circuits and spilling acid from batteries
 - h. Keep a fire extinguisher handy since gasoline burns easily
4. Administer written safety tests at the beginning of each new class

CHAPTER XIII

GRAPHIC ARTS—SENIOR HIGH SCHOOL

PURPOSE

Graphic arts in industrial arts education is concerned with the study and practice in the various methods of printing and its allied trades. An introduction to graphic arts is provided through a variety of experiences and activities in photography, silk screen, block printing, composition, offset lithography, letterpress printing, and rubber stamp making.

Graphic arts is a subject area which affords the student most of the values inherent in the academic program as well as values peculiar to graphic arts as an industrial arts medium. Each subarea is specifically identified and students are encouraged to select certain subareas for emphasis. Special attention is given to the development of habits concerning safety, good working relationships, and economical use of the time and material.

Occupational guidance is an integral part of the instruction offered. Students plan and design their projects, figure costs involved, and assist in ordering material.

Objectives

1. To insure self-assurance through problem solving.
2. To improve ability to solve daily problems by interpreting and expressing oneself graphically.
3. To improve aesthetic appreciation.
4. To improve social attitudes and participation in informal class activities and study of working relations in the graphic arts industry.
5. To increase understanding of values of everyday uses of the graphic arts products and processes.
6. To offer exploratory contacts with the graphic arts areas.
7. To increase avocational interest and pursuits in the field of graphic arts.
8. Provide vocational guidance in the field of graphic arts and pre-vocational experiences with special attention upon skill in performance, planning, selection of materials, selection of equipment, management, safety and pupil cooperation.

The graphic arts laboratory may be divided into three major departments:

- printing
- related graphic arts processes
- photography

These in turn may be redivided into numerous logical subdivisions.

The printing division should contain basic processes and projects in its four basic divisions: composition, imposition, presswork, and bindery.

In the related graphic arts division, basic processes and projects should be included in the following fields: bookbinding, block printing, etching, thermography, stereotyping, rubber stamp making, paper-making, embossographing, silk screen, and offset, most of which bear heavily on the avocational phase of industrial arts objectives.

In the photographic division, basic processes and projects should be included to teach the following: chemistry of photography, composition of a good photograph, contact printing, enlarging and tinting.



A Student in the Graphic Arts Shop

This in general should constitute the scope of the graphic arts laboratory, allow for minor variations in local graphic arts needs, and for the instructor's particular interests.

This program has been planned for the model graphic arts program. The instructor should, in the absence of the equipment needed for instruction in the various areas, use film, field trips, lectures and demonstrations by competent people from industry, as well as magazines, wall charts, advertising literature, etc., to acquaint the students with the most recent developments in the area.

No special units on safety are included in this outline as each teacher is expected to integrate safety with each operational and instructional activity.

INSTRUCTIONAL CONTENT

Relief Printing

- Printing (letterpress)
- Principles of job layout and design
- Hand composing
- Plate making (line cuts, halftones, stereotypes, electros, linoleum and wood blocks, rubber stamps, plastic plates)
- Proofing
- History of printing
- Type, designing and the manufacture of type
- Machines of the printing industry
- Careers in printing
- Techniques of composition (by hand or machine)
- Measuring type matter
- Operating various types of relief presses
- Clean and care for equipment
- Type case layouts
- Safety in the printing shop
- The interdependence of graphic arts industries
- How our daily newspapers, magazines, textbooks are produced
- Use of dictionary and other references
- Technical terms of the printer
- English and grammar
- Science, technology and new frontiers in printing
- Care for equipment
- Printing halftones and other relief cuts
- Human relationships and labor management problems

Stencil Printing (Silk Screen, Mimeographing, Xerography)

- Preparing and applying stencil (mimeograph, silkscreen, paper photographic stencils, painting, duplicating)
- Care for tools and equipment
- Making the design or layout
- Various uses of silk screen printing, such as ads, posters, and names on industrial products
- Principles of design for silk screen work
- Methods of making designs
- Adaptability of silk screen process
- Silk screen printing as a hobby in rehabilitation
- Opportunity in silk screen in industry
- Principles of silk screen printing
- Types of stencils used on silk screen printing
- Construction of frames
- Operating a stencil duplicating machine

Bookbinding

- Jog and fold paper
- Sewing the book
- Preparing the book and/or materials
- Repair a book
- Uses and significance of books and bookbinding
- History of bookbinding
- Types of binding
- Essential tools and equipment
- Career opportunities
- Procedures for bookbinding
- Types of tools and materials
- Kinds of sewing
- Lettering or decorating

Paper and Papermaking

- Papermaking in industry
- Selecting paper suitable for specific uses
- Cutting and packing
- Figure paper stock
- Making the paper (draining, sizing, rolling)
- Obtaining the raw materials and making the pulp
- Standard finishes, weights, sizes, and packaged units of paper
- Types of paper and how to select them
- Figure and cutting paper

Selecting and mixing pulp ingredients
History of papermaking
Logging and pulpmaking industries
Paper merchandising



Locking Up For the Press

Photographic Processes (Photography, Photocopying, Photostating, Duplicating, and Reproduction, Ozalid Printing, Blueprinting)
Printing and developing the copy print, enlargement, slide ozalid, blueprint, plate or master

Adjusting the camera or instrument and taking the picture or making the copy

Developing the film and touching up the negative

Selecting and/or preparing the subject to be photographed or copied

Composition

Uses and importance of photography, photocopying, and photostating in graphic arts and everyday life

Important types of cameras available today

Principles of photography

Choosing the paper with the most appropriate contrast and finish

Meters and their uses

Photography by artificial light

Color photography

Method of making blueprints

Photography as a hobby

History of picture making

Career possibilities in photographic industries

Photography in science, medicine, industry

Duplicating (Spirit, Hectograph)

Preparing the master copy

Duplicating and reproduction

Making the design and/or layout

Uses and advantages of duplicating methods

Operating gelatin hectograph and spirit duplicator

Clean machinery

Reproduce a drawing

Types of characteristics of duplicating machines

The principle of hectograph and spirit duplicating

Chemistry of plates and fluids

Lithographic Offset Printing

Making the plates (direct image and photographic processes)

Printing or duplicating

Uses and importance of lithographic printing

Composing and printed matter

Clean and care for equipment

Kinds of plates used, individual advantages, uses

Stone lithography and its historical and present day importance

Lithographic chemistry

Careers in lithographic printing and duplicating

Methods and techniques of placing the image on the plate by direct image processes

Operating offset duplicators and the large offset processes usually found in the printing industry

Theory of the offset press

Etching and Gravure Printing (Intaglio)

Making the plate (drypoint, acid etching, engraving, photographic processes)

Printing (etching, photogravure, rotogravure)

Making the lay out and/or design

Importance of intaglio methods (etching, drypoint, engraving, photogravure, rotogravure)

Types of intaglio printing

Industrial use of intaglio printing

Care for tools and equipment

Career opportunities

Methods and materials for etching and engraving

Kinds of plates used and their preparations

Styles of presses and their operation

Photographic methods of preparing plates

Ink

Use ink properly

Mix colors

Select colored inks

Types of ink

Color principles

History of ink making

Skills

Adjustments on the composing stick

Justify and set a line of type

Center a line of type

Set a paragraph of straight matter

Set the styles of indention (paragraph, hanging, squared, half-diamond, diagonal)

Identify spaces and quads and their uses

Remove type from composing stick

Place type on galley

Tie up type forms

Pull a proof on proofpress

Make a stone proof

Learn proof marks
Read and properly mark proofs
Correct errors in a type form
Accurately distribute type
Set a paragraph using an initial letter
Set a line of display type
Lock up a type form using furniture and chaser method
Locate oil holes and oil press
Make-ready on the platen press
Feed a job press
Lay a case
Distribute composing room materials
Wash up a job press
Hand folding
Make up a four-page folder
Set a newspaper ad
Set a handbill
Set a placard
Set and print a two color job
Set up rule borders
Set a job involving the composition of tickets
Design a business form
Design a page ad using samples of the five basic types
Make sketches illustrating optical center, balance, grouping, proportion, and other essentials of design
Prepare special envelope make-ready
Adjust and set rollers
Use special make ready for perforating rules
Cut and figure stock
Printer's point system
Set examples of: special composition for programs, menus, cover pages, reports, letterheads, booklets, etc.
Make newspaper makeup and headings (as applied to school papers)
Stitch a booklet
Bind a book
Make pad, tablet
Cover worn book
Make a color chart or color wheel
Make tint of primary colors
Demonstrate positive and reverse method of cutting a stencil

Transfer design and cut linoleum block
 Trace and identify steps in making paper
 Make sample of ink using oil and lamp black
 Transfer image to zinc or copper plate for relief line etching,
 apply resist, do acid etching, mount cut, use router, and print
 Make rubber stamp pad
 Prepare art and copy for lithography
 Strip, mask and opaque negatives
 Make plates
 Operate small press
 Determine printing troubles and correct them
 Make a frame for silkscreen printing
 Prepare art and copy for the process
 Make the various kinds of stencils
 Adhere the various kinds of stencils
 Print in register with paints and inks
 Apply flock and beads
 Print on odd shapes
 Enameling on metal and glass
 Print on textiles
 Prepare art copy for the various duplicating processes
 Make the various kinds of stencils and spirit masters
 Design and print copies on a spirit duplicator
 Design and print copies on a stencil duplicator
 Design and print copies on a gelatin duplicator
 Operate cameras of various types
 Use various lighting methods efficiently
 Develop films
 Improve poor films (reducing, intensifying, and retouching)
 Make color prints
 Make an enlargement
 Make a tint photograph
 Make a simple photo-greeting card

See Appendix for equipment list and reference books.

CHAPTER XIV

GENERAL PLASTICS—SENIOR HIGH SCHOOL

PURPOSE

Industrial arts teachers should offer the courses which better prepare the student to live in a modern, industrial, technological society. Synthetic plastics will inevitably replace many products now being used. A course in general plastics will aid students to be better consumers of plastic-made articles, to acquire skill in the repair and maintenance of various types of plastics, and may lead to a vocational or avocational interest in later life. Materials and processes used in school laboratories must be constantly investigated and evaluated to insure growth in the ever-increasing complexity of space-age society. Progress through the use of plastics is the purpose and obligation in giving the students a choice to use and work with this material in its various forms.

METHODOLOGY

Teaching plastics as a course in the industrial arts shop should be interesting and rewarding. A mass production project is desirable at this level. This may be done in the form of vacuum or blow forming, using acrylic plastic.

After various demonstrations and instructional materials have been presented to the students, they may choose from a selection of projects. The materials may be used to mold objects from pre-constructed molds involving some of the various methods used in molding. Later, methods of allowing the student to rotate through construction of projects in the various areas will give him a basic insight into the multi-uses of plastic materials. After certain skills in the use of these various plastic materials have been acquired, the student should be given the opportunity to design and build a major project of his own, which will include the construction of molds.

INSTRUCTIONAL CONTENT

General Information

A class in general plastics should include various materials on as many types of plastics and methods as can be conceived and devised by the teacher. The types and methods should follow the trends of industrial use as nearly as possible. The following is a tentative instructional outline which could be used to make up the content for a course in general plastics.

1. History and development of plastics
 - a. Plastic tree
 - b. Inventors and developers
 - c. Present contributors to the field
 - d. Future expectations in the field of plastics
2. Types of plastics
 - a. Thermoplastics
 - (1) vinyls
 - (2) saran
 - (3) acrylics
 - (4) cellulose
 - (5) nylons
 - (6) polystyrene
 - (7) polyformaldehyde
 - (8) polyethylene
 - (9) polypropylene
 - b. Thermosetting
 - (1) polyesters
 - (2) polyurethanes
 - (3) phenolics
 - (4) melamines
 - (5) epoxies
 - (6) ureas
3. Molding techniques
 - a. Vacuum
 - b. Pressure bag
 - c. Blow
 - d. Injection
 - e. Contact
 - f. Matched die
4. Acquisition of skills
 - a. Audio-visual aids
 - b. Competent demonstrations
 - c. Field trips through plastic industries
 - d. Lectures from people who work in the plastic industries
 - e. Practical experience on the part of the student through the construction of individual projects.

5. Making of molds
 - a. Development of patterns
 - b. Construction of solid wood molds
 - c. Paper-mache mold construction
 - d. Plastic molds made from polyester or epoxy resin with fiberglass



The Molds and the Finished Product

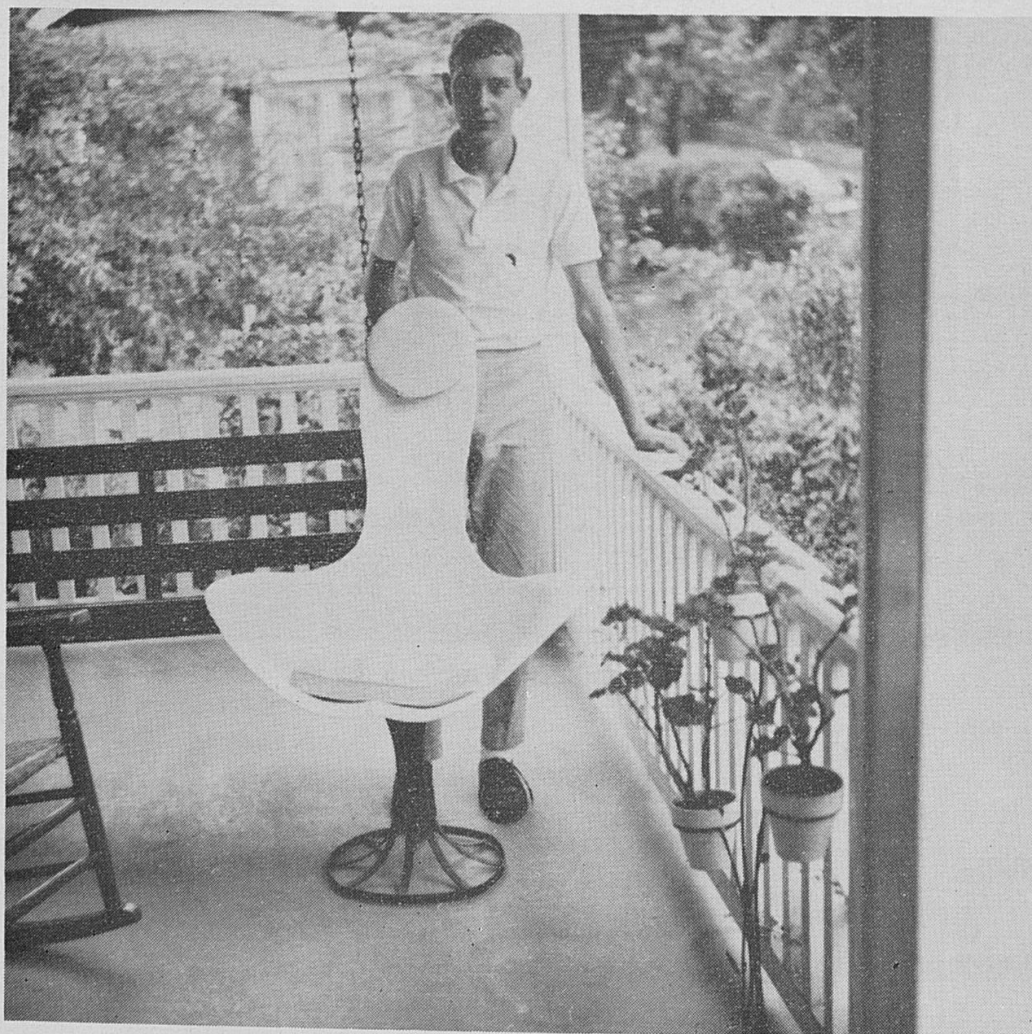
6. Design of projects
 - a. Function and appropriate use
 - b. Forms and shapes

Skills

In a general plastics course, a wide variety of skills, techniques, and procedures should be acquired by the student.

1. Student should make use of as many different types of plastics as physical facilities in the shop will allow.

2. Proper use of tools in drilling, sawing, filing, sanding, and gluing of plastics should be acquired.
3. Every student should be required to construct at least one minor project by vacuum forming, pressure bag, blow forming, injection molding, positive and negative contact molding, and matched die molding.
4. Skill in the construction of individual molds through the use of wood, metal, plaster, paper-mache, and various plastics should be accomplished on the part of the student.
5. Skill in the use of various spray finishes, such as, application of lacquer and the use of flecking or the epoxy spray paints, should be understood by the student.
6. Proper utilization and conservative use of materials should be exercised in the use of plastics.



The Student and His Project

SAFETY

Confidence and skill in the use of various plastics will eliminate most of the hazards which could endanger students. Constant evaluation of the class and their work while handling certain materials can dictate corrective measures which need to be taken in a class of this type.

1. Adequate ventilation should be included in the plans for the work area.
2. Refrigeration should be provided for the thermosetting materials and their catalysis.
3. Protective work clothes should be required when sanding a plastic which has fiberglass as a reinforcement.
4. Asbestos gloves should be worn when free-forming the acrylic plastics to various shapes.
5. All combustible materials should be stored in a fireproof cabinet.
6. Rags which may have been saturated in plastic thinner, such as, acetone, should be disposed of in a fireproof container.
7. A wash area should be provided for students to use after working with plastics.
8. The instructor should be able to visually supervise the working area.
9. The first aid box should contain various creams for preventing skin rash which might occur from improper handling of fiberglass materials.
10. A student should pass a test on uses and handling of materials which constitute good safety procedures before being allowed to start a project of his own.

CHAPTER XV

APPENDIX

A. Chapter VI (Problem-solving, Creativity and Design)

References

- Dewey, John, *How We Think*, Boston: D. C. Heath, 1933
- Dreyfuss, Henry, *Designing for People*, New York: Simon and Schuster, 1955, Preface
- Russell, David, *Children's Thinking*, New York: Ginn, 1956
- Thorndike, R. L., "How Children Learn the Principles and Techniques of Problem Solving." In N. B. Henry (Ed.) *Learning and Instruction*. The Forty-ninth Yearbook of the National Society for the Study of Education, Part 1. Chicago: University of Chicago Press, 1956
- Periodicals
- "Annual Design Review," *Industrial Design*, 1:29-41, December, 1954
- Ashton, Shirley, "Maloof: Craftsman of Furniture," *Craft Horizons* 14, No. 3, 15-21, 1954
- Brennen, Harold, "American Craftsman: 1956," *Craft Horizons*, 16, No. 1, 9, 1956
- "Charles Eames: A Designer's Progress in the Development of Plywood Furniture," *Interiors*, 105, 52-59, July, 1946
- "Craftsmanship in Architecture," *Craft Horizons*, 16, No. 3, 26-31, 1956
- Defenbacher, D. S., "Knife, Fork and Spoon," *Craft Horizons*, 11, No. 2, 18-21, 1951
- "Furniture Report," *Interiors*, 115, 118-126, February, 1956
- Nelson, George, "Good Design: What is it For?" *Interiors*, 113, 72-74, July, 1954
- Nelson, George, "Obsolescence," *Industrial Design*, 3, 81-88, December, 1956
- Silverstone, Marilyn, "Clocks," *Industrial Design*, 1, 92-101, October, 1954
- Wallance, Don, "Design and Craftsmanship in Large Scale Industry," *Industrial Design*, 3, 38-41, April, 1956

B. Chapter VII (The Comprehensive General Shop)

Drawing and Planning (7th and 8th grade level)

References

- Feirer, J. L. *Drawing and Planning for Industrial Arts*. Peoria, Illinois, Charles A. Bennett Company, 1956
- French, T. E. and Svensen, C. L. *Mechanical Drawing*. New York McGraw-Hill Book Company, 1960
- Fryklund, V. C. and Kepler, F. R. *General Drafting*. Bloomington, Illinois, McKnight and McKnight, 1960
- Gronemen, C. H. and Feirer, J. L. *General Shop*. New York, McGraw-Hill Book Company, 1956
- Newkirk, L. V. *General Shop for Everyone*. Boston: D. C. Heath, 1959
- Olson, D. W. *Industrial Arts for the General Shop*. Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1955
- Spencer, H. C. *Basic Technical Drawing*. New York: The Macmillan Company, 1962

Woods

A suggested tool list for the woods area of the general shop follows:

Cutting Tools		Number			Number
A. Hand Planes			E. Wood Bits		
Block		2	One set auger bits, sizes #4		
Junior jack		8	thru #16; one extra in sizes		
Fore		1	#12, #10, #8, #6		
Rabbet		1	Plug cutter, $\frac{3}{8}$ "		1
Router		1	Plug cutter, $\frac{1}{2}$ "		1
Spokeshave		2	Forstner bit, $\frac{3}{8}$ "		1
B. Scrapers			Forstner bit, $\frac{1}{2}$ "		1
Hand		4	Gimlet bits, #2 thru #12		
Cabinet		2	(set)		1
Burnisher		1	Countersink, rosehead		1
C. Wood Chisels, socket firmer			Twist bits, $\frac{1}{8}$ "- $\frac{1}{2}$ " by 16th		
1"		1	(set)		1
$\frac{3}{4}$ "		2	Machine spur bits, $\frac{1}{4}$ "-1"		
$\frac{5}{8}$ "		1	by 8th (set)		1
$\frac{1}{2}$ "		2	F. Files		
$\frac{3}{8}$ "		4	Half round bastard, 10"		4
$\frac{1}{4}$ "		2	Flat bastard, 10"		2
D. Saws			Square bastard, 10"		1
Dovetail		1	Round bastard, 10"		1
Coping		4	Anger bit file		1
Back		4	Mill cut, 8"		2
Crosscut		2	Sur form tools		2
Rip		2	G. Carving Tools		
			Wood carving set		1
Driving Tools		Number	Layout and Measuring Tools		Number
Claw hammers, 8 oz.		4	Bench rules, 24"		8
Claw hammers, 14 oz.		2	Try squares, 6"		8
Mallets, wood or fiber		4	Framing squares		2
Automatic screwdriver		1	Combination square		1
Automatic drill		1	Trammel points		1
Screw drivers, assorted sizes		8	Combination square		1
Screwdriver bits, $\frac{5}{16}$ " and $\frac{3}{8}$ "		2	T-bevel		1
Ratchet braces, 10" sweep		2	Marking gauges		2
Hand drills		2			
Holding Tools					
Clamps, I-bar, 4'		4			
Handscrews, assorted sizes		10			
C clamps, assorted sizes		10			

Metals

A suggested tool list for the metals area of the general shop follows:

1. Grinder, bench or pedestal model, fine and medium grain wheels $1\frac{1}{2}$ inch thickness, 8 to 10 inches diameter, $\frac{3}{4}$ H.P., 220 V. single phase, 60 cycle motor.

2. Drill press, floor model, 17 inch, variable speed, jacob's chuck $\frac{1}{2}$ " capacity, Number 2 M.T. hollow spindle, $\frac{3}{4}$ H.P., 220 V. single phase, 60 cycle motor.
3. Jig saw, slow speed for metal cutting, 24" capacity, variable speed, chuck jaw for saber cutting and filing, $\frac{1}{3}$ H.P., 110 V., 60 cycle motor.
4. Drill, portable electric hand, $\frac{3}{8}$ " chuck capacity, 110 V., 60 cycle motor.
5. Lathe, metal spinning, (heavy duty wood lathe with extra thrust bearing headstock, and ball bearing tailstock), one set of spinning tools, 1 H.P., 220 V. single phase, 60 cycle motor.
6. Buffing machine, combination wire wheel and cloth wheel, or bench cabinet model for craft work, $\frac{1}{2}$ H.P., 110 V. single phase, 60 cycle motor.

References

- Johnson, Harold V., *General Industrial Machine Shop*, Charles A. Bennett Company, Inc., Peoria, Illinois, 1963
- Feirer, John L., *General Metals*, New York, New York: McGraw-Hill Book Company, 1953
- Fraser, Roland R. and Bedel, Earl L., *General Metal Principles, Procedures, Projects*, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1955
- Giachino, J. W., *Basic Sheet-Metal Practice*, Scranton, Pennsylvania, International Textbook Company, 1952
- Giachino, J. W. and Feirer, J. L., *Basic Bench-Metal Practice*, Peoria, Illinois, Charles A. Bennett Company, 1943
- Guide to Improving Instruction in Industrial Arts*, American Vocational Association, 1010 Vermont Avenue, N. W., Washington 5, D. C., 1953
- Giachino, J. W., Weeks, William, Brune, Elmer, *Welding Skills and Practices*, Chicago, Illinois, American Technical Society, 1960
- Glazener, Everett, *Modern Metalwork*, Austin, Texas, The Steck Company, 1954
- Groneman, Chris H. and Rigsby, H. P., *Elementary and Applied Welding*, Milwaukee, Wisconsin, Bruce Publishing Company, 1948
- Jennings, R. F., *Gas and A. C. Arc Welding and Cutting*, Bloomington, Illinois, McKnight and McKnight Publishing Company, 1956
- Johnson, W. H., and Newkirk, Louis V., *The Metal Crafts*, New York, New York, The Macmillan Company, 1942
- Ludwig, O. A., *Metalwork Technology and Practice*, Bloomington, Illinois, McKnight and McKnight Company, 1955 (3rd edition)
- New York State Education Department, *General Metalwork (Related Information)* Albany, New York, Delmar Publishers, 1951
- Reagan, J. E. and Smith, E. E., *Metal Spinning*, Milwaukee, Wisconsin, Bruce Publishing Company, 1936
- Sheet Metal Series: *Industrial Arts Related Information, Sheet Metal Mathematics, Hand Processes, Machine Processes, Measurement and Layout, Job Sheet Series and Teachers Manual for Sheet Metal Work*, Albany, New York, Delmar Publishers, Inc., 1947
- Silvius, G. Harold and Curry, Estell H., *Teaching Multiple Activities in Industrial Education*, Bloomington, Illinois, McKnight and McKnight Publishing Company, 1956
- Smith, Robert E., *Bench Metal Work*. Bloomington, Illinois, McKnight and McKnight Company, 1952

Plastics

The following equipment and hand tool list was prepared for use in plastics as an area of the general shop. Much of the equipment needed for working in plastics will be available in woodworking or some other area of the general shop. This list has been broken down into two groups, thermoplastics and thermosetting.

A. Thermoplastic tools, equipment and materials list

1. Coping saw
2. Hack saw
3. Block plane
4. Assortment of metal files
5. Hand drill and assortment of bits
6. Drill press
7. Wood lathe or metal lathe
8. Jig saw
9. Heating oven
10. Electric buffer
11. Diarco plastic press
12. Asbestos gloves
13. Molding plaster
14. Assortment of wood for pattern and mold construction

B. Thermosetting tools, equipment and materials list

1. Scissors
2. Trimming knife
3. 2" bristle brush
4. Manual for hydraulic controlled press
5. Spray paint equipment
6. Five gallon polyester resin and one pint catalyst
7. 10 yards fiberglass mat
8. 10 yards fiberglass cloth
9. One gallon acetone thinner
10. Can of paste wax
11. Electric drill fitted with a buffer bonnet

References

1. Allied Resin Products Corporation. *Fiberglass Reinforced Plastics*. Hingham, Mass. (no publication date)
2. Bick, A. F. *Plastics for Fun*. Wisconsin; Bruce Publishing Co. 1954.
3. Cherry, R. *General Plastics*. Bloomington, Illinois; McKnight & McKnight, 1948
4. Conley, F. D. *Plastics in Industrial Arts*. (Thesis) Eastern Kentucky State College, June, 1961.
5. Cope, D. *Copes Plastic Book*. Illinois; The Goodheart-Wilcox Co., 1960.
6. Dillon, P. R. *Fiberglass and Polyester Resin in Industrial Arts*. (Thesis) Eastern Kentucky State College, 1962.
7. McNeil, W. R. "A planter in molded fiberglass," *Industrial Arts & Vocational Education*, May, 1960, 34.
8. Newkirk, L. V. *General Shop for Everyone*. Boston, Mass.; D. C. Heath and Co., 1959.

9. Sonneborn, R. H. *Fiberglass Reinforced Plastics*. New York; Reinhold Publishing Corporation, 1954.
10. Steele, G. L. *Fiber Glass*. Bloomington, Illinois; McKnight & McKnight, 1962.

Electricity (8th grade level)

Equipment

Power sources:

- AC—120 volts AC
- AC 0—50 volts—5 amp
- DC 0—50 volts—20 amp
- Assorted dry cells and batteries

Instruments:

- Meters
- AC—volts 0-150 volts
- AC—volts 0-50 volts
- AC Amperes 0-5
- DC—volts 0-15
- DC—volts 0-120
- DC Milliamperes—0-100
- DC Amps 0-50
- V.T.V.M.
- Colt Ohm-Meter
- Watt Meter 0-500
- Kilowatt Meter
- Oscilloscope

Equipment:

- Magnetic compass
- Bells, chimes, buzzers
- Earphones

Graphic Arts (8th grade level)

Equipment List

Letterpress:

- 4 Type cabinets, steel construction, double working blanks, 24 case capacity
- 1 Proof press, bed size 15¼" x 34½"; with Brayer frame and 2 covers; cabinet with ink plate
- 1 Galley cabinet, steel, storage for 50 8¼" x 13" galleys
- 1 Imposing table, iron top, 51", x 39", with storage for chases, furniture, reglets and galleys
- 1 Table, metal, 80" x 36"—30" high; with 16" lower shelf
- 1 Cabinet, storage, full size, 24 case capacity
- 50 Case, California job
- 10 Case, blank
- 6 Case, triple
- 3 Case, lead and slug
- 2 Case, wood type
- 2 Case, metal furniture
- 4 Case, adjustable
- 4 Case, quarter size rule

Equipment (Continued)

- Hand powered AC generator
- Telephones
- 2 soldering guns and irons
- Transformers—6.3V, 5A
- Transformers—10VAC-5A
- Transformers—Variable 0-50V

Tools:

- Screw drivers (assorted sizes)
- Phillips drivers (assorted sizes)
- Hex nut driver set 3/16" to 7/16"
- 2 diagonal cutters, wire
- 2 electricians' pliers
- 1 allen set screw wrench assortment
- 1 hack saw
- 2 electrician's knives
- 2 pliers, slip joint
- 2 pliers, round nose
- 2 pliers, needle nose
- 1 hammer ball peen, 3 oz.
- 1 wire gauge
- 1 set of Greenlee chassis punches

Type: Faces, sizes, and amounts to be determined by needs

Spaces: Sizes and amounts to be determined by needs

Leads and slugs: Determined by need

Furniture, wood, width in picas

2, 3, 4, 5, 6, 8 and 10; length in picas

10, 15, 20, 25, 30, 40, 50, 60, 80, 100, and 120; 10 pieces each

Reglets, 1 bundle, 100 yards, 6 points; 1 bundle, 100 yards, 12 points

2 Presses, hand, chase size 6½" x 10", completely equipped

1 Cutter, hand lever, 30"

1 Binding unit, Pratt, complete

1 Shelving, metal, for stock room storage

1 Lead and rule cutter, Rouse

1 Miter, hand

1 Tape moistener, 2"

Miscellaneous Items:

1 Can, 1 gallon, Justrite storage

1 Can, 1 quart, Justrite storage

2 Brushes, type washing

2 Chases, extra for 6½" x 10" pilot press

12 Sticks, Rouse, composing, 6"

2 Sticks, Rouse, compose, 8"

30 Galleys, press steel, 8¾" x 13"

12 Pins, gauge, Megill

3 Gauge, line, 12", graduate to pica, nonpareil and inches

30 Quoins, Hi-speed, as follows: Challenge Company, 20-3", 10-6"

2 Quoin keys for Hi-speed quoins

1 Can, oil, 1 pint, pressure

2 Cans, waste, safety with foot level

2 Planers, type 3¼" x 6"

2 Mallets, printers hickory, 1202

2 Knives, square end ink

1 Bellows, leather

Rubber Stamp Making:

Rubber stamp press

Assorted stamp mounts

Tempered stamp gun

Bakelite mounting material

Soapstone release powder

Rubber stamp cement

Rubber stamp cement dispenser

Rubber stamp pads

Gold Stamping:

Gold stamping press

Colored foils

Brass type

Brass type cabinet

Hand pallet

Binding:

Paper cutter

Bindery table

Vise on table

Drilling jig

Drill stop

Backing metals

Sewing frame

Hand drill

Back saw

Bone folders

Knives

Scissors

Standing press

Backing hammer

Glue and paste brushes

Hot glue pot

Bookbinders awls

Needles

Binding Supplies:

- End papers
- Linen thread
- Binders board
- Bookcloth
- Padding compound
- Library paste

Photograph:

- Camera
- Light meter
- 8 ounce graduate
- Glass stirring rods
- Safe light
- Developing tank
- Interval timer
- Film clips
- Scissors
- Developing trays
- Contact printer
- Enlarger
- Squeegee plates
- Roller
- Masks for prints
- Print tongs

Photographic Supplies:

- Film
- Contact printing paper
- Enlarging paper
- Developer

Acid stop

Fixer

Silk Screen Printing:

- Frame and base
- Silk bolting cloth, No. 10 mesh
- Film-stencil sheets
- Squeegee
- Film adherent
- Stencil filler and brush
- Gummed Kraft-paper tape, 1½ and 2 inch
- Stencil knife
- Silk screen paint
- Screen cleaner
- Steel-edged ruler
- Paint solvent
- Paper
- Drying rack

Linoleum Block Cutting and Printing:

- Linoleum (mounted or unmounted to base)
- Cutting jig or bench hook
- 1/16" veiner
- ⅛" U-shaped gouge
- ¼" gouge
- Small knife
- 6" Brayer
- Press
- Ink

References

- Carlsen, Darvey E. *Graphic Arts*. Peoria, Illinois, Charles A. Bennett Company, 1958
- Haque, C. W. *Printing and Allied Graphic Arts*, Milwaukee, Wisconsin, The Bruce Publishing Company, 1957
- Jackson, Hartley E. *Printing: A Practical Introduction to the Graphic Arts*. New York, McGraw-Hill Book Company, Inc., 1957
- Kagy, Frederick D. *Graphic Arts*, Chicago, Illinois, Goodheart-Wilcox Publishing Company, 1961
- Bauer-Thompson. *Comprehensive General Shop-1*, Milwaukee, Wisconsin, The Bruce Publishing Company, 1959

Crafts (8th grade level)

A suggested tool list for the crafts area of the general shop follows:

- Coping saw
- Hand crosscut saw
- Block plane
- Combination square or tri square
- Set of cabinet chisels
- Dividers
- Auger bits

Brace, 6 inch swing
 Auger bits, $\frac{1}{4}$ to 1 inch
 Drills, from $\frac{1}{16}$ to $\frac{1}{2}$ inch
 Fostner bit
 Countersink
 Screwdriver
 Socket chisels $\frac{1}{4}$ to 1 inch
 Carving chisels
 Mallets
 "C" clamps
 Hand screws

C. Chapter VIII (Drafting)

Equipment List

Note: The following equipment list is based on a ratio of equipment to student(s). Thus, an entry of $\frac{1}{4}$ indicates 1 item of the equipment should be provided for each 4 students. A single numerical entry such as the number 1 indicates 1 item of the equipment is needed for each class regardless of the number of students enrolled. No entry, indicated by 0, indicates an item of equipment is not felt necessary for the specified level.

Equipment	Seventh Grade	Eighth Grade	High School
1. Work station individual	$\frac{1}{4}$	$\frac{1}{1}$	$\frac{1}{1}$
2. Stool, adjustable height	$\frac{1}{4}$	$\frac{1}{1}$	$\frac{1}{1}$
3. Classroom chalkboard kit containing T-square, straight edge, protractor, and triangle	1	1	1
4. Reproduction machine, 24"-27" capacity with internal ammonia developer			
OR			
Reproduction machine, 24"-27" capacity with 27" capacity dry tube developer	0	1	1
5. Drafting machine, 15"-24" arm length, automatic indexing, with full and half-size full-divided scales	0	0	$\frac{1}{2}$
6. Drawing board, portable, with parallel rule attachment	0	0	$\frac{1}{8}$
7. Drawing board, 20" x 26", with soft textured surface	$\frac{1}{4}$	$\frac{1}{1}$	$\frac{1}{1}$
8. Compass, 4 $\frac{1}{2}$ "-6" giant bow combination, with interchangeable pen, pencil, and divider	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{1}$
9. Pen, ruling	0	0	$\frac{1}{4}$
10. Scale, architect's, 12", open-divided, triangular	$\frac{1}{4}$	$\frac{1}{1}$	$\frac{1}{1}$
11. T-Square, 24" blade, transparent edge	$\frac{1}{4}$	$\frac{1}{1}$	$\frac{1}{1}$
12. Triangle, 30-60-90 degree, 8" transparent	$\frac{1}{4}$	$\frac{1}{1}$	$\frac{1}{1}$
13. Triangle, 45-45-90 degree, 8", transparent	$\frac{1}{4}$	$\frac{1}{1}$	$\frac{1}{1}$

14. Triangle, adjustable, 8", transparent	0	0	1/12
15. Protractor, 6", semicircular, transparent	1/8	1/8	1/6
16. Irregular curve, transparent, assorted sizes, set of 6	1	1	1
17. Template, circle, transparent	0	0	1/8
18. Template, large circle, transparent	0	0	1/12
19. Template, isometric, transparent	0	0	1/8
20. Template, house plan, transparent	0	0	1/8
21. Template, landscape, transparent	0	0	1/12
22. Ames Lettering instrument	0	0	1/2
23. Lettering set, complete with guides and scribe (Leroy, Wrico, Zephyr, or equal)	0	0	1
24. Template, lettering, transparent, set of 3 ($\frac{1}{8}$ ", $\frac{3}{16}$ ", $\frac{1}{4}$ ")	1	1	1
25. Lead holder	0	0	1
26. Sharpener, pencil, with draftsman's cutters	0	1	1
27. Pointer, pencil, sandpaper pad type	1/1	1/1	1/1
28. Pointer, pencil, mechanical	0	0	1/12
29. Shield, erasing	0	1/4	1/4
30. Pen, lettering, medium point	0	0	1/6
31. Pen, lettering, set of assorted styles (Speedball, Esterbrook, or equal)	0	0	1/12
32. Pen holder	0	0	1/6
33. Cutter, paper, 24" x 24"	0	0	1
34. Shears, trimming, 12"	0	1	1
35. Brush, dusting, 8"	0	1/6	1/2

References (9th through 12th grades)

- Bellis and Schmidt. *Architectural Drafting*. Chicago, Illinois, McGraw-Hill Book Company
- Brown, Walter C. *Drafting*. Chicago, Illinois, Goodheart-Wilcox Company, Inc., 1961.
- Feirer, John L. *Drawing and Planning for the Industrial Arts*. Peoria, Illinois, Charles A. Bennett Company, 1956.
- French and Svensen. *Mechanical Drawing*. New York, McGraw-Hill Book Company, 1960.
- Fryklund and Kepler. *General Drafting*. Bloomington, Illinois, McKnight and McKnight Publishing Company, 1960.
- Giachino and Beukema. *American Technical Society Drafting*. Chicago, Illinois, American Technical Society
- Giesecke, Mitchell, and Spencer. *Technical Drawing*. New York, The Macmillan Company, 1957.
- Hornung, William J. *Mechanical Drafting*. Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1957.
- Hornung, William J. *Architectural Drafting*. Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1960.
- Kaberlein, Joseph J. *Air Conditioning Metal Layout, Short Cuts for Round Layouts, Triangulation Short Cut Layouts*. Milwaukee, Wisconsin, Bruce Publishing Company.

- McGee and Sturtevant and Fugleby. *General Mechanical Drawing*. Milwaukee, Wisconsin, Bruce Publishing Company, 1962.
- Ray, Edgar J. *Graphic Architectural Drafting*. Bloomington, Illinois, McKnight and McKnight. 1961.
- Spencer, H. C. *Basic Technical Drawing*. New York, The Macmillan Company, 1962.
- Townsend, Dalzell, and Betenberg. *How To Plan a House*. Chicago, Illinois, American Technical Society.
- Waffle, Harvey W. *Architectural Drawing*. Milwaukee, Wisconsin, Bruce Publishing Company, 1962.
- Walker and Plevyak. *Industrial Arts Drafting*. Chicago, Illinois, Goodheart-Wilcox Company, 1960.
- Wyatt, Edwin M. *Modern Drafting*. Milwaukee, Wisconsin, Bruce Publishing Company, 1962.

D. Chapter IX (Woodworking)

Equipment

Hand Tools

Claw hammer	3	Auger bit brace, 10" sweep	2
Wooden mallet	4	Auger bit depth gauge	2
Rubber mallet	1	Hand drill	2
Back saw	4	Twist drill, 3/32" to 1/4", by	
Dovetail saw	1	thirty seconds (each)	3
Keyhole saw	1	Jack plane	12
Coping saw	2	Block plane	1
Handsaw, crosscut	2	Hook scraper	4
Handsaw, rip	1	Hand scraper	4
Hacksaw	1	Burnisher	1
Combination square	12	Nail set, 1/16" and 3/32"	4
Framing square	2	Pliers, needle nose, side cut-	
Marking gauge	4	ting, and slip joint (pair each)	1
Divider	2	Chisel, assorted, 1/8" to 3/4"	12
Trammel (set)	1	Files, assorted	12
Scratch awl	2	Sur-Form file, flat	2
Steel rule, 36"	2	Sur-Form file, half round	2
Bench rule, 24"	12	Sur-Form file, round	1
Protractor	1	File card	2
Sliding T-bevel	2	Scissors (pair)	1
Screwdriver, assorted, 2" to		Handscrew, #0	8
4"	6	Handscrew, #1	8
Screwdriver, offset	2	Handscrew, #2	6
Screwdriver bit, assorted	6	Bar clamp, 3'	12
Countersink bit, square tang	2	Bar clamp, 4'	6
Countersink bit, round shank	2	Bar clamp, 6'	2

Power Tools

- Variety saw, 10"
- Jointer, 8"
- Lathe, 12" swing, 36" between centers—2
- Surface planer, 16" or 20" capacity

Drill press, $\frac{1}{2}$ " capacity, variable speed
 Band saw, 14" or 20" capacity
 Electric router, with assorted cutters and 12" dovetail attachment
 Saber saw
 Electric drill, $\frac{3}{8}$ "

Furniture and Fixtures

Two station work tables, with storage underneath—12
 Glue table, with metal top
 Tool panel
 Supply and storage cabinets, assorted
 Instructor's desk, chair, and file cabinet
 Display case
 First aid cabinet
 Planning table, with seats for six
 Book case
 Magazine display rack
 Finishing cabinet
 Scrap box and other waste receptacles, as needed

References

- Douglass, J. H., *Woodworking with Machines*, McKnight and McKnight
 Feirer, John L., *Industrial Arts Bench Woodwork*, Bloomington, Illinois, Charles A. Bennett Company, 1958
 Feirer, John L., *Industrial Arts Woodworking*, Peoria, Illinois, Charles A. Bennett Company, 1960
 Groneman, Chris H., *General Woodworking*, New York, New York, McGraw-Hill Book Company, 1959
 Hammond, James J., Donnelly, Edward T., Harrod, Walter F., and Rayner, Norman A., *Woodworking Technology*, Bloomington, Illinois, McKnight and McKnight Publishing Company, 1961
 Madden, Ira C., *Woodworking for Industrial Arts*, Chicago, Illinois, The Goodheart-Wilcox Company, 1959
 Smith, Robert E., *Machine Woodworking*, Bloomington, Illinois, McKnight and McKnight Publishing Company, 1958
 Wagner, Willis H., *Woodworking*, Chicago, Illinois, The Goodheart-Wilcox Company, 1961

E. Chapter X (Metalworking)

Text Books, Reference Books, and Work Books

- Metallurgy (Ferrous Metallurgy Lab. Manual)*—Joseph S. Umowski, American Technical Society, 848 East 58th Street, Chicago 37, Illinois
Forging and Forming Metals—S. E. Rusinoff, American Technical Society, 848 East 58th Street, Chicago 37, Illinois
Foundry Practices—S. E. Rusinoff, American Technical Society, 848 East 58th Street, Chicago 37, Illinois
Machine Shop Operations and Setups—Harold W. Porter, Charles H. Lawshe, and Orville D. Lascoe, American Technical Society, 848 East 58th Street, Chicago 37, Illinois

- Metal Technology and Practice* (1962 ed.) O. A. Ludwig, McKnight & McKnight Publishing Company, Bloomington, Illinois
- Bench Metalwork* (1952 ed.)—Robert E. Smith, McKnight & McKnight Publishing Company, Bloomington, Illinois
- Etching, Spinning, Raising, and Tooling Metal* (1951 ed.)—Robert E. Smith. McKnight & McKnight Publishing Company, Bloomington, Illinois
- Sheet Metal Work* (1952 ed.)—Robert E. Smith. McKnight & McKnight Publishing Company, Bloomington, Illinois
- Gas and A. C. Arc Welding, and Cutting* (1956 ed.)—Royalston Jennings. McKnight & McKnight Publishing Company, Bloomington, Illinois
- Forging and Welding* (1956 ed.)—Robert E. Smith. McKnight & McKnight Publishing Company, Bloomington, Illinois
- Contemporary Metal Home Furnishings* (1957 ed.)—Donald G. Lux and Edward R. Towers. McKnight & McKnight Publishing Company, Bloomington, Illinois
- New Lessons in Arc Welding* (1957 ed.)—Lincoln Electric Welding Company, Cleveland, Ohio
- Metalworking*—T. Gardner Boyd. Goodheart-Wilcox Company, 1322 South Wabash, Chicago, Illinois
- Art Metals*—C. Vernon Siegner. Goodheart-Wilcox Company, 1322 South Wabash, Chicago, Illinois
- Metalwork Essentials*—F. E. Tustison & B. F. Kranzusch. The Bruce Publishing Company, Milwaukee 1, Wisconsin
- Machine Shop Technology*—C. A. Felker. The Bruce Publishing Company, Milwaukee 1, Wisconsin
- Arc Welding*—Charles H. Zielke. The Bruce Publishing Company, Milwaukee 1, Wisconsin
- Pipe Fitter's and Pipe Welder's Handbook*—Thomas W. Frankland. The Bruce Publishing Company, Milwaukee 1, Wisconsin
- The Machining of Steel* (1960 ed.)—Lea and Simons. Macmillan Company, New York, New York
- General Metal*—Roland R. Fraser & Earl L. Bedell. Prentice-Hall, Inc., Englewood Cliffs, New Jersey
- Sheet Metal Pattern Drafting and Shop Problems* (1959 ed.)—James S. Daugherty and Robert E. Powell. Charles Bennett Company, 237 North Monroe Street, Peoria, Illinois
- Basic Bench-Metal Practice*—J. W. Giachino and John L. Feirer. Charles Bennett Company, 237 North Monroe Street, Peoria, Illinois
- Bench Metalwork*—J. W. Giachino. Charles Bennett Company, 237 North Monroe Street, Peoria, Illinois

Project Books

- Machine Shop Project Book*—South Bend Lathe, Inc., South Bend 22, Indiana
- Contemporary Sheet Metal Projects*—O'Neil-Irwin Manufacturing Company, 355 8th Avenue, Lake City, Minnesota
- Project in General Metalwork* (1951 ed.)—M. J. Ruley. McKnight & McKnight Publishing Company, Bloomington, Illinois
- 56 Graded Problems in Elementary Sheet Metal* (1959 ed.)—Algot E. Anderson. McKnight & McKnight Publishing Company, Bloomington, Illinois

- Self Welding for Home Workshop (80 Projects with Plans)*—L. H. Houck. Lincoln Welding Company, Cleveland 17, Ohio
- Arc Welding Projects for School Shop* (1958 ed.) (Bulletin)—William A. Sellon. Lincoln Welding Company, Cleveland 17, Ohio
- Metal Spinning Techniques and Projects*—Harold V. Johnson. The Bruce Publishing Company, Milwaukee 1, Wisconsin
- Modern Wrought Iron Furniture*—Ned Frisbie. The Bruce Publishing Company, Milwaukee 1, Wisconsin
- Creating With Aluminum* (1961 ed.)—E. B. Mattson. The Bruce Publishing Company, Milwaukee 1, Wisconsin

Audio-Visual Aids

- "Grinding Wheels and Their Applications" (16mm color, 24-min.) Free. Simonds Abrasive Company, Tacomy and Fraley Streets, Philadelphia, Pennsylvania
- "Engineering Screw Machine Tooling Application" (16mm color) Free. Brown & Sharpe Manufacturing Company, Providence 1, Rhode Island
- "From Print to Product and The Little Show Off" (16mm color), on rotary head milling. Kearney and Trecker Corporation, 6784 West National Avenue, Milwaukee, Wisconsin
- "An Introduction to the Hossfeld Bender" (16mm color, 20-min.) Free. Hosfield Manufacturing Company, 460-462 West 3rd Street, Lake City, Minnesota
- "It's Easy to Bend" (16mm color, 17-min.) Free. O'Neil-Irwin Manufacturing Company, 303 8th Street, Lake City, Minnesota
- "Milling Practice" (Sound color film strips, six half-hour units with 16" LP records). Kearney and Trecker Corporation, 6784 West National Avenue, Milwaukee, Wisconsin
- "Pullmax Sound Film" (16mm, 35-min.), illustrating operations of Pullmax shearing and forming machines. American Pullmax Company, Inc., 2453 North Sheffield, Chicago 14, Illinois
- "Soft Soldering and Drilling—Basic Holding Techniques" (color). 3015 Dolores Street, Los Angeles 65, California.
- Motion Picture Films, South Bend Lathe Works, South Bend, Indiana: "The Metalworking Lathe" (16mm sound, 20-min.). "Plain Turning" (16mm sound, 20-min.). "Grinding Basic Lathe Tool Cutter Bits" (16mm sound, 20-min.).
- Motion Picture Films by the Colorado Fuel & Iron Corporation, Thomas J. Barbre Productions, 2130 South Bellaire Street, Denver 22, Colorado:
- | | |
|--------------------------------|----------------------------------|
| "Indian Paints—Rails" | "Changing the Face of the Earth" |
| "Indian Paints—Wickwire Rope" | "Farmer Brown Steelworker" |
| "Indian Paints—Grader Blades" | "Steel's Party" |
| "Indian Paints—Reallock Fence" | "Quality Unlimited" |
| "Reinforced for Life" | "Another Step Forward" |
| "Know Your Ropes" | |
- "The Drama of Metal Forming."
- Shell Oil Company, 50 West 50th Street, New York 20, New York
- Motion Pictures by United States Steel, 208 South La Salle Street, Chicago 90, Illinois:
- "The Making and Shaping of Steel" (16mm silent, 15-min. each seven films) or (16mm or 35mm, 11-min. each seven films).

- "Steel-Man's Servant" (16mm or 35mm, 38-min.).
- "Walls Without Welds, on seamless pipe" (16mm or 35mm, 28-min.).
- "An Orchid to Mr. Jordan on Stainless Steel" (16mm or 35mm, 25-min.).
- "Punch Press Guarding," depicting duties of pressman (11-min. color). International Film Bureau, Inc., 57 East Jackson Blvd., Chicago 4, Illinois
- "Using a Shell End Mill, Cutting a Dovetail, Taper Slide, Milling a Helical Groove and Milling a Circular T-Slot" (4-16mm b & w sound). Kearney and Trecker Corporation, 6784 West National Avenue, Milwaukee, Wisconsin
- "Arc Welding Electrode Selection" (16mm color, 25-min.). Film Library, Hobart Brothers Company, Troy, Ohio
- "Teach-O-Filmstrip Teaching Guide on Welding" (three films). Popular Science Publications, 352 4th Avenue, New York 10, New York
- "Filmstrips for Metalworking." Charles A. Bennett, Peoria, Illinois
- "Filmstrips for Metalworking." McGraw-Hill Book Publishing Company, 330 West 42nd Street, New York

Wall Charts

- How to Read Starrett Satin Chrome Micrometers (24" x 22"). L. S. Starrett Company, Athol, Massachusetts
- Precision Tool Wall Chart (20" x 46" roll-up). Lufkin Rule Company, 1730 Hess Street, Saginaw, Michigan
- Chart of Standard Bolt, Nut, and Screw Sizes, Corresponding to Nominal Sizes Marked on Proto Wrenches and Sockets (8½" x 11"). Proto Tool Company, 2109 Santa Fe Avenue, Los Angeles, California
- From South Bend Lathe Company, South Bend, Indiana:
- How to Become a Machinist (13" x 19")
 - Decimal Equivalents (13" x 19")
 - Tap Drill Sizes (13" x 19")
 - Principal Parts of a Lathe (17" x 22")

Bulletins and Manuals

- "Steel Facts" (monthly)—American Iron and Steel Institute, 150 East 42 Street, New York 17, New York
- "Steel Ways" (bimonthly)—American Iron and Steel Institute, 150 East 42 Street, New York 17, New York
- "Steelmaking Illustrated" (bound 12" x 18" flow charts)—American Institute, 150 East 42 Street, New York 17, New York
- "Light Gage Cold-Formed Steel Design Manual" (1951 ed.)—American Iron and Steel Institute, 150 East 42 Street, New York 17, New York
- "Fabrication USS Stainless and Heat Resisting Steels"—USS Steel, 525 William Penn Place, Pittsburgh, Pennsylvania
- "Suiting The Heat Treatment to the Job"—USS Steel, 525 William Penn Place, Pittsburgh, Pennsylvania
- "Hot Rolled Carbon Steel Structural Shapes"—USS Steel, 525 William Penn Place, Pittsburgh, Pennsylvania
- "Painting Galvanized Steel"—National Paint, Varnish, and Lacquer Association, Inc., 1500 Rhode Island Avenue North West, Washington, D. C.
- "Painting Steel"—Wilbur C. Porter, U. S. Department of Commerce, National Bureau of Standards. Report BMS 102, Superintendent of Documents, US Painting Office, Washington 25, D. C.

- "Durability of Paints on Weathered Galvanized Roofing"—M. L. Burgener and Deane G. Carter. Bulletin 565, University of Illinois Agricultural Experiment Station, Urbana, Illinois
- "Zinc Die Casting"—American Zinc Institute, 292 Madison Avenue, New York 17, New York
- "The Zinc Spotlight" (newsletter)—American Zinc Institute, 292 Madison Avenue, New York 17, New York
- "Inspection Manual for Hot Dip Galvanized Products" (bulletin AZI-40) American Zinc Institute, 292 Madison Avenue, New York 17, New York
- "Zinc Procurement—Galvanized Steel Sheets" (Bulletin 37)—American Zinc Institute, 292 Madison Avenue, New York 17, New York
- "Brazing Manual for the Service Trades" (24 page bulletin)—All-State Welding Alloys Company, White Plains, New York
- "Enamel on Copper Idea Book" (61 page illustrated catalogue)—Division of Immerman and Sons, 1812 East 13th Street, Cleveland 14, Ohio
- "Foundry Facts; Metal Casting of Brass, Bronze, and Aluminum," Crucible Manufacturers Association, 11 West 42nd Street, New York 36, New York
- "The Art and Application of Copper Enameling" (32-page pamphlet), Seeleys' Ceramic Service, 7 Elm Street, Oneonta, New York
- "Recommended Practices for Automobile Welding Design" (18-page Booklet), American Welding Society, Technical Department, 3 West 39th Street, New York 18, New York
- Machine Operating Manuals—South Bend Lathe Company, South Bend 22, Indiana:
- "How to Run a Lathe" (50c)
- "How to Run a Drill Press" (25c)
- "How to Run a Shaper" (25c)

F. Chapter XI (Electricity-Electronics)

Equipment

Description	Number	Description	Number
Variable power source DC-0-150 volts	1	Earphones, 2K ohms Z	2
Variable power source AC-0-150 volts	1	Pliers, Needle nose	1
Dry cells and batteries of various types and sizes	assortment	Pliers, Electricians	1
Vacuum tube voltmeter	1	Pliers, Slip joint	1
Multimeter, 20,000 ohms per volt sensitivity	1	Pliers, Diagonal, wire cutters	1
Meters DC Volt 0-15V, 0-150V (each)	1	Screwdriver, off set	1
Meters DC Ampere, 0-25A, 0-5A, 1-0-1 MA, 0-25MA, 0-100 MA (each)	1	Screwdriver, 10", 8", 6" (each)	1
AC Volts, 0-15V, 0-150V, 0-300V, Meters (each)	1	File, Flat 6" mill	1
Meters, AC Amperes, 0-5A, 0-25A, 0-500 MA (each)	1	File, Half round 6", bastard	1
Laboratory magnet set	1	File, Round 6", bastard	1
		File, card	1
		Wire stripper	1
		Soldering gun	1
		Electrician's knives	2
		Hammer, Ball peen 8 oz.	1
		Hammer, Claw 10 oz.	1
		Hammer, Tack	1
		Bench Rule 2 feet	1
		Neon test light	1

Description	Number	Description	Number
Awl	1	Radio Frequency Signal Generator	2
Saw, hack saw, coping, back (each)	2	Vacuum Tube Voltmeters	2
Wrenches, Box wrench set $\frac{1}{4}$ to $\frac{3}{4}$ (set)	1	Watt Meter 0-500 Watts	1
Wrenches, Open end set $\frac{1}{8}$ to $\frac{1}{2}$ (set)	1	Transistor Tester	1
Wrenches adjustable 4", 6", 8", and 10" (each)	1	Radio Signal Tracer	2
Hex nut drivers $3/16"$ to $7/16"$ (set)	1	Flexiformer Transformer	1
Drill, hand $\frac{1}{4}"$	1	Working TV Receiver	1
Drill bit set (fractional sizes)	1	Code oscillator and code key	1
Drill, electric $\frac{1}{4}"$	1	Oscilloscope 5" general purpose	1
Radio chassis punch set	1	Assortment of Radio Receivers	1
Vise, machinist 3" swivel base	2	Set of static electricity demon- strating equipment	1
"C" Clamp set	1	Battery elemenator and charger 6 to 12 volts	1
Allen wrench set	1	Audio amplifier and microphone	1
Adel nibbling tool	1	Phonograph turn table	1
Radio-T. V. alignment tool set	1	60 Ampere power distribution panels	2
Tin Snips, Hawk Bill 10", Straight 10", Aviation 10" (each)	1	Set of demonstration fuses and circuit breakers	1
Wire Gauge	1	Set of reamers $\frac{1}{8}"$ to 1"	1
Drill Press 15" floor model	1	Generator AC Hand Powered	1
Mallet $2\frac{1}{2}"$ x 6"	1	Set of telephone equipment	1
Drill Press Vise	1	Assortment of AC and DC Meters	1
Buffer Grinder Combination 6"	1	Kilowatt Hour Meter	1
Box and Pan Brake 24"	1	First Aid Kit Per Class	1

References

- Marcus, A., *Basic Electricity*, Prentice-Hall
- Turner, *Basic Electricity*, Rinehart Company
- Buban and Schmitt, *Understanding Electricity and Electronics*, McGraw-Hill Company
- Crow, L., *Learning Electricity Fundamentals*, H. W. Sams Company
- VanValkenburgh, *Basic Electricity*, Rider Publisher Company
- Nooger and Neville, *Basic Electricity*, Rider Publishing Company
- Nooger and Neville, *Basic Electronics*, Rider Publishing Company
- Nooger and Neville, *Basic Television*, Rider Publishing Company
- Marcus and Marcus, *Elements of Radio*, Prentice-Hall
- Navpers, *Basic Electricity*, U. S. Navy
- Navpers, *Basic Electronics*, U. S. Navy
- Philco Corporation, *Electronic and Electrical Fundamentals*, Vol. I, II, III, IV, V, VI
- Timmie, *Elements of Electricity*, J. Wiley Company
- Henry and Richardson, *Principles of Radio*, J. Wiley Company
- Wilcox, *Basic Electronics*, Holt-Rinehart-Winston
- Slursburg and Oserheld, *Essentials of Radio*, McGraw-Hill Company
- Zbar-Schildkraut, *Basic Electricity*, McGraw-Hill Company
- EIA.,

Zbar-Schildkraut, *Basic Electronics*, McGraw-Hill Company
 Zbar-Schildkraut, *Basic Radio and Radio Receiver Servicing*, McGraw-Hill Company
 Steinberg and Ford, *Electricity and Electronics Basic*, American Technical Society
 Mandl, Mathew, *Fundamentals of Electronics*, Prentice-Hall
 Periodical, *Popular Electronics*, Ziff Davis Publishing Company
 Rosenberg, Robert, *Electric Motor Repair*, Rinehart Company
 Turner, *Basic Electronic Test Instruments*, Rinehart Company
 Chirard-Johnson, *Radio and Television Receiver, Circuitry and Operation*, Rinehart Company
 Jackson, Herbert, *Introduction to Electric Circuits*, Prentice-Hall Pub. Company
 Marcus, Abraham, *Radio Projects*, Prentice-Hall Pub. Company
 Marcus, Abraham, *Radio Servicing Theory and Practice*, Prentice-Hall Pub. Company
 Jones, E. W., *Essentials of Applied Electricity*, McKnight & McKnight Pub. Co.
 McDougal, Ranson, Dunlop, *Fundamentals of Electricity*, American Technical Society
 Gerrish, *Electronics*, Goodheart and Wilcox
 Gerrish, *Electricity*, Goodheart and Wilcox
 Oldfield, *Radio, Television, Basic Electronics*, American Technical Society
 Watson, Welsh, Eby, *Understanding Radio*, McGraw-Hill Company
 Dunlap, Carl, *Transformers*, American Technical Society
 Corneter, *Principles of Electricity*, McKnight & McKnight Pub. Co.
 Abbott and Stetka, *National Electric Code Handbook*, McGraw-Hill Company
 Jones, E. W., *General Electricity*, McKnight & McKnight Pub. Co.
 Crouse, William H., *Electrical Appliance Servicing*, McGraw-Hill Company
 Grob, Benard, *Basic Electronics*, McGraw-Hill Pub. Company
 Sufferin, *Basic Electrical and Electronic Principles*, McGraw-Hill Pub. Company
 American Radio Relay League, *Amateur Radio Handbook*
 Tepper, Marvin, *Basic Radio*, J. F. Rider
 Pollack, Harvey, *Experimental Electronics for Young People*, Rider Publishing Company
 Shure, A., *Basic Transistors*, Rider Publishing Company
 Frye, John, *Radio Receiver Servicing*, H. W. Sams Pub. Company
 Whitmer, *Experiments in Industrial Electronics*, H. W. Sams Pub. Company
Receiving Tube Manual, R. C. A.
 Willoughby, G. A., *Practical Electricity for Beginners*
 Oldfield, R. E., *The Practical Dictionary of Electricity-Electronics*
 Collings and Dragoo, *Projects in Electricity*, McKnight & McKnight
 American Red Cross, *First Aid Text*
 Cook, Sherman R., *Electrical Things Boys Like To Make*, Bruce Pub. Company
 Dean, Willard, *Experimental Electricity For Boys*
 Dragoo and Dragoo, *General Shop Electricity*
 Ferier, John L. and Williams, Ralph O., *Basic Electricity*
 Ford, Walter E., *Electrical Projects of School and Home Workshop*, Bruce Pub. Company
 Johnson, William H. and Newkirk, K. V., *Fundamentals of Electricity*
 Jones, E. W., *Fundamentals of Applied Electricity*, Bruce Pub. Company
 Meister and Morris, *Magnetism and Electricity*

Perry and Sheffenbook, *Fundamental Jobs in Electricity*
 Sams, H. W. Company, *Learning Electricity Fundamentals*
 Sams, H. W. Company, *Basic Electricity and an Introduction to Electronics*
 Slursberg and Ostershield, *Elements of Electricity*
 Stanley, J. A., *Electronics for the Beginning Student*, H. W. Sams Pub. Company

G. Chapter XIII (Graphic Arts)

Equipment

Letterpress:

- 10 Type cabinets, steel construction, double working blanks, 24 case capacity
 - 1 Proof press, bed size 15 $\frac{1}{4}$ " x 34", with Brayer frame and 2 covers; cabinet with ink plate
 - 1 Galley cabinet, steel, storage for 50 8 $\frac{1}{4}$ " x 13" galleys
 - 1 Imposing table, iron top, 51" x 39", with storage for chases, furniture, reglets and galleys
 - 2 Tables, metal, 80" x 36"—30" high, with 16" lower shelf
 - 1 Cabinet, storage, full size, 24 case capacity
- 100 Case, California job
- 20 Case, blank
 - 6 Case, triple
 - 4 Case, wood type
 - 2 Case, metal furniture
 - 4 Case, adjustable
 - 4 Case, quarter size rule

Type: Faces, sizes, and amounts to be determined by needs

Spaces: Sizes and amounts to be determined by needs

Leads and slugs: Determined by need

Furniture, metal, 5 pieces of each

10, 15, 20, 25, 30, 35, 40, 50, 60 pica length and 2, 3, 4, 5, 6, 8, 10 pica width

Furniture, wood, width in picas

2, 3, 4, 5, 6, 8, and 10; length in picas

10, 15, 20, 25, 30, 40, 50, 60, 80, 100, and 120; 10 pieces each

Reglets, 1 bundle, 100 yards, 6 points, 1 bundle, 100 yards, 12 points

- 2 Presses, hand, chase size 6 $\frac{1}{2}$ " x 10", completely equipped
- 1 Press, Chandler and Price, 10" x 15", completely equipped
- 1 Press, Chandler and Price, 12" x 18", completely equipped
- 1 Cabinet, school pressroom, with storage for rollers, ink and drying racks
- 1 Cutter, hand lever, 30"
- 1 Stapler, foot, heavy duty, flat and saddle
- 1 Binding unit, Pratt, complete
- 1 Drill, paper, floor model, 1" capacity
- 1 Shelving, metal, for stock room storage
- 1 Lead and rule cutter, Rouse
- 1 Miter, hand
- 1 Tape moistener, 2"

Miscellaneous items

- 1 Can, 1 gallon, Justrite storage
- 1 Can, 1 quart, Justrite storage

- 1 Brush, type washing
- 2 Chases, extra for 6¼" x 10" pilot press
- 2 Chases, extra for 10" x 15" press, C. and P.
- 2 Chases, extra for 12" x 18" press, C. and P.
- 24 Sticks, Rouse, composing, 6"
- 4 Sticks, Rouse, composing, 8"
- 1 Stick, Rouse, composing, 12"
- 60 Galleys, press steel, 8¾" x 13"
- 12 Pins, gauge, Megill
- 3 Gauge, line, 12", graduated to pica, nonpareil and inches
- 30 Quoins, Hi-speed, as follows: Challenge Company, 20-3", 10-6"
- 2 Quoin keys for Hi-speed quoins
- 1 Can, oil, 1 pint pressure
- 2 Cans, waste, safety with foot lever
- 2 Planers, type, 3¼" x 6"
- 2 Mallets, printers hickory, 1202
- 2 Knives, square end ink
- 1 Staples, 5000 size for stapler
- 2 Machines, numbering
- 1 Bellows, leather
- Rubber Stamp Making:
 - Rubber stamp press
 - Assorted stamp mounts
 - Tempered stamp gun
 - Bakelite mounting material
 - Soapstone release powder
 - Rubber stamp cement
 - Rubber stamp cement dispenser
 - Rubber stamp pads
- Gold Stamping:
 - Gold stamping press
 - Colored Foils
 - Brass type
 - Brass type cabinet
 - Hand pallet
- Binding:
 - Paper cutter
 - Bindery table
 - Vise on table
 - Drilling jig
 - Drill stop
 - Backing metals
 - Sewing frame
 - Hand drill
 - Back saw
 - Bone folders
 - Knives
 - Scissors
 - Standing press
- Backing hammer
- Hot glue pot
- Glue and paste brushes
- Bookbinders awls
- Needles
- Binding Supplies:
 - End papers
 - Linen thread
 - Binders board
 - Bookcloth
 - Padding compound
 - Library paste
- Photography:
 - Camera
 - Light meter
 - 8 ounce graduate
 - Glass stirring rods
 - Safe light
 - Developing tank
 - Interval timer
 - Film clips
 - Scissors
 - Developing trays
 - Contact printer
 - Enlarger
 - Squeegee plates
 - Roller
 - Masks for prints
 - Print tongs
- Photographic Supplies:
 - Film
 - Contact printing paper

Enlarging paper	Steel-edged ruler
Developer	Paint solvent
Acid stop	Paper
Fixer	Drying rack
Silk Screen:	Linoleum Block Cutting and Printing:
Frame and base	Linoleum (mounted or unmounted to base)
Silk bolting cloth, No. 10 mesh	Cutting jig or bench hook
Film-stencil sheets	1/16" Veiner
Squeegee	3/8" U shaped gouge
Film adherent	1/4" Gouge
Stencil filler and brush	Small knife
Gummed draft-paper tape, 1 1/4 and 2 inch	6" Brayer
Stencil knife	Press
Silk screen paint	Ink
Screen cleaner	

References:

- Auble, J. Woodard. *Arithmetic for Printers*. Peoria, Illinois, The Manual Arts Press, 1940
- Carlsen, Darvey E. *Graphic Arts*. Peoria, Illinois, Charles A. Bennett Company, 1958
- Cleeton, Glen U., and Charles W. Pitkin. *General Printing*. Bloomington, Illinois, McKnight and McKnight Publishing Company, 1953
- Haque, C. W. *Printing Instruction Sheets*. Set No. 1; Set No. 2. Milwaukee, Wisconsin, The Bruce Publishing Company, 1961
- Haque, C. W. *Printing and Allied Graphic Arts*. Milwaukee, Wisconsin, The Bruce Publishing Company, 1957
- Haque, C. W. *Graphic Arts Instruction Sheets*. Milwaukee, Wisconsin, The Bruce Publishing Company, 1959
- International Graphic Arts Education Association, *Courses of Study in Graphic Arts*. Washington, D. C.
- Jackson, Hartley E. *Printing: A Practical Introduction to the Graphic Arts*. New York, McGraw-Hill Book Company, Inc., 1957
- Jahn, Hugo. *Hand Composition*. New York, John Wiley and Sons, Inc., 1947
- Kagy, Frederick D. *Graphic Arts*. Chicago, Illinois, Goodheart-Wilcox Publishing Company, 1961
- Karch, R. Randolph. *How to Recognize Type Faces*. Bloomington, Illinois, McKnight and McKnight Publishing Company, 1959
- Karch, R. Randolph. *Graphic Arts Procedures*. Chicago, Illinois, American Technical Society, 1957
- Polk, Ralph W. *Elementary Platen Presswork*. Peoria, Illinois, Charles A. Bennett Company, 1955
- Polk, Ralph W. *The Practice of Printing*. Peoria, Illinois, Charles A. Bennett Company, 1952
- Zahn, Bert. *Screen Process Methods of Reproduction*. Wilmette, Illinois, Frederick J. Drake and Company, 1950
- U. S. Department of Health, Education and Welfare. *An Analysis of 39 State Curriculum Guides*. 1953-1958

Periodicals

- Educational Council of the Graphic Arts Industry. *Career Opportunities in the Printing and Publishing Industry*. Washington, 1959
- Educational Council of the Graphic Arts Industry. *Executive and Professional Career Opportunities in the Printing and Publishing Industries*. Washington, 1959
- International Typographic Composition Association, Inc. *Career Opportunities in Typographic Composition*. Philadelphia, Pennsylvania, 1956
- National Association of Printing Ink Makers. *Printing Ink Handbook*. New York, 1958
- United States Department of Printing Ink Makers. *Employment Outlook in Printing Occupations*. Bulletin 1215-8, Washington, 1957
- United States Government Printing Office. *Layouts for Imposition*. Washington, 1950
- United States Government Printing Office. *Style Manual*. Washington, 1959
- United States Government Printing Office. *Word Division Supplement to Style Manual*. Washington, 1954



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