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INDUSTRIAL ARTS

for

KENTUCKY HIGH SCHOOLS



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FOREWORD

The State of Kentucky is becoming increasingly industrialized. The development of its industrial resources and the training of its citizens in the understanding of materials, processes and products of industry may no longer be ignored.

Kentucky schools are beginning to recognize the need for all students to have an opportunity to study the materials, processes, and products of industry as organized in industrial arts courses and to acquire work habits and social attitudes that can be effectively developed in these courses.

This bulletin is designed to present approved practices in industrial arts teaching and to promote a more unified and coordinated curriculum in this important field of instruction.

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CHAPTER I

INTRODUCTION

Industrial arts is frequently referred to as a new school subject, yet it is as old as education itself. The form has changed markedly from time to time and in recent years the educational value has received much greater emphasis. Early history tells us of the place of hand work in the educational program of the monastery. The graphic arts, stone cutting, carving and forging were common mechanical activities among the monks. The other and somewhat later form of technical training was through apprenticeship in the crafts. The chief educational agency for the middle class youth up to the nineteenth century was the apprenticeship system and only about the time of the Industrial Revolution did the public school seriously enter the field of technical training.

The earliest record of a publication dealing with handwork was by Joseph Moxon, January 1, 1677. This treatise dealt with the various forms of smithing, joinery, carpentry and turning. In 1697 John Locke became the chief exponent of the idea that education should fit a boy for practical life. Jean Jacques Rousseau advocated "learning by doing" and recognized hand training as a means of mental training. While many other educational leaders of the sixteenth and seventeenth centuries experimented with teaching hand work in one form or another with objectives ranging from trade or vocational training to a means of recreation, certainly John Henry Pestalozzi was the outstanding leader of all in teaching the practical arts as a part of every child's educational career. His thoughts as to the manipulative subjects are well presented in the following quotation: "And I am more than ever convinced that as soon as we have educational establishments combined with workshops, and conducted on a truly psychological basis, a generation will necessarily be formed which, on the one hand, will show us by experience that our present studies do not require one-tenth part of the time or trouble we now give to them."¹

In our own public schools the influence of Calvin M. Woodward's efforts toward the establishment of a manual training pro-

¹ Roger DeGimps, *Pestalozzi—His Life and Work*, p 169 New York: D. Appleton and Co., 1895

gram at St. Louis, and Dr. John D. Runkle's efforts in Boston about 1877 were important factors. In 1879 the Manual Training High School movement started and in many cities throughout the nation a new type of educational program sprang up with practical arts as the core. By 1905 there were schools of this type operating in Chicago, Omaha, Louisville, Cincinnati, St. Paul and many other cities. This program soon expanded to the elementary and with the inauguration of the junior high school, developed to a much greater degree. We find a very definite trend in the direction of an exploratory program on the junior high school level and a more specialized program in the senior high school. Work in the field of industrial arts on the secondary school level will contribute greatly to the pupil's preparation for college entrance, and particularly in many technical vocational fields.

Society as we know it today is fundamentally industrial. Therefore, we should make provisions for a wider and more varied program of industrial education for both boys and girls. The industrial shops should now be opened to girls as well as boys. Girls and women have demonstrated their ability in industry by showing their capacities for meticulous accuracy in fields that require highly skilled performance and their qualities of endurance and quick adaptability. Trade schools may offer courses to girls in drafting, sheet metal, machine shop, automotive mechanics, aeronautics, printing and woodwork.

More thought should be given to the preparation of vocational rehabilitation courses for men who are in need of retraining as a result of their war experiences. These courses could be planned for employees in those fields of the light industries which do not require a great amount of physical strength and stamina. Thousands of these wounded men, whose normal strength and endurance have been destroyed by the ravages of war, need a type of training during the post-war period to rehabilitate them and enable them to become self-sustaining. An enlarged and specific industrial education program through the public schools could be the solution of this important problem.

Technical training is of great value to all young people whether their normal life work is in an industrial pursuit or not. There are few classroom activities which have a greater appeal to the average child or a more far-reaching effect on his adult experiences than does his shop training.

DEFINITION OF INDUSTRIAL ARTS

Teachers are urged to keep clearly in mind the fundamental difference between industrial arts and vocational education. Although both of these phases of education deal with the broad general field of industry, the aims and methods of instruction are distinctly different. It is a serious error for one to assert that industrial arts serves the same function as vocational education. It does not and was never intended to do so. One may as truly claim that the study of hygiene, or general science prepares a pupil for the practice of medicine as to claim that the study of industrial arts prepares him for industry. A clear definition of the two phases of industrial education is found in the following quotation:

"Industrial arts is a phase of general education designed to develop certain habits, attitudes and abilities desirable for all citizens of an industrial civilization regardless of their vocations. It should not be confused with vocational education, which is designed to train prospective and employed workers for proficiency in vocations.

Industrial arts is concerned with providing experiences for pupils which will aid them in understanding the industrial factors in their environment, in developing interest in modern industry, in finding desirable means of expressing their natural urge for constructive activity and in developing good habits of attacking problems. Vocational education on the other hand, is concerned with specific training of youth and adults who have definitely chosen an occupation as their means of livelihood."³

In the preparation of the program presented in this bulletin, the committee has endeavored to observe this differentiation between the two major areas of industrial education, industrial arts and vocational-industrial education.

The purpose of this bulletin is to assist the industrial arts teachers in Kentucky to plan their program with the assurance that they are conforming to a more or less standardized practice and thus encourage the standardization of the specific operation and information units in the various industrial art activities. It is presented with the aim of assisting teachers of industrial arts and thus helping to bring improvement of instruction in the schools of Kentucky.

³ Monroe, W. S. Encyclopedia of Educational Research, p 602 The Macmillan Co., New York, 1941

The material contained in this bulletin should be helpful in measuring the quantity and quality of any of the activities for which standards have been set up. It is hoped that in the future, standards of attainment may be included for a number of other activities.

This material is not meant to supplant the usual course of study or shop curriculum but is solely for the purpose of enabling each of us who is interested in doing a more effective job of teaching young boys and girls technical procedures, to do a more adequate and effective piece of work with the knowledge that we are conforming to a standard in greater or lesser degree.

CHAPTER II

GENERAL INDUSTRIAL ARTS OBJECTIVES

1. To develop in each pupil an appreciation of good workmanship and good design which will enable him to enjoy a finer culture as regards materials in an involved technological society.
2. To develop in each pupil elementary skills in the use of the more common tools and machines in modifying and handling materials, and an understanding of some of the more common construction problems.
3. To develop in each pupil an active interest in industrial life and in the methods of production and distribution.
4. To develop in each pupil the following habits:
 - A. The habit of an orderly scientific procedure in the performance of any task.
 - B. The habit of careful, thoughtful work without loitering or wasting time.
 - C. The habit of self-discipline which requires one to do a thing when it should be done, whether it is a pleasant task or not.
 - D. Habits of safety and health.
5. To develop in each pupil the ability to select wisely, care for, and use properly the things he buys or uses.
6. To toughen the fibre of each pupil through the necessity of completing difficult tasks, thus developing desirable social attitudes and a civic-mindedness.
7. To discover aptitudes and develop interests that have significance in life work.
8. To develop an attitude of pride in his ability to do useful tasks.

Industrial Arts in Relation to the Eight Objectives of Secondary Education (formerly called the Seven Cardinal Principles of Secondary Education)

HEALTH. "The first statement, taken from the original seven and adapted to this field, would indicate that through industrial arts the pupil should: (1) become better acquainted with the health needs; (2) acquire better health habits; (3) be more intelligent about cleanliness and sanitation around the home; (4) learn how to con-

serve and gain strength and muscular control through manual activities; (5) become familiar with occupational dangers and health hazards; (6) learn occupational safety precautions; and (7) take account of personal health possibilities in the selection and pursuit of a vocation.

FUNDAMENTAL PROCESSES. "The second cardinal principle has to do with acquiring familiarity with the processes which have come to be recognized as fundamental in the school system. While education and training in these processes is carried on to a considerable degree by means of other school subjects, still there is strong evidence that industrial arts is also a contributing factor, in that it offers: (1) innumerable situations for the application of these processes; (2) opportunities for more firmly fixing them by means of tangible relationships, particularly in arithmetical computations; (3) a necessary stimulus to many pupils not otherwise attracted to abstract fundamentals; and (4) an insight into the fundamentals in actual life outside the school. In this connection, then, industrial arts is thought of as presenting a sort of laboratory in the school where many of the fundamentals may be tried out with much the same application as will be required in later life.

WORTHY AND ECONOMIC HOME MEMBERSHIP. "The statement of this third principle is simply a reminder of an essential feature of education that has always been recognized, and toward which every subject of school work has aimed to contribute, either directly or indirectly. Industrial arts has always had its share in such a contribution, and the general statement still strongly supports the belief that such work should materially assist the pupil to (1) recognize quality, appropriateness, and value in industrial products of use in or about the home; (2) properly care for industrial products within one's possession in order to retain the fullest measure of serviceability, particularly (a) caring for food products economically, (b) caring for and repairing clothing, and (c) keeping in repair the common features of the modern home; (3) appreciate the skill and labor required to establish and maintain a home; and (4) develop ability and resourcefulness which will function in the accomplishment of each. It is perhaps a simpler matter to comprehend the function of industrial arts in these connections than in some of the others.

VOCATION. "The mention of vocational values in connection with intermediate industrial arts always opens the way for some one

to jump to the conclusion that it is vocational training. Such is not the case, however, for it appears that vocational values have been included in the seven principles underlying all secondary education. According to the theory contained therein, industrial arts should result in: (1) appreciation of the significance of vocations to the community; (2) some conception of desirable relationships between vocational groups; (3) the discovery of one's interests and capabilities by means of experiences in typical manipulative activities; (4) subsequent vocational selection as a result of which will best enable him to (a) secure a livelihood for himself and those dependent on him, (b) serve society through his vocation, (c) maintain right relationships toward his fellow workers, and (d) as far as possible find in that vocation his own best development"; and (5) the acquisition of skills and abilities practically and technically correct, which may serve as a foundation for later vocational training. This is a rather long-drawn-out and formidable list of vocational values, but it should be noted it does not suggest vocational training itself.

CIVIC AND SOCIAL EDUCATION. "In the accomplishment of civic and social objectives industrial arts can probably make as much of a general claim as any of the other subjects of the curriculum, but not as specific claims as the subjects which are in the school solely for that purpose. Toward that end the principles set up would support the assumption that industrial arts should help to: (1) develop loyalty to ideals of civic righteousness as a fundamental element in all work; (2) establish habits of cordial cooperation in social undertakings, by means of group and community undertakings which involve individual contribution to the general good; (3) realize right relationships between various vocational groups and other groups of society.

LEISURE AND RECREATION. "The sixth principle upon which are based the fundamental objectives for secondary education has to do with another phase of life with which school work is likely to have an indefinite relationship unless specifically provided for. There is perhaps a stronger possibility for a definite tie-up with industrial arts than with many other subjects. The original statement of the principle included (1) 'Foster in each individual one or more special vocational interests'.

"Industrial arts offers opportunity for such fostering in: (a) manipulative activities, (b) experiment, (c) special readings, (d)

observation, and (e) enjoyment of the products and performances of others. In addition, toward the further realization of this principle as an objective, industrial arts may: (2) develop a love for that which is beautiful; and (3) promote a desire for that which is artistic, appropriate and harmonious in one's surroundings. There is a broad and varied field here, the opportunities of which are sometimes disregarded by the teacher whose attention is too closely confined to technical or routine details.

ETHICAL CHARACTER. "The final principle mentioned as a desirable feature of all education has to do with the development of ethical character. It is probably true that all teachers will admit this is a fundamental objective to be desired in the lives of the pupils as a result of their work. Part of the original statement of this principle suggested the development of valuable personal traits. More specifically, industrial arts may contribute toward the development of character in such traits as: (1) habits of industry; (2) responsibility for a task; and (3) ethical integrity of the worker as shown in the finished product. This principle of education, in connection with any of the subjects of school work furnishes excellent beginnings for varied flights of thought and expression, but causes some difficulty when it comes to specific application of proof."¹

WORLD MINDEDNESS. "This eighth objective has been added to the seven original principles. With the expansion of industries and the development and perfection of methods of transportation and communication, this eighth objective has increased in importance until it can no longer be overlooked. Industrial arts has and is doing its share in the contribution to world mindedness through: (1) the use of materials and resources of foreign nations; (2) the recognition of skills and craftsmanship of other countries; and (3) the standardization of operations, drawings, and specifications.

¹ Dea M. Schweickard—Industrial Arts in Education

CHAPTER III

ORGANIZATION AND ADMINISTRATION

IMPORTANCE. Industrial arts embraces multiple problems of organization and administration. New problems are arising constantly and programs are continually undergoing change to keep pace with the times. The importance of administration is well stated in a bulletin from the Office of Education:

Because of its dynamic nature, its development in a school system should be the responsibility of some individual with a sound educational background, a familiarity with modern industrial practices and developments, a philosophy of life broad enough to interpret the present social order, and an ability to present the case of industrial arts whenever an education program is under consideration.¹

How the problems of administration are met will vary with the many types of school systems. In small schools the responsibility will naturally lie with the industrial arts teacher. It will then behoove the school administrator to choose a teacher who is capable of achieving the desired results. In large systems, the supervisor will assume administrative control working directly with or under the superintendent or his assistants.

TEACHER QUALIFICATIONS. Great stress must be placed on the importance of the teacher in carrying out these necessary administrative duties. Certain qualifications are desirable if the industrial arts teacher is to meet the many problems of administration, instruction and supervision.

Certainly he must possess an educational background and personality comparable to other teachers in the system. He should demonstrate ability to teach and manifest a genuine interest in youth. In addition to these, the Missouri Industrial Arts Handbook states the following as being necessary special qualifications:

1. A genuine interest in things mechanical.
2. Good muscular coordination and a wholesome attitude toward physical labor.
3. Expert craftsmanship in at least one major industrial arts area, and proficiency in several others.

¹ "Industrial Arts—Its Interpretation in American Schools", Bulletin No. 34, United States Department of the Interior, Office of Education, Washington, D. C., 1937.

4. A wide range of information concerning tools, materials, processes, products, and problems of occupational life in industry.
5. Ability to distinguish between poor design and good design in industrial projects, and to design shop projects which are structurally sound and aesthetically pleasing.
6. A sense of neatness and orderliness with respect to shop house-keeping.²

TYPES OF SHOPS. The three distinct types of industrial arts shops now in operation are: (1) the composite general shop; (2) the general unit shop; (3) the unit shop. The composite general shop provides pupils experiences in a number of different industrial activities carried on **simultaneously in one room under the direction of one teacher**. The general unit shop provides a general training on a rather broad basis in one field. The unit shop is confined to a single phase of one field of industry, such as cabinet-making or carpentry in the woodworking field, typesetting or press-work in the printing industry.

TIME ALLOTMENT AND CREDIT. Considerable variation exists in the amount of time given to industrial arts in the public schools of Kentucky. Time allotments range from one to ten forty-five minute periods per week, with some schools offering five sixty-minute periods. The State Curriculum Committee urges the adoption of a uniform period with other classroom activities.

This committee urgently recommends that industrial arts be placed upon the same credit basis as other school subjects. This recommendation is made as a result of an investigation of trends in other states.

SIZE OF CLASSES. Varied opinions exist regarding the number of pupils to be enrolled in any one class. This condition is the result of the variances in shop space, equipment and pupil work stations provided. These variances exist not only in different communities but sometimes between shops within the same building. Wherever shop facilities are inadequate to accommodate the number of pupils scheduled for academic classes, one safe rule to follow is this: **The number of pupils in any industrial arts shop should never exceed the number of work stations provided.** A class of from 18 to 24 pupils is generally considered as a standard size group.

² "Industrial Arts Handbook", Bulletin 7B, Secondary School Series, State Department of Education, Jefferson City, Mo., 1945.

Seventy-five square feet of floor space is suggested as a minimum per pupil in the shop. This space is exclusive of the areas allotted for tools, library, finishing and storage rooms, supply cabinets, planning areas, and other auxiliary rooms attendant thereto. This specification in itself should provide a basis for determining the number of pupils to be accommodated. This need not be considered as a hard and fast rule, but may well serve as a suggestion for the planning of future shops.

COSTS. The cost factor is probably the greatest element affecting the development of industrial arts in the smaller school districts.

Some of the fears of administrators concerning the cost of supporting a program are unfounded, since it has been discovered that, excluding the initial expense for equipment, the per-pupil cost of instruction is only twenty per cent above the average of academic subjects.

The cost of industrial arts depends chiefly upon the local organization, enrollment, salaries, and other factors that are merely phases of the local situation. The cost of industrial arts does not vary from other subjects as the result of characteristics peculiar to this subject. In any well administered program the cost is comparable to that of any other laboratory course. In fact, industrial arts and other forms of industrial education will pay the community dividends in a happier, more successful, and more useful citizenry.

SHOP ORGANIZATION. Modern industrial arts laboratories and shops involving the use of tool and supply items, industrial machines and auxiliary equipment of various types, present problems of organization and supervision not present in earlier days. Increased teacher-pupil loads have added to the complexity of these problems.

In order to cope with this problem, industrial arts teachers developed a student personnel organization whereby students, under the direction of selected leaders, are assigned a considerable portion of routine duties, allowing the instructor more time to devote to instruction. At certain intervals the assignments should be shifted so that all students will have an opportunity to assume positions of responsibility and leadership. This plan has proven its worth educationally to students and has been so successful in relieving the teacher of numerous duties that it is now considered a vital phase of efficient shop management.

The type of personnel organization to be employed will vary somewhat in different types of school shops. The personality of the teacher, size and nature of classes, number of activities engaged in and kind and arrangement of equipment must be considered.

The number of student officers selected and their duties will depend upon the type and size of shop, as well as the character and number of students in classes. The following list of officers, along with the duties of each, may be helpful to industrial arts teachers in organizing a student personnel program :

1. Shop Superintendent

- A. Responsible for the overall operation of the student personnel program.
- B. Supervises assistants and reports any discrepancies to the teacher.
- C. Calls class to attention when directed.
- D. Gives signal for clean-up at end of period.
- E. Inspects all stations and reports to teacher.
- F. Trains his successor before being relieved.

2. Assistant Shop Superintendent

- A. Assists the superintendent in every way possible.
- B. Assumes full responsibility when the superintendent is absent.
- C. Familiarizes himself with all the duties and responsibilities of the superintendent.
- D. Succeeds the superintendent when shifts are made.

3. Shop Secretary

- A. Checks class roll and records absences and tardiness.
- B. Checks absence excuse slips.
- C. Checks shop records.
- D. Checks bulletin board, reference materials, etc.

4. Tool Foreman

- A. Checks out tools to students.
- B. Checks in tools and reports those missing or needing attention.
- C. Responsible for condition to tool room and/or tool cabinets.

5. Stock Foreman

- A. Issues stock to students as needed.
- B. Assists students in selecting stock wisely and economically.
- C. Keeps a running inventory of stock.
- D. Reports when low limits are reached.
- E. Responsible for the condition of stock storage.

6. Safety Engineer

- A. Familiarizes himself with safety rules and practices.
- B. Searches for safety hazards and corrects or reports them to the superintendent or his assistant.

- C. Inspects safety features of tools, machines and other facilities.
- D. Checks clothing of students that appears to be unsafe—loose sleeves, ties, etc.
- E. Stops or reports irregular conduct of students that might create a safety hazard.
- F. Keeps first aid kit in order and administers first aid treatment in minor cases.
- G. Constantly strives to promote safety throughout the shop.

7. Clean-up Foreman

- A. Checks condition of each area at the beginning of the class period.
- B. Checks to see that each student in the shop is familiar with and successfully carries out his cleanup assignment.
- C. Checks to see that all areas of the shop are properly cleaned before class leaves.
- D. Responsible for storage and condition of cleaning facilities.

TOOL STORAGE. The problem of storing, distributing, and checking tools is one that concerns every industrial arts teacher and supervisor. How this is done may well affect the efficiency of instruction and operation of the shop.

The following points should be studied and evaluated when selecting a system for tool arrangement in the school shop.

1. Provisions should be made to permit maximum use of each tool with a minimum duplication of equipment.
2. Tools should be arranged so that students will be able to secure them quickly and with minimum interference and congestion in the shop.
3. An arrangement should be devised to permit quick and accurate inspection by the teacher and/or his assistant.
4. The arrangement should provide adequate protection from theft, rust, and excessive heat.

Several methods of storing and checking tools are used. Some of the more common systems, together with their advantages and disadvantages, follow:

1. The toolroom requires an enclosed room or area within or adjacent to the shop from which tools are checked out and in by a clerk who maintains a record of each tool issued to and returned by students. It is time consuming, however, and may cause considerable congestion at the beginning and end of the class period.
2. The open tool panel. This system is very convenient and allows tools to be secured quickly with minimum congestion. This plan, when properly organized, permits a quick inventory by the instructor. Tools are not protected against loss, especially after class hours.

3. Enclosed floor or wall cabinet. This plan provides almost as much security as the toolroom and is very convenient. It is economical of space and is easy to check.

4. Portable tool cabinet or rack. These are especially adaptable for automotive shops and other types of work where considerable tools are required. They are also valuable in rotating general shop units. These may be rolled into a tool or store room after class to provide additional security.

5. Individual tool kits. These are convenient where it is necessary to take a standard kit of tools to a particular job as in automotive work and certain other similar activities. It is difficult to check tools with this system and there may be expensive duplication of tools.

SHOP FORMS AND RECORDS. Efficient administration of a shop program requires the use of suitable records and forms to facilitate the work of grading, ordering supplies, checking tools and supplies, checking pupil progress, cost accounting, etc. Basic forms are explained here in detail as to their requirements. Others are mentioned because of their occasional use.

1. Inventory. Under this heading falls the cumulative list of tools and equipment, separated in subject area groups (such as: sheet metal, machine shop welding, etc.). The date of purchase, cost, source, name, and a brief description should be a part of this form. Yearly, and continuous supply inventories are also very necessary parts of the shop records. They should contain the description of the items, cost, amounts on hand, amounts needed, and sources of supply.

Where bidding lists are used, they could be standardized with inventories by alphabetizing the items to be purchased. The resultant mimeographed or printed sheets could be filled in with a minimum of effort on the part of the administrator, teacher and supply man.

2. Progress Chart. This involves a cumulative record of each project or problem completed by the pupil throughout his period in the shop. It can be arranged for a semester or longer. Usually the entire class is listed on this chart, making a semester or year record the extent of time covered. Where a period of years is concerned, a personal card for each pupil (cumulative record card) is used.

The progress chart should include the names of all the pupils arranged alphabetically; title of the course; a year; list of units to be learned, or a list of problems to be completed and appropriate squares for checking and/or grading. Some provision for indicating

the time expended in covering any one series of units or projects will be of help. Needless to say, the possibilities of such a chart are unlimited, but simplicity will be more apt to insure its effectiveness. The teacher should remember that this chart is intended to supplement the use of the regular class record book.

3. Class Record Book. This is the orthodox tabulation of attendance, progress, and grading that is furnished to the administrator. It should contain alphabetical lists of absences, test grades, project grades, and averages all grouped under the class heading for that course. Usually the teacher is furnished with standard record books, but various methods are used to accommodate this information.

4. Shop Record. This usually is an individual card form catalogued alphabetically in a file provided for that purpose. It should contain the record of payments, projects, chargeable supplies, hardware, etc., pertaining to pupil cost. Provision should be made for the pupil's name, age, grade, course, and semester.

5. Cumulative Record. A less common, but none the less important form supplements the progress chart mentioned above. It provides a condensed record of the development and background of each pupil. One such form in use contains the following items suggestive of its purpose:

- a. Name, age, address, father's occupation, etc.
- b. Classification, course, shop courses taken previously, occupational interests, etc.
- c. Scores on standardized tests, special aptitudes demonstrated, unusual personality traits, etc.
- d. Other matters pertinent to the student's personal educational and occupational adjustment.

Additional forms not widely used, but applicable to some situations include:

- a. Time slips—daily record of pupil time.
- b. Material slip—record of materials needed for any project.
- c. Assignment sheet—daily or weekly assignment to machines, duties, responsibilities, etc.
- d. Tool loan card—record of out-of-shop tool use.
- e. Machine permit—slips issued by the teacher or foreman for machine operation. Some schools require parental approval on these slips.
- f. Hall pass—pupil permission to carry out some necessary errand elsewhere in the school.

These, and the standard forms can be made available to any school by the use of standard duplication processes or printed form.

SAFETY. Probably no instruction, gained from the school shop, will have more carry-over value than that given to the safe use of machines and equipment and at the same time, help prevent needless accidents.

The Missouri Handbook classified the causes of shop accidents under the following headings:

1. Conditions of room and equipment.
 - a. Poor lighting.
 - b. Improper location of machines.
 - c. Unguarded belts, pulleys, gears, leadscrews, cutter, etc.
 - d. Floors, passage ways, and stockrooms littered with scraps.
 - e. Dull tools and machines.
 - f. Unguarded switches.
 - g. Pushers, jigs, or guards not used.
2. Inefficient instruction.
 - a. No thought to safety; too much taking chance.
 - b. No machine permit.
 - c. Small boys allowed to operate machines.
 - d. Boys allowed to play.
 - e. Overtime work without supervision.
 - f. No thought to proper attitude.
 - g. Failure to check faulty machines.

To combat these accidents, it is imperative that adequate supervision be maintained at all times. It is necessary that the teacher present adequate, safe machine operating instructions to all students permitted to use machines and provide proper safeguards for all machines. He should schedule periodic safety discussions—make available safety charts, films, signs and facts, and require learners to secure operating permits. Before issuing any operating permits, the instructor should obtain permission from the parents for the child to use the machines. The instructor must ban conversation by or to the operator of a machine, forbid “horseplay” in all areas of the shop and encourage the wearing of suitable clothing for safe operation of machinery.

When accidents occur, first-aid treatment should be immediately provided by the teacher, school nurse or doctor. If one, or both, of the last two named are available, they should be given full charge

of all treatment because of the advantage gained of sterility, specialized knowledge, and first-aid equipment at hand. Needless to say, all shops should have a readily accessible first-aid kit. Particularly is it necessary for schools having no nurse or doctor in full-time attendance.

Finally, it is advisable to keep an accurate record of all accidents, their treatment and causes. This will serve to provide measures of preventing future accidents of like nature, and will serve as case history in dealing with serious accidents. In this latter sense, a bulletin entitled, "Teacher Liability for Pupil Injuries",³ will aid in answering the legal questions of the harassed teacher or administrator, in whose shop has occurred a serious mishap.

³ "Teacher Liability for Pupil Injuries", and other safety bulletins may be secured from the National Education Association, 1201 16th Street, N. W., Washington, D. C. (A small charge is made for these bulletins.)

CHAPTER IV

PLANNING AND EQUIPPING THE INDUSTRIAL ARTS SHOP

CONFORMING TO OBJECTIVES. The purpose and objectives of the Industrial Arts program should be clearly defined and well understood before attempting to plan school shops. It is imperative that decisions be made on the following before planning physical facilities: The broad areas of experience offered, learning units involved, age and grade level of students, present and predicted enrollment and the size and number of classes. Many shops have been built and equipped without any serious thought given to the above factors. This can only lead to an inadequate physical plant and wasteful results.

TEN STEPS IN PLANNING SCHOOL SHOPS. A recent study in California summarizes preliminary steps in planning.¹

1. The first step in planning a school shop is to describe in some detail the educational activities to take place in the shop. The instructor, the supervisor, the administrator, the advisory committee and the group of participants concerned with the educational program should participate in the planning.
2. The second step is to determine the shop load—the number of students to be accommodated, the time available for instruction, the age and grade levels of the students, and the size and number of classes.
3. The third step is to become acquainted with current codes and standards for the construction of school shops and from this study to develop a reference check list applicable to the shop being planned.
4. The fourth step is to hold a preliminary conference with the architect, discussing educational activities, shop load, standards, building design, space considerations, and cost limitations for guidance in further planning. Visits with the architect to well planned school and industrial shops is recommended.
5. The fifth step is to make a list of the equipment, tools, and supplies to be used in the shop.
6. The sixth step is to decide what principal areas, facilities, and auxiliary rooms are needed.
7. The seventh step is to draw, in consultation with the architect, a preliminary shop floor layout to scale, showing location of principal areas, facilities, auxiliary rooms, and equipment.

¹ Benbow, S. D. et al., *California School Shop Planning Study* (1942-1944), Sacramento, California, State Department of Education.

8. The eighth step is to prepare, for the architect, a description of the shop and a set of "instructor specifications" to explain and supplement the floor plan.
9. The ninth step is to assist the architect in the revision of the preliminary plan, answering additional planning problems posed by the architect. Detail sketches of built-in equipment should be provided at this time.
10. The tenth step will be to assist the architect by providing answers to questions of detail as they appear during final planning and construction.

LOCATION. Shops may be located in a separate structure or in a wing of the regular school building. A separate building can often be of cheaper construction than the main building and lower insurance rates may be secured, but unless a central heating system is used the final cost may not be lower. If located in a separate building, there should be a covered passageway leading from the main building to the shop. Care should be taken that departments or classes are not located adjacent to the shop if they are likely to be disturbed by the noise of machines and students working.

Most shops should be located on the first floor, never below the ground level. Consideration should be given to accessibility of drives so that heavy machinery and bulky supplies may be easily moved into the shop.

SIZE. Many shops located within the school building are restricted in width to that allocated a standard classroom. However, it is highly desirable to increase this to not less than thirty feet if conditions permit. A general industrial arts shop that is approximately 30 x 60 feet, without auxiliary rooms, is considered adequate. However, the size of any shop must be determined by the number of students that it is expected to handle. This number is considered to be from 18 to 24 students per class. Approximately 75 square feet should be allocated each student in the heavy shops. Storage, finishing, planning, and tool rooms should be added to this space.

SPACE ALLOTMENTS RECOMMENDED FOR OPEN SHOP AREA IN INDUSTRIAL ARTS SHOP.²

A. "Heavy" shops (general shop, wood, metal, machine, graphic arts, auto, electric, aviation.)

Shop	Sq. Ft. Per Pupil	Sq. Ft. Total Open Shop Area
Minimum	75	1800
Adequate	100	2400
Desirable	125	3000

² Ibid.

B. Light shops (mechanical drawing, crafts.)

Shop	Sq. Ft. Per Pupil	Sq. Ft. Total Open Shop Area
Minimum	40	960
Adequate	50	1200
Desirable	60	1440

SHAPE. The shop should be rectangular in shape. The instructor should be able to view the whole room from any position within it. The planning area and finishing rooms should be separated from the shop with clear glass partitions.

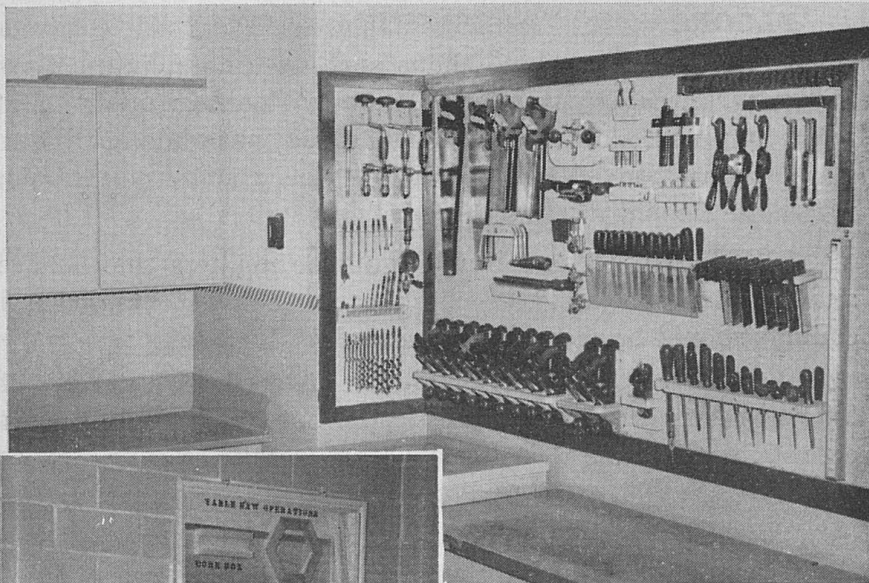
LIGHTING, NATURAL AND ARTIFICIAL. The window glass area should equal at least one fourth the floor area. Artificial light should be such as to provide minimum illumination without natural lighting and be glare and shadow free. It may be either indirect or semi-indirect, using either incandescent or fluorescent fixtures.

"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 carried on should produce 50 foot candles, or more, of light on the work.³

POWER, WATER AND GAS. The locked master power panel for all machines should be located in the tool room or in a position near the instructor's desk. Machines should not be connected to the light circuit and all should be provided with safety switches. Locate washing and toilet facilities within easy access of the shop. Finishing and metal working areas should have sinks with both hot and cold running water. A drinking fountain should be placed in the shop. Locate an adequate number of gas and electrical wall outlets throughout the room.

HEATING AND VENTILATION. The heating system should maintain room temperature automatically over the whole shop. The ventilating system should be such as to constantly bring in fresh air and conform to modern standards. Dust should be removed by an exhaust system with openings in the areas needed.

³ *Industrial Arts in Pennsylvania*, Bulletin 331, Department of Education, Harrisburg, Pennsylvania, 1951.



A well organized tool panel, machine area with visual aid, and a planning center with magazines and related instructional materials illustrate good shop planning.



FLOORS. Most modern school buildings are constructed of reinforced concrete. Some shops such as auto-mechanics, machine, and general metal may use a concrete floor. In others, a straight grain maple floor or certain composition materials are best. Safety mats of an approved type should be placed at all machine locations where the floor is likely to become slippery.

CEILINGS. The ceiling should be not less than 12 feet high and in some special types of shops it should be higher. All shop ceilings should be acoustically treated.

WALLS. The walls should be covered with glazed tile to a height of four or five feet. It is desirable to treat the upper wall with acoustical material.

DOORS AND WINDOWS. Double doors should lead from the corridor into the shop. Wide single or double doors should connect the shop with the finishing and storage rooms. There should be not less than two doors leading from the shop outside. A garage door leading outside is necessary, if auto-mechanics is offered. Low windows that may cause the attention of machine operators to be detracted by outside activity should be avoided. Glass brick is sometimes used to a height above eye level to eliminate this hazard.

PAINTING. Much has been done in the development of color schemes for schools and industry. These findings and recommendations are based upon experimentation and research. Many paint companies have pioneered in this field and will gladly share their knowledge with the schools. Standards of health, safety and efficiency may be increased through scientific painting of walls, ceiling, furniture and machines.

The body of machinery should be painted a light neutral shade with moving parts a lighter shade, and switches painted an orange color. Recommendations of specialists should be followed in painting all machines.

CHALK-BOARD, BULLETIN BOARD, AND DISPLAY CASE.

A chalk-board and bulletin board may be placed adjacent. The bulletin board is often located near the drinking fountain or entrance. A display case sufficient to hold student projects is most desirable. It is preferable to have such a case located in the corridor.

FINISHING ROOM. A well-lighted finishing room should adjoin the shops and be separated from it by a glass partition. It should be equipped with sink, cabinets for finishing supplies, drying racks and an exhaust fan if a spray booth is included.

PLANNING CENTER AND LIBRARY. A shop library and planning center is an essential part of any effective shop program. Here plans are prepared and filed for student use and selected industrial materials are catalogued. Planning tables and the instructor's desk may be located here. This auxiliary room should also be separated from the main shop by a glass partition. If a room is not available, then the planning center may be located in one corner of the shop.

SUPPLY ROOM. An adequate supply room equipped with shelves and racks is needed in every department. Stock should not be stacked in the shop proper. **Only those materials which students are using should be kept in the shop.** Storage lockers should be provided for all student supplies and equipment.

TOOL ROOM. The tool room, if one is used, should be placed in a central location. It is strongly recommended that tool cases or tool boards be used in industrial arts shops. A tool room may be used for special tools and supplies.

SHOP ARRANGEMENT

LOCATING AREAS. Consider the relationship of the various areas of instruction when planning. Some are closely related and may use the same tools and equipment. Welding, forging, and foundry are "hot metal" areas and should be located together. The machine shop area should be placed where the light is best. The auto-mechanics and the metal working may be located in the same section of the shop.

BENCH AREAS. Locate the bench area so that no machine is in such a position as to be considered a hazard to elementary students. Some machines such as lathes, jig saws, grinders, and drill presses are used by nearly all students and should be placed adjacent to the bench area. The work benches should be of the cabinet type with storage facilities in the base.

TOOL CENTERS. Locate tools on panels or in cases in each area to be served. A careful study should be made of tool panels and their arrangement so that the most efficient method may be used for each tool.

ASSEMBLY AREA. A large open space should be left in the shop for assembling. Locate it so as not to interfere with bench or machine work. Avoid placing the assembly area behind machines

where stock may be kicked or thrown back. A sturdy bench with a steel plate top will prove very useful. It will aid in leveling furniture projects, and dried glue can be easily scraped from the surface.

LOCATING MACHINES. Wood working machines should be placed so that stock may be properly routed and so that there is easy access to the stock room. The table saw should be located so that no student will be working behind it. Engine lathes and other equipment on which precision work is done should be placed so that there is adequate light. Each machine should be in such a position that stock of maximum length may be processed. Machines must not be so crowded that the operators do not have sufficient room to use them safely.

FIRE EXTINGUISHER AND FIRST AID. A fire extinguisher should be installed in a prominent place. A well equipped first aid cabinet is an important part of every well planned shop.

SELECTION OF EQUIPMENT

THE FACTORS IN SELECTION OF EQUIPMENT:

1. Objectives of program
2. Courses to be taught
3. Subject matter of each course
4. Size of classes
5. The grade level and maturity of students
6. The size and location of shops
7. Present and future needs
8. Trends and practices in industrial arts
9. Funds available

QUALITY, SIZE, AND TYPE. Only machines and tools of the best quality should be purchased. Inferior products will not withstand the wear and tear of student use. High quality equipment will last indefinitely. There are many school shops in the state equipped with tools that have been used for more than twenty years.

Some schools have made a serious error by purchasing machines that were entirely too small for an industrial arts laboratory. Others have spent large sums on heavy production equipment that was not needed. Manufacturing firms are now providing equipment that is specifically designed for school shop use.

The following factors and characteristics should be considered in selecting machines:

1. Purpose for which machine is to be used (type of shop or program; general shop, unit shop, etc.)
2. Size, capacity, weight, power and speed appropriate to use.
3. Unit type machines—avoid two or more machines in one.
4. Safety features of machine.
 - a. Automatic guards covering saws and cutter heads.
 - b. Belts and moving parts well guarded
 - c. Grinding equipment guarded with safety shields
 - d. Motors equipped with overload and under voltage switches
 - e. Size and capacity should be determined somewhat by the age level of the student
5. Design
 - a. Pleasing appearance
 - b. Proper height for students using equipment
 - c. Direct drive or vee type belts
 - d. Switches and controls easily accessible to the operator
 - e. Sealed bearings whenever possible
 - f. Cushion mounted to reduce vibration
 - g. Local lighting as part of machine
 - h. Motors mounted within machine
 - i. Push button type switch
 - j. Easily adjusted—parts quickly changed
 - k. Floor type—enclosed base on machines

SPECIFICATIONS AND ORDERING. After decisions have been made to purchase certain tools, every particular should be given consideration concerning each tool and machine in order that the quality desired may be secured. The specifications must be correctly written for all motors giving the voltage, phase, cycle, type of current, horse power, and r.p.m. Three phase current should not be specified unless it has been ascertained that it is available without prohibitive cost. Some equipment is only powered by three phase motors. Several copies of specifications should be prepared and competitive bidding required. Inform all bidders that the equipment is for educational purposes, thus securing any discount allowed schools.

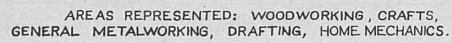
Check all bids to see that they conform to specifications. Do not accept substitutes, unless standards are fully met.

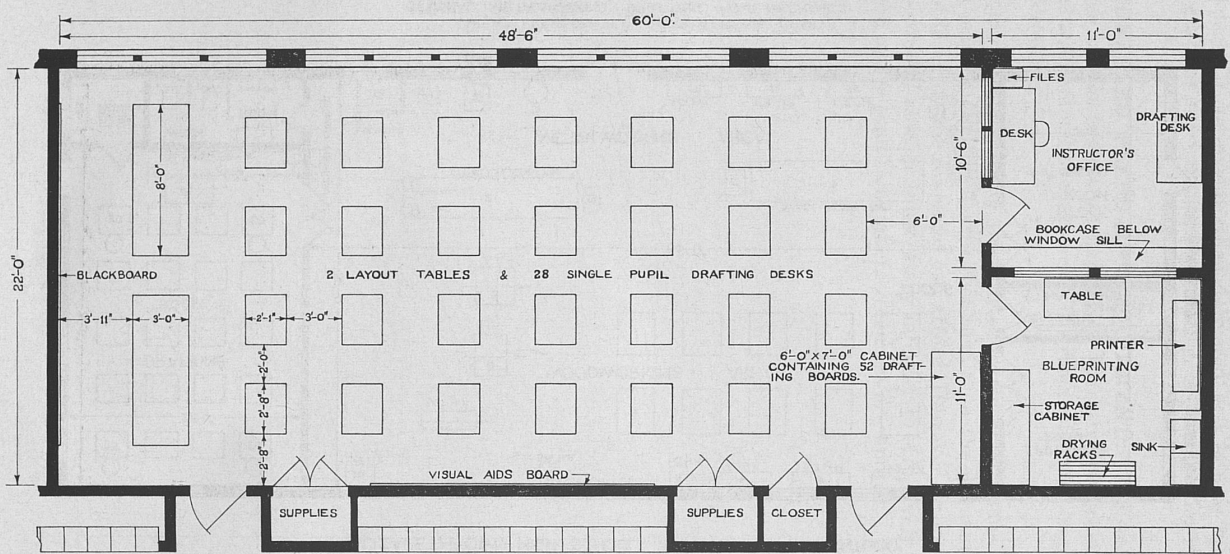
Inspect all equipment when delivered and inform the firm at once regarding any existing irregularity, or damage done to equipment.

SUGGESTED PLANS AND EQUIPMENT. The accompanying plans are for complete laboratories. Effective programs may be initiated with minimum equipment. The remainder may be purchased at a later date.

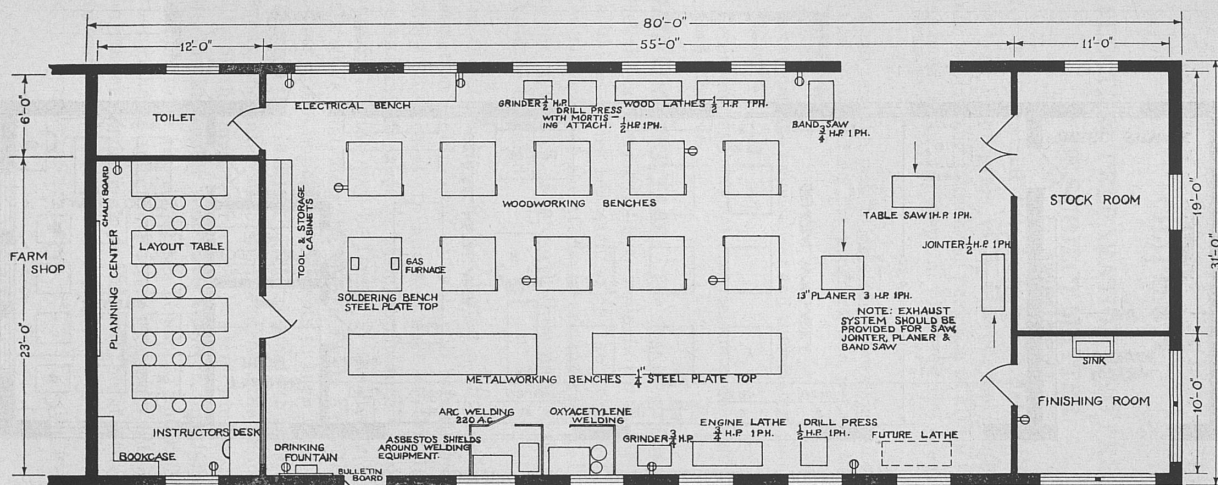
Programs emphasizing the crafts, drawing, and household mechanics may be developed at a cost that even the community with the least in economic resources can afford. However, an imaginative and resourceful teacher is necessary in order to effectively organize and teach under conditions where resources are limited.

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Drawing Department



COMPREHENSIVE GENERAL SHOP
 Proposed shop for CENTRAL HIGH SCHOOL.

The floor plan shows a mobile home interior with the following layout and dimensions:

- Drafting Room:** 13'-6" x 12'-0". Contains a display and visual aids board.
- Planning Center:** 12'-0" x 12'-0". Contains a blackboard.
- Finishing Room:** 7'-6" x 12'-0". Contains a sink, counter, and shelves.
- Tool & Supply Room:** Adjacent to the Finishing Room.
- General Metal Area:** 50'-0" x 22'-0". Contains a bar furnace.
- General Wood Area:** 50'-0" x 22'-0". Contains a 370 5 H.P. furnace.
- Material Storage:** 12'-0" x 12'-0".
- Steel Storage:** 12'-0" x 12'-0".
- Lumber:** 12'-0" x 12'-0".
- Other areas:** Includes a bulletin board, a table, and various storage units.

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CHAPTER V

THE SELECTION, PREPARATION AND PRESENTATION OF SUBJECT MATTER

After the Industrial Arts teacher has decided upon his objectives, the type of program to be offered, and organized his shop, he is ready to plan and launch the program to attain these objectives. The three most important steps in planning the program are as follows:

1. Analyzing the task to determine the experiences and information to constitute the program and permit the attainment of objectives.
2. Arranging the experiences and information into effective teaching units.
3. Preparing instructional materials in order that teaching may be most effective.

ANALYZING THE TASK. The first step in analyzing the task is to select the industrial fields to be included in the program. These fields should be those represented in the area or in the fields in which the majority of the students are interested. In strictly rural communities, activities of a worthwhile nature about the home or farm should be included.

After the fields have been selected a study of the experience and information requirement in each will reveal the elements most contributory to success. In another part of this bulletin the experiences and information of basic importance to some of the principal industrial fields may be found. If the instructor will consult these lists while analyzing the chosen fields he will find that they contain most of the important elements in each field. It is important to bear in mind that in selecting the elements to constitute the course the maturity and interests of the students, the shop facilities, and the ability of the instructor must be determining factors. Having done this, the instructor will have a list of the things the student should be able to do and the things he should know. Needless to say, no instructor should select objectives he cannot attain, teaching elements he cannot teach, or units that will be of little or no interest to his students.

As the last step in analysis it is necessary to select the elements from the lists that will contribute most to the attainment of objectives. The resulting lists will contain manipulative skills, principles, laws, information, procedures, and factual material.

ARRANGING THE TEACHING UNITS. The second step in planning the program is the arranging of the previously selected elements into teaching units based on the procedure involved in giving instruction. To accomplish this it is necessary for the instructor to select projects that meet the seven following conditions: First, the projects should involve some of the elements previously listed. Second, they should be of genuine interest and value to the group for whom they are intended. Third, they must be within the capacity of the student yet difficult enough to offer a challenge. Fourth, they must be suitable to existing shop conditions. Fifth, they should have some intrinsic value in the community. Sixth, the students should be able to complete them in a reasonable time. Seventh, they should embody good design. In some situations it is advisable that these projects be considered as "Suggested Projects" and the students allowed to select projects containing the same or similar elements.

On the basis of the projects selected and the elements involved it is now possible for the instructor to arrange these elements in order of relative importance and frequency of use. In general all manipulative and informational elements should be grouped in order under the headings, "What the student should be able to do." and "What the student should know", respectively. From this arrangement the instructor may now develop his teaching units (course of study) in the order in which they will be required.

Figure A. shows an analysis and the arrangement of the elements that might be selected as representative of the skills involved in sheet metal work. Notice that the instructor may tell at a glance the nature of the elements he must teach and the order in which they should be taught. The form also lists the information topics that are included in the unit.

PREPARING INSTRUCTIONAL MATERIALS. The last step in planning the program is the preparation of instructional materials in order that teaching may be most effective. The term instructional materials as used here includes such devices as lesson plans, lesson outlines, instruction sheets, charts, maps, diagrams, pictures, blue prints, models, mock-ups, films, (slide, strip, sound, and silent) and all other sensory aids to teaching.

The truly efficient and effective teacher never attempts to present a subject to his class without some form of instructional material at hand. This may be only a lesson plan and lesson outline (or a combination of both). Nevertheless he knows that regardless of his years of experience it is possible for him to forget parts of the material he has planned for the class. In addition the outline makes continuity of presentation possible.

LESSON PLAN. Prior to meeting each class the instructor should list the topics he intends to cover, whether they be informational or demonstrational in character. Under each topic he should also list the important points in order that nothing may be omitted.

UNIT IN SHEET METAL WORK

What the student should be able to do:	Projects:				What the student should know:
	Utility Box	Funnel	Quart Cup	Ash Tray	
1. Read a working drawing.	x	x	x	x	1. Sheet metal tools, names and parts.
2. Make out a bill of material.	x	x	x	x	2. How to care for tools and equipment.
3. Plan the procedure for the job.	x	x	x	x	3. How to identify sheet metals.
4. Measure and lay out with a rule.	x	x	x	x	4. How sheet metals are produced.
5. Develop and layout rectangular forms.	x				5. Sizes and shapes of sheet metals.
6. Cut sheet metal with snips.	x	x	x	x	6. The composition of sheet metals.
7. File sheet metal edges.	x	x	x	x	7. The kinds of solders and their uses.
8. Clean sheet metal.	x	x	x	x	8. Fluxes and their use.
9. Form sheet metal with hand tools.	x	x	x	x	9. Occupational information, including requirements, opportunities, and conditions in the industry.
10. Hem-sheet metal.	x				
11. Drill holes in sheet metal.	x				
12. Rivet sheet metal.	x				
13. Prepare cut acid flux.	x	x	x		
14. Clean, tin and care for an electric soldering iron.	x	x	x		
15. Solder sheet metal.	x	x	x		
16. Develop and lay out conical forms.		x			
17. Fold and set a lock seam.		x	x		
18. Use a wiring machine to wire an edge.		x	x		
19. Use stakes in forming sheet metal.		x	x		
20. Develop and lay out cylindrical forms.			x		
21. Roll a sheet on a roll former.			x		
22. Burr with a machine.			x		
23. Make a setting down seam by hand.			x		
24. Bead with a machine.			x		
25. Raise or bump sheet metal in a form.				x	
26. Anneal copper.				x	
27. Give a hammer finish to copper.				x	
28. Chase a design in copper.				x	
29. Polish copper.				x	
30. Apply lacquer finish.				x	

FIGURE A.

The following lesson plan is given as an example. This particular lesson plan is intended for use with a class entering the shop for the first time on the first day of school.

LESSON PLAN FIRST CLASS MEETING

Before the class arrives:

1. Prepare student information cards.
2. Be sure tools and equipment are in perfect condition.
3. Have all tools and materials ready for the first demonstration.
4. Prepare to explain the purpose and nature of the course. Have projects ready for display.
5. Plan safety program.
6. Visualize the class as completely as possible.
7. Prepare to be happy to see the class arrive.

After the class arrives:

1. Introduce yourself to the class.
2. Pass out information cards. (These cards are to be filled out and returned to the instructor in order that he may become better acquainted with his students.)
3. Explain purpose and nature of course and shop procedure. (Display projects made by previous classes, or yourself.)
4. Tour shop and briefly explain purpose of equipment.
5. Discuss safety in the shop and explain safety procedures that will apply to the class.
6. Ask if students have any questions.
7. Assign student lockers and work stations.
8. Pass out Job Assignment Sheets and explain their use.
9. Demonstrate the first operation. (Steps of demonstration should be listed.)
10. Pass out material and start class to work.

- NOTE:**
1. The above 10 steps should require no more than 30-35 minutes.
 2. Discipline in the shop is not mentioned because it should not be brought up until its need is apparent. Rules of conduct should then be developed by the class with the instructors guidance.

LESSON OUTLINES. Lesson outlines refer mainly to the outlines used in presenting informational material to the class. A lesson outline may be a part of a lesson plan. This outline presents the main topics and the items included in each topic and is used to remind the instructor of each item and to maintain the continuity of the presentation.

INSTRUCTION SHEETS. Instruction sheets is the term used to include the Operation Sheet, Information Sheet, Job or Informational Assignment Sheet, and the Job Sheet.

The Operation Sheet presents the steps involved in performing a specific operation and is titled "How to Sharpen a Drawing Pencil," "How to Grind a Bevel Edge Tool," etc. A decade or two ago very little information was available in this form. Today a great variety of very satisfactory operation sheets are available in book or manual form and the need for the instructor's writing this type of material is limited to special operations.

The Information Sheet presents selected information on a subject and is usually titled, "How Nails Are Made," "The Story of Iron," "The Requirements, Opportunities, and Working Conditions in the Foundry," etc. Information Sheets are also available today in printed form, however, it is sometimes necessary for the instructor to prepare Information Sheets on special subjects that are not available in printed form.

The Assignment Sheet may take the form of a Job Assignment Sheet or an Informational Assignment Sheet and is concerned with assigning the student to a particular job or to the task of reading a reference, visiting a factory or in some other manner gaining information on his own accord. They are usually titled, "To Make a Utility Box," "To Visit an Industrial Drafting Room," etc.

Very few good assignment sheets are available in published form, therefore it remains for the instructor to prepare his own. In the present day shop and especially the Composite General Shop, or Laboratory of Industry, the proper use of assignment sheets can change the instructors teaching task from one of drudgery to one of pleasure and result in teaching efficiency never before dreamed of.

Job Assignment Sheets are prepared after the instructor has selected the element and the projects for a course. The sample Job Assignment Sheet in Figure B. illustrates its form. The Sheet presents the job in its entirety. The numbers in the parentheses following the learning units and steps of procedure refer to the pages in the listed references that describe the operation or procedure. Where adequate references are not available the term demonstration is inserted to designate the steps the instructor is to demonstrate.

With these sheets in use it is possible for individuals to progress at their own rate; the instructor is relieved of the burden of repeating countless demonstrations and is free to supervise his class more closely; and in addition he is relatively certain that every member of his class experiences the manipulative activities he has selected as most important.

NAME OF SCHOOL

Job No. _____

Date _____

Industrial Arts

Department

JOB ASSIGNMENT: TO MAKE A TURNED FRUIT BOWL

Student's Name _____

SPECIFICATIONS: To be made of cherry, finished with clear lacquer.

DRAWING — Attached STUDENT'S JOB PLAN

Before you start to work on this project read this job plan carefully, and estimate the time you will need to complete the job. Then follow the "steps of procedure" listed below, checking each step as you complete it. This will save you time, labor, and material, and will result in a better job.

Estimated time required _____ Actual time _____

Cost _____

BILL OF MATERIAL

No. of Pieces	Finished Size	Kind of Material	Name of Part
1	2½" x 10" x 10"	Cherry	Bowl
1	2⅜" x 2⅜" x 2 9/16"	Cherry	Spindle
1	⅝" x 4½" x 4½"	Cherry	Base

STEPS OF PROCEDURE:

1. Make out bill of material.
2. Get out stock.
3. Scribe a circle approximately 10½" diameter on bowl piece and cut out with band saw.
4. Center piece on face plate and fasten with screws.
5. Turn down 10" diameter.
6. Turn bottom side of bowl to shape.
7. Turn 1" hole in bottom of bowl ⅝" deep.
8. Remove bowl from face plate.
9. Fasten a piece of hardwood ¾" thick to face plate and turn a chuck to fit ⅜" shoulder on bottom of bowl.
10. Mount bowl in chuck and run tail stock center against face of bowl.

11. Turn inside of bowl, leaving a 1" dowel in center for tail stock center.
12. Sand bowl.
13. Move tail stock back and turn center dowel out.
14. Sand center of bowl.
15. Scribe 4 $\frac{3}{4}$ " diameter circle on stock for base and saw out.
16. Mount base on face plate, using $\frac{1}{4}$ " plywood between base and face plate.
17. Turn base to 4 $\frac{1}{2}$ " diameter.
18. Turn base to shape.
19. Turn $\frac{3}{4}$ " hole through the base.
20. Sand base.
21. Mount stock for spindle between centers.
22. Turn spindle.
23. Sand spindle.
24. Place glue in holes in base and bowl.
25. Assemble base, spindle, and bowl in the lathe, with base against the face plate and with a pad block between bowl and tailstock center.
26. Spray on sealer.
27. Spray on clear lacquer.
28. Rub down.
29. Submit for grading.

LEARNING UNITS INVOLVED IN THIS JOB

In making this bowl, you will have an opportunity to learn the new skills listed below and to gain additional practice in the ones with which you are already familiar. The page and title of the book that will tell you how to do these things is indicated after each item.

HOW TO:

1. Read a working drawing.
2. Make out a bill of material.
3. Lay out a circle with dividers. (C, p. 39)
4. Saw out circles with a band saw. (A, p. 105)
5. Center stock on a face plate. (A, p. 105)
6. Mount stock on a face with screws. (C, p. 39; A, p. 105; B, p. 39-40)
7. Use common lathe tools for face plate turning. (A, p. 105; B, pp. 41-48; D, pp. 58-64)
8. Turn holes in face plate work. (B, p. 47)
9. Re-chuck turned work. (C, pp. 51-54)
10. Turn stock between centers. (C, pp. 16-34)
11. Sharpen lathe tools. (C, pp. 69-76)
12. Sandpaper turned work. (C, pp. 55-56)

REFERENCES:

- A. Shea & Wenger, WOODWORKING FOR EVERYBODY
- B. Milton & Wohlers, COURSE IN WOODTURNING
- C. Smith, MACHINE WOODWORKING
- D. Klenke, THE ART OF WOOD TURNING

The use of the Job Assignment sheet is especially valuable in starting a new class to work in that the usual confusion is completely eliminated. As the class advances the Job Assignment Sheet may be gradually modified to the point where the student finally prepares the entire sheet after securing the instructor's approval on a project of his own choice.

The Informational Assignment Sheet presents all the instructions, references, and questions necessary to launch the student on the solution of a problem. As in the case of the Job Assignment Sheets, these sheets may best be prepared by the instructor to most fully utilize the facilities at hand.

The Job Sheet presents all the necessary information and steps of procedure involved in carrying a job through to completion. It is usually titled "To Electroplate a Metallic Article," "To Build a Bird House," "To Make a Box Kite," etc. Job Sheets are usually reserved for more-or-less special cases in the shop where available material will not satisfactorily fill the needs.

CHARTS, MAPS, DIAGRAMS, PICTURES, BLUE PRINTS.

These instructional materials are valuable in reinforcing the usual lecture or informational discussion in that they are another avenue down which to drive home an idea. Many aids of this nature are available to instructors, free of charge, from most large industrial concerns.

MODELS. Models are small imitations of the real thing. They are valuable in that they bring into the classroom articles that might otherwise never be available for study.

MOCK-UPS. Mock-ups are usually full size displays of the actual parts of a mechanism. For example, the ignition system of an automobile could be arranged on a wall board to show the actual hook-up and even the function of each part. Working aids of this type are possibly the most effective single teaching aid. The space required for storage and cost are, however, limiting factors in most shops.

FILMS. Films, when properly selected and judiciously used, are excellent teaching aids. Sound-motion films are probably the most satisfactory type of training film because they present the sounds or noises as well as the accompanying action. Films are available from many sources including University and College film libraries, industries, and commercial film-renting agencies. When ordering films for class use it is important to place the order sufficiently in advance to insure delivery.

A word or two of caution should be injected into the use of training films however. Much favorable publicity has been given to the use of films and one might suspect that only good can result. To the contrary, some films are only a waste of valuable time and money in that the instructor himself might equally well demonstrate and explain the same idea in a few minutes and at no cost. Other films include too much extraneous material and thereby conceal or obliterate altogether the original intention.

SENSORY AIDS. The foregoing teaching aids may all be classified as sensory aids. In addition, many other aids are available to the instructor or may be easily prepared. In any event these aids are no better than the instructor who uses them. Success in their use for one instructor does not necessarily imply success for another.

PRESENTATION OF SUBJECT MATTER

When the instructor has prepared his teaching materials as previously mentioned, he is ready to begin his instructional program. This will involve the use of various teaching techniques and procedures as will result in the attainment of objectives and the mastery of the subject matter by the student.

Learning takes place only when the student has the desire and readiness to learn. The normal urge of the student on first entering the shop is to do something or to make something. If the instructor has his program well organized and has selected his projects wisely the matter of creating and maintaining a desire to learn will be accomplished. The state of readiness to learn follows the desire to learn and it is here that the techniques and methods of presentation of subject matter by the instructor either facilitate or hinder the learning process.

BEFORE THE CLASS BEGINS. A good start is of fundamental importance in teaching Industrial Arts subjects as many lasting

impressions are made at the first meeting. To instill favorable impressions it is important that the instructor have his shop in perfect order and his instructional materials prepared and ready prior to the first class.

AFTER THE CLASS ARRIVES. The sample lesson plan given earlier illustrates a procedure for the first meeting of a class. By taking a little time to start the class properly much time may be saved later.

Prior to each new unit the instructor should prepare the class by giving a brief overview of the unit, explaining its connection to previous units, and in general pointing out the practical applications of the unit in the light of student interests and possible future applications.

METHODS OF PRESENTATION. The demonstration, the lecture, and the discussion methods of presenting subject matter are probably the most commonly used teaching methods in existence. This does not mean that they are the best, however, it does mean that they are the easiest methods of presentation and that they fit into the program without too much effort. While these methods are valuable they are not always the most ideal. In a single class it may be necessary for the instructor to present an idea in as many as three or four different methods in order to reach every member. The majority of the members of a class usually comprehend instruction given through a demonstration, and/or discussion on the first presentation. If the instructor is capable of presenting his material by using other techniques or methods he is able to eventually reach every member of the class.

INDIVIDUAL ORAL INSTRUCTION. Individual instruction given orally has always been the chief teaching method in the shop. It is effective because it deals with a specific problem and effects a pupil-teacher relationship that is difficult to surpass.

WRITTEN INSTRUCTION. Originally school shops were publicized as escapes from books and other printed matter. With the change in shop organization the need and value of written instructions became apparent. With properly written and properly used instruction sheets the instructor may expect to realize the following:

1. A greater variety of work may be offered.
2. A saving of time in that repetitions and lengthy descriptions are eliminated.

3. Student time is saved in that he does not have to wait on the instructor.
4. Student interest is maintained in that he may advance at his own pace.
5. A simulation of industry results in that printed instructions find considerable use.
6. Increased resourcefulness in the students in that they cannot "lean" on the teacher. Increased self-reliance and the development of a sense of responsibility.
7. Greater ease in handling large classes.
8. Opportunity for closer supervision of the class.

Some limitations of instruction sheets are:

1. The instructor may substitute instruction sheets for teaching.
2. With improper supervision, materials may be wasted, tools may be used improperly, and safety may be ignored.
3. They require much outside time to prepare when ready-made sheets are not available.

In general, these limitations are the result of the inefficiencies of the instructor rather than the instruction sheets. Under close supervision it is possible for instruction sheets to greatly increase the instructor's efficiency.

DEMONSTRATIONS. Estimates on the amount of learning that takes place through the eyes of an individual vary from 60 to 85 per cent. The demonstration when followed by application, utilizes a maximum number of the senses in learning. When properly planned and executed, the demonstration is one of the most effective teaching methods. While demonstrating the "how" of an operation the instructor should include the "why" in order that he may utilize the demonstration technique to its fullest advantage.

In general, there are two types of demonstrations. The group demonstration is used to give instruction that is needed by a certain group or the entire class. The individual demonstration is used when it is necessary to help an individual student concerning some question or problem. Both types are necessary and important methods of instruction.

To give a demonstration most effectively the following principles should be observed:

1. There should be a need for the demonstration.
2. The demonstration should be planned in advance and all necessary tools and materials arranged for ready use.
3. Arrange students so they can see and hear.
4. Face and talk to the students.

5. Explain purpose of the demonstration and develop interest.
6. Advise students of the important points to look for in the demonstration.
7. Explain new terms and parts.
8. Supplement demonstration with visual aids whenever possible.
9. Use the tools and materials the class must use and hold demonstrations to level of students.
10. If written instructions are used follow them completely.
11. Perform operations skillfully and at correct pace.
12. Ask questions during demonstration to test understanding.
13. Avoid giving correlated and unrelated material. Truly related material may be included if it is important to clarity in the demonstration.
14. Encourage students to ask questions.
15. Stress safety.
16. Select students to aid with the demonstration when possible.
17. Form connections with previous and future lessons if possible.
18. Summarize key points.
19. Refrain from holding up the progress of the group for a few.
20. Opportunity should be provided for immediate application of instruction.
21. Follow-up and check on effectiveness of the demonstration.

TRAINING FILMS. Training films, to be most effective, require some preparation on the part of the instructor. After the film has been selected the following principles should be observed.

1. Films are to be used as aids, not substitutes for the instructor.
2. Do not use a film when more effective methods may be used.
3. Guard against the possibility of the student thinking of the film as an entertainment feature. In mentioning the film to the class refer to it as a part of the lesson rather than as a **show**. They should understand that the film is intended to help them learn.
4. Films should be scheduled as they fit into the course.
5. Always preview a film before using it to determine if the content is satisfactory.
6. Make a lesson plan for use when presenting the film. This lesson plan should include the following:
 - a. Lesson title
 - b. Objectives of presenting film
 - c. Time required for lesson
 - d. Other teaching methods and devices to supplement the film
 - e. Means of securing student interest and participation
 - f. Explanations of new terms in film
 - g. List of important points for students to look for in the film
 - h. Summary points
 - i. Methods of testing students
 - j. Assignments
 - k. References

7. Provide seats where all may see.
8. Set up and focus the projection before the class arrives.
9. Make certain the room is properly ventilated and darkened.

After the class arrives

1. Prepare the students for the film by advising them of the important points to look for.
2. Present the entire film to provide an overview of the content.
3. Review the important points in the film.
4. If necessary re-run the film, or parts thereof, for clarification.
5. Test students on understanding.

THE FIELD TRIP. The most effective method of developing an understanding and appreciation of industry is by means of visits into industries. No other training device or method is comparable to the field trip for this purpose for none can simulate all the conditions that actually exist in industry.

In order that the field trip may be educationally worthwhile, it must be carefully planned. The class must be made to realize that the trip is a part of their regular school work. In conducting a field trip the instructor should observe the following principles:

1. There should be a need for the field trip.
2. Secure approval of both school and factory administrations.
3. Request a conference with a factory representative in order that the trip may be planned most effectively.
4. Prepare the students for the trip by advising them of the important points to look for and explaining the conduct and procedure for the trip.
5. Small groups should travel through the plant separately so that all may see and hear.
6. In first class after the trip review the important points and test for understanding.

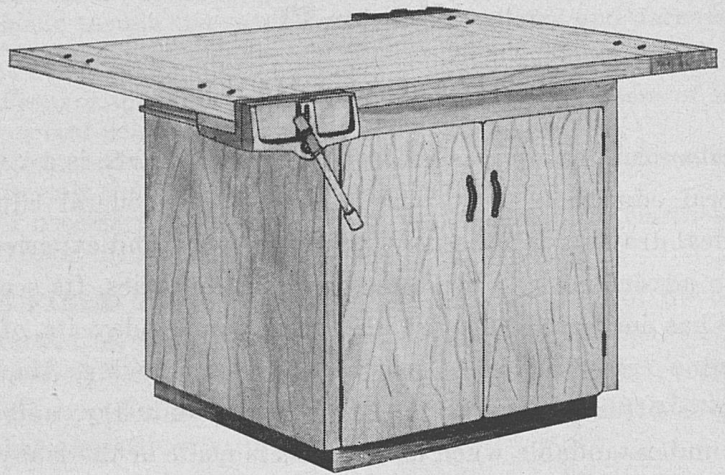
Chapter VI

MECHANICAL DRAWING

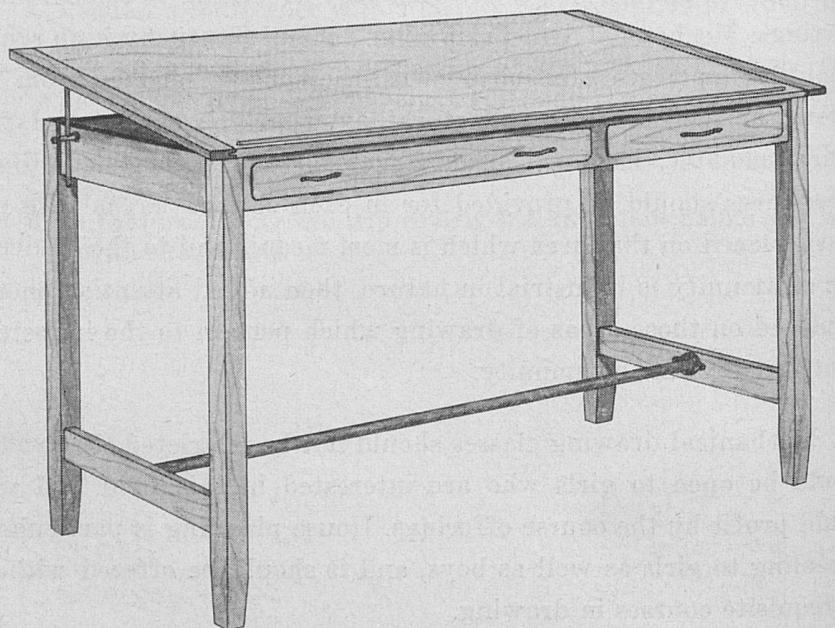
Mechanical drawing, as an area of industrial arts, is a vital part of general education. From the standpoint of general education, mechanical drawing is not a new field of learning and experience but has been advocated by educators for many centuries. Its scope and content has increased through the years, and today its offerings represent a cross section of many phases of drawing. Mechanical drawing is often known as the language of industry, and this is readily understandable when an analysis is made of the many divergent fields of drawing incorporated under the general heading, "mechanical drawing."

It should be kept in mind from the onset that industrial arts mechanical drawing has no avowed vocational objective. Of course, in technical high schools, this would vary according to the curricula offerings. Mechanical drawing for the typical Kentucky high school should be exploratory in nature with the content selected from the following broad areas: architectural, aviation, chart, electrical, furniture, machine, map, pictorial, structural and sheet metal. Basic experiences should be provided for in each of these areas with emphasis placed on that area which is most meaningful to the students. If a community is industrial in nature, then added attention should be placed on those areas of drawing which pertain to the industries located within the community.

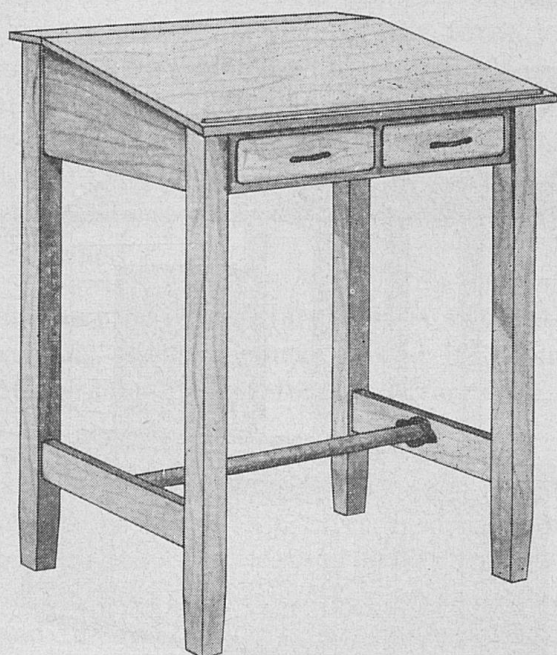
Mechanical drawing classes should not be restricted to boys but should be open to girls who are interested in this field and who would profit by the course offerings. House planning is particularly appealing to girls as well as boys, and it should be offered without prerequisite courses in drawing.



Woodworking Bench



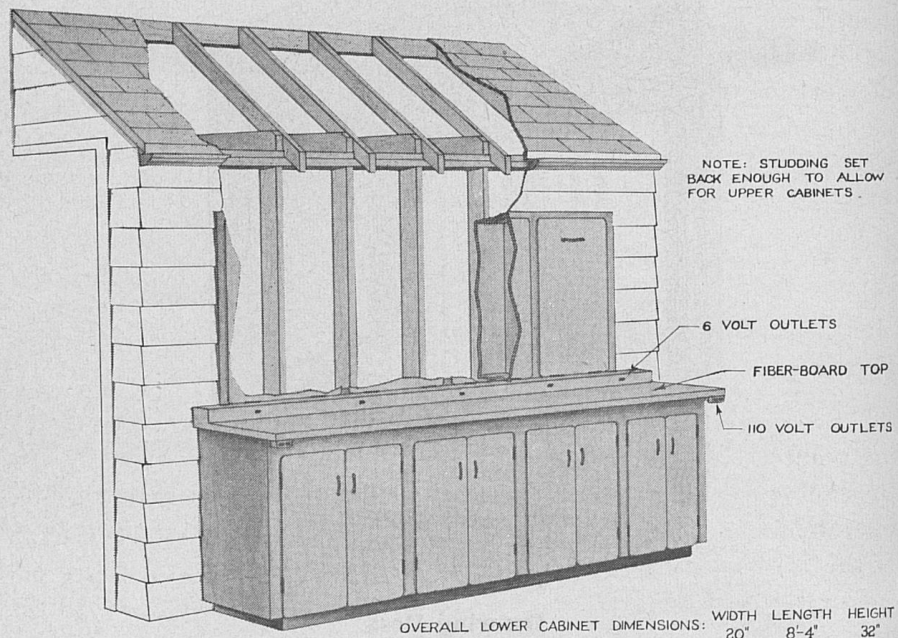
Drawing Desk



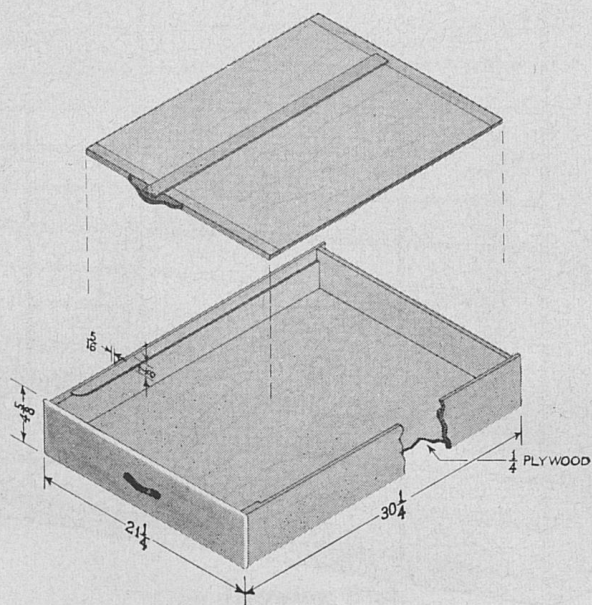
Drawing Desk



Drafting Room Cabinet



Electrical Bench & House Wiring Section



Drawer Detail

SET
ALLOW
TS

This unit covers work for four semesters beginning with the ninth grade or with the first year of the three year senior high school. For each of these semesters the work is planned for five sixty minute periods per week. It is recommended that a limited amount of work be done outside of class. Student interest is generally high enough that additional problems to be completed at home are desirable and through this means the regular course work may be substantially enriched.

D TOP

An introductory or exploratory unit is also outlined for use in junior high schools. Such a course should be offered only in the eighth or ninth grades and preferably after some shop work has been given.

OUTLETS

Some students will take only one semester of mechanical drawing whereas others may take two, three or four semesters, therefore the course is organized so that various phases of drawing are touched upon briefly in the first and second semesters and again more fully in the third and fourth. In this way a student who completes only one or two semesters should secure a better-balanced training than he would if all the work on one phase of drawing were placed at one point in the course. However, in the event that only two semesters of drawing may be offered, it is recommended that the first semester be devoted to general mechanical drawing and the second semester to house planning.

HEIGHT
32"

The unit is organized in terms of Operation Units, the things which the student should be able to do; and Information Units, the things which the student should know. There is, of course, much overlapping between the two.

Problems to be drawn should be selected to illustrate certain principles, and the problems drawn in each semester should be carefully analyzed by the teacher to determine that they cover the minimum essentials for that semester's work. It is suggested that wherever possible, the problems to be drawn should be familiar to the students. For instance, if there is a farm shop in the school, some drawing problems may be taken from agricultural implements, farm buildings, crop surveys, drainage problems, etc. Wherever the school has a shop of any kind, the drawing problems should be related as closely as possible to the work being done in these shops. The drawing of purely theoretical or abstract problems should be avoided. For instance, instead of the theoretical development of a

cone, the drawing of a sheetmetal pattern for a simple funnel should be used; instead of the drawing of abstract screw threads a simple machine part requiring the use of screw threads should be required.

As this course is a part of the student's general education, much stress should be laid upon the teaching of related information. The information which the student is to gain from the course should be presented as of importance equal to that of the finished drawings, without disparaging the necessity for careful and accurate workmanship.

Each drawing should be presented as a problem, not as a copy plate. The student should be given an example of a typical problem worked out, and the necessary information for the working out of several similar problems, and be required to select one of them and work it out for himself. In all cases the finished drawing should be a result of the student's own work and not a copy of a drawing made by the teacher. It is in this planning of a problem that related information may best be taught.

A good recent textbook should be used and definite assignments made for textbook reading, study of mimeographed or printed information sheets, and examination of models and commercial drawings. Much of this study should be done outside of class. The consistent use of a notebook is essential if the student is to learn much more than the drawing of plates.

In order to emphasize the importance of the related information and to determine the extent to which it has been learned, a systematic program of periodic testing is necessary.

MECHANICAL DRAWING I

OPERATION UNITS

1. Fasten the drawing paper onto the drawing board using drafting tape.
2. Sharpen the drawing pencil with knife and sandpaper.
3. Measure with the architect's scale.
4. Mark off points with the pencil.
5. Choose the necessary views of an object.
6. Plan a drawing and make a layout of the sheet.
7. Figure spacing.
8. Make freehand sketch of a simple straight-line object.
9. Sketch circles and arcs.
10. Make a complete sketch on cross-section paper, with dimensions and notes.
11. Use the T-square and pencils in making horizontal lines.
12. Use the T-square, triangles, and pencils and draw vertical lines and lines at all common angles.

13. Use two triangles to draw a line through a given point, perpendicular to a given line.
14. Clean and care for drawing instruments.
15. Draw, and know when to use, the different kinds of lines used in mechanical drawing; border line, object line, hidden line, dimension line, center line, extension line, and cutting plane line.
16. Erase pencil lines.
17. Block out views.
18. Make a front view and a top view, and know the relationship between them.
19. Make a front view and an end view, and know the relationship between them.
20. Make three views and know the relationship between them.
21. Pencil a drawing in correct order.
22. Draw views with hidden edges.
23. Dimension a drawing.
24. Use the pencil compass.
25. Make arrowheads.
26. Letter numerals.
27. Lay out a title.
28. Letter single stroke Gothic capital letters.
29. Make drawings to scale.
30. Check a drawing, using a check list.
31. Draw sectional views of an object and know when they are required; full sections, half sections of cylindrical objects, and revolved sections of spokes, ribs, and handles.
32. Letter notes and specifications.
33. Draw an octagon when the short diameter (across flats), or the long diameter (across corners) is given.
34. Construct a hexagon.
35. Indicate and dimension drilled holes.
36. Indicate and dimension keyway for square key.
37. Draw a fillet tangent to two lines perpendicular to each other.
38. Draw a line through a given point tangent to a given circle.
39. Draw a line tangent to two circles of varying diameters.
40. Crosshatch sectioned surfaces to indicate wood, cast iron, or steel.
41. Make a detail of a chamfered, beveled, or other molded edge on a simple woodworking project.
42. Use conventional breaks to decrease space required for representing long regular parts.
43. Draw small fillets freehand.
44. Make an orthographic projection from a model.
45. Divide a line into a given number of equal parts with the scale (parallel line method.).
46. By the use of two triangles, draw a line through a given point, parallel to a given slant line.

MECHANICAL DRAWING I

INFORMATION UNITS

1. The kinds of scales used in drafting and the purpose of each.
2. Names and uses of drafting instruments.
3. How to arrange work for proper lighting and care of the eyes; how to avoid fatigue and work most efficiently.

4. Kinds, standard sizes, and costs of drawing papers.
5. Conventional breaks and cross-hatching symbols.
6. Definition and spelling of a selected list of technical words and phrases.
7. Review of fundamentals of arithmetic, particularly addition and subtraction of common fractions.
8. Review of fundamentals of geometry.
9. Principles of dimensioning.
10. Purpose and construction of each of the projects drawn.
11. How to take notes on technical reading.
12. Occupation information; opportunities, training, etc.
13. Kinds of pencils used in mechanical drawing.
14. Erasers; methods of cleaning and caring for drawings.
15. How to read a mechanical drawing.

MECHANICAL DRAWING II

OPERATION UNITS

1. Letter notes and specifications.
2. Use two triangles to draw a line through a given point at any common angle to a given line.
3. Figure a complete bill of material for a small woodwork project or sheetmetal project.
4. Transfer measurements with the dividers.
5. Draw a fillet (arc) tangent to two lines not perpendicular to each other.
6. Draw a fillet (arc) tangent to a circle and a line.
7. Sharpen and adjust the ruling-pen and compass-pen.
8. Ink the line with a ruling-pen.
9. Ink circles and arcs.
10. Ink a drawing in the proper order.
11. Erase an ink line or spot.
12. Make a blueprint.
13. Make an ink tracing.
14. Make an auxiliary view.
15. Dimension an auxiliary view.
16. Use the irregular curve.
17. Draw a simple floor-plan, using the proper symbols and conventions.
18. Bisect an angle.
19. Draw the development of a cylinder.
20. Draw the development of a cylinder cut by an oblique plane.
21. Draw the development of a cone and its frustrum.
22. Draw the development of a simple irregular surface with parallel elements (cup handle, etc.)
23. Make a detail drawing.
24. Make an assembly drawing.
25. Make an isometric drawing involving only straight lines.
26. Dimension an isometric drawing.
27. Design and draw a simple woodworking project.
28. Draw a pentagon.
29. Obtain data, plan layout, determine scale, and draw, a simple chart or graph.
30. Make drawing using symbols for concrete reinforcing steel, cinders and clay.
31. Draw an ellipse by trammel method, cutting plane method, method of major and minor axes, or four-center approximation.
32. Use a partial auxiliary view to complete a main view.
33. Dimension a simple reinforced concrete drawing.

34. Use reference numbers to refer from a detail to an assembly or to a bill of materials.
35. Estimate the cost of a simple woodworking project.
36. Use single stroke Gothic lower case to letter.
37. Draw conventional screw threads.

INFORMATION UNITS

1. Definition and spelling of selected list of technical words and phrases.
2. Purpose and construction of each of the projects drawn.
3. How to take notes on technical reading.
4. Occupational information; opportunities, training, etc.
5. Use of charts and graphs.
6. Reinforced concrete construction.
7. Drawing inks.
8. Conventional forms for doors, windows, and walls.
9. How iron castings are made and why fillets are used.
10. Review of fundamentals of arithmetic; proportion circles, triangles, rectangles, areas, volumes, decimals.
11. Weights and gauges of sheet-metals.
12. Standard wire gauges.
13. American National screw threads.

MECHANICAL DRAWING III

OPERATION UNITS

1. Divide a line into a given number of approximately equal parts with the dividers.
2. Make a black and white print.
3. Indicate finish on a simple machine part.
4. Draw two circles tangent to each other externally.
5. Use a table of decimal equivalents.
6. Draw isometric circles and arcs in all three plans.
7. Draw an isometric section.
8. Draw tangents to isometric circles and arcs.
9. Use all common scales in addition to those already used.
10. Make a cabinet section drawing.
11. Make a cabinet drawing involving circles.
12. Use shading lines to indicate curved surfaces in pictorial drawings.
13. Make a simple semi-mechanical perspective.
14. Draw a circle, giving the radius and two points on the circumference.
15. Make a house wiring diagram.
16. Make a radio wiring diagram.
17. Make a detail and an assembly drawing of a simple electrical project.
18. Draw U.S.S. bolts, nuts, and machine screws.
19. Draw structural rivet heads.
20. Draw standard structural steel shapes.
21. Make a simple structural steel detail drawing.
22. Use inside and outside calipers for measuring simple machine parts.
23. Use thread gauge to determine pitch of threads.
24. Use machinists scale, combination square, and surface gauge to measure machine parts.
25. Make complete freehand sketch of a machine part on cross section paper.

26. Dimension to limits: using decimals.
27. Make complete drawing of a machine part, following a free-hand sketch.
28. Make a pencil tracing on tracing paper.

INFORMATION UNITS

1. Definition and spelling of a selected list of technical words and phrases.
2. Purpose and construction of each of the projects drawn.
3. How to take notes on technical reading.
4. Occupational information; opportunities, training, etc.
5. Review of fundamentals of algebra; substitution in formulas.
6. Use of data tables.
7. Structural steel shapes, methods of fabricating, riveting, welding.
8. The use of untrue projection to clarify a drawing.
9. Why different holes are marked "drill," "ream," "bore," etc.
10. The meaning of finish and where it is used.
11. A.S.A. radio symbols.
12. A.S.A. house wiring symbols.
13. Sizes, and kinds of standard bolts, nuts, and screws.
14. Limit dimensioning.

MECHANICAL DRAWING IV

OPERATION UNITS

1. Make drawing of aircraft part involving curves.
2. Develop sheetmetal pattern involving cylinders with axes intersecting perpendicularly.
3. Develop sheetmetal pattern with axes of cylinders intersecting obliquely.
4. Develop oblique conic section.
5. Draw an end elevation of a simple one or two room building.
6. Draw a front elevation of a simple one or two-room building.
7. Draw a simple property plat.
8. Indicate welded joints.
9. Draw complete assembly of a piece of cabinet work.
10. Draw sectional detail of mortise and tenon joint.
11. Draw sectional detail of drawer construction.
12. Detail turnings.
13. Make complete bill of material for a piece of cabinet work.

INFORMATION UNITS

1. Definition and spelling of a selected list of words and phrases.
2. Purpose and construction of each of the projects drawn.
3. Occupational information; opportunities, training, etc.
4. Estimating costs of simple one- or two-room building.
5. Special kinds of drawing used in aircraft design; lofting, fairing, rolled assembly drawings, zone marking.
6. Special kinds of drawing used in automotive design; precision drawing on plate glass and aluminum, Ford decimal system of dimensioning, etc.

7. Special applications of mechanical drawing in various types of shopwork; sheetmetal layout directly on the metal, cabinet full size drawings or "rods" full size hull patterns for ship building.
8. Design of simple one- or two-room building.
9. Use of simple property plats, surveying, civil engineering.
10. American Standard Fusion Welding Symbols.

MECHANICAL DRAWING FOR JUNIOR HIGH SCHOOL

OPERATION UNITS

1. Fasten the drawing paper onto the board with tape or tacks.
2. Sharpen the drawing pencil.
3. Make full size and half size measurements with the architect's scale.
4. Mark off points correctly with the pencil.
5. Locate on the paper the necessary views of an object.
6. Make a simple sheet layout.
7. Make a freehand sketch of a simple straight-line object.
8. Sketch circles and arcs.
9. Draw horizontal lines with T-square and pencil.
10. Draw vertical lines with T-square, triangle, and pencil.
11. Draw lines with T-square and triangles, at angles of 30 degrees, 45 degrees, and 60 degrees.
12. Clean and care for equipment.
13. Draw, and know when to use, the following: border line, visible edge line, invisible edge line, dimension line, extension line, center line.
14. Erase pencil lines.
15. Block out views.
16. Draw front, top and end views, and know their relationship.
17. Pencil a drawing in correct order.
18. Draw views with invisible edges.
19. Dimension a drawing.
20. Use the pencil compass.
21. Sharpen lead and adjust the compass.
22. Make arrowheads.
23. Letter numerals.
24. Letter single stroke Gothic capital letters.
25. Check a drawing with a checklist.
26. Dimension circles and arcs.
27. Use 45-degree line to project from top view to end view.
28. Project details from one view to another.
29. Draw a circle tangent to vertical and horizontal lines.
30. Make an orthographic projection from an isometric drawing.
31. Make an orthographic projection from a model.
32. Properly clean up and finish a drawing.

INFORMATION UNITS

1. Kinds of boards used in mechanical drawing.
2. Kinds of triangles used in mechanical drawing.
3. Kinds and sizes of T-squares.
4. How to read the architect's scale.
5. Grades and kinds of pencils and erasers.
6. Definition and spelling of common words used.
7. Review of fundamentals of arithmetic; common fractions.

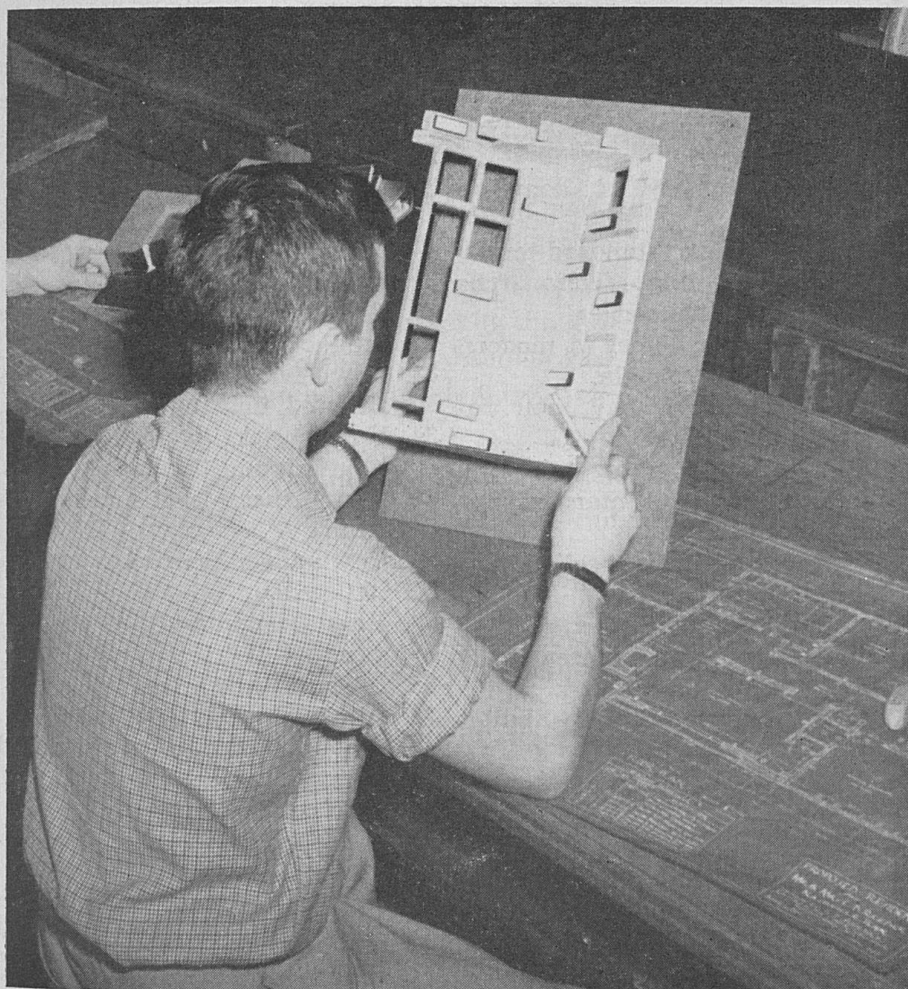
8. Review of fundamental geometric terms and forms.
9. Kinds, cost, sizes, etc. of mechanical drawing papers.
10. How to arrange work for proper light and care of the eyes.
11. Principles of dimensioning.
12. Occupations related to and dependent upon mechanical drawing.
13. Kinds of drawing; orthographic, isometric, perspective.
14. How to read a simple mechanical drawing.

HOUSE PLANNING

The emphasis in this phase of mechanical drawing has been laid on the planning and background work of home construction, rather than on the drawing of plans or the actual construction itself. The ability to plan, rather than the ability to draw plans, is a main objective of house planning. The actual drawing of plans is a major objective of architectural drawing, whereas it is only incidental to house planning. However, certain elementary drawing skills should be taught as a part of the regular course work in order that students will be equipped to execute simple house planning drawings.

SPECIFIC OBJECTIVES

1. To provide a knowledge of the history and background of house planning and construction.
2. To provide a knowledge of accepted types of house construction.
3. To develop the ability to evaluate the common types of construction.
4. To provide a knowledge of the function and professional services of the architect.
5. To provide a knowledge of contracting procedure, property deeds, building restrictions and permits, and home financing.
6. To provide a knowledge of house planning procedure as distinguished from drafting procedure.
7. To develop the ability to read house plans.
8. To develop the ability to plan rooms and whole house units.
9. To develop the ability to select equipment and materials.
10. To provide a general basis of information for future home ownership.



Instructional aid used by students in house planning.

OPERATION UNITS

1. Select a site.
2. Locate building on site.
3. Orient rooms and whole buildings with regard to light and air.
4. Make a plan of a room, allowing for furniture, equipment, fenestration, etc.
5. Read construction plans.
6. Read detail drawings.
7. Read specifications in connection with working drawings.
8. Draw the accepted material symbols and use them in drawing.
9. Make a preliminary house plan and several elevations in the form of a presentation sketch.
10. Make a working plan.
11. Make a working elevation.
12. Make a wall section detail.
13. Make a simple rendering of an elevation (no perspective.)
14. Locate rooms under a roof (dormers, etc.).
15. Locate equipment for economy of piping, etc.
16. Measure any room and make a working sketch of it.
17. Recognize any part of a house on sight.

INFORMATION UNITS

1. A brief history of architectural forms.
2. An acquaintance with the classic orders.
3. A brief history of domestic building.
4. The meaning of standard terms, as cornice, column, frieze, architrave, and their origin.
5. The styles of homes in modern use, and their origin.
6. Historical styles and their regional suitability.
7. How to read working drawings.
8. How to read and interpret specifications.
9. Precedence of specifications over drawings.
10. Criteria for site selection.
11. Criteria for house placement.
12. Criteria for orientation.
13. Legal requirements for building.
14. How to select and employ an architect.
15. How to select and employ a contractor.
16. How to make a working sketch.
17. Procedure in making preliminary sketch.
18. Procedure in making working drawings.
19. The use and relationship of building materials.
20. The symbolism of house plans.
21. Standard practices in construction.
22. Standard door, window, and other millwork sizes and uses.
23. Room type arrangement — as "U" or "L" kitchens, etc.
24. Elements of a building.
25. Nomenclature of various types of building materials.
26. Equipment of a modern house.
27. Placement of doors and windows.
28. Planning for the family.
29. Planning for expansion.
30. Nomenclature of parts of a house.
31. How foundations are built.
32. The use of concrete in concrete products in a modern house.
33. How frame walls are constructed, and the various types.
34. How brick walls are constructed, and the various types.
35. How stucco walls are constructed.
36. How veneer-type walls are constructed.
37. How stone walls are constructed.
38. How floors are framed.
39. How partitions are framed.
40. How openings are framed, and terminology.
41. How roofs are framed.
42. How rafters are cut.
43. Types of roofs.
44. Types of equipment necessary.
45. The plumbing needs of a modern house.
46. The heating needs of a modern house.
47. The wiring needs of a modern house.
48. Paints and finishes in home buildings.
49. The meaning of interior decoration.
50. The relationship of building to decoration.
51. The significance of property deeds, building restrictions and permits.
52. Methods of financing homes.

Chapter VII

WOODWORKING

Woodworking is one of the most common industrial arts subjects. The lumber industry ranks third among all of our industries. It employs over a million workers. The material used has been one of our most abundant resources, but the great supply is being rapidly depleted and it is likely to become one of our scarce national products unless some of the destructive methods practiced cease.

Wood is a pliable industrial arts medium and may be worked with tools that are frequently available in many homes. Both tools and materials are readily obtainable and not prohibitive in cost.

Specific Objectives

1. Develop skill in the use of woodworking tools.
2. Acquire a knowledge of tools and materials related to woodworking.
3. Acquire a knowledge of the characteristics and uses of wood.
4. Develop habits of planned and orderly procedures.
5. Develop the ability to read a working drawing.
6. Develop an appreciation for good design and sound construction in wood products.
7. Acquire knowledge of various kinds of hardware as used in woodworking and their application.
8. Acquire a knowledge of period furniture.
9. Acquire a knowledge of the basic principles of wood finishing.
10. Develop attitudes and habits of observing safety precautions.
11. Develop an interest in woodworking for its avocational value.

Operation Units (Hand)

- | | |
|--------------------------------------|---|
| 1. Read a working drawing. | 4. Lay out and cut stock. |
| 2. Make out a bill of material. | 5. Check material when received. |
| 3. Plan the procedure in doing jobs. | 6. Measure and divide spaces with a rule. |

7. Sharpen plane iron.
8. Adjust jack plane or smooth plane.
9. Plane chamfers and bevels.
10. Square stock to dimensions.
11. Lay out and finish curves.
12. Drill holes in wood.
13. Fasten stock with screws.
14. Saw to a line with a back saw.
15. Round edges.
16. Bore holes with an auger-bit.
17. Trim or pare with a chisel.
18. Cut a groove with a gouge.
19. Clamp stock with hand screws and bar clamps.
20. Make a butt joint.
21. Make a dado joint.
22. Make a dovetail joint.
23. Make a rabbet joint.
24. Make a mortise and tenon joint.
25. Make a miter joint.
26. Make a dowel joint.
27. Bore holes using a dowel jig.
28. Round or form work with a spokeshave.
29. Apply stain.
30. Clean and care for stain brushes.
31. Mix and apply glue.
32. Sharpen and burnish a scraper.
33. Dress a screwdriver.
34. Use sandpaper.
35. Lay out irregular design by means of squares.
36. Do upholstery that involves simple padding.
37. Do simple upholstery that involves webbing and rolled edges.
38. Do simple upholstery that involves use of springs.
39. Set and bore holes with expansive bit.
40. Apply fillers.
41. Apply shellac.
42. Apply varnish.
43. Apply lacquer.
44. Apply enamel.
45. Clean and care for brushes used in all finish.
46. Fasten a table top.
47. Fit hinges.
48. Put on drawer pulls.
49. Make a drawer slide.
50. Make and fit a drawer.
51. Rub a finish using pumice stone.
52. Rub a finish using sandpaper and steel wool.
53. Cut a cross and end lap joint.
54. Drive and draw nails.
55. Adjust and use a T-bevel.
56. Sharpen edge tools.
57. Gauge to line with a marking gauge.
58. Apply a satin finish.
59. Dress an emery wheel.

Information Units

1. Be able to identify the common woods, the pines, spruce, cypress, oak, walnut, birch, maple, mahogany, red cedar, hickory, gum, chestnut, and poplar.
2. The woods common to your community.
3. The characteristics, the working properties, use, and the important sources of supply of each wood.
4. The effect of moisture on wood.
5. The methods of cutting and milling lumber and conservation practices.
6. The standard dimensions of lumber and how they are classified.
7. The nominal and the actual dimensions of lumber.
8. How lumber is dried.
9. Lumber abbreviations.
10. How veneer and plywood are made, and their uses.

11. The purpose of various finishes.
12. The common types of finishes.
13. The characteristics and use of the common finishes.
14. The composition of the various finishing materials.
15. The kinds of glue, preparation of glue.
16. The conditions, requirements and use of glue.
17. The correct names and use of the common woodworking tools.
18. Kinds of nails, uses and sizes of nails.
19. How nails are manufactured and sold.
20. Kinds of screws, uses and sizes and how they are sold.
21. Kinds of woodworking abrasives.
22. Grades and principal uses of woodworking abrasives.
23. Grades and uses of steel wool.
24. Distinguishing characteristics of the distinct periods of furniture designs.
25. Basic principles of furniture design.
26. The types of joints and their use.
27. The principal types of hardware and their use.
28. The kinds of grinding and sharpening stones — their grades and uses.
29. The opportunities, working conditions and requirements in cabinet making, carpentry, and other wood working trades.
30. Brushes, types, source, manufacture and use.
31. The common wood using industries.
32. Common wood defects.
33. Wood products and their use.
34. Factors to consider in the successful application of enamel, interior and exterior paint.

MACHINE WOODWORKING

Specific Objectives

1. Develop skill in the use of woodworking machines.
2. Develop habits of orderly procedure in routing materials.
3. Gain a knowledge of the use of jigs and templates.
4. Develop safe and sound methods in machine operation.
5. Develop the habit of a carefully planned procedure in work.
6. Develop the habit of self-reliance.
7. Develop the ability to care for and maintain woodworking machinery.
8. Develop an appreciation for the part machines play in everyday life.
9. Become familiar with methods of production in the woodworking industries, working conditions and opportunities for employment.
10. Develop a knowledge of and skill in spray finishing.

OPERATION UNITS

Turning Lathe

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Safety rules for operating a lathe. 2. Range of work which may be done on a lathe. | <ol style="list-style-type: none"> 3. Adjust and care for a lathe. 4. Center stock. 5. Mount work between center. 6. Rough down with gouge. |
|--|---|

7. Smooth with a skew.
8. Lay off pattern on piece.
9. Mark off with pencil.
10. Use cut-off tool.
11. Cut tapers with a skew.
12. Cut beads with a skew.
13. Cut concave cuts with a gouge.
14. Measure with outside calipers.
15. Measure with inside calipers.
16. Make and use a template.
17. Mount work on a face plate.
18. Mount work on a screw chuck.
19. Size work on face plate.
20. Hollow out work on the face plate of screw chuck.
21. Fasten pieces together temporarily for turning.
22. Cut off stock in lathe.
23. Sand paper in lathe.
24. Apply finish in lathe.
25. Make a spindle chuck.
26. Make a set up for duplicate parts.
27. Make hollow chuck.
28. Do off center turning.
29. Make a split turning.

Jointer

1. Safety rules for operating the jointer.
2. Range of work which may be done on the jointer.
3. Care for and adjust the machine.
4. Joint an edge.
5. Plain end grain.
6. Cut a chamfer.
7. Make a spring joint.
8. Surface narrow stock.
9. Take the wind out of a board.
10. Cut a rabbet.
11. Cut tapers.
12. Cut a recess.

Table Saw

1. Safety rules for operating saw.
2. Range of work which may be done on the saw.
3. Care for and adjust the saw.
4. Remove and mount saw blades.
5. Rip narrow and wide stock.
6. Cut off.
7. Cut grooves.
8. Cut dados.
9. Cut tenons.
10. Cut miters.
11. Cut tapers.
12. Cut Box.
13. Re-saw.
14. Saw a bevel.
15. Fit circular saw blades.
16. Cut rabbets.

Jig Saw

1. Safety rules for operating saw.
2. Range of work which may be done on the saw.
3. Care for and adjust the saw.
4. Make exterior and interior cuts.
5. Cope work.
6. Do marquetry sawing.

Drill Press

1. Safety rules for operating drill press.
2. Range of work which may be done on the drill press.
3. Adjust and control speeds.
4. Use attachments.
5. Reeding and fluting with dividing head and jig.
6. Drill holes using twist bits.

Band Saw

1. Safety rules for operating the saw.
2. Range of work which may be done on the saw.
3. Care for and adjust the saw.
4. Saw curves.
5. Rip.
6. Cut off.
7. Cut tenons.
8. Re-saw.
9. Cut duplicate circles.
10. Do compound sawing.

The Surfacers

1. Safety rules for operating the surfacer.
2. Range of work which may be done on the surfacer.
3. Care for and adjust the surfacer.
4. Adjust for depth of cut.
5. Adjust and control feed.
6. Feed work into the machine.

Belt Sander

1. Safety rules for operating sander.
2. Range of work which may be done on the sander.
3. Remove and replace belt.
4. Care for and adjust the sander.
5. Operate sander on flat work.
6. Operate sander on curved work.

Disk Sander

1. Safety rules for operating disk sander.
2. Range of work which may be done on a disk sander.
3. Adjust fence and table for angle cuts.
4. Sand after pattern.

The Mortiser

1. Safety rules for operating the mortiser.
2. Range of work which may be done on the mortiser.
3. Adjust and care for the mortiser.
4. Set and adjust chisel and bits.
5. Feed stock.
6. Set up for duplicate parts.

Shaper

1. Safety rules for operating shaper.
2. Range of work which may be done on the shaper.
3. Care for and adjust the shaper.
4. Change and set shaper knives.
5. Shape straight edges and ends.
6. Shape curved edges with collars.
7. Hone shaper cutters.
8. Cut grooves and rabbets.
9. Cut a rule joint.
10. Shape after patterns or templates.

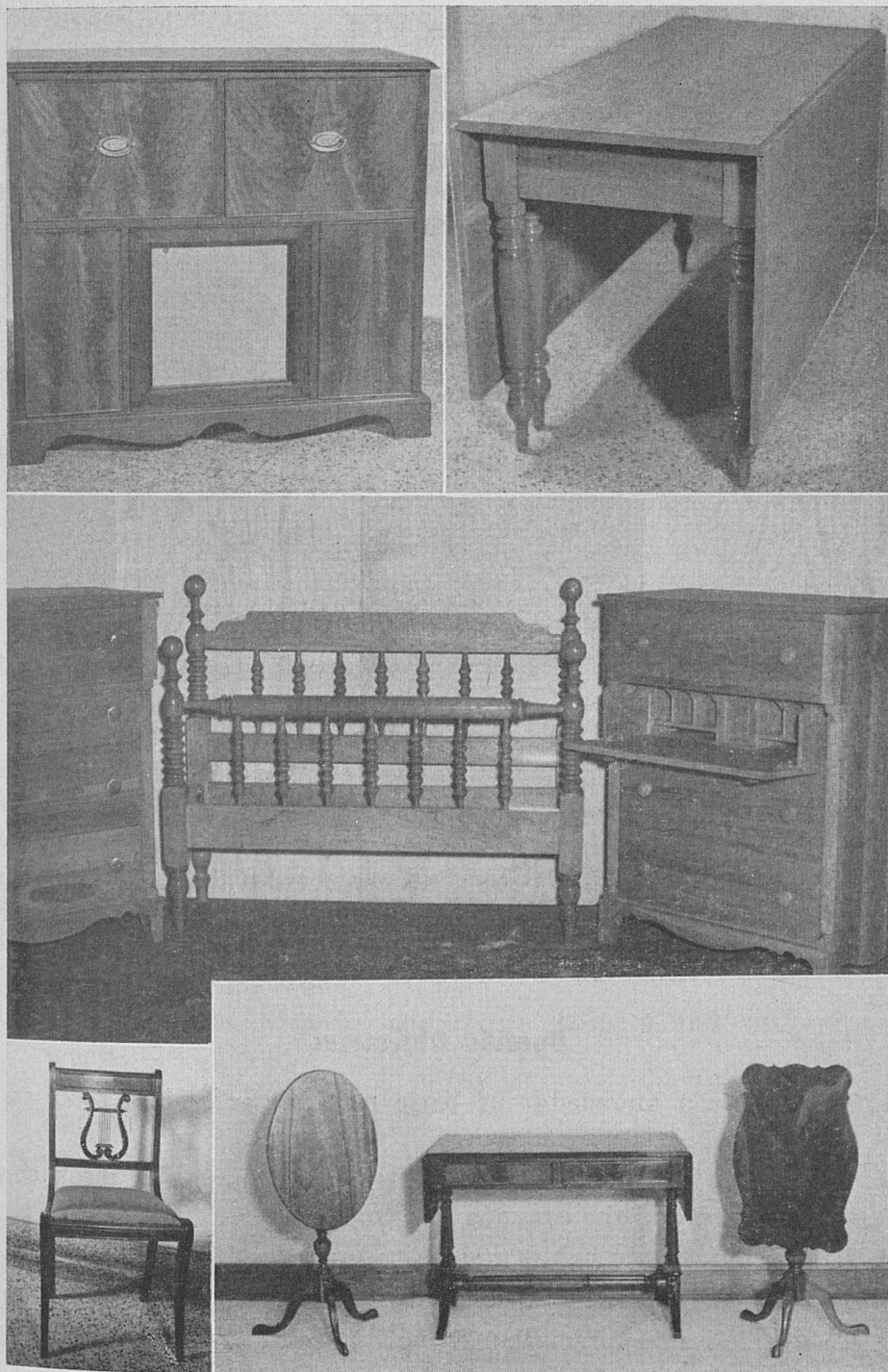
Tool Grinder

1. Safety precautions.
2. Types of sharpening stones, their grades and uses.
3. Speeds of grinding wheels.
4. Mounting emery wheels.
5. Dressing emery wheels.

INFORMATION UNITS

(Woodworking Machines)

1. Types of machines and their characteristics.
2. Nomenclature of parts and attachments.
3. History and development of woodworking machinery.
4. Common sizes and specifications of each machine.
5. Factors that influence quality of work.
6. Safety practices of each machine.
7. Range of work that may be done.
8. Types of blades, cutters, knives or cutter-heads used.
9. Speeds of machine appropriate for various types of work.



Projects made by students in woodworking classes.

Chapter VIII

METALWORKING

For many years metalworking has been one of the important phases of American industry. Recent developments in this field have placed it foremost in importance. Due to the fact that many millions of men and women are employed in the metalworking industries, and also that the lives of many more millions are affected by the uses of metals, it is logical to expect considerable emphasis upon this phase of public education.

The program presented here includes the following phases of metalworking: Sheet metal, foundry, forging, heat treating, welding, and machine shop practice.

A. MACHINE SHOP

Since the machine shop forms the basis for the manufacture of practically all precision tools used in the production of other machines and equipment necessary for the maintenance of all industries, its importance can hardly be over emphasized. The opportunities it affords for the development of skills in dimensioning and shaping metal are unlimited. The high degree of accuracy required in successful machine shop practices contributes definitely towards the development in the pupils of a critical and analytical approach to their problems.

Specific Objectives

1. To provide a knowledge of basic machine and hand tools and their uses.
2. To develop skills in the use of hand tools, precision measuring instruments, and the common machine tools.
3. To develop certain habits and attitudes desired in the shop.
4. To train the student to become proficient in simple tool design.
5. To develop an appreciation for good tools, machines, and other equipment.
6. To develop an appreciation of safety.



Projects made by students in metal working classes.

Operation Units

1. Lay out work, using steel scale, combination square and dividers.
2. Measure with inside and outside calipers.
3. Measure with gages — depth, thickness, thread, etc.
4. Measure with micrometer calipers.
5. Locate centers with hermaphrodite calipers and with center square.
6. Grind chisels.
7. Chip by hand.
8. Cross-file.
9. Draw-file.
10. Straight plain surface.
11. Saw with hack-saw.
12. Dress a screwdriver.
13. Ream with hand reamers.
14. Cut threads with hand dies.
15. Tap holes with hand tap.

16. Braze a joint.
17. Remove a broken tap.
18. Remove a broken stud.
19. Lace belts.
20. Cement leather belts.
21. Bend round or rectangular stock.
22. Draw out stock.
23. Upset stock.
24. Anneal metal.
25. Harden carbon steel by quenching.
26. Temper a cold chisel.
27. Case-harden.
28. Test metals for hardness — Rockwell-Brinell, etc.
29. Rivet.
30. Punching.
31. Broaching.
32. Fit and assemble.
33. Align and level machines when installing.
34. Drilling.
35. Determine speed with a speed indicator.
36. Check with test indicator.
37. Fit by lapping.
38. Measure and test angles with a sine-bar.
39. Drive studs by hand.
40. Mark with steel stamps.
41. Mark by etching.
42. Oil shafting.
43. Dress emery-wheels.
44. Lay up machinery and tools.

MACHINE TOOLS

INFORMATION UNITS FOR ALL MACHINES

1. The safety rules with respect to the particular machine.
2. The type and general description of the machine, including its size, capacity, and principal uses.
3. The names and functions of the principal parts of the machine.
4. The different working speeds of the machine, and how they are obtained.
5. How the lines of power are transmitted through the machine and how the different types of motion are produced.

THE ENGINE LATHE

Operation Units

1. Start, stop and reverse the lathe.
2. Grind and set the tools for a roughing cut on cast iron, cold rolled steel and tool steel.
3. Grind and set the tools for a finishing cut on cast iron, cold rolled steel and tool steel.
4. Grind and set cut-off tools.
5. Grind and set threading tools to center gage.
6. Grind and set threading tools for special threads.
7. Grind and set facing tools.
8. Grind and set boring tools.
9. Determine cutting speeds required for effective work.
10. Prepare work for mounting between centers.
11. Mount work between centers.
12. Remove and replace centers.
13. Test live centers for accuracy.
14. Grind centers.
15. Test for alignment of centers.
16. Put on and remove a face-plate.
17. Mount work on a face-plate.
18. Put on and remove chuck.
19. Center cylindrical work in a chuck.
20. Center irregularly shaped work.
21. Center hollow ring work in a chuck.
22. Lay off lengths on work held in lathe.
23. Cut off work with a cut-off tool.
24. Do cylindrical turning, including roughing and finishing cuts.
25. Face work in the lathe with a facing tool.
26. Face work in the lathe with a round-nose tool.
27. Cut square shoulders.
28. Cut fillets.
29. Cut external National coarse threads.
30. Cut internal National coarse threads.
31. Cut acme threads.
32. Cut taper threads.
33. Cut tapers, compound rest method.
34. Cut tapers, attachment methods.
35. Set over tail-stock for taper.
36. Make taper fit in the lathe.
37. Cut irregular forms with compound rest.

38. Set up a collet chuck.
39. Set up work in jigs.
40. Mount work on a mandrel for turning.
41. Regulate speed for lathe.
42. Bore with a boring bar.
43. Turn work with a follow rest.
44. Turn work in a steady rest.
45. Drill and ream in the lathe.
46. File work in the lathe.
47. Caliper work in the lathe with outside calipers.
48. Caliper work in the lathe with inside calipers.
49. Caliper work in the lathe with micrometer calipers.
50. Polish work in the lathe.
51. Knurl work in the lathe.

THE DRILL PRESS

Operation Units

1. Start and stop the machine.
2. Clean, oil, and care for the machine.
3. Adjust speed and feed of the machine.
4. Set up and secure work on the table.
5. Set up work in the vise.
6. Set up work in jigs.
7. Lay out a hole for drilling.
8. Set over a drill.
9. Do tapping.
10. Do reaming.
11. Do counter boring.
12. Do countersinking.
13. Do spot-facing.
14. Do boring.
15. Drill oversize holes.
16. Drill cylindrical work.
17. Drill holes at an angle to a surface.
18. Drill holes to a measured depth.

THE SHAPER

Operation Units

1. Start and stop the machine.
2. Clean, oil and care for the machine.

3. Adjust the stroke and speed of the machine.
4. Adjust the feed of the machine.
5. Grind and set tools for finishing cuts.
6. Grind and set tools for roughing cuts.
7. Set up work in vise.
8. Set up work on table.
9. Make a roughing horizontal cut.
10. Make a finishing horizontal cut.
11. Machine surfaces at right angles.
12. Machine angular surfaces.
13. Machine curved surfaces.
14. Machine tapered surfaces.
15. Cut V's and dovetails.
16. Cut teeth.
17. Cut T-slots.
18. Cut a key-way.
19. Adjust the shaper head.
20. Do undercutting.
21. Set up work in jigs.

THE PLANER

Operation Units

1. Start and stop machine.
2. Clean, oil and care for the machine.
3. Adjust the speed and length of stroke.
4. Adjust the feed of the machine.
5. Grind planer tools.
6. Set up and fasten work on the table.
7. Do horizontal planing.
8. Adjust and use the clapper-box.
9. Take the "rock" out of a job.
10. Set up work on angle-plates.
11. Set up work in jigs.
12. Set up work in vise.
13. Plane a tee-slot.
14. Plane angular work.
15. Plane tapered work.
16. Plane a key-way.
17. Plane a curved surface.

THE MILLING MACHINE

Operation Units

1. Start and stop the machine.
2. Clean, oil and care for the machine.
3. Set up cutters on arbor.
4. Set up end-mill.
5. Set up for face milling.
6. Do plain milling.
7. Do side milling.
8. Line table, vise, and work with cutter.
9. Set feed-trips.
10. Set up work in vise and jigs.
11. Clamp work to table.
12. Do profiling.
13. Do routing.
14. Do gang milling.
15. Do angular milling.
16. Do end milling.
17. Do flute milling.
18. Do straddle milling.
19. Saw with a slitting saw.
20. Do drilling.
21. Do boring.
22. Do form milling.
23. Do spiral and helical milling.
24. Do taper milling.
25. Do direct indexing.
26. Do plain indexing.
27. Do differential indexing.
28. Do rack milling with attachment.
29. Cut grooves with a slotting attachment.
30. Mill with universal attachment.
31. Do high speed milling.
32. Do circular milling with attachment.
33. Mill with vertical attachment.
34. Cut special shapes with fly-cutter.

THE GRINDER

Operation Units

1. Start and stop the machine.
2. Clean, oil, and care for the machine.

3. Adjust the speed of the machine.
4. Grind a flat surface.
5. Grind a vertical surface.
6. Do angular grinding.
7. Grind slots.
8. Grind to shoulders.
9. Grind to a form.
10. Do straight cylindrical grinding, outside.
11. Do taper cylindrical grinding, outside.
12. Do angular cylindrical grinding, outside.
13. Do internal straight grinding.
14. Do internal taper grinding.
15. Do face grinding.
16. Do form grinding, cylindrical.
17. Grind form-tools.
18. Mount grinding wheels.
19. Dress grinding wheels.

THE POWER HACK-SAW

Operation Units

1. Start and stop the saw.
2. Clean, oil, and care for the machine.
3. Regulate weight of the stroke.
4. Change blades in the machine.
5. Secure work in the saw vise.
6. Feed the saw into the work.
7. Saw thin stock on the machine.
8. Saw hollow stock on the machine.

Information Units

1. The names of tool bits; round-nose, square-nose, side, threading, boring and others.
2. The types of chucks and face-plates.
3. How an indicator is used.
4. The types of threads; National Coarse, "V", square, Acme, Worm, Whitworth, National Fine.
5. The meaning of pitch, lead, left-hand, right-hand, single and multiple threads.
6. The meaning of ratio between pitch and lead.
7. The proper lubricants to use in cutting threads.
8. Various cooling agents used in machine work.
9. The types of taps and dies in common use.

10. The care of taps and dies.
11. The names and uses of small hand tools.
12. The number and letter sizes of drills.
13. The drill gages.
14. Keys and their proportions.
15. Belt measurements.
16. The kinds of chisels; flat, cape, gouge, side, diamond-point, and others.
17. The grade of steel used in making chisels.
18. The forms of files; flat, square, round, three-cornered, half-round, taper, blunt.
19. The cuts of files, single and double.
20. The grades of files; rough, coarse, bastard, second, smooth, dead smooth.
21. The terms used with respect to files; "safe-edge", tang, heel, pitch.
22. How sizes and kinds of saws are designated.
23. The grades of iron and steel.
24. Blast furnace, open hearth, Bessemer converter, Electric Furnace and crucible processes.
25. Hot rolled, cold rolled, bar and sheet steel.
26. The making of cast iron castings.
27. The composition of brass and bronze.
28. The standard tapers — Morse, Browne & Sharpe, Jarno.
29. How to calculate tapers and tail-stock set-over.
30. The kinds of drills; straight-shank, square, taper.
31. Drill terms; tang, shank, flute, lips, body clearance, web, heel.
32. The speeds and feeds of drills.
33. The kinds, grades and speeds of grinding wheels.

B. SHEET METAL

These courses in sheet metal were prepared for the Junior and the Senior High School levels.

Specific Objectives

1. To give the student exploratory experiences in the use of sheet metal tools and equipment.
2. To develop in each student an appreciation of high standards of workmanship and efficiency.
3. To develop skill in designing, planning, and executing a project.
4. To provide a knowledge of metals, their sources, manufacture, properties and uses.

5. To investigate data concerning the employment, status, salaries, and opportunities for advancement of workers in the sheet metal industries.
6. To develop an appreciation of the importance of safety.

Operation Units

1. Read a working drawing.
2. Make out a bill of material.
3. Plan a procedure.
4. Measure with a rule.
5. Check material when received.
6. Make a dimensioned sketch.
7. Lay out a circle with dividers.
8. Mark pattern on sheet metal.
9. Cut with :
 - A. straight shears, right and left.
 - B. curved shears.
 - C. pivoter shears.
 - D. aviation shears.
 - E. hawk bill shears.
 - F. stock shears.
 - G. double cutting shears.
 - H. circle shears.
 - I. square shears.
 - J. throatless shears.
 - K. slitting shears.
10. Bend in vise, — bar folder, cornice brake, finger brake, box brake, etc.
11. Make single and double hem.
12. Form or shape metal over a stake with a wood mallet.
13. Form a cylinder on the slip roll forming machine.
14. Make a lapped seam.
15. Light and operate a blow torch or furnace.
16. Solder tin plate, galvanized sheet metal, copper, stainless steel, brass, monel and pewter.
17. Make a grooved seam with a hand groover.
18. Turn wire edge on bar folder, and in turning machine (both flaring and straight edge projects).
19. Set down wire edge with wiring machine on both straight edged and flaring projects.
20. Wire a curved object on the wiring machine.
21. Make a simple parallel line development.
22. Make a simple radial line development.

23. Crimp edge in crimping machine.
24. Re-enforce and decorate with beading machine.
25. Turn a burr on a circle using the burring machine.
26. Turn flange on burring machine.
27. Form a double seam by hand or on machine.
28. Tin a soldering copper.
29. Finish metal by planishing, peening, painting, lacquering and chemical coloring.
30. Locate and center punch holes.
31. Rivet sheet metal by hand, using riveting set.
32. Rivet sheet metal using squeeze gun and air gun.
33. Drill sheet metal and strap iron.
34. Punch holes with solid, hollow, and hand punches.
35. Cut strap iron with the hack saw.
36. Form strap iron.
37. Peen strap iron.
38. Cut threads with tap and dies.
39. Spot weld.
40. File a piece of metal.
41. Copy from a template.
42. Machine groove a piece of metal.
43. Double seam by hand.
44. Double seam with machines.
45. Raise bottom seam.
46. Chisel.
47. Hand punch, hollow punch, center punch, tool punch and machine punch steel.
48. Use elbow edging machine.
49. Use setting down machine.
50. Drill a piece of metal by hand and machine.
51. Sharpen a drill bit.
52. Sharpen a pair of snips.
53. Grind.
54. Gutter bead.
55. Spot weld.
56. Cut, straighten, form and bend wire.
57. File.
58. Scrape.
59. Assemble and fit.
60. Polish and clean metal.
61. Read blue prints for sheet metal.

62. Make the following: Pittsburgh seam, Boston seam, drive slides and "S" slides.
63. Construct square ducts.
64. Read the circumference rule.
65. Install control dampers.
66. Use air hammer.
67. Use aluminum rivets (aviation types).
68. Etch copper and brass and aluminum.
69. Raise copper, brass and aluminum.
70. Color copper and brass.
71. Hand hammer metal.
72. Chase metal.
73. Spin metal.

Information Units

1. The name, use and care of tools.
2. The name, use and care of stakes.
3. The name, use and care of machines.
4. Identification of the various kinds of sheet metal.
5. The kinds of soft solder and their uses.
6. The kinds of flux and dipping solutions and their uses.
7. The kinds and sizes of rivets.
8. Standard gauges of wire.
9. Standard sizes of strap iron.
10. Kinds of threads and standard sizes of taps and dies.
11. Occupational information, including employment, status of workers, salaries, and opportunity for advancement.
12. Temporary metal fasteners, clecoes, etc.
13. The circumference rule.
14. Recognition of the following materials, their general characteristics and uses: terne-plate, coke plate, charcoal tin, soft and planished copper, lead, stainless steel, aluminum, brass and black iron.
15. Recognition of the following materials, their general characteristics and uses: zinc, tin, monel, hard solder, Russian iron, hot rolled pickled and annealed sheet steel and cold rolled sheet steel.
16. Kinds and sizes of drills.
17. Type of flux and dipping solutions.
18. Thickness, specification, and commercial sizes of the following: galvanized iron, sheet copper, tin plate and terne-plate.

19. Thickness, specifications, and commercial sizes of the following:
brass, monel, stainless steel and zinc.
20. Sizes and shapes of soldering coppers.
21. Types of soldering pots — gas, gasoline and charcoal.
22. Safety rules.
23. Sheet metal screws.
24. Probable future for sheet metal industries.
25. Standard sheet metal code.
26. Aviation techniques in working aluminum.

C. FOUNDRY

Specific Objectives

1. To stimulate the acquisition of knowledge relative to the design, structure, and materials used in pattern making.
2. To provide a general knowledge of foundry and heat-treating practices.
3. To provide a knowledge of ferrous and non-ferrous metals, alloying elements, melting temperatures, fluxes, etc.
4. To stimulate a study of the various processes used in the manufacture of iron and steel.
5. To develop skill in the uses of foundry and forge tools and equipment.
6. To develop an appreciation of the importance of good design and appropriate use of metals.
7. To furnish a background for pupils desiring to enter the various related vocations.
8. To develop an appreciation of the necessity for safety and to caution on hazards to health.

Operation Units

1. Construct a simple pattern.
2. Select proper shrinkage rule suitable for type of metal to be cast.
3. Make a split pattern.
4. Build a pattern by the segment process.
5. Make core prints.
6. Prepare sand for molding.
7. Cut sand.
8. Test sand for proper moisture.
9. Riddle sand.
10. Select flask and arrange patterns.
11. Ram a mold.
12. Use parting and facing materials.
13. Vent mold.

14. Remove pattern.
15. Use slick, spoon, etc.
16. Patch broken mold.
17. Cut sprue gate.
18. Cut an irregular parting in a mold.
19. Make a sand core.
20. Prepare and pour metal.
21. Remove gates and clean casting.
22. Set a core in a mold.
23. Judge the heat of metal by color.
24. Make a pattern from a commercial job.
25. Use bellows.
26. Draw pattern out of sand.
27. Use auxiliary holding devices, such as crossbars, gagers, solders, nails, etc.
28. Cut skim gate.
29. Pour small castings using hand ladles.
30. Light melting furnace.
31. Build proper equipment for handling molten metal.
32. Skim molten metal.
33. Handle molten metal.
34. Keep a steady stream of metal flowing into the mold.
35. Dispose of left-over metal.
36. Pour light and heavy work.
37. Clamp mold.
38. Identify molding, fire and free sands.
39. Clean and care for crucibles.
40. Alter flask and adjust pins.
41. Build flasks and molding boards.
42. Select gagers, solders, and nails for retaining sand.
43. Use shovel in handling sand and other materials.
44. Use core plates in handling sand and other materials.
45. Place patterns on a molding board.
46. Swab, rap, and draw patterns.
47. Use vent rods and risers in venting a mold.
48. Pre-heat crucibles.
49. Select and set sprues.
50. Test for pouring temperature.

Information Units

1. Types of materials used in pattern making.
2. Classifications of castings as to strength, toughness, durability.

3. Types of molding: green-sand work, core work, dry-sand work, form work.
4. How to select proper sand for class of work to be done.
5. Types of flasks.
6. Manufacture of iron and steel.
7. Sources and use of copper.
8. Sources and use of brass.
9. Sources and use of lead.
10. Sources and use of aluminum.
11. Types of metals and their melting points.
12. Types of patterns.
13. Methods of finishing.
14. Terminology used in foundry.
15. Types and kinds of facing materials.
16. Molding tools and equipment.
17. Cores and binders.
18. Safety measures and health precautions.
19. Cupola and melting practices.
20. Methods of cleaning castings.
21. Identification of metals.
22. Identification of molding, fire and free sands.
23. Identification of clay and lining mixture.
24. Fuels used to light core ovens and furnaces.
25. Chaplets and their use.
26. Where metals used in foundry are obtained and prepared for use.
27. Characteristics of metals used in foundry.
28. Melting points of metals.
29. Source of sand materials.
30. Compositions of sands.
31. The manufacture and mining of facing materials.
32. The purpose of blakenings and how accomplished.
33. Relation of foundries to other industries.
34. Opportunities in foundry work.

D. FORGING AND HEAT TREATING

Specific Objectives

1. To teach the importance of iron and steel in our present civilization and its influence on United States History.
2. To teach the characteristics of iron and steel and how they are altered by alloying and heat treatment.

- work,
3. To give practical application to physics, chemistry and mathematics.
 4. To teach safety in the handling of things of potential danger.

Operation Units

1. Build and maintain a forge fire.
2. Light and operate a gas forge.
3. Fit and hold work with tongs.
4. Heat work in forge to working heat.
5. Measure and cut stock.
6. Draw out and upset stock.
7. Forge round and rectangular stock.
8. Bend eyes and scrolls.
9. Twist square or rectangular stock.
10. Punch hot metal.
11. Clean tuyere.
12. Make coke from green coal.
13. Decrease thickness, width, or both and increase length.
14. Point stock.
15. Flare stock.
16. Twist metal.
17. Cut off stock.
18. Use cold cutter.
19. Use hot cutter.
20. Use hardie cutter.
21. Grind and care for tools.
22. Use forge vise.
23. Use edge of anvil.
24. Use jigs.
25. Use scroll horn and wrench.
26. Prevent fractures.
27. Prepare stock for hardening.
28. Harden, temper and test stock.
29. Anneal stock.
30. Use heated block for tempering.
31. Case harden.
32. Use fluxes.
33. Determine metals by spark test.
34. Lay out and measure given pattern.
35. Use square, calipers, center punch, scratch awl, and trammel points.

36. Use lever shear.
37. Heat treat chisel or punch in gas forge or electric furnace.

Information Units

1. Manufacture of steel and iron.
2. Identification and characteristics of the following metals: machinery steel, mild steel, tool steel, Swedish iron and wrought iron.
3. Types and kinds of fuels.
4. Source and composition of common fuels.
5. Types of cooling mediums used in heat-treating.
6. Advantages and disadvantages of fuels, cooling mediums, etc.
7. Case hardening materials and cautions to observe.
8. Smoothing and polishing materials.
9. The relative location of shop equipment.
10. Types of forges and function of their various parts.
11. The anvil, the use of its various parts.
12. Names and uses of blacksmith tools.
13. Effect of heat on steel.
14. The principles of welding.
15. How fluxes act.
16. Annealing of ferrous and non-ferrous metals.
17. Types of fire used in forge.
18. Proper heat-treatment of metals.
19. Safety precautions.
20. The proper handling of tools and materials.
21. Shop problems involving fundamentals of arithmetic, fractional measurements.
22. How to estimate a bill of material.
23. Correct pronunciation and spelling of tools, materials, operations and processes.
24. Testing of metals (heat-treating).
25. Heat-treatments of non-ferrous alloys.
26. Types of heat-treating furnaces and equipment.
27. Types of quenching equipment.
28. Types of liquid baths.
29. Effect of improper heating on metals.
30. Tempering colors and degrees of each.
31. Oxidizing fire.
32. Kinds of equipment for determining hardness.
33. Kinds of equipment for discovering flaws.

E. WELDING — ARC AND OXY-ACETYLENE

Specific Objectives

1. To provide a knowledge of elementary electricity which forms the basic principles of the arc welding machine.
2. To acquire a knowledge of the different types of welding equipment.
3. To establish definite habits of safety.
4. To develop skill in the use of welding and cutting tools.
5. To become familiar with various kinds of metal and the means of identifying them.
6. To become familiar with the methods employed in testing welds.

ARC WELDING OPERATION UNITS

1. Strike an arc and run flat beads.
2. Run continuous beads.
3. Weave and oscillate.
4. Build up a pad.
5. Use different size electrodes.
6. Construct Tee or fillet welds.
7. Make a butt weld with bare electrode.
8. Do vertical welding.
9. Cut, using the electric arc.
10. Weld with bronze electrode (shielded arc).
11. Weld a butt pipe weld using shielded arc.
12. Set machine for proper polarity.
13. Test welds properly.
14. Weld light gauge steel.

ARC WELDING INFORMATION UNITS

1. Precautions and safety practices.
2. Standard welding symbols.
3. Types of joint construction and design.
4. Development of arc welding.
5. Types of welding machines.
6. Types of welding electrodes.
7. Knowledge of reverse and straight polarity.
8. Principles of the arc welder.
9. Methods of striking an arc.
10. Common methods used in welding various joint construction.
11. Expansion and contraction.
12. Cutting with electric arc.

13. The principles of arc weld surfacing.
14. Welding accessories essential.
15. Jig construction.
16. Identification of different metals.
17. Effect of arc length, amps and speed on bead.
18. Padding, building up plates.
19. Penetration.
20. Speed of welding.
21. Strength of welds.
22. Preparation of work.
23. Normalizing.
24. Preheating and annealing.
25. Qualities of efficient cables.
26. Types of electrode holders.
27. Care of materials to be welded before the arc is applied.
28. Knowledge of coated electrodes.
29. Materials used for electrodes.
30. Types of eye shields.

OXY-ACETYLENE WELDING OPERATION UNITS

1. Connect oxygen supply to the torch.
2. Connect acetylene supply to the torch.
3. Operate welding torch.
4. Adjust neutral, excess acetylene and excess oxygen flames.
5. Operate the cutting torch.
6. Apply general operating rules.
7. Melt various metals to learn their characteristics.
8. Prepare steel plate for single "Vee" joint, double "Vee", etc.
9. Test weld for penetration.
10. Weld typical joints on sheet metal.
11. Construct simple frame and weld.
12. Bronze weld cast iron.
13. Identify metals by spark test.
14. Handle welding outfit safely.
15. Care for and set up apparatus.
16. Run continuous beads on flat work using light gauge metal.
17. Recognize action of molten metal under flame.
18. Make butt welds in different gauge metals.
19. Bevel steel plate, cut holes in steel plate and cut off rivet heads.
20. Heat and bend metal into various angles.
21. Bronze-surface steel and cast iron parts.

22. Make a hose connection or a splice ; using scrap piece of hose.
23. Cut cast iron.
24. Weld cast iron with cast rod.
25. Pre-heat cast iron for welding.
26. Care for expansion and contraction in welding.
27. Lap weld flat, vertical and overhead.
28. Make a "tee" weld, flat, vertical and overhead.
29. Make a butt, "tee", angular and fillet weld (pipe welds).
30. Make a flange weld.
31. Make a butt weld open single "Vee".
32. Make tubular butt weld.
33. Make a vertical fillet weld.
34. Make a combination plate and tube fillet weld.,
35. Weld aluminum, cast and rolled.
36. Weld stainless steel.

OXY-ACETYLENE WELDING INFORMATION UNITS

1. Precautions and safety practices.
2. Standard welding symbols.
3. Types of joint construction and design.
4. Historical development of oxy-acetylene welding.
5. Construction and operations of torches.
6. Construction and operations of regulators.
7. Welding and cutting accessories.
8. Preparing for welding.
9. The oxy-acetylene flame.
10. Characteristic of oxygen and acetylene.
11. Principles of oxy-acetylene cutting.
12. Setting-up apparatus.
13. Scope of the oxy-acetylene process.
14. Welding of different metals.
15. Explosive gas mixtures — back-fires and flashbacks.
16. Characteristics of iron and steel.
17. Welding of non-ferrous metals.

Chapter IX

ELECTRICAL WORK

The field of electricity is so broad that only a small part of it can be included in the industrial arts curriculum. There are however, certain basic fundamentals and practical phases of the field that can well be presented with value to students in junior and senior high school. It is not considered desirable, in most instances, to go beyond the basic fundamentals as this would approach specialized vocational training.

Generally, industrial arts work should not be organized with a view of preparing students for specific electrical employment. Rather, available time should be spent in giving them a broad understanding of electrical theory through the use of carefully selected projects.

Elementary electrical work contains very few "doing" units that require any considerable degree of manipulative skill. Most of the operations are readily learned, such as the splicing of wires, removing insulation, soldering, connecting to binding-posts, insulating, and the like, together with certain standard methods of construction. The "knowing" units concern the flow and transmission of current, the characteristics of current, and the methods employed in making it serve our purposes in common ways.

Pupils can do many interesting things with the electric current, but the projects assigned or approved should be the means of teaching fundamental principles. The installation of a bell circuit introduces certain manipulative skills and certain problems of construction, but these are largely superficial. Such a task affords a safe, easy, and inexpensive means of presenting ideas about the electric circuit, the use of metallic conductors, and the principles of electromagnetism.

Specific Objectives

1. To provide the student with a knowledge of elementary electrical theory.
2. Provide the student an opportunity to develop skill in use of tools for electrical work.

3. Provide the student with a knowledge of materials used in electrical work.
4. Train the student to be an intelligent consumer of electricity and electrical devices in the home and community.
5. Provide the student with a conception of world significance concerning the field of electricity.
6. Safety.

Operation Units

1. Read a wiring-diagram.
2. Make a wiring-diagram.
3. Plan a procedure for doing a job.
4. Remove insulation or covering from wire.
5. Make a rat-tail splice.
6. Make a Western Union splice.
7. Make a tap splice.
8. Solder and tape a splice.
9. Attach wire to a binding-post.
10. Uncoil wire without twisting.
11. Connect dry-cells in series.
12. Connect dry-cells in parallel.
13. Plan and construct a simple electric circuit which may be opened and closed at one point.
14. Plan and construct an electrical circuit which may be opened and closed at either or both of two points.
15. Plan and install electric devices in a circuit in series.
16. Plan and install electric devices in a circuit in parallel.
17. Plan and construct circuits to give selective control of devices in the circuit.
18. Attach a cord to a lamp socket.
19. Attach a cord to a plug.
20. Test and replace fuses.
21. Read an electric meter.
22. Interpret the identity marks on a motor.
23. Administer first aid in case of shock.
24. Attach a terminal to a wire.
25. Provide a "make and break" in a circuit, as in a timer.
26. Apply the principle of electro-magnetic force in order to operate mechanisms, as in a buzzer or bell.
27. Employ resistance to generate heat, as in a toaster or a soldering-copper.

28. Wire a circuit so as to prevent a dangerous rise in temperature, due to resistance.
29. Reduce voltage on a line.
30. Locate a break in a circuit.
31. Tie an underwriter's knot.
32. Calculate the resistance of a circuit, using Ohm's Law.
33. Install a snap-switch.
34. Install a flush-switch.
35. Install a flush-receptacle.
36. Measure voltage with a volt meter.
37. Measure amperage with an ammeter.

Information Units

1. The properties of the magnet and the characteristics of the magnetic field.
2. The source of electric current or pressure.
3. The characteristics of the electric current.
4. How the electricity is conveyed.
5. The kinds of conductors and their uses.
6. The meaning of volt.
7. The meaning of ampere.
8. The meaning of watt.
9. How the electric current gives light.
10. How the electric current gives power.
11. How the electric current gives heat.
12. The difference between direct and alternating current.
13. The sources of direct current.
14. The source of alternating current.
15. The meaning of phase and cycle.
16. The meaning of "series" and "parallel", and the difference between the effects of these connections.
17. Resistance and its effect.
18. Ohm's Law.
19. How the electric bell works.
20. Why splices should be soldered.
21. The importance of proper insulation.
22. The sizes of wire.
23. The effect of an overload.
24. Symbols used in wiring-diagrams.
25. Safety rules in working with electricity or electrical appliances.
26. How the rheostat works.

27. How the volt meter works.
28. How the ammeter works.
29. How the electric meter works.
30. The construction of the dry-cell and how it works.
31. The construction of the wet-cell and how it works.
32. The kinds of fuses and their uses.
33. The kinds of electric lamps and how they are made.
34. The causes and effects of short circuits.
35. The types of motors and how to identify them.
36. The types of transformers and how they work.
37. The types, purposes, and working of condensers.
38. The principle of the three-wire system.
39. Pay-roll jobs and opportunities in the electrical industry.
40. Imperfections in housewiring which involve fire hazards or personal injury.
41. Modern electric light fixtures.

RADIO

Specific Objectives

1. Provide the student with a knowledge of Elementary Radio theory and function of radio parts.
2. Provide the student with an opportunity to develop skills in the use of radio tools and instruments.
3. Train the student in reading radio diagrams.
4. Provide the student with a knowledge of materials used in radio.
5. Provide student with a knowledge of radio receiver construction.
6. Provide the student with a knowledge of the opportunities in radio and safety methods.

Information Units

1. Brief history of radio.
2. Elementary transmitter and receiver.
3. Waves.
4. The antenna, lead in, and ground system.
5. The function of the tuning coil.
6. The function of the tuning condenser.
7. The function of the detector.
8. The reproducer.
9. The function of the diode.
10. The function of the triode.

11. The function of the grid leak and condenser.
12. The operation of the regenerative detector.
13. Methods of regeneration control.
14. Function of audio frequency amplifier.
15. Kinds of audio frequency amplifiers.
16. The fundamentals of radio frequency amplifiers.
17. Methods of volume control.
18. Power supply fundamentals.
19. Fundamentals of the superheterodyne.
20. Types of vacuum tubes.
21. Fundamentals of radio test instruments.
22. Radio frequencies spectrum.
23. Radio repair fundamentals.
24. Fundamentals of amateur radio.
25. Fundamentals of commercial radio.
26. Advanced direct current circuits.
27. The magnetic circuit.
28. Direct current generators.
29. Direct current motors.
30. Theory and construction of the volt-ohm-milleammeter.
31. Alternating current circuit.
32. Characteristics of vacuum tubes.
33. The rectifier.
34. The audio frequency amplifier.
35. The radio frequency amplifier.
36. The vacuum tube oscillator.
37. The radio transmitter.
38. Modulation:—amplitude and frequency.
39. Radio wave propagation.
40. Transmitting antennas.
41. Television.

Operation Units

1. Construct an antenna ground system.
2. Construct two kinds of crystal sets.
3. Construct the following receivers:
 - a. One tube set without grid leak.
 - b. One tube set with grid leak.
 - c. One tube regenerative detector.
4. Construct a regenerative detector followed by one stage of resistance coupling audio frequency amplification, followed by one stage of transformer coupling.

5. Add to set mentioned in number 4, a stage of tuned radio frequency amplification.
6. Construct a simple superheterodyne receiver and align it.
7. Construct a power supply.
8. Construct a public address system.
9. Construct a phono amplifier.
10. Run a laboratory experiment or watch a demonstration on most of the information units.
11. Perform laboratory experiments on direct current and alternating current circuits.
12. Perform laboratory experiment with a direct current motor generator set.
13. Perform experiments on inductance-capacitance.
14. Run experiment on resonance.
15. Construct a radio frequency oscillator.
16. Construct a doubler used in a transmitter.
17. Construct a radio frequency amplifier and neutralize it.
18. Run experiments on vacuum tubes.
19. Run experiments on modulation system.
20. Repair radio receivers and equipment.
21. Construct some electronic project for the student's own use.
22. Convert some piece of electronic equipment.

Chapter X

AUTOMOTIVE SHOP

In order to present a program adaptable to many different school situations, this section is divided into two major sub-divisions:

I. Driver Education.

This area is intended to serve as a guide for a program where shop facilities may or may not be available. Particular stress is to be placed on the consumer education phase of automotive transportation.

II. Auto Mechanics.

This division is designed for use where it is desired to give particular emphasis to the more technical aspects of the automobile.

The two divisions mentioned above are herewith presented, with a condensed statement of the specific objectives of each.

I. DRIVER EDUCATION

With the importance of the automobile in modern life, and with the tremendous death rate due to automobile accidents, it is evident that there is need for a course in driver education in the secondary school today. The purpose of driver education is to enable the student to better understand, care for, and drive an automobile intelligently and safely.

There is a difference of opinion among educators as to the content and organization of a course in driver education. However, it is generally believed that the course should include three phases of work:

1. The classroom phase.
2. The laboratory phase.
3. The behind the wheel driving phase.

If physical facilities are not available for all three phases, one or two phases may be offered, since it is evident that the student can profit greatly from any one of the three phases of work.

Many good instructional materials and help in organizing a course in driver education are available from the American Automobile Association and local automotive dealers may provide assistance in organizing and teaching a program in driver education.

Specific Objectives

1. To give the student an understanding of how to care for an automobile intelligently.
2. To give the student a fundamental understanding of the function and operation of the various parts of the automobile.
3. To give the student an understanding of traffic rules and regulations.
4. To give the student an understanding of the responsibilities of the driver or the automobile owner.
5. To develop the ability to drive an automobile safely and intelligently.

CLASSROOM PHASE

Information Units

1. Importance of the automobile in modern life.
2. How the automobile influences family activities.
3. The automobile and community planning.
4. Truck transportation.
5. The automobile and its influence upon employment.
6. Community services influenced by the automobile.
7. Automobile accidents, their causes and effects.
8. The death rate due to automobile accidents.
9. Driver training in the schools.
10. Employment opportunities as a commercial driver.
11. Attitudes necessary for the careful driver.
12. Eyesight tests for the driver.
13. Physical health and its influence on the driver.
14. Tests of physical fitness for the driver.
15. The influence of intoxicants on the driver.
16. Carbon monoxide poisoning.
17. Worry and its effect on the driver.
18. Reaction time and its influence on the driver.
19. Braking distances at various speeds.
20. The influence of habit formation in learning to drive.
21. Safe practices as a pedestrian.
22. Mounting and dismounting from street cars and buses.
23. Safety in bicycling.
24. Safety in driving small powered vehicles.
25. Pedestrian accidents, their causes and effects.
26. The play yard versus the street for recreation.
27. Natural laws governing the driver.
28. Man made laws governing the driver.

29. Local traffic laws.
30. State traffic laws.
31. National traffic laws.
32. Right of way rules.
33. Responsibilities in case of accidents.
34. Types of automobile insurance.
35. Laws governing ownership and vehicle registration.
36. Motor vehicle operators licenses.
37. Regulations concerning the condition of a motor vehicle.
38. The promotion of traffic observation and enforcement.
39. Automobile gauges and indicators.
40. How to care for the cooling system.
41. The care of the braking system.
42. When and how an automobile should be lubricated.
43. Precautions in caring for the power plant.
44. How it runs.
45. Types of motor fuel and oil.
46. Types of anti-freeze and their use.
47. Tires and tire service.
48. The influence of weather on driving.
49. The interpretation of traffic signs and signals.
50. Laws governing passing.
51. Reading road maps.
52. Types of highway intersections.
53. The battery, its care and use.
54. Liability of drivers and owners.
55. Modern highways and traffic safety.
56. The traffic engineer and his work.
57. The parking problem in metropolitan cities.

LABORATORY PHASE

Operation Units

1. Take a test for reaction time.
2. Take a test for hearing.
3. Take a test for color blindness.
4. Take a test for depth perception.
5. Take a test for field of vision.
6. Test your driving habits.
7. Make proper driving signals.
8. Test the brakes.
9. Adjust the brakes.
10. Check the inflation of the tires.

11. Check the oil level.
12. Lubricate the automobile.
13. Check water in the cooling system.
14. Check tail lights.
15. Clean the gasoline line.
16. Drain, flush, and clean radiator.
17. Check rubber hose connection on cooling system.
18. Remove and replace rubber hose connections on cooling system.
19. Clean and set spark plugs.
20. Change a tire.
21. Rotate tires for even wear.
22. Repair an inner tube.
23. Check head lights for proper alignment.
24. Check and add brake fluid.
25. Change oil in the crank case.
26. Grease an automobile.
27. Wash and polish an automobile.
28. Clean the sediment bowl in the gasoline line.
29. Test, service, and care for the battery.
30. Adjust the tension on the fan or generator belt.
31. Trace lines of power engine to wheels.
32. Clean the commutator.
33. Retouch scratches or damage to the finish.
34. Trace lines of power from battery to engine for starting.
35. Replace a light fuse.
36. Trace lines of power from engine to distributor.
37. Test the fuel pump for pressure.
38. Trace and test a lighting system.
39. Inspect, lubricate, and adjust front wheel bearings.
40. Trade and check the ignition system.
41. Replace a light bulb.
42. Pass a written drivers test.
43. Replace an oil filter element.
44. Splice and solder wire.
45. Remove and replace a muffler.
46. Remove and replace an exhaust pipe.
47. Remove and replace a thermostat.

LABORATORY PHASE

Information Units

1. How the ignition system functions.
2. How the exhaust system functions.

3. How the steering system functions.
4. How the cooling system functions.
5. How the lubricating system functions.
6. How the braking system functions.
7. How the lighting system functions.
8. The power flow.
9. The parts of the power plant.
10. Carburetion.
11. The combustion cycle.
12. How the fuel pump works.
13. How the universal joint works.
14. What castor, camber, and toe-in are.
15. NOTE: Units of related information from the classroom phase which are applicable to the operations performed in the shop or laboratory phase should also be included here.

BEHIND THE WHEEL DRIVING PHASE

Operation Units

When this phase of driver instruction is offered, attention should be given to insure that the applicable operation and related information units in both the classroom and shop laboratory phases listed above are included in addition to the following list of operations:

1. Test your driving habits.
2. Adjust the seat.
3. Adjust the rear view mirror.
4. Shift gears.
5. Start the engine.
6. Apply the emergency brake.
7. Steer the automobile, right or left.
8. Back the automobile.
9. Turn the automobile around.
10. Make a "U" turn.
11. Do angle parking up-grade.
12. Do angle parking down-grade.
13. Do parallel parking up-grade.
14. Do parallel parking down-grade.
15. Start the engine while on an up-grade.
16. Start the engine while on a down-grade.
17. Turn a corner.
18. Pass another automobile.

19. Make correct driving signals.
20. Drive on the open highway.
21. Drive in heavy city traffic.
22. Test the brakes.
23. Check the oil.
24. Check the battery water level.
25. Check the inflation of the tires.
26. Check the water level in the radiator.
27. Pass a driving test on the road.

II. AUTO MECHANICS

Most of our youth will eventually own and operate automobiles, yet few of the school systems provide any training in auto-mechanics. The automobile is more widely used than any other major machine. It is important, therefore, that people know something of the principles upon which it operates in order that it may be used with a greater degree of satisfaction and safety. The owner should know something about the causes of the common failures and how to prevent them.

If we are to teach people to operate and care for automobiles intelligently, the instruction must be specific and systematic and the shop equipment must be sufficient and up to date.

The list of operation units outlined is not necessarily a list of repairs each student should be able to make, but a list of experiences he should have in order that he may understand some of the fundamental principles of machines, how to care for machines, and how to make minor repairs and adjustments.

AUTO MECHANICS

Operation Units

1. Plan the procedure in doing a job.
2. Test and clean spark-plugs.
3. Clean and adjust breaker-points.
4. Grease a car.
5. Change oil in the engine.
6. Wash and polish a car.
7. Repack water-pump glands.
8. Clean gasoline lines.
9. Replace light bulbs.
10. Remove sediment from the radiator.

11. Test and care for the battery.
12. Adjust tension on a fan or generator.
13. Remove and replace a tire.
14. Repair punctures with cold patches.
15. Repair punctures with hot patches.
16. Insert a boot in a casing.
17. Grind valves.
18. Trace lines of power from engine to wheel.
19. Adjust the charging rate of a generator.
20. Clean the commutator.
21. Iron out dents or bends in fenders or body.
22. Retouch scratches or damage to the finish.
23. Replace a water-manifold gasket on a water-cooled engine.
24. Align the front wheel.
25. Adjust mechanical brakes.
26. Reface valves and valve seats.
27. Trace lines of power from battery to engine for starting.
28. Trace lines of power from engine to generator.
29. Trace lines of power from engine to distributor.
30. Trace electric circuit from generator to battery.
31. Inspect a vacuum-tank.
32. Inspect a fuel-pump.
33. Trace and test the lighting system.
34. Test, focus, and adjust lights.
35. Adjust valve clearance in L-head engines.
36. Adjust valve clearance in valve-in-head engines.
37. Inspect and adjust front-wheel bearing.
38. Test for and correct lost motion in the steering mechanism.
39. Inspect and adjust a clutch.
40. Remove and inspect a floating rear axle.
41. Remove and inspect a semi-floating axle.
42. Inspect and adjust the differential.
43. Adjust hydraulic brakes.
44. Adjust main bearings.
45. Adjust connecting-rod bearings.
46. Scrape a bearing.
47. Time valves.
48. Clean and adjust the carburetor.
49. Trace and test the ignition system.
50. Locate and repair a short circuit in the electrical system.
51. Locate and repair an open circuit in the electrical system.
52. Test an ignition-coil.

AUTO MECHANICS

Information Units

1. The types and uses of anti-friction bearings.
2. What is meant by camber, castor, and toe-in, and how they affect the operation of the car.
3. The principle of the worm-gear, and how it is applied to the steering gear.
4. How the cam-and-lever type of steering-gear works.
5. How the planetary type of steering gear works.
6. The different types of axles.
7. The different types of brakes, and the principal characteristics of each.
8. The types of engine bearings, and the reasons for using such bearings.
9. The kinds of pistons and types of rings, their purposes and characteristics.
10. How the fuel pump works.
11. The purpose of the carburetor, and how it works.
12. The necessity for proper lubrication and how it is accomplished.
13. Safety precautions while driving.
14. The types of clutches, and how they work.
15. The universal joint, and how it works.
16. How the gear-shift transmission works.
17. How the planetary transmission works.
18. How the free-wheeling device works.
19. How the differential works.
20. The meaning of gear ratio, and its effects on power and speed.
21. How the fluid drive works.
22. How the starting-system works.
23. How the lighting-system works.
24. How the ignition-system works.
25. How the over-drive mechanism works.
26. The meaning of cycle in a gas engine.
27. How the gas-pump works.
28. Importance of the automobile in modern life.
29. The automobile and community planning.
30. Opportunities in truck transportation.
31. The automobile and its influence upon employment.
32. Automobile accidents, their causes and effects.
33. Employment opportunities as a commercial driver.
34. Attitudes necessary for the careful driver.

35. The influence of intoxicants on the driver.
36. Reaction time and its influence on driving.
37. Braking distances at various speeds.
38. Safe practices as a pedestrian.
39. Natural laws governing the driver.
40. Local traffic laws.
41. State traffic laws.
42. National traffic laws.
43. Right of way rules.
44. Laws governing ownership of an automobile.
45. Regulations concerning the condition of an automobile.
46. Automobile gauges and indicators.
47. Types of motor fuel and oil.
48. Types of anti freeze.
49. Tires and tire service.
50. Reading road maps.

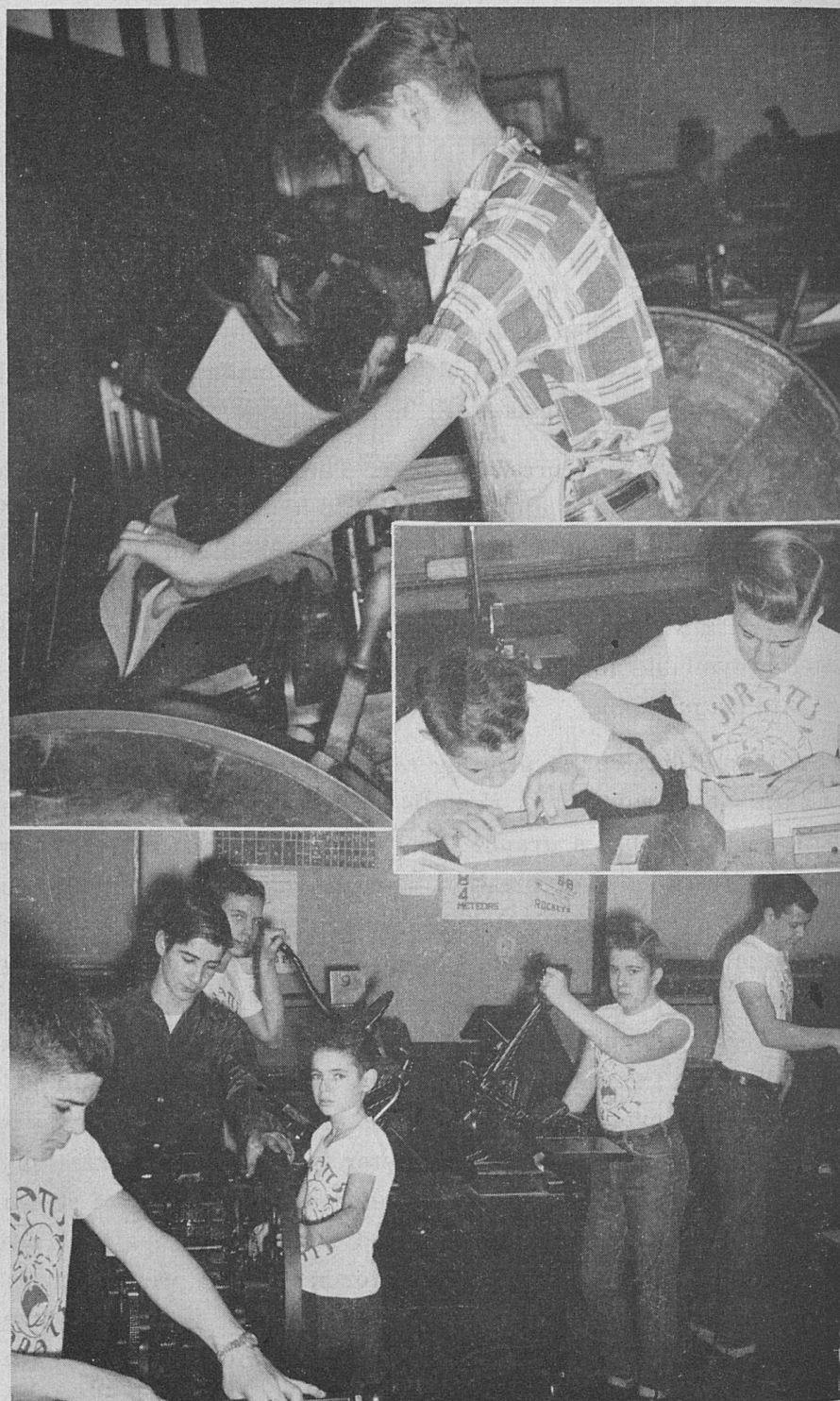
Chapter XI

PRINTING

Printing is, and for centuries has been, one of the leading industries of the world. Millions of men and women are employed in the printing industry. Our entire educational system depends upon the printed page. Our general public is affected by it through newspapers, magazines, books, and other printed material. It is logical to expect that great emphasis will be placed upon this subject.

Two programs are presented here. The one for the junior high school is based upon the idea that it should be an exploratory period for the young pupil and that major emphasis should be placed upon a variety of experiences rather than upon skills. The instructor who is unfamiliar with any of the processes will find ample instructional material available and he should not hesitate to introduce the subject into his program.

Although letterpress printing retains its popularity in the junior high school curriculum there is evidence that more and more schools are favoring a graphic arts type of program. This allows for more freedom of expression, and provides general education values that are not usually achieved in a limited letterpress course. Interest is more easily sustained because of the diversity of methods used, and the pupil derives satisfaction from working with the various materials and tools that are used. The many projects that can be made in the graphic arts shop are attractive to the pupil and useful in the home or school. Interest exhibited by the pupils is usually most gratifying to the instructor and to the administration. Equipment need not necessarily be expensive and much of it can be made by the instructor. Texts and instructional material are available and the fact that the instructor has had no previous training in the new techniques should not hinder their inclusion in the program. Pupils like to experiment and the instructor can be a learner along with them.



Students at work in printing classes.

Letter press printing is the basic process and should be the first one included in the graphic arts program. Paper making, linoleum block or rubber block carving and printing, book repair and binding, and silk screen printing are the processes usually included in the program.

In a letter press program continuing throughout the entire school year much of the work is repetitive in nature, having been originally included in the course with the idea of developing skill in setting type. The prime objective of the graphic arts program is to develop interests and understanding rather than skills.

The time allotted for each of these processes or units in the program must be governed by the local school calendar. Letterpress printing, being the most involved process, will require from one-third to one-half of the time allotted to the program. The other units can be allotted such time as may seem needed, roughly one-fourth of the remaining time to each of them. The schedule of time must be flexible. In some cases one of the units may be more popular to or more difficult for the pupils, thereby requiring more time.

The general objectives of the graphic arts program may be stated as follows:

1. To introduce the pupil to the field of graphic arts, and to provide information pertaining to the opportunities this field holds for its workers.
2. To develop an appreciation of the contribution of the graphic arts to the field of communication and public enlightenment.
3. To develop sufficient interest in the subject that some pupils may wish to continue its study in more advanced courses and to seek employment in some phase of graphic arts work after they leave school.
4. To develop orderly work habits, and to promote a spirit of cooperation among members of the group.

Specific objectives of the letterpress printing unit may be stated to be:

1. To give the pupil an understanding of the process of printing and an appreciation of the contribution it has made to our civilization.
2. To cultivate in the pupil an interest in the printed page and a desire to read.

Suggested projects: Seasonal poems for Thanksgiving and

Christmas, greeting cards, personal name cards, stationery, shopping lists, identification cards for billfold, tickets and programs for class activities. The use of raised printing, known by the trade name of Virko-type, and the use of dusting gold and silver will increase the interest and attractiveness of some of the projects. The production of large jobs of school printing is not advised for this graphic arts program.

No graphic arts program would be complete without a project in paper making. This project can be introduced by the use of one of the numerous commercial films available showing the manufacture of paper. Very little equipment is needed and the pupils get a genuine thrill from making a sheet of paper and then printing something on it. The objectives of this unit can be stated as:

1. To give the pupil an understanding of the process of manufacturing paper from wood pulp or rags.
2. To give the pupil the experience of producing a useful product from raw material by the use of chemical and mechanical processes.

The project in this unit is the making of a sheet of paper from wood fibre. The process of reducing wood to fibre can be eliminated by using cellu-cotton or Klenex tissue. Some of the paper can be colored by the addition of dyes.

Linoleum or rubber block carving and printing is an easy, inexpensive, and interesting method of producing illustrations and designs. Its objectives are:

1. To acquaint pupils with the history of this first method of producing a printed picture.
2. To develop an understanding and appreciation of some simple forms of art and design.
3. To teach the application of design and decoration to useful articles.

Suggested projects: Bookplate for pupils' books, initial for printing on paper napkins, or on cloth. A picture may be carved, printed and framed for hanging on the wall. The only limit to the range of activity is the amount of time available, and the ingenuity of the pupil.

Every home has books and they have a habit of becoming damaged. The Bookbinding unit in the graphic arts program has as its objectives:

1. To teach the pupil the importance of books to our civilization and to develop a desire to read them and to care for them properly.
2. To give the pupil a general knowledge of how books are made and to learn how to make simple repairs to them.

Suggested projects: A memorandum or household needs pad. This may be a piece of binders board covered with binders cloth, to which is fastened a pad of paper. The pad of paper may be made so that it will fit into a pocket on the board. This is a project on which the pupils may learn to handle paste and acquire some understanding of neatness. An address book may be the second project. A magazine may be bound or a book repaired. If the group shows adeptness in acquiring skill an attempt may be made to rebind a book or to undertake a job requiring sewing.

Silk screen printing is the newest of the graphic arts and is now being practiced commercially. For a long time it was strictly a hand operation. Now silk screen stencils are being produced photographically and presses have been built to produce prints from these stencils. There are numerous books on the subject. Practically all equipment can be made by the instructor or the pupils and the instructor need not hesitate to introduce it into the graphic arts program.

The objectives are:

1. To develop an understanding of the contributions of this graphic arts medium.
2. To develop in the pupil a better understanding of design and color and their application to graphic arts processes. This understanding may later be reflected in their choice of rugs, wallpaper, furniture, and other articles which may be decorated.

Suggested projects: A hot pad of cardboard, or a wall plaque of cardboard or cork may be decorated with a design. A scarf may be decorated. A poster may be made announcing some coming event in the school program. One popular project is the decorating of "T" shirts for a softball or basketball team.

The senior high school program is planned with the idea that the pupils in the classes have made a selection of the subject because of an interest in it. It is not to be considered a vocational course; but rather a pre-vocational experience. Upon completion of the course a pupil should be qualified to seek employment as a beginner in a printing plant. In the senior high school program an

emphasis is placed upon skill in performance, planning, selection of materials, selection of equipment, management, safety, and pupil cooperation. It is anticipated that the senior high school printing department will be required to produce a certain part of the printed material used by the school. If this is the case, advantage can be taken of the situation, and the department can be organized as a commercial print shop. This will provide the opportunity for shop organization and pupil participation in management.

This program has been planned for letterpress printing as the average high school printing department is equipped for only such work. It would be well for the instructor to make use of magazines, films, and the advertising literature to acquaint his pupils with equipment for machine composition, cylinder and rotary presses, mechanical feeders, offset printing, and bindery equipment. He should provide them with information about the most recent developments in photo-typesetting equipment. Visits to printing plants are suggested.

No projects have been suggested. They will present themselves from day to day. It is suggested that the instructor bear in mind that the objective of the program is to develop certain traits in the pupil and that the project is the means, rather than the end.

The Operation Units, the Information Units, and the Suggested Assignments listed here are for reference. The order of their use will necessarily depend upon the local situation. Ample instructional material is available in the form of books, magazines, and films.

Specific Objectives

1. To develop a knowledge of the method of procedure of producing printing.
2. To develop the ability to definitely plan an orderly procedure for executing a job.
3. To develop an appreciation of the printed page.
4. To develop habits of good workmanship through the medium of printing.
5. To acquire industrial information as a means of educational and vocational guidance.

Operation Units

1. Locate instantly any letter or character in the case.
2. Set the composing stick to measure.

3. Hold a stick properly.
4. Set type — straight matter.
5. Read type in a composing stick.
6. Dump a stick.
7. Tie up a form.
8. Take a proof on a proof-press.
9. Take a stone proof.
10. Read proofreader's marks.
11. Make corrections.
12. Wash type and rules.
13. Distinguish difficult letters such as n, u, b, d, etc.
14. Distribute type.
15. Distribute leads, slugs, and brass rules.
16. Remove a job from galley to imposing stone.
17. Remove a job from imposing stone to galley.
18. Plan a job.
19. Collect all necessary material for the job.
20. Set various styles of paragraphs.
21. Set a work and turn job.
22. Lay a case.
23. Clean a case.
24. Lubricate a job press.
25. Ink a job press.
26. Prepare a tympan.
27. Set gauge pins.
28. Make ready.
29. Feed a job press.
30. Prevent offset.
31. Wash up a job press.
32. Care for an ink slab.
33. Count paper.
34. Jog stock.
35. Pad paper stock.
36. Hand folding.
37. Wrap a package neatly.
38. Lock up form for press.
39. Setting a tabular form using leaders.
40. Setting a tabular form using rule.
41. Make up a six-page folder.
42. Use of initial letters.

43. Set a display job; newspaper advertisement, placard or hand bill.
44. Set form for two-color job.
45. Lock up forms for two-color job.
46. Mixing printing inks.
47. Punch and perforate stock.

Information Units

1. The layout of the California Job Case.
2. The names of the principal tools, materials, machines and equipment.
3. The component parts of a platen press.
4. The printer's system of measurement.
5. Sizes of type and spacing material.
6. The component parts of a type.
7. Rules for punctuation, spelling, capitalization, and division of words.
8. The parts of a composing stick.
9. Posture, health, and safety habits.
10. Printer's terms and meanings.
11. Brief history of printing.
12. How paper is made.
13. How ink is made.
14. Related mathematics.
15. Trade practices.
16. The use of layouts.
17. The use of borders.
18. Principles of color harmony.
19. Principles of tone harmony.
20. Principles of shape harmony.
21. The principle of balance.
22. The principle of proportion.
23. The principal kinds of paper used in printing and the type of work for which each is generally used.
24. Standard sizes and weights of paper stock.
25. Methods of designating quantities, sizes and qualities of paper.
26. Composition and care of press rollers.
27. Kinds of ink and methods of handling.
28. How cuts are made: zinc etchings, half tones, electrotypes, wood, linoleum, and rubber.
29. How a half tone cut is "made ready".
30. How wire stitching is done.

- hand
31. Opportunities and requirements of the printing trades.
 32. Differentiation between folders and booklets; posters, and placards.
 33. Care of equipment.
 34. Importance of cleanliness in handling paper.
 35. The composition and care of type.
 36. The meaning of a font.

SUGGESTED ASSIGNMENTS

- equip-
- sion of
1. Set composing stick to a given measure and set a line of type composed of words involving the use of the same letters; the, they, them, then, these, those, etc.
 2. Set a short paragraph composed of definite instructions about some phase of type setting.
 3. Set corner card for envelope.
 4. Set a calling card.
 5. Set a business card.
 6. Set a personal or professional note head.
 7. Set a business letterhead.
 8. Set a statement or invoice.
 9. Set a poem.
 10. Set a bank check.
 11. Lay out and set an announcement — professional or business.
 12. Set a menu for a luncheon or dinner.
 13. Plan and set a one-page program for school assembly.
 14. Plan and set a ticket for school play or game.
 15. Design and set a title page for booklet.
 16. Design layout and set a placard announcing school play.
 - A. For one color.
 - B. For two colors.
 17. Set a rule form with two or more columns to run "work and turn."
 18. Set a panel using initial letter (a motto or poem).
 19. Set a four-page program for a music recital.
 20. Lay out and set a newspaper advertisement with a rule border.
 21. Set a tabular form with leaders as cross members and brass column rules.
 22. Prepare stock for jobs to be printed — count and cut.
 23. Lock forms for press.
 24. Prepare press for job — clean, oil, and ink.
- type of
- paper.
- s, wood,

25. Make job ready for running: prepare tympan, adjust grippers; pull proof; set gauge pins; underlay and overlay where necessary; manipulate ink if needed; check carefully for proper volume of ink to be carried. Run job. Distribute printed sheets on drying racks.
26. Inspect printed forms; jog; wrap; label; and deliver.
27. Make scratch pads from scrap paper: perforate, pad, stitch (wire staple), bind top with gummed paper tape, trim.
28. Print, fold, saddle stitch, trim, and wrap for delivery booklet of four or more pages.

The field of printing furnishes an inexhaustible avenue for activities which are related to every phase of the school program; spelling lists; mathematical problems; art projects such as wood cuts and linoleum blocks; cut out tags and programs; ballots and campaign material for student council elections; lunch room signs and price tags; the school paper; office forms, etc.

Chapter XII

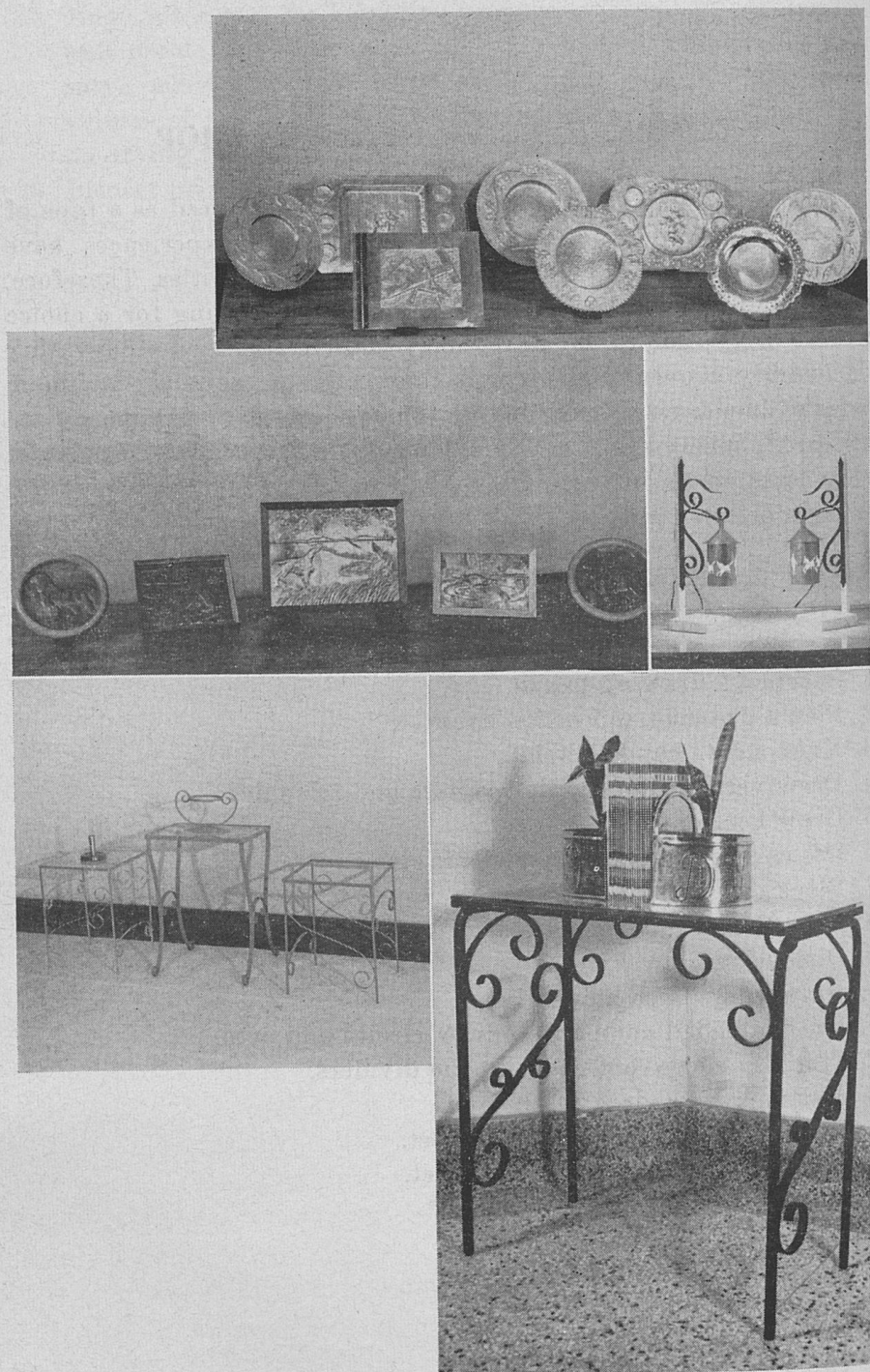
COMPREHENSIVE GENERAL SHOP

In this section, the general shop will be considered as a type of Industrial Arts organization in which student experiences have been selected from a wide range of industrial activities. Therefore, a variety of activities are presented herewith allowing for a choice of those best suited to the individual situation. Experience has rather conclusively proven that perhaps four major areas is the optimum for any one course, hence the following tentative groupings are suggested. Where space and equipment permit, progress in age and grade level on the part of the student may be provided for by following a selected sequence of these courses.

GENERAL DRAWING AND PLANNING

Operation Units

1. Sharpen a drawing pencil.
2. Plan a drawing and make layout.
3. Make a free hand sketch.
4. Draw vertical lines with T-square and triangles.
5. Draw horizontal lines.
6. Use correct lines and symbols in drawing.
7. Block out views.
8. Draw front, top, and side or end views.
9. Dimension a drawing.
10. Draw views with hidden lines.
11. Use the pencil compass to draw circles and arcs.
12. Transfer measurements with the dividers.
13. Make arrowheads.
14. Letter upper case Gothic alphabet.
15. Letter lower case Gothic alphabet.
16. Make numerals and fractions.
17. Measure with the scale.
18. Draw to scale.
19. Draw section views.
20. Draw auxiliary views.
21. Divide a line into equal parts.
22. Divide a space into equal parts.



Typical projects completed by students in general shop classes.

23. Draw an octagon.
24. Draw a hexagon.
25. Transfer or enlarge by use of squares.
26. Measure angles with a protractor.
27. Bisect an angle.
28. Make a straight line development.
29. Make a cylindrical development.
30. Make a machine drawing.
31. Make an assembly drawing.
32. Trace a drawing.
33. Make a blueprint.
34. Make a pictorial sketch.
35. Draw a simple floor plan.
36. Draw elevations.
37. Make a bill of material.
38. Compute cost of materials.
39. Plan a procedure.
40. Design useful objects from various materials to be used in shop activities.

GENERAL DRAWING & PLANNING

Information Units

1. Hardness or softness of drawing pencil leads.
2. Proportions and style of Gothic alphabet, upper and lower case, with numerals and fractions.
3. Importance of drawing, designing, and planning in industry.
4. The alphabet of lines.
5. Common symbols.
6. Elementary principles of design.
7. Nomenclature and characteristics of materials used in shop projects.
8. Building materials (brick, tile, block, siding, roofing, insulation, windows and doors, and interior trim.)
9. Elementary domestic architectural design.
10. Architectural symbols.

HAND WOODWORKING

Operation Units

1. Measure with a square, tape, or rule.
2. Gauge with pencil or marking gauge.
3. Scribe lines square with a surface or edge with try square or combination square.

4. Lay out miters with combination square.
5. Lay out miters with framing square.
6. Set and use T bevel to transfer angles.
7. Use T bevel to check bevels, chamfers and angles.
8. Sharpen edge tools.
9. Adjust a plane.
10. Plane a surface true.
11. Plane edge straight and square with adjoining surface.
12. Plane end straight and square with adjoining surface and edge.
13. Saw to a line with cross cut and rip saw.
14. Use back saw.
15. Saw curves with coping saw.
16. File and sand curves.
17. Bore holes with auger bit.
18. Drill holes with twist drill.
19. Countersink holes for flat head screws.
20. Counterbore screw holes with auger bit.
21. Drive screws.
22. Use chisel to cut dado and gain joint.
23. Bore out mortise with auger bit.
24. Use chisel to square out mortise.
25. Cut tenons with back saw.
26. Make a half lap joint.
27. Make a cross lap joint.
28. Cut a miter.
29. Make an edge to edge joint.
30. Make a dowel joint.
31. Fit a drawer.
32. Cut a chamfer.
33. Cut a bevel.
34. Clamp stock with hand screws.
35. Clamp stock with bar clamps.
36. Use common glues.
37. Plane end grain with block plane.
38. Sharpen and use a scraper.
39. Sand stock for finishing.
40. Prepare and apply oil stain.
41. Prepare and apply filler.
42. Prepare and apply shellac.
43. Apply varnish.
44. Rub down a finish.

- edge.
45. Apply wax.
 46. Clean and care for brushes.
 47. Make a bill of material.
 48. Identify common furniture woods.
 49. Plan procedure for a job.
 50. Drive and draw nails.
 51. Use nail set to set nail heads.
 52. Upholster a padded seat.
 53. Mount webbing.
 54. Install coil springs.
 55. Tie springs.
 56. Tack on burlap.
 57. Pad with appropriate materials, such as tow, moss, and cotton.
 58. Make a rolled edge.
 59. Pad with sponge rubber.
 60. Cover with muslin.
 61. Tack on upholstery material.
 62. Tack on gimp.
 63. Install prefabricated springs.

HAND WOODWORKING

Information Units

1. Identification of common woods.
2. Properties of common woods.
3. Useful native woods.
4. Methods of cutting and planing lumber.
5. Standard lumber dimensions.
6. Lumber grades and specifications, such as:
 - FAS
 - FAS 1F
 - No. 1 COM.
 - G1S
 - S2S
 - 4/4
7. Commercial uses of woods.
8. Safety precautions in using edged tools.
9. Auger bit sizes.
10. Sizes and types of wood screws.
11. Sizes and types of nails.
12. Composition of common glues used in woodworking.
13. Composition and grits of common abrasives.

14. Finishing materials suitable for application by hand.
15. Composition of finishing materials.
16. Thinners for various finishing materials.
17. Solvents for cleaning brushes.
18. Kinds of brushes.
19. Oil stains.
20. Shop nomenclature.
21. Grades of upholstery materials.
22. Sources of supply for upholstery materials.
23. Fabrics suitable for upholstery.
24. Common sizes and kinds of upholstery tacks.
25. Types of wood carving.
26. Carving tools.
27. Carving designs.

MACHINE WOODWORKING

Operation Units

Units listed under Hand Woodworking should be included with the following:

The Jointer

1. Adjust for depth of cut.
2. Joint an edge straight and square with a surface.
3. Cut a chamfer.
4. Cut a bevel.
5. Cut a rabbet.
6. Cut a straight taper.
7. Plane a surface.
8. Lubricate the machine.
9. Sharpen jointer knives with an oil stone.
10. Align outfeed table with knives.
11. Lubricate the machine.

The Bandsaw

1. Adjust upper wheel to track blade.
2. Adjust blade guides.
3. Saw simple curves.
4. Kerf cut for sawing complex curves.
5. Tilt table and saw bevels.
6. Make straight cuts.
7. Lubricate the machine.

The Table Saw

1. Rip stock.

2. Cut off stock.
3. Cut grooves.
4. Cut dados.
5. Cut tenons.
6. Cut miters.
7. Cut tapers.
8. Cut rabbets.
9. Cut bevels.
10. Make stop cuts.
11. Use clearance block on fence.
12. Lubricate the machine.

The Surfer

1. Surface stock to thickness.
2. Surface square stock to dimension.
3. Lubricate the machine.

The Drill Press

1. Mount mortising attachment.
2. Install auger bit and hollow chisel.
3. Attach fence and hold-down clamps to table.
4. Set for depth of cut.
5. Cut mortises.
6. Do simple routing.
7. Drill holes.
8. Set depth stop and counterbore holes.
9. Make jig for boring dowel holes.
10. Bore holes with machine auger bits.
11. Lubricate and care for drill press.

The Lathe

1. Center stock.
2. Mount work between centers.
3. Rough down with a gouge.
4. Smooth with a skew.
5. Lay off pattern on stock.
6. Work with a skew.
7. Use a parting tool.
8. Cut tapers with a skew.
9. Cut coves with a gouge.
10. Make V cuts with a diamond point.
11. Mount work on a face plate.
12. Mount work on screw chuck.
13. Turn stock on face plate and screw chuck.

14. Make a dowel joint.
15. Sand stock in the lathe.
16. Apply French polish.
17. Lubricate the machine.
18. Care for centers.

The Jig Saw

1. Select proper blade.
2. Mount blade correctly.
3. Adjust tension on blade.
4. Adjust blade guide.
5. Saw external curves.
6. Saw pierced work.
7. Lubricate and care for jig saw.

MACHINE WOODWORK

Information Units

The units listed under General Woodwork should be included with the following:

1. Safety precautions for each machine.
2. Range of operations for each machine.
3. Common types of each machine.
4. Relation of machines in shop to production machinery.
5. Power and speed of motors on machines.
6. Effect of grain and texture of wood on quality of machine cut.
7. Types of circular saw blades.
8. Capacities of each machine.
9. Advantages of various type machines.
10. Occupational opportunities in the woodworking industry.

SHEET METAL WORK

Operation Units

1. Make out bill of material.
2. Plan procedure.
3. Measure and lay out with a scale.
4. Transfer patterns to sheet metal.
5. Make straight cuts with snips.
6. Make curved cuts with snips.
7. Clean and tin a soldering copper.
8. Solder tin, galvanized iron, brass, and copper, using soldering copper.
9. Solder tin, galvanized iron, brass, and copper, using torch.

10. Turn hems and folds with bar folder.
11. Drill holes in sheet metal with hand drill.
12. Center punch sheet metal for drilling.
13. Punch holes in sheet metal.
14. Set sheet metal rivets with rivet set.
15. Make lock seam joint.
16. Set lock seam with hand groover.
17. Turn folds and hems with mallet.
18. Roll sheet metal on slip roll former.
19. Wire an edge by hand.
20. Use the combination machine for wiring, burring, and turning.
21. Make straight line developments.
22. Make cylindrical developments.

SHEET METAL

Information Units

1. Common kinds of sheet metals.
2. Industrial uses of sheet metal.
3. How sheet metals are manufactured.
4. How sheet metals are gauged and sold.
5. Common kinds of solder.
6. Soldering fluxes.
7. Rivet sizes.
8. Most common sheet metal seams and joints.
9. Safety rules for sheet metal work.
10. Types of stakes and their uses.

PLASTICS

Operation Units

1. Read a working drawing.
2. Design projects.
3. Make a bill of material.
4. Make a plan of procedure.
5. Measure with a scale.
6. Lay out stock.
7. Lay out with a template.
8. Lay out a duplicate part.
9. Hold stock in clamps.
10. Saw an edge.
11. Plane an edge.
12. File a plain surface.

13. File a curved or irregular surface.
14. Sand a plain surface.
15. Sand a curved or irregular surface.
16. Buff a surface.
17. Square stock.
18. Gauge a line.
19. Locate holes.
20. Center punch holes.
21. Drill holes.
22. Counter sink holes.
23. Counter drill holes.
24. Make a chamfer.
25. Make a form for simple bending.
26. Bend to shape.
27. Transfer a design.
28. Apply monogram filler.
29. Make an inlay.
30. Carve a design.
31. Engrave a design.
32. Drive self-tapping and driving screws.
33. Tap by hand.
34. Fasten with machine screws.
35. Fasten with cement.
36. Fasten acrylic plastics with solvent cement.
37. Dye cement.
38. Attach fittings.
39. Make a miter joint.
40. Make a bevel.
41. Make a butt joint.
42. Store plastics.
43. Dress a drill.
44. Sharpen an edged tool.
45. Make a simple mold.
46. Prepare plastics for molding.
47. Cast liquid plastics.
48. Cure plastics.

PLASTICS

Information Units

1. Safety precautions.
2. Types of plastic.
3. The constituents and properties of plastics.

4. The cost of plastics.
5. Drill speeds and feeds.
6. Tap and drill sizes.
7. Types of files.
8. Types of saw blades.
9. Types of abrasive materials.
10. Carving tools.
11. Bending heats.
12. Metal fittings.
13. Cement and cement dyes.
14. Coloring and finishing.
15. Elements of design.
16. Testing for hardness.
17. History of plastics.
18. The uses of plastics in industry.
19. Opportunities in the plastic industries.

ART METAL

Operation Units

1. Anneal non-ferrous metals.
2. Pierce with jeweler's saw.
3. Tool light metal.
4. Raise objects over a concave form.
5. Raise objects on a sand bag.
6. Clean non-ferrous metals.
7. Planish metals.
8. Etch common metals.
9. Buff and polish metals.
10. Sweat solder.
11. Color copper and brass.
12. Make simple chucks for metal spinning.
13. Spin an object.
14. Pein metal surfaces.
15. Form scrolls with band iron.
16. Twist square stock.
17. Cut metal with hack saw.
18. Apply protective clear lacquer finish.

ART METAL

Information Units

1. Acids suitable for etching common metals.
2. Solutions suitable for cleaning common metals.

3. Acid resistant coatings suitable for use in protecting parts of etched metals to be left plain.
4. Properties of art metals with respect to malleability and ductility.
5. Purpose of annealing metal to be spun or raised.
6. Proper heat for annealing.

LEATHER WORK

Operation Units

1. Plan a procedure.
2. Make a bill of material.
3. Compute cost of material.
4. Cut leather along a straight edge.
5. Lay out designs.
6. Prepare leather for tooling and stamping.
7. Tool designs.
8. Emboss designs.
9. Stamp designs.
10. Stipple backgrounds.
11. Raise designs.
12. Crease edges.
13. Carve designs.
14. Skive edges.
15. Lay out line for lacing.
16. Punch lacing holes with thonging chisel.
17. Lace edge with whip stitch.
18. Lace edge with single buttonhole stitch.
19. Lace edge with double buttonhole stitch.
20. Splice lacing.
21. Fasten key plates with eyelets.
22. Set snap fasteners.
23. Cement edges and lining.
24. Insert gussets.
25. Clean and polish leather.
26. Use slitting knife.
27. Plait simple belt.
28. Mount buckles.
29. Clean and polish leather.
30. Care for leather tools.

LEATHER WORK

Information Units

1. History and early uses of leather.
2. The preparation of leather for tanning.
3. The tanning of leather.
4. The kinds of leather.
5. Commercial uses of leather.
6. Kinds of leather suitable for various uses.
7. How leather is sold.
8. Sources of supply for leather craft tools and supplies.
9. Essential leather tools and equipment.
10. Variations in quality of consumer goods made from leather.

Chapter XIII

FARM SHOP

The industrial arts program is not fundamentally vocational in its objectives, but based on the philosophy that school shop activities should be fitted to the vocational interest of a community. Farm shop should be well adapted to the average rural community program in Kentucky. This does not necessarily mean that a certain amount of furniture making would not be just as vital as an industrial arts activity in the rural area as it would in the urban center, since the rural family is in need of a knowledge of furniture design, construction, and selection just as is the resident of any other section. On the other hand, the average farm boy is confronted with certain mechanical tasks which are slightly different than those of the boy attending the city school system. Consequently, the care and repair of hand tools and small farm implements as well as the more elaborate equipment such as farm machinery can well be added to the industrial arts program. Many of the farm shop units can be carried on in the form of a general shop and the organization of the shop may be determined to a certain extent by the local administrative and existing housing situation. Where feasible, a much more effective program could be set up with a building and physical equipment planned specifically to meet the school and community needs.

Specific Objectives

1. Develop skill in the use of tools.
2. Develop orderly thinking and doing habits.
3. Encourage habits of economy and thrift.
4. Enable the farmer to become more nearly self-sufficient and independent.
5. Develop a knowledge and appreciation for things mechanical.
6. Develop an interest in and understanding of materials such as wood, metals, paints, etc.
7. Furnish a working knowledge of drawing and reading drawings.

FARM CARPENTRY

Operation Units

1. Handle tools without abuse.
2. Protect working edges.

3. Prevent rusting.
4. Store tools.
5. Use handsaw (cross-grain and rip).
6. Use nail hammer.
 - a. Drive nails.
 - b. Draw nails.
7. Use a rule, square, and tapeline for measuring.
8. Use brace and bit.
 - a. Use proper grip.
 - b. Start bit.
 - c. Finish the hole.
 - d. Countersink for screws.
 - e. Set and use expansive bit.
9. Use and adjust planes.
 - a. Take plane down and reassemble.
 - b. Adjust bit to depth and laterally.
 - c. Use plane properly.
10. Use square as a straight edge, and to square a line.
11. Use wood chisel.
 - a. Chisel with grain.
 - b. Chisel across grain.
12. Use marking gauge.
13. Use draw knife.
14. Use wood rasp.
15. Use nail set.
16. Use screw driver.
17. Use sandpaper.
18. Use dividers.
19. Compass saw.
20. Hand drill.
21. Spoke shave.
22. Construct farm equipment made principally of wood.
23. Simple carpentry.
 - a. Lay out foundations.
 - b. Build and place foundation forms for small buildings.
 - c. Frame and inclose a small building.
 - d. Attach hinges, locks, etc.
24. Do such repair work as:
 - a. Repair foundations.
 - b. Replace defective timbers.
 - c. Replace flooring and siding.

- d. Repair leaky roof.
- e. Rehang doors.
- f. Replace window sash.
- g. Repair and replace locks, hinges, etc.
- h. Repair screens.
- i. Replace window glass.

Information Units

- 1. Read and interpret simple blueprints and drawings.
 - a. Understand scale.
 - b. Understand blueprints and drawings.
 - c. Determine dimensions.
 - d. Interpret details.
 - e. Make free-hand sketches.
- 2. Choose lumber and builders' hardware.
 - a. Select lumber.
 - b. Select builders' hardware.
- 3. Make out bills of materials.
 - a. Calculate board feet.
 - b. Figure cost.

FARM TOOLS

Operation Units

- 1. Clean tools.
- 2. Decide what sharpening equipment to use.
- 3. Grind to proper angle with grindstone.
- 4. Use emery grinder.
 - a. Grind to the proper angle.
 - b. Prevent burning.
 - c. Use emery wheel dresser.
- 5. Hone to cutting edge.
- 6. Use files.
 - a. Employ proper strike.
 - b. Care for files.
- 7. Clean saws.
- 8. Joint.
- 9. Shape and file teeth.
- 10. Set teeth.
- 11. Side joint.
- 12. Gum circle and timber saws.
- 13. Clean and sharpen auger bits and drill bits.

14. Fit handle.
 - a. Select or make the handle.
 - b. Fit handle.
 - c. Fasten the handle in place.
 - d. Finish the handle.

Information Units

1. Select hand tools.
 - a. Select hand tools of proper size and design.
 - b. Recognize quality of workmanship and materials in tools.

LEATHER WORK

Operation Units

1. Repair and care for harness.
2. Replace worn or broken straps.
 - a. Cut to proper length and width.
 - b. Make stitched splice.
 - c. Make riveted splice.
3. Replace worn or broken fittings.
4. Clean and oil harness.
 - a. Take harness apart.
 - b. Soak and scrub the harness.
 - c. Dry the harness.
 - d. Apply harness oil.
5. Repair work shoes.
 - a. Restitch rips.
 - b. Put on half soles.
 - c. Replace rubber heels.
 - d. Repair leather heels.
 - e. Put on heel and toe plates.

INFORMATION UNITS

1. Acquire a knowledge of leather and its qualities.
2. Select leather for various uses.
3. Knowledge of leather dressings.
4. How to care for leathers.

FENCING

OPERATION UNITS

1. Construct fences.
2. Locate lines and corners.
3. Line, space, and dig post holes.

4. Set, line and tamp posts.
5. Brace corners, ends and stretching posts.
 - a. Cut and place stiff braces.
 - b. Attach wire braces.
6. Unroll, cut and splice wire.
7. Stretch wire.
8. Staple wire to post.
9. Space barbed wire.
10. Repair fences.
11. Splice and patch wire.
12. Take down and re-stretch wire.
13. Replace and reset posts.
14. Re-staple wire.

Information Units

1. Select and secure materials.
2. Determine amounts of material to secure.
3. Select fabricated wire fencing.
 - a. Understand wire gauges.
 - b. Understand wire spacings.
 - c. Recognize quality of workmanship and materials.
 - Galvanization.
 - Wire material.
 - Joints.
 - Expansion crimps.
 - d. Recognize trade names and brands.
 - e. Understand type of fencing for different uses.
 - f. Compare prices.
4. Select smooth and barbed wire.
5. Select staples.
 - a. Length.
 - b. Wire gauge.
6. Select, secure and treat posts.
7. Select and secure braces.
8. Select and secure fencing tools.

SHEET-METAL

Operation Units

1. Make sheet-metal appliances.
2. Decide on design and kind of joints.
3. Measure and lay out stock.
4. Bend and shape sheet metal.

5. Cut sheet metal.
6. Make joints.
7. Drill, punch and rivet.
8. Do soldering.
9. Operate blowtorch.
10. Tin soldering coppers.
11. Heat soldering iron.
12. Clean and prepare metal for soldering.
13. Select and use fluxes.
14. Apply soldering to tin, iron, and steel, copper, brass, lead, and aluminum.
15. Repair roof and such appliances as milk cans and buckets.
16. Solder open seam or crack.
17. Repair small hole.
18. Patch large hole.
19. Patch small hole.
20. Remove excess soldering.

Information Units

1. Acquire a knowledge of sheet metals.
2. Sheet-metal layouts.
3. Preservation of sheet metals.
4. Solders and their uses.
5. Select soldering coppers.
 - a. Kind.
 - b. Sizes — use of each.

PLUMBING

Operation Units

1. Install plumbing.
2. Measure pipe.
3. Cut pipe.
 - a. Pipe cutter.
 - b. Hack saw.
4. Ream pipe.
5. Thread pipe.
6. Connect pipe and fittings.
7. Install a pitcher pump or well pump.
8. Keep plumbing in repair.
 - a. Repair a broken pipe.
 - b. Replace faucet washers.

- c. Clean out traps and drain pipe.
- d. Protect plumbing against freezing.
- e. Thaw out frozen pipes.

Information Units

- 1. Select and secure plumbing materials and fixtures.
- 2. Determine the kind, size and amount of pipe.
- 3. Determine the kind, number and size of such fittings as elbows, T's, unions, reducers, caps, plugs, valves and faucets.
- 4. Select such plumbing fixtures as lavatory, bathtubs, sinks and toilets.
- 5. Estimate costs of plumbing materials for a job.

PAINTING

Operation Units

- 1. Apply paint, whitewash, etc.
- 2. Apply paint.
 - a. Prepare surface.
 - b. Mix to proper consistency.
 - c. Apply first, second and third coats.
- 3. Paint roofs.
- 4. Apply home-made paints.
- 5. Apply whitewash.
- 6. Prepare home-mixed paints, whitewash, etc.
 - a. Prepare lead base paint.
 - b. Prepare red metallic iron oxide paint.
 - c. Prepare crankcase oil paint.
 - d. Prepare whitewash.
- 7. Care for brushes.
 - a. Clean brushes.
 - b. Store brushes.

Information Units

- 1. Plan the work.
- 2. Determine the need for painting, etc.
- 3. Decide on the kind of material to use.
- 4. Determine the amount of material needed.
- 5. Select and secure materials and equipment.
- 6. Select and secure brushes.
 - a. Kind.
 - b. Size.
 - c. Quality.

- bows,
s and
7. Select ready-mixed paint.
 - a. Determine quality.
 - b. Lead, zinc and oil content.
 8. Understand trade names and brands.
 9. Choose color.
 10. Select and secure solvents and thinners, as linseed oil, turpentine, etc.
 11. Select and secure materials for home-mixing.
 - a. Paint.
 - b. Whitewash.
 - c. Concrete paint.

TRACTOR, TRUCK AND AUTOMOBILE

1. Operate farm equipment having internal combustion engines.
2. Use mechanic tools without abuse.
3. Service the internal combustion engine.
 - A. Cooling System.
 1. Replace parts.
 2. Clean and adjust parts.
 - B. Fuel system.
 1. Remove, clean, adjust and replace carburetor.
 2. Service induction system.
 3. Service lines, fuel pump.
 - C. Lubrication system.
 1. Change oil.
 2. Install new, or clean and replace oil filters.
 3. Service the crankcase ventilation system.
 - D. Ignition system.
 1. Clean and adjust spark plugs.
 2. Recondition or replace ignition points.
 3. Time and ignition.
 4. Check automatic advance mechanism in distributor.
 5. Remove and install ignition cables.
 6. Trace circuit from battery to spark plug.
 - E. Electrical system.
 1. General lighting replacement and adjustment.
 2. Test circuits for ground.
 3. Remove and replace generator and starter.
 4. Sand and clean commutators.
 5. Service the storage battery.

- F. Do general trouble shooting and tune up.
 - 1. Locate ignition, fuel, or engine troubles systematically.
 - 2. Follow a logical procedure in tune up.
- G. Service brakes.
 - 1. Make adjustments.
 - 2. Inspect and service the various parts.
- H. Service tires.
 - 1. Remove, inspect and replace tires.
 - 2. Determine the cause of uneven wear.

Information Units

- 1. Understand the principles of internal combustion engines and engine accessories.
- 2. Understand and use the symbols common in the mechanic trade.
- 3. Speeds through gear train.
- 4. Principles of lubricants — oil specification and test.
- 5. Principles of wheel alignment.
- 6. Condensation — detonation (chemical treating of gas).
- 7. Principles of clutches.
 - a. Application of levers.
 - b. Application of friction.
- 8. Principle of transmissions.
- 9. Conduction of heat by metals — expansion of metals.
- 10. Principles of ignition system.

ELECTRICITY

Operation Units

- 1. Do simple house wiring.
- 2. Plan circuits.
- 3. Install wire.
 - a. BX cable.
 - b. Rigid conduit.
 - c. Romex cable.
- 4. Install outlet boxes.
- 5. Install switches.
- 6. Circuit breakers.
- 7. Make and attach drop cord.
 - a. Make box connection.
 - b. Attach sockets.
- 8. Make an extension.
- 9. Hang and connect light fixtures.

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- s and
- trade.
10. Install and connect electric motors.
 11. Operate and care for electric motors.
 - a. Oil motor.
 - b. Clean and replace motor brushes.
 - c. Keep wiring and equipment in repair.
 - d. Replace fuses.
 - e. Replace switches, cutouts and relays.
 12. Repair extension cords, drop cords, etc.
 13. Repair sockets.
 14. Understand some of the principles of electricity.
 - a. Ohm's law.
 - b. Transformer.
 - c. Electro-magnet.
 - d. Direct current.
 - e. Alternating current.
 - f. Resistance.
 - g. Motor.
 - h. Generator.
 - i. Incandescent light.

Information Units

How to:

1. Select materials and equipment — wire, switches, fuse boxes, outlet boxes, conduit, circuit breakers and electric motors.
2. Read meters.

ROPE WORK

Operation Units

1. Tie useful knots, hitches and splices.
2. Whip the end of a rope.
3. Tie useful knots as:
 - a. Overhand.
 - b. Square.
 - c. Weaver's.
 - d. Binder twine.
 - e. Slip.
 - f. Bowline.
 - g. Sheep shank.
 - h. Miller's.
4. Tie useful hitches as:
 - a. Half hitch.
 - b. Blockwell.

- c. Timber.
- d. Scaffold.
- e. Well-pipe.
- f. Clove.
- g. Throwing.
- h. Manger.
- 5. Tie useful splices as :
 - a. Crown or end.
 - b. Eye or side.
 - c. Short.
 - d. Long.
- 6. Repair a broken strand in a rope.
- 7. Make rope halters as :
 - a. Temporary.
 - b. Adjustable.
 - c. Non-adjustable.
- 8. Reeve a block and tackle.
- 9. Care for rope.
 - a. Treatment.
 - b. Storage.

Information Units

How to :

- 1. Secure rope.
- 2. Decide on the kind, size and amount of rope needed.
- 3. Buy rope.
- 4. Make a rope.
 - a. Make rope-making machine and equipment.
 - b. Select and secure twine.
 - c. Make the rope.

CONCRETE AND MASONRY

Operation Units

- 1. Do concrete construction.
- 2. Lay out the work.
- 3. Do the excavation.
- 4. Place reinforcing steel.
- 5. Build and set forms.
- 6. Mix concrete.
- 7. Pour concrete.
- 8. Finish concrete.
- 9. Cure concrete.

10. Waterproof concrete.
11. Remove and clean forms.
12. Do concrete plastering.
13. Care for concrete tools.
14. Repair concrete and plaster.
15. Repair surface or place.
16. Mix materials for making the patch.
17. Apply the patch.
18. Do stone or brick construction.
19. Select materials.
20. Lay out the work.
21. Shape stone.
22. Lay stone or brick.
23. Point or strike joints.

INFORMATION UNITS

How to:

1. Plan the work.
2. Decide on blueprint or drawing to use.
3. Secure materials.
 - a. Estimate amount of materials such as stone, brick, gravel, sand, cement and form material.
 - b. Test material.
 1. Content of sand and gravel.

FARM MACHINERY REPAIR

Operation Units

1. Do forge work.
2. Build and maintain a forge fire.
3. Choose stock for different kinds of work.
4. Measure and cut stock.
5. Heat to the proper temperature.
 - a. Draw out or sharpen stock.
 - b. Upset or enlarge stock.
 - c. Bend or twist stock.
6. Make simple welds.
 - a. Secure proper fire.
 - b. Enlarge stock where weld is to be made.
 - c. Scarf portions to be welded.
 - d. Apply welding compound before and during heating.
 - e. Bring stock to the proper heat.
 - f. Weld the pieces together.

7. Punch hot metal.
8. Temper tools.
 - a. Bring stock to the proper heat.
 - b. Cool the stock.
 - c. Polish stock with emery cloth or sandstone.
 - d. Observe the colors as they form.
 - e. Plunge in water when the desired color is reached.
 - f. Test tool for proper temper.
9. Use cold-metal working tools.
10. Use hacksaw.
11. Use cold chisels.
12. Use metal drills.
13. Sharpen drill bits.
14. Use taps and dies.
15. Do metal riveting.
16. Bend cold metal.
17. Overhaul and repair farm machinery.
18. Inspect the machine for worn, broken or loosened parts.
19. Replace worn or broken parts.
 - a. Make repairs in parts when practical to make them.
 - b. Buy parts that should not be made at home.
20. Tighten bolts, rivets and screws.
21. Clean the machine of rust.
22. Adjust machine for efficient work.
23. Sharpen cutting edges.
24. Paint the machine.
25. Oil and grease all parts not painted.
26. Clean the machinery before storing.
27. Store machinery.

Information Units

How to:

1. Plan the work.
2. Decide when to do the work.
3. Determine what repairs are needed.
4. Decide whether to make or buy repair parts.
5. Order repair parts.

APPENDIX A

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APPENDIX B

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AUDIO-VISUAL AIDS — PRINTING

RAINBOWS TO ORDER

Source: International Printing Ink Corporation
67 West 44th Street, New York 18, N. Y.

LOOK TO THE YEARS AHEAD

Source: The Miehle Printing Press Mfg. Co.
2011 Hastings Street, Chicago 8, Illinois.

INTERTYPE STEPS AHEAD

Source: Intertype Corporation
536 South Clark Street, Chicago 5, Illinois

THE GIFT OF TS' AI LUN

Source: Mammernill Paper Co., Erie, Pa.
The University of Kentucky, Lexington, Kentucky

ADVANCEMENT IN PRINTING PRESS DESIGN

Source: The Miehle Printing Press Mfg. Co.
2011 Hastings Street, Chicago 8, Illinois

HOW TO MAKE A GOOD IMPRESSION

Source: Harris-Seybold-Potter Co.
4510 East 71st Street, Cleveland 5, Ohio

A CLEAN CUT PROPOSITION

Source: Harris-Seybold-Potter Co.
4510 East 71st Street, Cleveland 5, Ohio

A BETTER RUN FOR YOUR MONEY

Source: Harris-Seybold-Potter Co.
4510 East 71st Street, Cleveland 5, Ohio

ANOTHER MAN'S BUSINESS

Source: Miller Printing Machinery Co.
1117 Reesdale Street, Pittsburgh 12, Pennsylvania

26 OLD CHARACTERS

Source: W. A. Sheaffer Pen Co.
Ft. Madison, Iowa

TREES TO TRIBUNE

Source: Modern Talking Picture Service
45 Rockefeller Plaza, New York 20, N. Y.

THE BOOK OF BOOKS

Source: National Bible Press
234 South Market Street, Philadelphia 5, Pennsylvania

MAKING A 24 SHEET POSTER

Source: Maclandish Lithographing Corporation
Roberts Avenue and Stokeley Street
Philadelphia, Pennsylvania

MAKING ADVERTISING DISPLAYS

Source: Maclandish Lithographing Corporation
Roberts Avenue and Stokley Street
Philadelphia, Pennsylvania

FIVE CENTURIES OF TYPE FOUNDING

Source: American Type Founders Co.
200 Elmora Avenue
Elizabeth, New Jersey

THE COLONIAL PRINTER

Source: Colonial Williamsburg
Williamsburg, Virginia

THE MAKING OF A MAGAZINE

Source: C. T. Dearing Printing Co.
Broadway at 11th Street
Louisville 1, Kentucky

MAGAZINE MAGIC

Source: Modern Talking Picture Service
45 Rockefeller Plaza
New York 20, New York

FARM SHOP

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APPENDIX C

Magazines And Periodicals For Industrial Arts Teachers And Students

- The American Printer*. 48 West 38th Street, New York, N. Y.
- The Deltagram*. The Delta Manufacturing Company, Milwaukee, Wisconsin (sub. \$.50)
- Furniture Manufacturer*. Vincent Edwards and Company, New York, N. Y. (sub \$2.00)
- Hobbies*. Society of Philatelic Americans, Chicago, Illinois (sub. \$2.00)

Home Craftsman. Home Craftsman Publishing Corporation, New York, N. Y. (sub. \$1.25)

Industrial Arts and Vocational Education. Bruce Publishing Company, Milwaukee, Wisconsin (sub. \$3.00)

The Inland Printer. 309 Jackson Street, Chicago, Illinois

Model Airplane News. Jay Publishing Company, New York, N. Y. (sub. \$1.25)

Modelmaker. Modelmaker Corporation, Mauwatosa, Wisconsin (sub. \$1.50)

Occupations. The Vocational Guidance Magazine, National Vocational Guidance Association, New York, N. Y. (sub. \$3.50)

Popular Homecraft. General Publishing Company, Chicago, Illinois (sub. \$2.00)

Popular Mechanics. Popular Mechanics Company, Chicago, Illinois (sub. \$2.50)

Popular Science Monthly. Popular Science Publishing Company, New York (sub. \$2.50)

Printing Magazine. 93 Worth Street, New York, N. Y.

School Arts Magazine. Davis Press, Worcester, Massachusetts (sub. \$3.00)

School Life. U. S. Office of Education, Federal Security Agency, Washington, D. C. (sub. \$1.00)

School Shop. Box 100, Ann Arbor, Michigan (sub. \$2.00)

Woodworking Digest. Hitchcock Publishing Co., Wheaton, Illinois. (sub. \$2.00)

