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Title of Study: A COURSE OF STUDY FOR NINTH GRADE UNIT GENERAL SHOP

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Scope of Study: The purpose of this study is to develop a course of study in industrial arts suitable to meet the needs of the present day ninth grade student. A brief history and philosophy of industrial arts is presented to show how industrial arts has grown, developed, and become a definite part of general education. This course of study is divided into four major units of instruction; mechanical drawing, woodwork, electricity, and metal work. Each unit of instruction is further divided into lessons which have information and manipulative assignments. This course of study also has the teaching methods, class organization, and methods of grading listed.

Findings and Conclusions: Industrial arts is not a new field of education; it has been in existence for many years, but it has not always been known by the name of industrial arts. The general shop is the most widely used method of teaching industrial arts in the junior high school. The general shop is a room in which two or more activities are taught at the same time by one teacher. The general shop is well adapted for the junior high school because it enables the student to come in contact with a wide range of materials and tools. Working with the materials and tools in the shop enables the student to explore many areas of industry, thereby discovering his ability and aptitude in what might become his vocation.

ADVISER'S APPROVAL John B. Tate

A COURSE OF STUDY FOR NINTH GRADE

UNIT GENERAL SHOP

By

WALTER TRAVIS GREEN, JR.

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East Central State College

Ada, Oklahoma

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Report Approved:

John B. Tate
Report Adviser and Assistant Professor,
Department of Industrial Arts Education

A. R. Hill
Associate Professor and Head,
Department of Industrial Arts Education

Dean of the Graduate School

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TABLE OF CONTENTS

Chapter Page

CHAPTER I

INTRODUCTION

Industrial arts is a phase of general education that concerns itself with the materials, processes, and products of manufacture, and with the contribution of those engaged in industry. The learning process comes through the pupil's experiences with tools and materials and through his study of resultant conditions of life.

If a single outstanding trend of the present were to be used to predict the future of industrial arts work, it would most certainly be the trend toward the organization of pupil experiences for instructional purposes around the central idea of the general shop. Probably nothing in industrial arts work has shown the growth on a country-wide basis as has the general shop, especially for the junior high school level.

The general shop is well adapted to the junior high school. This is the period when pupils are making exploratory contacts with objects and materials. The pupils need information about the things they meet in the world; they need the experience that comes from handling and knowing these products. They also need to try their skill in manipulating tools and materials. They need to learn how to care for the electrical and mechanical devices about the home and community. The students should be trained to become efficient members of the family group, regardless of the vocation they may choose. They need training in the selection of the commodities which they will consume as members of a modern American community. (30, page 16)

Purpose of the Study. This study was made because of the need for general shop instruction. Woodwork was the only area taught in the Satanta Rural High School until 1955. Mechanical drawing, woodwork, and metalwork are now taught. These subjects are taught as unit shops because they are located in separate rooms.

The majority of ninth grade students in this school have not had any industrial arts. To bring this school up to the standards of the better schools of the United States, a general exploratory course for the first year students will be offered. The areas to be taught will be drawing, woodwork, metalwork, and electricity. Arts and crafts are to be added in the near future. This course of study is to be an aid in teaching the exploratory course in the unit general shop.

Commonly Taught Industrial Arts Subjects. Industrial arts for junior high school should be an exploratory course, and a variety of fields are needed to meet this requirement.

A number of studies show the very decided trend toward differentiated industrial arts offering. Emphasis has rapidly shifted away from just woodwork and mechanical drawing. The exploration possible through woodwork and mechanical drawing is naturally limited. The rise of the general shop in its various forms was one answer to this demand for a greater number of industrial activities.

In 1951 Chris H. Groneman of Texas A. and M. College conducted a study to determine what was being offered in the comprehensive general shops of the American schools. This survey revealed that the following were being taught, listed in the order of the most emphasis: woodwork, drawing and planning, metalwork, electricity, arts and crafts, home mechanics, auto mechanics, ceramics, and printing and graphic arts. (32, page 52)

A biennial survey of education in the United States of offerings and enrollments in high school subjects made in 1948 found the frequency of industrial arts subjects offered in Kansas to be as follows: woodwork, general shop, mechanical drawing, metalwork, printing, electrical work, auto mechanics, handicrafts, and home mechanics.

Research Technique. This report was made through the extensive use of the many books, magazines, and reports in the library at Oklahoma State University. Other books were used from the personal library of the industrial arts staff at Oklahoma State University, the library of the industrial arts department of the Satanta Rural High School, and the personal library of the author. The historical content of this report was obtained from books written by recognized educators.

Definitions of Terms.

Course of Study: A comprehensive plan which shows the scope and teaching sequences of all activities provided for a particular subject in a curriculum.

Curriculum: The whole body of courses offered in an educational institution, or by a department thereof.

Industrial Arts: Those phases of general education which deal with industry--its organizations, materials, occupations, processes, and products--and with the problems resulting from the industrial and technological nature of society. (36, page 2)

Industrial Education: A generic term including all educational activities concerned with modern industry and crafts, their raw materials, products, machines, personnel, and problems. It therefore includes both industrial arts and vocational industrial education. (16, page 7)

General Education: General education aims to develop general intelligence, the power of appreciation in all common fields of utilization,

and the ability to use language, scientific methods, etc., without reference to any specific calling. (6, page 2)

Vocational Industrial Education: Preparation for entrance upon and for making progress in "trades" and industrial occupations of all kinds. (16, page 7)

Vocational Education: A generic term whose scope embraces all kinds of vocationally purposeful education such as industrial, homemaking, agriculture, commercial, mining, and so on. (16, page 7)

General Shop: The general shop is a room that has been equipped and organized so students may participate in various activities and have experiences with a variety of tools, equipment and materials. (32, page 31)

General Shop, Comprehensive: An organizational plan for combining unrelated major activities of different materials or occupations such as woodworking, leatherworking, plastics, auto mechanics, welding, and electricity. This type of general shop is popular in smaller communities where space for only one shop is provided. All activities need not occur concurrently. (32, page 460)

General Shop, Limited: An organizational plan where the activities are centered around one type of material or occupation; examples are general woodworking, general metalworking, and graphic arts. (32, page 460)

Manual Training: A historical term describing education of the mind through the hands based on hand work instruction in the elementary industrial processes and the theory of formal discipline. It was offered originally for general educational value without regard to vocation and usually applied to the training of boys. (32, page 6)

Manual Arts: Its chief purpose is that of developing within the pupil, through work in the school shops, manual skill and an appreciation of good design and construction by practice with a variety of exercises and practical projects of personal value. (32, page 7)

The Outcome of the Study. The main outcome of this study should be a course of study to fit the needs of the industrial arts students in the ninth grade in the Satanta Rural High School. The industrial arts student will have more industrial arts subjects to experience and this will develop his industrial appreciations more than was the case with only one shop area. The materials with which he works will be more varied and he will be able to become an intelligent comsumer of the products of modern industry. Thus the student who gains these experiences will become a more intelligent and cooperative student.

Organization of the Remaining Chapters. Chapter two contains the history of industrial arts from primitive man to the present time. It includes the early leaders and their contributions from the apprentice through manual training, manual arts, and industrial arts to the present time. Chapter three is a philosophical chapter. It contains the early philosophies, developments to cause changes in philosophies, the author's personal philosophy, and the objectives of industrial arts. Chapter four is a course of study for ninth grade unit general shop. It includes teaching problems, class organization, time available, shop controls delegated to the pupils, methods of teaching, factors determining grades in industrial arts, and the instructional units for general drawing, woodwork, metalwork, and electricity. Chapter five gives the summary and recommendations of the author.

All teachers are concerned with pupil guidance. Each time a decision is made accepting or rejecting subject matter, the teacher's action affects

the life of the child of today and just as certainly the adult of tomorrow. The aim we establish or accept is the influence of historic trends. A brief look at the history of industrial arts will give some idea of the basis of the industrial arts programs in the schools of today.

CHAPTER II

HISTORY OF INDUSTRIAL ARTS

Before one can enter into an intelligent study of the proper place of the manual arts as an integral part of the present-day educational system, it is advantageous to survey briefly the factors which have influenced its present development. As statesmen, economists and scientists turn to the pages of history for information about the results of past experiences and experiments, so educators turn to educational works of the past to assist them in the formulation of new and better types of endeavor.

Part A

Early History of Industrial Education

If one is to understand and appreciate the field of industrial arts, a study should be made of its origin and development.

Primitive Man. Industrial arts dates beyond recorded history back to the time when primitive man used his skill to make hand tools to protect and provide food for his family. The father taught his son all the crafts he knew and the exceptionally skilled worker was regarded as possessing super-human power. (3, page 11)

Barbaric Man. When man gained the power to control fire he passed into another stage of civilization--from savagery to barbarism. Then he was able to cook his food, to smelt metals and shape them into tools, and

and with these tools to engage in crafts unknown and impossible before, and to further develop many others. (3, page 12)

Ancient Jews. As far back as 2000 B. C. the Jews definitely recognized the social value of handwork. The youths went to school to learn the Law for one-half of the day. In their Talmud was the commission to all fathers to teach their sons a trade in the other half of the day.

Middle Ages. As the crafts developed from the early times, becoming more differentiated and specialized, apprenticeship in these crafts was the chief means of education. Apprenticeship began in the home, the father teaching his own son, and when he added another man's son he was to treat him as his own. The apprenticeship period usually covered seven years.

The invention of printing and the revival of classical learning, especially in Italy during the fifteenth century, and the Protestant Reformation with its center in Germany, beginning early in the sixteenth century, brought new educational possibilities and put new life into teaching methods. During this period there appeared two of the fundamental ideas upon which modern instruction in the manual arts has been built. The first of these is that sense impressions are the basis of thought and, consequently, of knowledge. The second is the related idea of "learning by doing". (3, page 30) Out of the first idea grew the object method of teaching and, later, the laboratory method; out of the second came the recognition of the value of working through a process, of making something with the hands or with tools, of doing something skillfully, as a basis for rational thinking. This idea led to placing handicrafts in the school and the children in the work shop and in the fields to receive instruction.

Martin Luther (1483-1546). He said the right kind of schooling should be given to all the people, noble and common, rich and poor; it

was to include both boys and girls. He advocated a school day of two hours with the rest of the time learning a trade at home. He wanted this school to be state supported and compulsory.

Richard Mulcaster (1531-1611). He believed that "the hand, the ear, the eye" be the greatest instruments whereby the receiving and delivery of learning is chiefly executed. His curriculum consisted of (1) reading (English), (2) writing, (3) drawing, (4) singing, and (5) playing a musical instrument. (3, page 33) He has been given credit for being the first to make drawing one of the fundamental studies of the school.

Comenius (1592-1670). He was the first to make scientific study of the child. He concluded that the constructive and destructive instincts in children were one and the same. He is responsible for putting handwork into primary education for the first time. (17, page 3)

John Locke (1632-1704). He was one of the most striking products of this period. He ranked high among the educationists. Locke became the chief exponent of the idea that education would fit a boy for practical life, whether it be in a trade or a profession. He advocated learning the manual trades (a) because they afford good physical exercises; (b) because skill gained is worth having--it may be useful; (c) because they provide diversions or recreations. (2, page 61)

With the exception of teaching drawing, all the theorizing of the sixteenth and seventeenth centuries merely resulted in change of educational philosophy and not a change in school work so far as the manual arts were concerned. This change in philosophy, however, was important and bore fruit later, but during these centuries the manual arts did not, with a very few exceptions, come within the walls of the school room.

August Hermann Francke (1663-1727). In 1694, he started a school and the primary aim was to provide religious education for the poor and

neglected children. Besides religious instruction, he gave practical instructions, including several manual arts.

As early as the eighteenth century some of the men who were working under Francke recognized the need for a new type of secondary school giving emphasis to science, art, and the trades and industry--one quite different from the usual classical school or gymnasium.

They therefore organized a curriculum which included mathematics, mechanics, natural science, and handicrafts. A few years later one of the foremost of these teachers under Francke, Hohann Julius Hecker (1707-1768) went to Berlin, where in 1747, he founded what was known as the Royal Realschule. The curriculum of this school included drawing, mathematics, science, and history as well as modern languages and Latin. In connection with this school, instruction was given in "turning, pasting, glass-cutting, finishing and other activities." (2, page 75)

Jean Jacques Rousseau (1712-1778). He was the first noted exponent of manual arts in education. He outlined a new system of education, in which handiwork in the trades and agriculture formed a very definite part. He urged the learning of a trade by all children who would have no inheritance of land. He saw in the manual arts education both social and economic values.

Rousseau believed that experience is the best teacher and he would therefore have everything possible taught by action, and say only what cannot be done. His recognition of the fact that the manual arts may be a means of mental training marked the beginning of a new era in education. (2, page 77)

Johann Bernhard Basedow (1723-1790). He was the successor of Rousseau in the field of educational reform. He wrote several books on education. One of these, Elementarwerk, was completed in four volumes in

1774. The Elementarwerk contained one hundred plates of illustrations. These illustrations were intended to help in giving the student a knowledge of the world and things. He founded an educational institution at Dessau in which the principles of the Elementarwerk were put into practice. Basedow proved to be totally unfitted to direct such a school and the management was turned over to one of his assistants.

Although the experiment was a failure as a school, it had a very stimulating effect on educational discussion, and through the assistance of Basedow, it was the center of several reforms.

Johann Heinrich Pestalozzi (1746-1827). Pestalozzi, like many other men, was impressed by the writings of Rousseau. After studying for the ministry he changed to law. Because of his belief which would limit advancement, he then changed to agriculture.

Pestalozzi's farming adventure failed but he was determined, at all cost, to begin to satisfy the great desire of his life by trying to lessen the misery and suffering and sin of the world through educating the children of the poor.

In the winter of 1774, Pestalozzi brought into his home about twenty poor children. He taught them by having them with him and sharing in the work on the farm. Very little time was given to actual lessons.

From the educational viewpoint this experiment was a complete success, but from the financial standpoint it was not. This experiment at Neuhof had been talked of far and wide and money was offered to Pestalozzi to carry on his work. This he did in 1776, but after five years of experiment and struggle he was forced to abandon the enterprise because he was so deeply in debt.

After several other teaching jobs, one in connection with Fellenberg for a short while, he accepted an old castle at Yverdun where, after more struggles with poverty, he and his assistants established the institute

that became famous.

Pestalozzian Methods. An excerpt from Charles A. Bennett's History of Manual and Industrial Education to 1870 states:

> Pestalozzi's great contribution to pedogogy grew rather naturally out of (a) his intense desire to improve the condition of the poor in Switzerland, especially the children, (b) his firm belief that such improvement, to be permanent, must come through education, (c) his stated opinion that the schools should be in closest connection with and prepare for the life of the home instead of leading away from it, (d) his interest in Rousseau's doctrine of education according to nature, (e) his early conviction that under favorable conditions the manual labor of children could be utilized to pay for their education, and (f) his repeated successful use of objects and manual labor both skilled and unskilled, as a means in teaching the traditional school subjects. (3, page 118)

Pestalozzi's work therefore pointed toward education for all children, poor or rich, and toward education by new methods--the methods that have found fuller development under the influence of modern psychology. "There are two ways of instructing," said Pestalozzi, "either we go from words to things or from things to words. Mine is the second method." (3, page 120)

Following the practice of Comenius and Basedow, Pestalozzi used woodcut illustrations in teaching the facts of nature, but later made more extended use of the natural objects themselves or well-made models of them.

Fellenburg's Farm and Trade School. In general the methods of teaching in the farm school were those inspired by Pestalozzi.

Fellenberg considered agriculture the best means of cultivating those faculties which "promote the permanent happiness of men," but next to agriculture were the mechanical arts. To supply the needs of his institution, Fellenberg employed mechanics representing several different trades, and each of these had a shop or place in which to work. Among the skilled workmen were one or more of each of the following: blacksmith,

wheelwright, carpenter, cabinet maker, turner, brass worker, shoemaker, harnessmaker, tailor, lithographer, and bookbinder. This afforded an exceptional opportunity for a young man to select and learn a trade. When a boy became old enough to select a trade, he worked at that trade during his working hours for the remainder of his stay at Hofwyl.

But in all this learning of trades the handwork, as such, was not taught except by the imitative methods of apprenticeship. Handwork itself had not been subjected to scientific analysis, and therefore was not taught in the sense that it is taught in most of the trade schools of today.

Wilhelm Augustus Froebel (1783-1852). Froebel taught under Pestalozzi and he was the one who took Pestalozzi's idea of organic growth and developed it into the doctrine of self-activity which he made the very center of his educational theory. He took Pestalozzi's practice of training in observation and sense perception and expanded and systematized it until he produced the kindergarten gifts and occupations.

This brief history of some of the early leaders in industrial education shows how the field of industrial arts came about and grew up to the middle nineteenth century. This also gives the basis for some of the present day philosophies in industrial education.

Part B

History of the Development of Industrial Arts in America

After studying the growth of industrial arts in Europe one should see what was happening in America and see how it started, who were the leaders, and why it was started.

Pre-colonization Days. As early as 1630 there were over 60,000

Christian natives in New Mexico, in 90 pueblos grouped in 25 missions, and many of these pueblos had schools.

A few years later the Franciscan friars established similar schools in Texas. The girls were instructed in household arts while the boys spent the greater part of their time at work in the shops or in the fields learning agriculture and stock raising. There was general instruction for all once a day, at least, which was chiefly catechetical in character. Little attention was given to the study of the ordinary school subjects. The idea was that of an industrial training, pure and simple. (3, page 76)

Massachusetts Bay Colony. In 1642 the Massachusetts Bay Colony passed a comprehensive apprenticeship law because there had been great neglect by many parents and masters in training their children in labor and learning and other employments.

In 1671 a new order required the officials of every town to see that all parents and masters endeavor to teach their children and servants to read. They should bring up their children an apprentice in some lawful calling, labor or employment. The Connecticut Colony passed similar laws.

Early School in Pennsylvania. In 1745 a group of Moravian Brethren established a colony at Bethlehem on the Lehigh River about 50 miles north of Philadelphia.

At the age of twelve the boys were sent to live at the house of the single, who all lived together, where their lives were regulated. The elder single men were nearly all artisans and worked at their trades, and the boys were instructed in the particular trades or arts they intended to pursue.

The provisions for industrial education in the nineteenth century were for the most part patterned after that in England.

Post Revolution Times. Throughout much of the nineteenth century, European and especially English influence continued to be a dominant

factor in determining the character of the provisions made in this country for systematic education in the industries.

The apprenticeship system seemed to prevail during this period even though there were several experiments taking place, such as The Mechanic's Institute, Franklin Institute and the American Lyceum.

Search for a School System of Industrial Training. In the sixties and seventies the American merchants and manufacturers were led, under the pressure of keen international competition, to advocate a more direct training of the young for industrial life in the public schools.

The industrial training, at that time, was skill in the use of tools. For this, however, no efficient system of school instruction had yet been found.

The problem, though formidable, did not seem incapable of solution. It was in the hope of finding such a system that President Runkle of the Massachusetts Institute of Technology visited the Centennial in 1876. He found the system he was looking for presented in the exhibit of the Imperial Technical School of Moscow. It had been worked out for the most part by its director, Della Vos.

The new plan was, in brief, that of analyzing workshop operations into their elementary processes, of arranging these in graduated series and making them the object of systematic drill by the students. An essential feature of the plan was the sharp distinction drawn between instruction and construction. The exercises were devised solely with the former end in view, no attempt being made at the "construction" of articles of use or beauty.

The system, Runkle pointed out, did not train to the mastery of any particular trade--this he believed impracticable--but rather it cultivated

skill in "the elements which underlie all industrial pursuits." It is this which made the Russian system valuable.

Manual Training School. The center of the movement for manual and industrial education soon shifted to St. Louis. The leader there was Calvin M. Woodward, Professor of Mathematics and Mechanics and Dean of the Polytechnic School at Washington University. Using the Russian system he founded the St. Louis Manual Training School.

The demonstrations of orderly progressive instruction which he showed its visitors contributed to the establishment of many manual training schools. Most of these schools were established by private means. Popular interest in the system seemed to increase steadily throughout the eighties. (2, pages 138-164)

Manual Training as Part of General Education. In 1884 the Industrial Education Association of New York City was organized. The organization of this body is an event of prime importance in the history of industrial education in America. It proposed to combine the schools of general education with the manual training and other systems of educational handwork. It devoted itself wholeheartedly to the task of introducing industrial education into schools for the general education of the young, not only in New York, but throughout the country.

During the later eighties a noticeable more favorable reception was given by members of the National Education Association to the introduction of manual and industrial training into the public schools. (2, pages 167-176)

Experimentation in Hand Training. The Russian system revealed, under the test of actual practice, a serious defect. Work with tools which produced no objects of use or beauty and which was performed merely for the sake of the skill to be gained proved to have little attraction for the average American youth. School handiwork was threatened with decline.

Under these circumstances, the American educator was directed to sloyd, a system of hand training which satisfied more fully the child's creative impulses and which seemed in other respects better adjusted to the nature of the child. The origin of this system came from the hand work of the Swedish peasant.

The sloyd influence in the United States was extended through the establishment of a Sloyd Training School in Boston under Gustaf Larsson.

At about the same time Charles Leland of Philadelphis was constructing a system of hand training closely correlated with art and nature study. The ideas characteristic of these two movements have become incorporated extensively in educational practice. (2, page 178)

History has shown how industrial arts has grown and developed. It gained a prominent place in the school systems as a part of general education during the latter part of the nineteenth century. Along about this time vocational education began to gain recognition.

Part C

Industrial Arts Since the Beginning of Twentieth Century

In the first decade of the twentieth century there was a reaction against the views that industrial arts was just for general education. They began to want some vocational preparation for those who left school in their early teens.

Early Movement for Vocational Education. With the opening of the twentieth century there was a tendency to emphasize the importance of vocational education as an end in school handiwork.

The most influential agency in starting the movement for vocational education in the schools was the Massachusetts Commission on Industrial and Technical Education, appointed in 1905 to "investigate the needs for

education in the different grades of skill and responsibility in the various industries in the Commonwealth." (2, page 199)

The decay of apprenticeship, increasing commercial competition, and lack of skilled workmen made the process of manufacture difficult and expensive. These were some of the factors in the trend toward vocational education.

Development of Government Support. An indication of the growth of the movement for industrial education was the appointment of governmental commissions in different states to investigate the need for industrial education and the best means of satisfying it.

The reports of the Massachusetts Commission and its successor, the Commission on Industrial Education, appointed in 1906, exerted a wide influence upon the theory and practice of school education in the industries. Similar work was carried on by committees appointed by commercial, educational, and other associations.

Guided by the reports of investigating commissions and committees, public and private, and urged on by an increasing popular demand for industrial and vocational education, the legislature of the different states made provision for its encouragement, direction and support in a variety of ways.

Various considerations led the advocates of vocational school training to look more and more to federal aid as essential to a satisfactory solution of the problem. An active campaign for securing federal aid led, in 1914, to the appointment by Act of Congress of the Commission on National Aid to Vocational Education. The commission reported, in the same year, in favor of federal support of vocational education in the form of appropriations to the states to be applied toward the training of vocational teachers and toward the payment of their salaries. Its

recommendations were embodied in the Smith-Hughes Bill, which became law in 1917. (2, page 235)

Development of Industrial Arts. By the turn of the twentieth century such pioneers as Professor Woodward and Dr. Runkle, previously mentioned, had expressed the need for industrial hand work in American education. It was first introduced on the collegiate level in scientific and technological schools before it was advocated for boys on the high school level. By 1900 St. Louis, Chicago, Baltimore, Cleveland, and other cities had high school manual training programs. Manual training was cut from the heart of two European systems, the Russian and the Swedish Sloyd. Manual training in the American schools was based on the common crafts of the day: carpentry, wood-turning, patternmaking, iron chipping and filing, forge work, brazing and soldering, the use of machine tools, and mechanical drawing. (32, page 6)

Terminology. The terms used in the American schools to describe what is now industrial arts began with the name manual training. Manual arts followed in the path of manual training and was sponsored by such leaders as Charles A. Bennett, Ira S. Griffith, William E. Roberts, Dr. William T. Bawden, Robert W. Selvidge, Frank M. Leavitt, and others. The term became popular as these leaders advocated broadening the activities of manual training and placing emphasis on the aesthetic approach to hand work. The manual arts remained popular up until the term industrial arts was advocated.

Industrial Arts had its birth between 1909 and 1911. At that time it was defined by Bonser and Mossman:

> The industrial arts are those occupations by which changes are made in the forms of material to increase their values for human usage. As a subject for educative purposes, industrial arts is a study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to these changes. (32, page 7)

Reason for the General Shop. The general shop came into being with the advent of the junior high school. The factors that set the stage for the junior high school movement were the same as those which encouraged the development of the general shop.

Reasons advanced by educators for changing from an eight-four to a six-three-three educational program were: (1) to hold students in school longer with a more interesting, diversified program, (2) to focus more attention on individual differences and provide programs more nearly tailored to the needs of the individual child, (3) to provide greater variety of activities which in turn provides more opportunity for exploration, (4) to provide a more adequate program of educational and vocational guidance, and (5) to provide more suitable learning conditions for adolescent children.

Then, too, in the early years of the twentieth century, the United States was rapidly moving from a rural farming to an urban industrial nation. This necessitated state and national legislation prohibiting child labor; it became increasingly difficult for children below the age of sixteen to work in factories. Educators were called upon to provide an interesting and challenging program for these older youth who were to remain in school. Up until that time the shop courses consisted primarily of hand woodworking. To interest these older youths, teachers found it necessary to turn to other media and a wider variety of subject matter. This was first done by increasing the number of courses, and then later by improving and changing the method of instruction. The wider range of courses in shop and drafting helped retain students in school, provided for exploration, encouraged programs built around the needs of the individual, directed youth in preparing for their life's work and provided a more interesting and challenging learning climate. (32, page 9)

The Early General Shops. The general shop was conceived and took form from 1906 to 1917. During that period several individuals began teaching more than one activity at the same time. Credit is given to Frederick G. Bonser and his colleagues for conducting the first general shop at State Teachers College, Macomb, Illinois, in 1906. It was here that Bonser experimented with rotating groups of students through experiences in shop, drafting, and home economics. Later Bonser moved to Teachers College, Columbia University, and did experimental work with Russell in the Speyer School.

It was in 1913 that John H. Trybom, the Director of Vocational Education for the Detroit Public Schools, called a meeting of his teachers and urged them to supplement woodworking with other lines of constructive work. This resulted in encouraging a number of teachers to add one additional activity. These new kinds of work included electricity, sheet metalwork, lock maintenance, and furniture repair.

After World War I the general shop spread rapidly. Often several general shops were built in each of the junior high schools that were being erected in larger cities.

Educational administrators in the smaller cities, towns, and villages soon learned that they could afford only one shop, but that with a general shop type of organization a number of major activities could be offered.

Since 1930 the growth of the general shop movement has been very rapid. Nearly all of the leaders in the 203 institutions now engaged in industrial arts teacher education are emphasizing the theory and organization of the general shop. A good portion of the text material which is now being published is organized so that it may be used effectively in general shop situations.

The General Shop in General Education. Industrial arts helps complete the general education program when offered in general shops. As early as 1929, Maris M. Proffitt, then Specialist for Industrial Arts in the United States Office of Education, made this observation:

> Among various plans for industrial arts work in the junior high school grades, the general-shop plan of organization is particularly adapted to the realization of the objectives as they have been outlined. This is especially true for the work done in the small school, but with proper modifications the plan can be used advantageously in the schools in large city systems.

The content for general industrial arts has been broadened as it is now offered in general shops throughout the nation. The organizational pattern provides for having industrial arts taught with the efficiency of twentieth century industrial technology. Proffitt's observation has become a reality as industrial arts now contributes to the general education of youth in the American schools.

The general shop organization which was primarily developed to be used at the junior high school level has found its way into elementary and senior high schools where multiple activity programs have been organized. The teachers in these shops have found that the methods and techniques used in organizing instruction for teaching multiple activities simultaneously are very effective. (32, page 19)

These pages of history have shown how the field of industrial arts has grown, how it has changed, and how it has been accepted as part of general education. It is very decidedly a part of the curriculum of the better schools of the United States. Industrial arts is accepted as part of general education because the aims and objectives meet the principles of the present day philosophy of education.

CHAPTER III

PHILOSOPHY OF INDUSTRIAL ARTS

During the last fifty years, as industrial arts has been projected and developed, much has been written about exploration. Educators have been concerned with having students, especially in junior high schools, work with many materials and have experience with a wide variety of tools and equipment. The purpose is to help boys and girls determine their interests and aptitudes. It is essential for youth to understand their capacities and abilities as they move forward educationally and occupationally in this complex world. They need to have experiences that will help them make wise choices.

Part A

Objectives of Education

The purpose of general education in the United States is to develop common values, skills, understandings and appreciations based upon the fundamental tenents of democracy. Since these values, skills, appreciations and understandings serve a social-integrative purpose, they center about the common core of enterprises which all the people share. Except for our democratic precepts and structure, the expansion of industrialism, supported by science and technology, has been the most pervasive post-Civil War influence on the American way of life. Industrial arts, as a study of industry, falls well within the limits of general education since industry has become the mainspring of our cultural enterprises. (1, page 10)

The school is essentially a behavior-changing institution. That is, school experiences make pupils different than they would be if they lacked these experiences. The direction of behavior change is determined by the ideals and traditions of the culture. The areas of change are derived through the "needs approach." The specific behavior changes may be classified for convenience as knowledges, skills, attitudes or values, appreciations, and special abilities. (1, page 13)

With the purpose and goal of education in mind, one should turn next to the specific objectives to be achieved by education in the school, which contribute to the ultimate goal.

Cardinal Principles of Secondary Education. The Commission on the Reorganization of Secondary Education, appointed by the National Education Association in 1918, formulated the educational creed known as the "Seven Cardinal Principles of Secondary Education." In varying degrees the different principles or objectives also apply to primary and higher education. The Cardinal Principles of Secondary Education are as follows:

1. Health (including hygiene and safety)
2. Command of the fundamental processes (reading, writing and numbers)
3. Worthy home membership
4. Vocation (equip the individual to secure a livelihood for himself and those dependent on him)
5. Civic education
6. Worthy use of leisure
7. Ethical character

Imperative Needs of Youth. A widely accepted presentation of general needs of youth has been presented by the Educational Policies Commission under the caption of "The Ten Imperative Educational Needs of Youth." These were formulated in 1952 and are as follows:

1. All youth need to develop salable skills and those understandings and attitudes that make the worker an intelligent and productive participant in economic life.
2. All youth need to develop and maintain good health and physical fitness.

3. All youth need to understand the rights and duties of the citizen of a democratic society, and to be diligent and competent in the performance of their obligations as members of the community and citizens of the state and nation.

4. All youth need to understand the significance of the family for the individual and society and the conditions conducive to successful family life.

5. All youth need to know how to purchase and use goods and services intelligently, understanding both the values received by the consumer and the economic consequences of their acts.

6. All youth need to understand the methods of science, the influence of science on human life, and the main scientific facts concerning the nature of the world and of man.

7. All youth need opportunities to develop their capacities to appreciate beauty in literature, art, music, and nature.

8. All youth need to be able to use their leisure time well and to budget it wisely, balancing activities that yield satisfactions to the individual with those that are socially useful.

9. All youth need to develop respect for other persons, to grow in their insight into ethical values and principles, and to be able to live and work cooperatively with others.

10. All youth need to grow in their ability to think rationally, to express their thoughts clearly, and to read and listen with understanding. (13, page 266)

Imperative Needs of Junior High School Youth. In 1951, the National Association of Secondary School Principals listed the following as the Imperative Needs of Junior High School Youth:

1. All junior high school youth need to explore their own aptitude and to have experiences basic to occupational proficiency.

2. All junior high school youth need to develop and maintain abundant physical and mental health.

3. All junior high school youth need to be participating citizens of their school and community, with increasing orientation to adult citizenship.

4. All junior high school youth need experiences and understandings appropriate to their age and development, which are the foundation of successful home and family life.

5. All junior high school youth need to develop a sense of the values of spiritual and material things and on the rights of ownership.

6. All junior high school youth need to learn about the natural and physical environment and its effects on life and to have opportunities of using the scientific approach in the solution of problems.

7. All junior high school youth need the enriched living which comes from appreciation of and expression in the arts and from experiencing the beauty and wonder of the world around them.

8. All junior high school youth need to have a variety of socially acceptable and personally satisfying leisure-time experiences which contribute either to their personal growth or to their development in wholesome group relationships, or to both.

9. All junior high school youth need experiences in group living which contribute to personality and character development; they need to develop respect for other persons and their rights and to grow in ethical insights.

10. All junior high school youth need to grow in their ability to observe, listen, read, think, speak, and write with purpose and appreciation.

The primary purpose of the junior high school may be thought of as orientation. The child discovers that he has a place in a complex technological society and that he must make choices from a wide range of activities. This suggests that the school program provide opportunity to satisfy investigative, manipulative, aesthetic, and social impulses. It will provide a good foundation for the more specific experiences of the higher secondary levels and aid in the development of well-rounded individuals. The experiences will be realistic in terms of living and the purposes of education in a setting which provides for social growth. (26, page 22)

Part B

Objectives of Industrial Arts

Industrial arts, as a part of general education, does not have a set of objectives which industrial arts alone supports but it does make unique contributions to objectives which are common to the entire school program.

Industrial arts is basically a shop or laboratory subject area; it emphasizes the use of tangible media and the problem solved usually results in concrete things; it provides for extensive expressional opportunities; it provides experiences in which the learning takes place through the sense of feeling or touch in conjunction with the avenues of seeing and hearing; it is conducive to informal class organization patterns; it derives its content from the world at work.

Quite obviously some of these features are shared with the physical sciences, some with the social sciences, some with the arts. Hence, a statement of objectives with an industrial arts curriculum constitutes points of emphasis rather than jurisdictional boundaries.

The objectives of industrial arts stem directly from the objectives of general education. This point is clear if an analysis is made of the implications of general education objectives. A set of objectives, once established, becomes the source or the foundation upon which to build a program. (1, page 13)

From time to time the leaders in industrial arts have written lists of objectives for industrial arts. These lists are essentially the same only reworded. Gordon O. Wilber, in his book, Industrial Arts in General Education, lists these objectives:

1. To explore industry and American industrial civilization in terms of its organization, raw materials, processes and operations, products, and occupations.

2. To develop recreational and avocational activities in the area of constructive work.

3. To increase an appreciation for good craftsmanship and design, both in the products of modern industry and in artifacts from the material culture of the past.

4. To increase consumer knowledges to a point where students can select, buy, use, and maintain the products of industry intelligently.

5. To provide information about and insofar as possible, experiences in, the basic processes of main industries, in order that students may be more competent to choose a future vocation.

6. To encourage creative expression in terms of industrial materials.

7. To develop desirable social relationships, such as co-operation, tolerance, leadership and followership, and tact.

8. To develop a certain amount of skill in a number of basic industrial processes. (36, page 42)

Louis V. Newkirk, in his book, Organizing and Teaching the General Shop, lists these objectives:

1. Self-expression through planning and building useful projects with tools and materials typical of modern industry.

2. Exploring aptitudes and interests in industrial work.

3. An understanding of industry, its workers, and processes.

4. Reading and making working drawings for personal use.

5. Choosing wisely the industrial products that are needed for modern living.

6. Adjusting and making minor repairs on the industrial products used around the home and community.

7. Providing craft experiences suitable for hobby interests.

8. Giving social experiences that will develop understanding and ability to work effectively with others.

The Kansas State Department of Education, in its bulletin, Tentative Guide to Teaching Industrial Arts, lists these objectives:

1. Interest in Industry. To develop in each pupil an active interest in industrial life and in the methods and problems of production and exchange.

2. Appreciation and Use. To develop in each pupil the appreciation of good design and workmanship, the ability to select, care for, and use industrial products wisely.

3. Self-discipline and Initiative. To develop in each pupil the habits of self-reliance, self-discipline, and resourcefulness in meeting practical situations.

4. Cooperative Attitudes and Democratic Ideals. To develop in each pupil a readiness to assist others, to join happily in group undertakings, and to engage in and study democratic practices.

5. Health and Safety. To develop in each pupil desirable attitudes and practices with respect to health and safety.

6. Interest in Achievement. To develop in each pupil a feeling of pride in his ability to do useful things and to develop worthy leisure-time interests.

7. Orderly Performance. To develop in each pupil the habit of an orderly, complete, and efficient performance of any task.

8. Drawing and Design. To develop in each pupil an understanding of drawings, and the ability to express ideas by means of drawing.

9. Shop Skills and Knowledge. To develop in each pupil a measure of skill in the use of common tools and machines, and an understanding of the problems involved in common types of construction and repair.

10. Social-Economic Understanding. To develop in each pupil a basic understanding and realization of social-economic problems brought about and inherent in our present industrialized society. (26, page 9)

Trends in Industrial Arts. Industrial arts is experiencing rapid growth in the public schools of the United States. Certain trends now in evidence hold promise for change in the total industrial arts picture for coming generations.

For many years industrial arts held the position of a "special" subject in the educational field. Educators now realize that the industrial arts program gives practical application of academic work and is therefore not a special subject, but rather a major area of general education.

The student is the end product of education according to the new concept of the purpose of industrial arts. The teaching of subject matter is subordinate to the development of the student's capacities and to increasing his usefulness to himself and society.

The more modern and progressive schools now refer to the class as "laboratory" and not "shop." The general type of organization provides experiences in a variety of tool and machine processes and with a variety

of materials. This has caused a change which adapts subject matter to the activity requiring it, and drops specialization in industrial arts courses. The activities in the general organization are designed as means of learning, and these activities are now grouped about the making of larger projects which involve many units of activity for completion. (26, page 6)

To insure maximum achievement of the objectives, the teacher must make specific plans and efforts toward that end. If the teacher is to teach students instead of a subject, it is desirable that he not only know his objectives but also have some definite ideas as to how to achieve them. Chapter four is a course of study which outlines these objectives.

CHAPTER IV

COURSE OF STUDY FOR NINTH GRADE UNIT GENERAL SHOP

In preparing this course of study for the ninth grade, the aim of the author has been to formulate suggestive units which may be adapted to meet the needs and conditions of the local school. It is understood that this course of study is not a finished product. It will require constant revision as defects become apparent through its use in the industrial arts program. It does, however, give the teacher a definite starting point and a wide range of material to be covered within certain time limits, and a definite goal toward which to work.

Industrial Arts Course Offerings. The following units were selected for their usefulness to the student. They were also selected to familiarize the student with the many processes and materials that he will use in each unit. The first unit to be taught will be mechanical drawing. All students will be taught this unit at the same time; it will be for a period of six weeks. The next units to be taught will be woodwork and electricity; they will be taught in the woodworking shop for a period of fifteen weeks, five weeks in electricity and ten weeks in woodwork. The following units will be taught in the metalworking shop; the areas to be taught will be acetylene and arc welding, sheetmetal, bench metal, and forging and heat treating.

PART I

GENERAL ORGANIZATION, MANAGEMENT, AND TEACHING OF THE CLASS

Time Available Per Day and Duration of the Term. The course covers a period of thirty-six weeks. The class meets for one sixty minute period each day five days a week. Time is alloted at the beginning of each unit of instruction for demonstrations, discussions, and class talks.

Average Size of Class. The class enrollment varies from fifteen to twenty pupils with an average of sixteen.

Previous Organized Industrial Arts Course Work. This will be the first industrial arts course for all boys except those transferring from other schools which offered a course in junior high school.

Shop Controls Under the Control of the Teacher. The instructor has direct charge of the money collections for supplies, checking attendance, controlling the class, issuing supplies, visual aids, closing and dismissal of the class.

Shop Control Delegated to the Pupils. Each student is responsible for getting out his equipment and returning it at the end of each class period, cleaning off his work station, and leaving the shop in proper condition. The students will take turns in the personnel policy of the shop.

General Statement of Methods. In the course, there is a wide variety of subject matter to be covered; this makes it necessary to use a number of the different teaching methods. The methods and aids used in teaching manipulative work are:

1. Demonstration
2. Visual aids
3. Group discussions
4. Individual instruction

Student activity is stressed to a large degree in the teaching of the related information. They are encouraged to look for reference

materials in magazines, trade journals, bulletins, and pamphlets. The following is a list of methods used to teach related information.

1. Lecture
2. Class discussion
3. Outside reading
4. Individual and group reports
5. Written reports

The following is a list of teaching aids to be used:

1. Drawings
2. Photographs
3. Charts
4. Motion pictures, film strips
5. Objects, samples, and models

Grading and Scoring. The system for grading in this school is based on the following:

94-100	A	Excellent
87- 93	B	Good
80- 86	C	Fair (average)
73- 79	D	Poor
0- 72	F	Failure

Three percent is taken off the students grade for each excused absence that is not made up. Provisions are made for make-up work. For each unexcused absence their grade is lowered one letter grade. The students ability and attitude are also taken into consideration.

The final grade in the course is determined in the following manner: manipulative work, fifty percent; related information, thirty percent; and test, twenty percent.

Examinations will be given at the end of each six weeks period and at any other time that the teacher deems necessary. The types of questions for the test are true and false, completion, and multiple choice.

PART II

OUTLINE OF INSTRUCTION

SIX WEEKS UNIT IN MECHANICAL DRAWING

The purpose of this unit is to teach the students how to make and interpret simple working drawings. General drawing should be the first unit taught in industrial arts since the knowledge of drawing is essential in the other areas of shop work.

The course is divided into fourteen units, each covering one of the fundamental principles of drafting. It is limited to the brief period of six weeks of study. Such a course is designed to serve in an exploratory or general education capacity, so that the student may either discover his taste and talents thereby enabling him to make a better choice of a life career or to learn fundamental information for use in every day life. In any general course, which is not planned for specialized vocational training, the field is so vast that only a small portion of the material can be presented in the allotted time.

The students will have the opportunity to learn vocational information about the field of drafting; including success factors, income, and opportunities.

In this course a comparison of design in furniture will be made. The various elements involved in furniture construction, such as usefulness, good proportion, pleasing lines, variety, harmony, and all factors which tend to make the designs pleasing and attractive will be studied.

Things That the Student Should be Able to Perform at the Completion of the Course

1. Sharpen a drawing pencil.
2. Fasten the paper to the board.
3. Lay out the sheet.
4. Mark points with a pencil.
5. Measure with an architects' scale.
6. Draw horizontal and oblique lines.
7. Draw arcs and circles.
8. Lay out the dividers.
9. Block out views.
10. Make simple working sketches in two and three views.
11. Choose and locate the views.
12. Make working-drawings in two or three views.
13. Represent a cross-section of an object.
14. Draw, and know when to use, the different kinds of lines in drafting; as visible line, invisible outlines, center-line, dimension-line, arrow-heads, extension-line, broken material, and cross-hatching.
15. Dimension a simple drawing.
16. Check a drawing.
17. Construct a hexagon on long or short diameter.
18. Construct an octagon.
19. Construct an elipse.
20. Divide a line by trial.
21. Bisect an angle.
22. Draw irregular curves.
23. Divide a line into any number of equal parts.
24. Transfer angles.
25. Make an isometric drawing.
26. Develop a pattern of a prism-shaped object.
27. Develop a pattern of a cone-shaped object.
28. Develop a pattern of a pyramid-shaped object.
29. Develop a pattern of a cylindrical object.
30. Make simple electrical diagrams.
31. Make out an order of procedure.
32. Make a bill of material.
33. Draw simple pieces of furniture in correct proportion.

Things That the Student Should Know at the Completion of the Course

1. The names and uses of the drafting instruments and how to care for them.
2. The kinds of scales used in measuring, and for what classes of work each kind is used.
3. The kinds and qualities of drawing paper and their uses.
4. The various grades of pencils and their uses.
5. How to select and care for the T-square and triangles.
6. The principles of orthographic projection.

7. When to use sectional views and the conventional ways of presenting them.
8. How to select and care for the drawing-board.
9. What a title should contain.
10. Occupational information; including success factors, income, and opportunities.

Equipment Available. The drawing room is equipped with sixteen drawing tables and stools, storage cabinet for drawing boards, and a tool storage panel. The tool panel contains the necessary equipment for sixteen students.

Drawings are Graded on the Following:

Accuracy	40 points
Legibility	30 points
Neatness	20 points
Speed	10 points

Shop Control Delegated to the Pupils. Each student is responsible for getting out his equipment and returning it at the end of each class period, cleaning off his table, and leaving his stool in the proper place. The students will take turns at checking the tool panel to see if all tools and equipment have been returned at the end of each period.

INSTRUCTIONAL UNITS IN MECHANICAL DRAWING

In the following outline, "A" indicates the informational material which is to be taught and learned as a part of this unit, and "B" indicates the manipulative work to be performed by the students in each unit of instruction.

The columns are arranged to match the recommended textbook and references. All assignments of manipulative work will be found in the textbook, and the informational units may be found in the reference books on the page referred to. The textbooks are referred to in columns with headings as follows:

Column No. 1 - Introduction to Applied Drawing, by E. M. Hale, H. McGinnis and C. L. Hill

Column No. 2 - Mechanical Drawing, by French and Svensen

Column No. 3 - Mechanical Drawing Problems, by Berg and Kronquist

Outline of Units for Drawing	1	2	3
Unit 1			
A. Description of Drawing		1	1
History			
Universal language		11	
Need for drawing			
Skill required			
Relationship between drawings and production operations in the shop and factory.			
B. Look up definition of isometric and orthographic.			
Unit 2			
A. Sketching-Isometric to Orthographic.		82	20
Uses		16	23
Purposes			
Equipment needed and how to use (paper, pencils, erasers, and drawing board)		16	4
Tell and demonstrate uses of different lines (horizontal, vertical, inclined, circles, arcs)	24	19	6
B. Listen to lecture			
Watch demonstrations			
Fasten paper to board and lay out plate	10	17	9
Draw all plates 1-9 in Unit A	9		
Answer questions at end of chapter	16		
Unit 3			
A. Sketching-Orthographic to Isometric.	17	82	
Isometric axes		83	140
Isometric circles		84	146
Isometric arcs		84	147
Centering drawing in drawing space			
B. Make free hand sketches, using reverse side of graph card, of all plates in Unit B.	17		
Unit 4			
A. Horizontal and Vertical Lines-Use of Mechanical Aids	24	16	11
Drawing paper (sizes, grades, attaching)		17	
Pencils (grades)		18	

Outline of Units for Drawing	1	2	3
Angles (45, 30-60 degree triangles)		21	11
T-square		19	
Curves		35	
Erasers		19	
Scales (Kinds and Uses)		26	
Dividers		30	5
Compasses		33	5
Drafting machine		26	
How to lay out plate	24		9
Dimensioning	25	121	24
Alphabet of lines	27	141	19
B. Attach paper			
Lay out plate	28		
Complete plates C-1	30		
C-3	30		
C-4	31		
Unit 5			
A. Oblique Lines and Inclined Surfaces	33	60	
Oblique lines	33	65	
True length	75	282	127
B. Complete plates D-1	33		
D-3	35		
D-5	37		
Unit 6			
A. Circles, Arcs, and Tangents	38	49	180
How to make circles	38	33	
Where they are used			
Diameter	38		
Radius	38		
Circumference	38		
Arcs	38	55	
Tangents	38	55	182
Hexagon		53	182
Octagon		54	183
Pentagon		54	
Ellipse		57	185
How to dimension	39	125	24
B. Complete plates E-2	41		
E-4	43		
E-5	44		

Outline of Units for Drawing	1	2	3
Unit 7			
A. Drawing to Scale			
What is the reason for drawing to scale?	45	28	
What are the types of scales?		26	
How and where are dimensions placed on drawings?	45	30	24
B. Complete plates F-1	45		
F-2, make out bill of material and find cost.	46		
F-3	47		
F-6	49		
Unit 8			
A. Sections			
Why are sections used?	51	97	80
What are full, half, and offset sections?		99	81
What are section lines and at what angle are they normally made?	27	101	82
What is a cutting-plane line and what is it used for?	27	98	80
B. Complete plates G-2	53		
G-5	56		
Unit 9			
A. Free Hand Orthographic Sketching			
What is the reason for sketching?	58	74	
Is consideration of proportion and choice of views important? Why?		78	
B. Complete plate H-2	59		
Make a sketch of a project you wish to make in woodworking.			
Make a bill of material and an order of procedure for this project.			
Unit 10			
A. Reading and Interpreting Drawings			
What should be looked for in order to translate a drawing?	63	87	
B. Complete all exercises in Unit I	63		
Work to be done outside of the class according to instructions of teacher.			

Outline of Units for Drawing	1	2	3
Unit 11			
A. Graphs			
Name the types of graphs.	71		
What are graphs used for?			
What are some of the methods of constructing graphs?	72		
B. Bring at least one graph to class.			
Make a graph according to instructions of teacher.			
Unit 12			
A. Developments			
Where are developments used?	73	275	110
What are plane and curved surfaces?	76	275	
What does true length of line mean?	75	282	111
What are cylinders, pyramids, and cones?	75	280	
What are seams and laps; where are they used?	76	292	
What does wiring and hemming mean?		293	
B. Develop a pattern similar to the one in plate K-1	73		
Make a copy of plate K-3	75		
Unit 13			
A. Electrical Layouts		254	
What are electrical symbols used for?	77	246	
Do electrical diagrams give a true picture?	78	254	
B. Complete problems and turn them in to the instructor. This work to be done outside of class.	79		
Unit 14			
A. Furniture Design			
Why is function the most important consideration in designing furniture?			
It should be of good form.			
It should be sturdily built.			
It should have good proportion and appearance.			
B. Make a drawing of the first project to be made in woodworking, and any other project to be built in woodwork and metalwork.			

PART III

OUTLINE OF INSTRUCTION

FIFTEEN WEEKS UNIT IN GENERAL WOODWORK AND ELECTRICITY

In these units the class will be divided into groups. The students will rotate; spending five weeks in electricity and ten weeks in woodwork. In the following units of instruction the electrical and woodworking units will be grouped separately. The teacher will have lessons for each area and start the students to work, then the following units of instruction will be taught in the sequence necessary to provide for student progress.

Things That the Student Should be Able to Perform at the Completion of the Course.

1. How to read and use the rule and square.
2. How to make patterns and geometric layouts.
3. How to make a material bill and plan the procedure for doing a job.
4. How to use the different saws.
5. How to use the common hand planes.
6. How to sharpen the plane iron.
7. How to square stock to dimensions.
8. How to plane chamfers and bevels.
9. How to lay out and cut curves.
10. How to smooth curved surfaces.
11. How to bore holes with wood bits.
12. How to fasten stock with screws.
13. How to drive and draw nails.
14. How to use the wood chisel, gouge, and carving tools.
15. How to make the common wood joints.
16. How to clamp stock for assembling and gluing.
17. How to install cabinet hardware.
18. How to sharpen and use scrapers.
19. How to prepare wood surfaces for finishing.
20. How to apply the different wood finishes.
21. How to refinish furniture.

Things That the Student Should Know at the Completion of the Course.

1. Safe practices in woodworking.

2. The common types of lumber.
3. The methods of cutting and milling lumber.
4. The standard dimensions of finished lumber.
5. The kinds of finishes in common use.
6. The kinds and uses of wood glue.
7. The kinds and sizes of nails and wood screws.
8. The kinds and grades of sand paper.
9. How to figure board feet.
10. How to select and care for woodworking tools.
11. Plywood and veneer; their uses and advantages.
12. Occupational opportunities in woodworking industries.

General woodwork at the junior high school level is a subject that is interesting to both the individual student and the group.

Skills should be stressed, but not at the specialist level. The principal experiences in woodwork are expected to develop the ability of the student, to plan constructively, to reason carefully, to use hand tools and materials in common use, to study fundamental processes and to understand their economic implications.

Woodwork should help to acquaint the student with wide variety of industries as a matter of general information, and provide exploratory experiences that may lay a foundation and help individuals in choices of an appropriate vocation.

Woodwork, as a part of general education, should place most emphasis on encouraging the individual to develop desirable attitudes, interests and appreciations, desirable techniques of reasoning, judgement, and habits.

UNIT ASSIGNMENTS FOR GENERAL WOODWORK

In the following outline, "A" indicates the informational material which is to be taught and learned as a part of this unit, and "B" indicates the manipulative work to be performed by the students in each unit of instruction.

The columns are arranged to match the recommended textbook and references. Column number one is the recommended textbook and the others are reference books. The books are referred to in columns with headings as follows:

Column No. 1 - Units in Hand Woodworking, by J. H. Douglass and R. H. Roberts

Column No. 2 - Woodwork Visualized, by R. C. Cramlet

Column No. 3 - Hand Woodworking, by D. Hunt and J. B. Tate

Column No. 4 - Modern Woodwork, by R. J. Vernon

Outline of Units for Woodwork	1	2	3	4
Unit 1				
A. Lumbering				
How do trees grow?	7		19	1
How are forests being conserved?	7			1
How are trees sawed?	8	33	26	10
What are the standard dimensions for hard and soft woods?	9	34	35	12
How is wood seasoned?	9	35	28	13
What are the parts of a tree?	10	32	22	5
How are grain patterns obtained?	23	32	26	14
What are some uses of lumber?	12	27		8
How are woods classified?	10	32	32	4
Where do the different trees grow?	12	29	31	8
What are the abbreviations and terminology used by lumber manufacturing concerns?			35	19
B. Written and oral reports.				
Inspect samples of wood and cross section of a tree.				
Film				
Unit 2				
A. Plywood and Veneer				
How is plywood made?	22		41	17
What are the methods of cutting plywood and veneer?	22		41	17
How are grain patterns obtained?	23		43	18
What are some of the uses of plywood?	22		41	18
Is plywood very strong?	22		41	
B. Written and oral reports.				
Inspect samples.				
Film				
Unit 3				
A. How to Make a Material Bill and Plan the Procedure for Doing a Job.				

Outline of Units for Woodwork	1	2	3	4
How to make a stock bill.	32	31	54	22
How to figure board feet and cost of material.	32	34	54	20
Procedure for doing a job.	33		18	21
How to get out stock.	35			
Values of planning.		10	15	
B. Study drawing of project	33		49	
Make parts list	32		55	
Figure cost	32	57	57	
Make out an order of procedure	35		18	
Unit 4				
A. Layout Tools				
What are the different rulers and how are they used?	26	21	66	27
What are squares; what are they used for, and how are they graduated?	26	21	67	28
What are the following layout tools used for?				
Marking guages	27	21	69	29
Dividers	27	21	70	29
Trammel points	27	21	71	29
Scratch awl				
Sloyd knife				
How to select tools for personal use.				
Cost, care and safe use of tools.				
B. Watch demonstration on how to use the layout tools. Learn how the different tools are graduated. When and how to use which tool.				
Select and get out stock for project.				
Unit 5				
A. Handsaws				
Is a saw one of the newer tools?			77	
How does a crosscut saw cut?	36	36	78	33
How does a rip saw cut?	36	36	80	34
How are the teeth of the rip and crosscut saws shaped?	36	36	79	33
How are the following saws used and how are their teeth shaped?				
Back	37	37	82	34
Dovetail	37		83	34
Coping	37	39	84	34
Compass	37	38	83	35
Keyhold	37			
Miter	37	41	87	
What are the sizes of the different saws that are available?				

Outline of Units for Woodwork	1	2	3	4
How to select saws for personal use. Cost, care and safe use of saws.				
B. Use saw to cut stock to rough size, sawing to a line.	40	36	80	36
Demonstrate the proper use of saws using the proper method of holding stock.				
Unit 6				
A. Hand Planes				
What did the first plane look like?			92	
How did the first plane originate?			91	
What are planes used for?	42	43	91	39
Why do they make different sizes and kinds of planes?	42	43	99	38
What are the major parts of a plane?	42	43	95	39
Is the bevel turned down on all planes?	43	44	97	40
What angle should a plane iron be ground?	44	90	93	39
How should a plane iron be whitted?	44	91	93	42
Where should the pressure be placed when planing? Should the bed of the plane be held in line with the stock when planing edge grain? Is a shearing cut best to use when planing end grain?	48	46	104	42
Identify and tell the uses of the following planes: Smoothing, Jack, Fore, Jointer,	45	44	99	40
Block, Bullnose, Rabbet, Router, Universal, and Circular	45	47	101	
Is a spoke shave a type of plane?	45	42	102	
What is a draw knife used for?		50	103	
B. Sharpen plane iron, whit and adjust.	44	90	100	41
Use plane to plane surface, edge and end grain of stock using the proper order of procedure for squaring stock.	50	153	107	42
Learn to select planes for personal use.				
Unit 7				
A. Wood Chisels, Gouges and Carving Tools				
What are the types of wood chisels?	74	48	116	46
Are all chisels made to be used with a mallet?	74	48	116	46
What are some of the shapes of gouges and carving tools?	74		123	47
How are chisels, gouges, and carving tools used?	75	48	116	47
How are these tools sharpened?			118	

Outline of Units for Woodwork	1	2	3	4
Does the woodworker ever use a pocket knife?		49		
What are oil and slip stones?		49	122	
Selection and safety with chisels.			118	
Is the wood chisel a dangerous tool?			118	
Should stock be clamped in position when chiseling?	75			
B. Use the chisel to remove surplus stock on curves.	75	48	119	
Use the chisel to pare end grain.	75	48		
Use the chisel to make chamfers.	75	48		
Unit 8				
A. Scraping Tools				
What are scraping tools used for?	101	88	111	51
Is the scraping tool used before the plane?				
How should the cabinet scraper be used?	104	87	113	51
Can the hand scraper be pulled as well as pushed?		88	111	53
How should the hand and cabinet scraper be sharpened?	103	87	112	52
What is a burnisher?		87	112	52
Identify and tell the use of the following scraping tools: wood rasp, wood file, mill file, surform, auger bit file.	102	51	135	49
What is a file card?	102			
How to select and care for files.				
B. Sharpen a hand scraper and a cabinet scraper, using the mill file and burnisher.	103	87	112	52
Use files to round edges.	59	51	135	49
Use scrapers to smooth surface of project.				
Unit 9				
A. Finishing Abrasives				
What is the difference in the following: Flint, Garnet, Silicon carbide, Aluminum Oxide, and Emery?	105	128	282	107
How are the above abrasives graded?	105	128	284	107
Does steel wool come in more than one grade?	106	128	287	108
What is pumic stone made from?	106	128	287	108
What is rottenstone made from?	106	128	287	108
Is pumic stone and rottenstone used after the finish has been applied?				
Should all of the dents and mill marks be removed before an abrasive is used?				

Outline of Units for Woodwork	1	2	3	4
What is the standard size of a sheet of sand paper?	106			
Is some sand paper water proof?				
Should sanding always be done with the grain?	106	128	286	107
B. Sand project using proper grade of abrasive.				
Be able to identify the different abrasives.			283	
Use sand paper economically. Tear sheet into four equal parts.				
Make a sanding block for personal use.				
Unit 10				
A. Preparing Surfaces for Finishing				
What are mill marks?	107		289	107
How should dents, checks, nail holes, and etc be removed or prepared for finishing?	107		290	107
What are the following and what are their uses: stick shellac, plastic wood, wood dough, water putty, and white lead.	104	131	290	
What is a heating knife used for?	107		290	
Should all of the visible glue be removed?	107	131	289	
Will dust left on the project affect the finish?	107	131	291	
What does raising the grain mean?	107		291	
B. Sand project and prepare for finishing.				
If there are more than one piece in the project, sand pieces and prepare for assembling.				
Unit 11				
A. Wood Bits and Boring Tools				
What is an auger bit, how is it made, and how is it used?	60	68	125	55
Identify the following bits, what are their uses, and how are they graduated? Twist, iron drill, gimlet, forstner, and expansive.	60	70	128	55
What is an automatic drill?	60	74	129	55
What is a brace? Is there more than one kind?	89	73	124	54
What is a bit stop?	63	68	133	56
What is a dowel jig?	80			
What is a counter sink?		86	131	56
What is a star drill?	90	74		
How are bits sharpened?	61	70	152	

Outline of Units for Woodwork	1	2	3	4
What is a hand drill?	90	74	128	54
How should a hole be drilled with an auger bit and not split through?	63		133	
How to select and care for bits.		69		
B. Use the bits and boring tools to fasten stock with screws and dowels.				
Unit 12				
A. Wood Screws				
What are the different types of screws?	64	112	261	59
How is the size of a screw determined?	64	112	262	59
What are the different metals that screws are made from? Why are they made from different metals?	64	86	261	59
What are some of the special types of screws?	65	124		60
How should the proper screw driver be selected?	66	86	263	58
What size holes should be drilled for screws?	67	86	265	60
What is a screw driver bit?	66	86		
Why are plugs used over screws?		86	266	
What may be used to make screws easier to drive?	66		266	
How are screws purchased?				
Why are there different sizes of screw-drivers?	66	86	155	
B. Use screws, screwdriver, and proper holding tool to fasten project with screws where necessary.				
Unit 13				
A. Nails and Other Wood Fasteners				
What are the different kinds of nails and what are their purposes?	69	113	267	63
Why are some nails galvanized, cement coated, blued, and etc.?				
What are the common sizes of nails?	69	113	269	63
Are all nails made the same?				
How should nails be driven?	72	85	268	63
How should the hammer be held?				
Is a block of wood sometimes necessary when pulling nails?				
Are some nails set below the wood surface?				
What are corrugated and scotch fasteners used for?	70	85		62

Outline of Units for Woodwork	1	2	3	4
What is a wire brad? How are they purchased?	69	85	270	
What is a nail set used for?	71	85	271	63
What is a nail puller?				
What is a mallet?				
What is a hatchet used for?				
What is a clamp nail?			237	
How are nails purchased?				
What is the difference between the common, box, casing, and finishing nail?	69	86	267	63
B. Be able to recognize the common types of nails. Use nails in project if necessary and use the hammer properly.				
Unit 14				
A. Kinds and Composition of Glue				
What is glue used for?	91	111	252	94
How is glue made?	91	111	252	94
What are the different kinds of glue?	91	111	253	95
How are glues prepared for use?	92	111	254	95
Are all glues made for the same purpose?				
Does glue make a strong joint?				
What causes glue to hold?	91	111	254	94
Is it necessary to remove the surplus glue?		108	253	97
What type of glue should be used for exterior use?				
B. Select and use the proper glue on all joints in project. Have instructor inspect work immediately after assembly.				
Unit 15				
A. Holding Tools				
What are holding tools?	89	23	137	95
What are the two types of woodworking vises?	89	23	137	
What is the difference between the wood-workers and the machinist vise?	89		137	
What is the bar or cabinet clamp used for?	89	23	139	95
What is the hand screw clamp used for?	89	23	137	96
What is a carriage clamp?	89	23	139	96
Is the saw horse a valuable holding tool?	90	23	141	
How is the bench hook used?	90	41	141	
What is a miter box?	90	41	85	35
What are corner clamps?	90			
How are clamps used to hold stock?	89	79	140	96

Outline of Units for Woodwork	1	2	3	4
Is it necessary to check for squareness when gluing projects together?	93	79	256	95
Is it necessary to use small blocks of wood when gluing?	95	79	140	96
B. Use the proper holding tool at the proper time on project.				
Unit 16				
A. Kinds and Composition of Stains and How to Use Them				
What are the three major kinds of stain?	109		295	110
What are the different stains made from and when are they used?	109		295	110
What are the advantages and disadvantages of each of the stains?	109		296	110
What are dry stains?	110			
What is bleach and what is it used for?			300	
How should the surfaces be prepared for the different stains?	110		295	111
What are some of the common colors of stain?	109		295	
B. Apply stain to project if necessary.				
Unit 17				
A. Wood Filler				
What is wood filler?	114		303	111
What is wood filler made from?	114		303	111
Is it possible to make your own filler?				
What is filler used for?	114		303	111
How may filler be purchased?				
How is filler applied?	115		304	111
How is filler rubbed in?	115		304	111
How is the excess filler removed?	115		304	111
What should be done with the rags used to remove the excess filler?	115			
Is it necessary to remove the excess filler?	115		304	111
How should filler brushes be cleaned?	115			
How long should filler be allowed to dry?	115		304	111
B. Apply filler to project if it is an open grain wood.				
Unit 18				
A. Shellac and its uses and How to Apply				
What is shellac; is it a new type of finishing material?	116		306	111

Outline of Units for Woodwork	1	2	3	4
What is shellac made from?	116		306	111
What is shellac thinned with?	116		306	112
Can shellac be used for a finish coat?	116		307	112
How much should shellac be thinned?	116		307	112
Is shellac used for a sealer coat?	116		307	112
Is shellac good to use if it is very old?	116		307	
What is the natural color of shellac?	116		306	112
What is the proper procedure for applying shellac?	122		307	112
Is shellac easy to apply?	117		307	112
How should shellac be rubbed?	117		308	112
Is shellac a water proof finish?	116			
B. Apply shellac to project for a sealer coat.				
Unit 19				
A. Varnish and its Uses and How to Apply				
What are the different kinds of varnish?	118		309	113
What are the purposes of the different varnishes?	118		309	113
What are varnishes made from?	118		309	113
What is used to thin varnish?	118		312	
Is varnish easy to apply?	119		312	113
What are the proper conditions for varnishing?	119		309	113
How should a varnish finish be rubbed?	119		313	113
Is varnish a good durable finish?				
Is it necessary to rub varnish between coats?				
B. Apply varnish to the project.				
Unit 20				
A. Lacquer and its Uses and How to Apply				
What are the different kinds of lacquer?	120		321	113
What is lacquer thinned with?	120		322	113
What should be used for a sealer coat for lacquer?	120		323	113
How is lacquer made?	120		321	113
How long does it take for lacquer to dry?	120		323	
What is the best method of applying lacquer?	121		323	114
Is lacquer a durable finish?	121		321	113
B. First year students are not allowed to use lacquer.				
Unit 21				

Outline of Units for Woodwork	1	2	3	4
A. Paints, Enamels, and Other Finishing Materials				
What are the different kinds of paint and what are their uses?	112		315	115
What is linseed oil made from?	112		315	
What are the kinds of linseed oil?	112		315	
Where is turpentine obtained and what is it used for?	112		316	
What is the difference between varnish and enamel?	112			115
What is the difference between inside and outside paint?	112			
What are the following used for: naptha, denatured alcohol, wax, oil colors, dry colors, rubbing oil, sealers, and dryers.	113			
B. Select and use the proper finishing materials on project.				
Unit 22				
A. Care of Brushes and Finishing Materials				
What are brushes made from and how should they be cared for?	126			
How should the different finishing brushes be stored?	127		62	
Should finishing materials be stored in a fire proof cabinet?	127			
Should finishes be applied direct from the can?	127			
What should be done with oily rags?	127			117
What may happen if oily rags are not kept in an air tight container?	127		117	117
Should the finishing room be well ventilated?				
B. Clean brushes and store finishing materials properly.				
Unit 23				
A. Common Wood Joints				
What are wood joints used for?	77	94	201	85
What is the purpose of the following joints, how are they made, and what are their characteristics? butt, rabbet, dado, dowel, mortise and tenon, dovetail, and the different lap joints.	78	96	202	85
What is the best joint for fastening rails to legs?	85	100	215	90

Outline of Units for Woodwork	1	2	3	4
What is the easiest joint to make?	77	94	201	85
How should a good joint fit?				
How are joints usually held together?	77	94	201	85
Is accuracy necessary to construct good joints?				
B. Lay off, cut and fit joints on project.				
Unit 24				
A. Drawer and Table Construction				
What is the best joint to use to fasten a drawer front?	87		246	92
What other joints are used on drawers?			246	
What are drawer guides and runners?	88		249	
What are rails and stretchers?	88		250	
What are the different methods of fastening table tops?	88	116	274	
B. Select and use the proper joints.				
Unit 25				
A. Hinges and Other Cabinet Hardware				
Identify and be able to select and use the following: hinges, hasps, catches, locks and knobs; castors, glides, lid supports,	96	120	278	
angle irons, leg hardware, tray supports, bed fasteners; lazy susans, picture	98	123	280	
hangers, table top fasteners, barrel bolts, and butt guage.	98	125		
B. Install proper hardware.				
Unit 26				
A. Carpentry				
This unit is for general information the class will study the textbook and reference books. They will be explained by the instructor and field trips will be taken after each part is discussed.	134		329	

PART IV

OUTLINE OF INSTRUCTION

FIVE WEEKS UNIT IN ELECTRICITY

The purpose of this industrial arts subject is to give the student confidence in working with electrical power. Electricity is a basic source of energy that plays an important part in the lives of all people. Students should learn how to use simple electrical tools and how to use electricity safely. They should have an opportunity to study the elementary and fundamental principles of electrical equipment. This course is designed to develop some initiative in the student by providing him with simple jobs in which a reasonable measure of success may be expected. The students will study about the divisions of the electrical trade and the opportunities that are afforded for employment.

Things That the Student Should be Able to Perform at the Completion of the Course.

1. Detect and replace a blown fuse.
2. Assemble or repair an attachment cord.
3. Hook up doorbells and buzzers.
4. Wire an extension cord for a lamp.
5. Read the electric meter.
6. Give first aid to one who has received severe electrical shock.
7. Make a National Electric Code splice.
8. Do simple house wiring.

Things That the Student Should Know at the Completion of the Course.

1. Simple electrical circuits.
2. The meanings of volt, ampere, and watt.
3. Direct and alternating current.
4. The meaning of series and parallel.
5. The principles of the electro-magnet.
6. Kinds of fuses and their uses.
7. Causes of short circuits.

INSTRUCTIONAL UNITS IN ELECTRICITY

This unit in electricity is taken from, A Course of Study for Beginning Electrical Work, revised by Arland Price.

In the following outline, "A" indicates the manipulative work to be performed by the students in each unit of instruction, and "B" indicates the informational material which is to be taught and learned as a part of this unit.

The columns are arranged to match the recommended textbooks and all assignments and topics of information are documented in as many of the recommended textbooks as contain information about them. Problem boards to use for each problem or assignment so far as formal boards are used are referred to as P. B.-1, P. B.-2, etc. The textbooks are referred to in columns with headings as follows:

Column No. 1 - General Electricity, by E. W. Jones

Column No. 2 - Basic Electricity, by J. L. Feirer and R. O. Williams

Column No. 3 - The Electrical Crafts, by W. H. Johnson and L. V. Newkirk

Column No. 4 - Electricity in the Home and on the Farm, by F. B. Wright

Column No. 5 - Fundamentals of Applied Electricity, by E. W. Jones

Outline of Units for Electricity	1	2	3	4	5
Unit 1a - Bells and Buzzers Operated with Dry Cells P. B.-1	5			236	322
A. Using one dry cell, one bell and one button, wire up a circuit so that the bell will ring when button is pushed.	5		4, 24	236	324
B. Voltage of any size of dry cell.	16	56			
(2) Amperes of a 6" dry cell.	17	56			
(3) Amperage of flash light dry cells.	17				
(4) Determine positive and negative poles of dry cells. (5) Several uses for dry cells. (6) Purpose of the magnets in bell. (7) Difference between a dry cell and a battery.	17 17 17	56 57 56	4 25	230 237 65	
Unit 1b - Bells and Buzzers Operated with Dry Cells, P. B.-1					
A. Using two dry cells, one bell and one push button, wire circuit so dry					

Outline of Units for Electricity	1	2	3	4	5
cells will be in series and so that bell will ring.	5		21	236	
B. Test voltage of the circuit.	17	56	94	22	
(2) Test amperes of the circuit.	17	93	94	39	
(3) Material in the two electrodes of the dry cell. (4) What materials are used inside of the dry cell? (5) Size of	17	56	4	87	51
bell wire. (6) How bell wire is		4			
attached to building. (7) Advantage	25	81			
of dry cells in series, disadvantage.	6				
(8) What maximum voltage can be attained?	16	57			55
	18	57, 92			55
Unit 1c - Bells and Buzzers Operated with Dry Cells P. B.-1	5		24		324
A. Using two dry cells, one bell and one push button, wire up circuit so dry cells are in parallel and so buzzer will ring.				24, 236	324
B. Which will ring the louder, dry cells in series or in parallel?	16, 18	57, 92		22, 24	55
(2) In which one will the dry cell last the longer? (3) Will the bell ring louder if one dry cell is added?	16	57			55
	18	92			55
(4) Voltage of the circuit. (5) Advantage of dry cells in parallel.	18	57			55
	16	92			55
Unit 1d - Bells and Buzzers Operated with Dry Cells P. B.-1	5,6		24-27	235	324
A. Using two dry cells, one bell, one buzzer and two push buttons wire up circuit so bell will ring from front door and buzzer will ring from back door.					324
B. Would you wire the dry cell in parallel or in series? Why?	16, 18	57, 92	21	22, 24	55
(2) Where would you place the dry cells?		57		24	
(3) Location of bell and buzzer?	6				
Unit 2a - Bells and Buzzers Operated from Bell Ringing Transformer P.B.-2			24		312
A. Using one transformer, one bell, one, push button, and insulated bell wire, connect them together so that bell rings	6				

Outline of Units for Electricity	1	2	3	4	5
by means of electricity passing through the transformer.					
B. Recognize bells and buzzers, transformers and size of wire to use.	5,6				312
(2) Alternating as compared to direct current. (3) Safety rules. Voltage of primary circuit. Voltage of current leaving transformer. (4) Install a simple bell circuit. (5) How does the transformer work? (6) Advantage of bell ringing transformer over a dry cell battery.	9 44, 45 6 6 60	159 162 191 190	10 23 118 118	20 32 100 92 92 92	18 258 312
Unit 2b - Bells and Buzzers Operated from Bell Ringing Transformer P.B.-2					
A. Using one transformer, two bells and one push button, connect bells together in series so that both bells ring when the button is pressed.	5,6				
B. How a number of bells in series will operate with one button. (2) How to adjust bells and buzzers when not working properly. (3) Know how to equalize energy. (4) Effect of connecting bells in series. (5) How many could be connected in series?	6	57, 92	25, 27 25	22, 23	324
Unit 2c - Bells and Buzzers Operated from Bell Ringing Transformer P.B.-2					
A. Using two bells, one push button, and insulated wire, connect bells together in parallel so that both bells ring from electricity passing through first.	6				
B. Understand a parallel circuit. (2) How many bells can be included in this circuit? (3) Is there a negative and a positive wire in this circuit? Why? (4) How many wires should run to each push button?	16 56	57, 92 92	21 24	25	105 324
Unit 2d - Bells and Buzzers Operated from Bell Ringing Transformer P.B.-2					
A. Using two bells, two push buttons,	6		24		

Outline of Units for Electricity	1	2	3	4	5
one transformer, connect bells together in a return-call system so that calls may be returned.					
B. Understand the uses of the return call system. (2) Economize in the use of wire when installing a return call system. (3) What is the purpose of a return-call system? (4) What is the advantage of using only three wires?	6 6				324
Unit 3a - Fuses--Kinds and Uses P.B.-3		126	86, 91	253-268	
A. Using one strand of picture wire (iron) add enough 75, 100 or 150 watt bulbs to cause the wire to melt. Also use copper wire.					
B. What number of watts was required to burn out the iron wire? (2) What caused the wires to melt? (3) Which was the better conducter? (4) Of what metal are fuse links made? (5) How are circuit breakers, temperature cutouts, and overload relays used?	24 31	126	91, 93	259 133	93
Unit 3b - Fuses--Kinds and Uses P.B.-3	31	126	86, 91	253-268	93
A. Use a 2, 3, 4 or 5 amp. link in a renewable base and add enough lamps to burn out the fuse.					
B. What are renewable type fuses? (2) What are one-time fuses? (3) Compute the number of watts necessary to burn the 5 amp. fuse. (4) How does this check with the actual number required? (5) How are watts of an appliance determined? (6) What type fuses are used on circuits of 30 amps or over?	31 31 31	126 126 128	119	257 256 256	94 94 94 94 94
Unit 3c - Fuses--Kinds and Uses P.B.-3	31	126	86, 91	253-268	93, 94
A. Calculate the number of 75 watt bulbs allowed by Underwriter Code on #14 wire. Do same on #12 and #16 wire.					95
B. How is wire numbered? (2) What is Underwriters Code? (3) What wattage will #14 wire carry? #12 and #16? (4) What	25	81	98 76	279 143	88

Outline of Units for Electricity	1	2	3	4	5
size fuse will protect #14 wire, #12, #16? (5) What is the meaning of single circuit and multiple circuit? What are circuit breakers?	25		93	133	95
Unit 3d - Fuses--Kinds and Uses P.B.-3	30, 31	126	86, 91		93-95
A. By investigating books and catalogs determine the number of watts required to operate each of the following household appliances; radio, refrigerator, flat iron, percolator, toaster, fan, sewing machine, heating pad, clock, vacuum cleaner, hot plate, range, water heater, various motors.	28			42	31
B. Which uses the most current, a radio or a toaster? (2) How much does it cost to operate an electric iron for three hours if electricity costs 7¢ per KW and the iron is rated 650 watts? (3) How many watts are required to operate an electric clock for one hour? (4) What is the cost of operation of a water heater for one month? (5) What is the cost of operation of an electric clock for one month? (6) What is the consumption of wattage on a door bell transformer in one day? (7) If all the equipment in your home were used at the same time, what total number of watts would be required?	28 28 28		119	42	31 31
Unit 4a - Circuit Wiring Using Several Kinds of Single Pole Switches P.B.-4					
A. Using a single pole snap switch wire up one lamp in a porcelain receptacle to be controlled from a single point.	35	99			
B. Determining hot wire. (2) To what part of the circuit does it lead? (3) Tracing the circuit, voltage of lamp switches used, differences noted. (4) Reason for entrance switches. (5) Difference in hour current and battery current?	78 78, 79 78, 79 34 50, 51		10, 66		
Unit 4b - Circuit Wiring Using Several Kinds of Single Pole Switches P.B.-4	35			238, 239	191

Outline of Units for Electricity	1	2	3	4	5
A. Using two receptacles and a single pole wall type push switch, wire two lights in series.			94, 95	23	105
B. Single or double pole switch? (2) Trace current through switch. (3) Difference in series and parallel. (4) Effect on first bulb if second bulb is removed. (5) Effect if one bulb burns out. (6) Difference in brilliancy in series and parallel wiring. (7) Account for any difference. (8) Effects when using bulbs of different wattage.			95 95 95	239 24	191
Unit 4c - Circuit Wiring Using Several Kinds of Single Pole Switches P.B.-4					
A. Using three or more receptacles and a single pole toggle switch, wire up several lamps in parallel. Compute both wattage and amps in this circuit.	35			25	
B. Single or double pole switch? (2) What does "toggle" mean? (3) Does the adding of extra lamps affect brilliancy of other lamps? (4) Effect of one lamp burning out? (5) How many lamps can be put on this circuit?					
Unit 4d - Circuit Wiring Using Several Kinds of Single Pole Switches P.B.-4					
A. Using several receptacles and another type of single pole switch, wire up several lights in parallel.	35	99		239	
B. Reason for using snap switches for high voltage. (2) How many circuits can be controlled by a single pole switch? (3) Is line drop greater in series or parallel wiring? (4) Explain how the voltage is the same at any point in a parallel circuit. (5) What is the law of the parallel circuit?				238 239 25 25	
Unit 5 - Identification of Electrical Supplies and Equipment P.B.-5					
A. Know and identify objects on equipment board.					

Outline of Units for Electricity	1	2	3	4	5
B. What is the purpose of wire guage? (2) Materials used in making wire.	25		99	279	104
(3) Wire used for outside wiring. (4) Wire used for interior wiring. (5) Materials used in drop cords. (6) Name four types of sockets. (7) Three types of low amperage wall switches. (8) How many wires on three-way switch? Insulation used on conductors. (9) Five porcelain electrical devices. (10) Three types of plugs and plug bases.	24 25 35 37 37	44	27 84, 85	278 295, 296 240 294	84 84 191
Unit 6 - Make a Drop Cord or an Extension Cord.	37				
A. Use any of the following attachments; plug cap, swivel plug, or ceiling rosette and any type of extension cord conductor and socket, and make a drop cord or extension.	37				
B. Name materials and appliances used. (2) Why should there be several wires in each cord? (3) Is the red thread in both strands of cord? (4) Give two rules for attaching strand of extension cord to the binding post(a) red thread, (b) direction of loop. (5) Where is the hot part of the socket? (6) Purpose of hard-rubber bushing in socket. (7) What is the importance of tinning cable ends? (8) Make Problem Board No. 6 containing several types of extension cords and appliance connector plugs.	 37		 82	296 291 294 291	
Unit 7a - Two Point Control Circuit P.B.-7	35			240	191
A. Using two three-way snap switches (to be taken apart for identification of working parts) wire up a light controlled from two points.	35			24	191
B. How many circuits are there that must be checked before current is turned on? (2) How can you determine a three-way switch? (3) For what purpose are the three-way switches used? (4) Do these switches have an "on" and "off" position? (5) Can one buy 3 wire cable with all wires a different color?				240 240	 191

Outline of Units for Electricity	1	2	3	4	5
Unit 7b - Two Point Control of Electrical Circuits P.B.-7	35			240	191
A. Using two three-way wall type toggle or push button switches, wire up a circuit of two lights to be controlled from two points.					
B. Number of points in three-way switch. (2) Number of pigtails in a three-way switch. (3) Where hot wire connects to switch. (4) Where neutral wire connects. (5) How many circuits must be checked before current is turned on? (6) Kinds of three-way switches.				240 240	191 191
Unit 8a - Three and Four Point Control of a Single Circuit P.B.-8				240	191
A. Using two three-way toggle switches and one four-way toggle switch, wire up one lamp to be controlled from any one of three points.					191
B. How many posts does a three-way switch have? (2) Where does hot wire lead to? (3) How many circuits must be checked? (4) Interpretation of wiring diagram. (5) How many pig-tails on a four-way switch?				240 240	 191
Unit 8b - Three and Four Point Control of a Single Circuit P.B.-8					
A. Using two three-way toggle switches and one four-way toggle switch and one double-pole double-throw knife switch, wire a lamp to be controlled from four points.				240	191
B. In what directions does a four-way toggle switch pass circuits? (2) How many pig-tails are there? (3) Where would a three-point control circuit be used?				240	191
Unit 9 - Heating Elements in Household Appliances P.B.-9					336

Outline of Units for Electricity	1	2	3	4	5
A. Determine the number of watts per hour consumed by at least three household heating elements. Use the watt-hour meter and determine the amount of current consumed in terms of kilowatt hours. Improvise necessary equipment and circuits.	28		119	41	
B. Definition of watt, kilowatt, kilowatt-hour. (2) Use of watt-hour meter. (3) Definition of amperage. (4) Use of ammeter. (5) Cause of heat in electric circuit. (6) Kinds of wire used in heating elements. (7) Computing resistance. (8) Watt's Law. (9) Three ways of determining wattage consumption of an appliance. (10) Materials used in insulating heating elements. (11) Practicability of repairing heating elements. (12) Comparison of heating cords with ordinary extension cords.	27 27 27 40 40 27 28	142 143 112 136, 140 	119 119 94 20 119 	41 41 35 57 302	31 32 20 336 32 13 327
Unit 10 - Make a Chemical Electric Cell.	49				52
A. Use a pint or quart fruit jar as a container and use electrodes of zinc and copper. Use diluted sulphuric acid for liquid. Use the home built galvanometer (Unit 11) to test the electric cell for current.	49				
B. What gas is given off in the bubbles? (2) What causes the current? (3) How long will current be given off?	55 55				
Unit 11 - Make a Small Galvanometer.	96				
A. Use either a small bought compass or make a small permanent magnet mounted on a needle and wind a coil of #18 bell wire. Assemble these similar to the problem in Chapter 4 in Lehmann's Shop Projects in Electricity, page 25. Test the home built chemical cell already made. (Unit 10)					
B. Answer all of the questions about the galvanometer in the Lehmann book (pages 27-28).					

Outline of Units for Electricity	1	2	3	4	5
Unit 12 - Make Three Standard Splices.			87		
A. Using #14 rubber covered wire, make the following standard splices; Western Union or End Splice, and	24				
Rat-tail Splice. Solder all joints and tape one joint.	24		87		
B. Why should the knife be slanted in cutting the insulation from the wire?					
(2) Why should the wire be cleaned thoroughly? (3) Where is the Western	24		87		
Union splice used? (4) Do the rat-tail	81,				
joints carry much strain? (5) How many	82			282	
turns should be used on a Western			87	289	
Union splice? (6) Why should the end					
wire on the rat-tails be turned back?			87	282	
(7) Why should one use splicing com-					
pound? (8) What two kinds of tape must			87	289	
be used in insulating a spliced joint?	82				
(9) How should a lamp cord be spliced					
and taped? (10) How is this joint					
soldered--soldering iron or torch?	24				
(11) What flux should be used?	81,				
(12) What kind of solder should be	82				
used? Wire or bar? (13) Use of porcelain	81,				
connectors, solderless connections and lugs.	82				
Unit 13 - Conductors, Types and Sizes of Single Wire and Stranded Cables.	23	44	98	278, 279	83
A. Make a collection of as many kinds of conductors as can be found in the shop and about the shop.	23				
B. Wire sizes, circular and mil. Rubber covered and weatherproof. Stranded cable. Leaded cable. New types of wire, synthetic insulated, flame-proof, etc.		81	99		86
Unit 14 - Meter Reading.					
A. Learn to read the meter. Work problems provided by the teacher.	27, 28			304	
B. Why is it convenient to know how to read meters? (2) Which dial is read	28			305	33

Outline of Units for Electricity	1	2	3	4	5
first? (3) Calculate the monthly consumption of electricity in your home. Read the meter at 30 day intervals.	28		121	306	34
Unit 15 - Using "Romex" or Non-Metallic Sheathed Cable in House Wiring.					
A. Add one complete circuit to the circuits in the practice wiring house frame. The following operations will be involved:					
(1) Make sketch of work to be done.					
(2) Locate and cut hole for outlet boxes and switches.				351	
(3) Install wall switch box.				351	
(4) Bore holes in studding plates, joints, etc. for cable.				350,	
(5) Pull Romex through holes.				355	
(6) Connect the two wires to the switch and lock cable to box.					
(7) Make proper joints, solder and tape in junction box.					
(8) Make proper connections to appliance and seal terminal boxes. (Be sure all cables are fastened to boxes).				134	
(9) Close main switch and check all outlets.					
B. Why is Romex better than knob and tube wiring? (1) Why should holes be bored in the studding? (2) What depth of box is recommended for side wall outlets? (3) Must the loom enter the box? (4) How is Romex fastened to boxes? (5) What must be done to all wire that runs into a junction box? (6) How should Romex be supported when not in bored studding?				134	

PART V

OUTLINE OF INSTRUCTION

FIFTEEN WEEKS UNIT IN GENERAL METAL

In these units the class will be divided into groups. The students will rotate through the different areas. The amount of time spent in each area will be specified by the instructor. In the following units of instruction the gas welding, arc welding, bench and sheet metal, and forging units will be grouped separately. The instructor will have lessons for each area and start the students to work; then the following units of instruction will be taught in the sequence necessary to provide for student progress. Safety precautions will be stressed at all times.

Things That the Student Should be Able to Perform at the Completion of the Course.

1. How to design and plan a project.
2. How to measure and divide spaces with measuring tools.
3. How to layout on paper and transfer it to metal.
4. How to cut metal with hand and power tools.
5. How to drill, bore, ream, and punch holes.
6. How to bend and twist metal.
7. How to shape and form metal.
8. How to heat treat metal.
9. How to smooth metal.
10. How to cut threads.
11. How to assemble metal parts.
12. How to finish the surface of metal.
13. How to clean and care for tools and machines.

Things That the Student Should Know at the Completion of the Course.

1. Sources of raw materials.
2. Refining of metals.
3. Characteristics of metals.
4. Consumer uses of metals.
5. Occupational information.
6. How to purchase and care for tools and machines.

The metalworking industry of today manufactures products of more value and employs a greater number of persons than does any other area of our industry. At least one out of every ten people works either directly or indirectly in the area of metalworking. Such great industries as the automobile, aviation, shipbuilding, and home appliance industry are only a few of those using metal.

All students in our schools should gain experiences in metalworking, because many will be producers, and all will be consumers of metal products. A large group of students will find in metals their recreational or hobby interest. In general metals, students should secure some fundamental skills in using tools and machines, a knowledge and appreciation of employment opportunities in metalworking, an appreciation for the care and use of metal products, an understanding of how the raw materials are converted into finished products, and an opportunity to develop some avocational interest. (1, page 57)

UNIT ASSIGNMENTS FOR OXY-ACETYLENE WELDING

In the following outline, "A" indicates the informational material which is to be taught and learned as a part of this unit, and "B" indicates the manipulative work to be performed by the students in each unit of instruction.

The columns are arranged to match the recommended textbook and references. Column No. 1 is the recommended textbook and the others are reference books. The books are referred to in columns with headings as follows:

Column No. 1 - Basic Welding Principles, by E. Stieri.

Column No. 2 - Gas and A. C. Arc Welding and Cutting, by R. F. Jennings.

Column No. 3 - The Oxy-Acetylene Handbook, by The Linde Air Products Co.

Outline of Units for Oxy-Acetylene Welding	1	2	3
How far should the oxygen valve be opened?		34	
What is the procedure for cutting holes?	62		425
B. Cut scrap metal for practice exercises.			
Unit 4			
A. Bronze Welding			
What are the principles of bronze welding?	138	23	246
What kind of rod is used for bronze welding?	139		247
Where may bronze welding be used?	139		247
How should the metal be prepared?	139	23	249
What is flux and what is it used for?	36	23	250
What type of flame is used for bronze welding?	139		
Is a bronze weld a strong weld?			
B. Practice making welds with the bronze rod. Design and make a tool chest using the proper joints and welding technique.			

All students are expected to complete the above units. The students who progress rapidly enough will have the opportunity to develop a wider range of skill in gas welding.

The instructor will discuss and demonstrate how to do the preceeding welding exercises. He will also demonstrate the following; galvanized welding, cast iron welding, aluminum welding, and pipe welding; vertical, overhead, and horizontal welding; and how to weld steel plate.

UNIT ASSIGNMENTS FOR ARC WELDING

In the following outline, "A" indicates the informational material which is to be taught and learned as a part of this unit, and "B" indicates the manipulative work to be performed by the students in each unit of instruction.

The columns are arranged to match the recommended textbook and references. Column No. 1 is the recommended textbook and the others are reference books. The books are referred to in columns with headings as follows:

Column No. 1 - Basic Welding Principles, by E. Stieri.

Column No. 2 - Gas and A. C. Arc Welding and Cutting, by R. F. Jennings.

Column No. 3 - Forging and Welding, by Robert E. Smith.

Outline of Units for Arc Welding	1	2	3
Unit 1			
A. Welding Machines and Equipment			
What is arc welding?	149	63	115
What is the difference between the D.C. welding generator and the A.C. transformer?	150	64	115
What is the advantage of arc welding over oxy-acetylene welding?			
What advantage has the A.C. arc over the D.C. arc?	150	64	115
Why are helmets and hand shields used?	153	66	116
What are the two rays caused by the electric arc?	153		115
Should goggles be used when chipping slag?	153		115
Are gloves necessary when arc welding?	154	65	116
Is protective clothing necessary when arc welding?	154		116
When arc welding, is more than one cable necessary?	154	65	115
What is an electrode holder?	154	66	
What accessories are necessary for cleaning?	154		
What is an electrode?	154		116
Is there more than one kind or type of electrode?	155		120
B. Make beads in the flat position.	166	68	123
What amperage should be used?			
How should an arc be struck?	162	68	122
What angles should the electrode be held?	166	68	123
What happens if not enough heat is used?	166		117
What happens if too much heat is used?	166		117
How should slag be removed?			
How should a crater be filled?	167		
Unit 2			
A. Electrodes.			
What is an electrode?	154		120
What are the classes of electrodes?	154		120
What are the common sizes of electrodes?	156		121
What are color markings for?			121
What do the classification numbers represent?			121
B. Make wide beads in the flat position and learn how to control the bead width.	168	70	
Build a pad with alternate layers of beads deposited in opposite directions.	170	72	

Outline of Units for Arc Welding	1	2	3
Unit 3			
A. Joints and Joint Construction.			
What are the different joints used in arc welding?	171	73	118
How are the different joints prepared?	171		118
What type of welds are used for the different joints?	172	74	131
B. Make a square butt weld and a single vee butt joint using the correct electrode size and the correct welding technique.			
Unit 4			
A. How to Make Fillet Welds.			
What is a fillet weld?	172	75	134
What are the different types of fillet welds?	174	75	135
How are the different types of fillet welds prepared?	174		
What angles should the electrode be held?	182	75	135
Should all the slag be removed from the preceeding bead when making multiple pass fillet welds?	174	72	135
What is a string bead?			
B. Make single and multiple pass fillet welds.	172	75	134
Unit 5			
A. Welding Positions.			
What are the four positions for welding?	193	73	125
What are the procedures for welding in the different positions.	180	76	126
B. Practice welding in the different positions.			
Unit 6			
A. Arc Cutting.			
How does the arc cut metal?	206		140
What type of rod is used for arc cutting?	206		140
What is the arc cutting procedure?	206		141
B. Practice cutting different thicknesses of metal with the arc rod.			
Design and make a suitable project.			

UNIT ASSIGNMENTS FOR FORGING AND HEAT TREATING

In the following outline, "A" indicates the informational material which is to be taught and learned as a part of this unit, and "B" indicates the manipulative work to be performed by the students in each unit of instruction.

The columns are arranged to match the recommended textbook and references. Column No. 1 is the recommended textbook and the others are reference books. The books are referred to in columns with headings as follows:

Column No. 1 - Forging and Welding, by Robert E. Smith.

Column No. 2 - Blacksmithing, by R. W. Selvidge and J. M. Allton.

Column No. 3 - Elementary Forge Practice, by Robert H. Harcourt.

Column No. 4 - Heat Treatment of Metals, by Delmar Publishers, Inc.

Outline of Units for Forging and Heat Treating	1	2	3	4
Unit 1				
A. Forges, Forging and Forging Equipment.				
What are the different types of forges?	11	13	16	1
What is forging?				1
Is the anvil an important piece of equipment?	13	126	19	2
How is a forge lighted and adjusted?	11	13	16	1
What is a blacksmith's vise?	13	102	28	
What are the different hammers and what are their uses?	14	131	21	2
What are the following and what are their uses: tongs, chisels, hardy, punches, fullers, swages, and flatters.	15	132	22	2
How is stock calculated, measured, and cut?	20	19	33	
How is stock held with the tongs?	22	15	23	
How is metal upset?	23	28	46	
What does drawing out mean and how is it done?	24	21	31	6
B. Select mild steel stock and draw out until it is 5/16 inch square to make a gate hook.			45	
Unit 2				
A. Metals Commonly Forged.				
How are the different metals produced?	16	136	140	15
What is the difference between the different metals?	16	136	141	16

Outline of Units for Forging and Heat Treating	1	2	3	4
What are the main ingredients of metal?	16	136	141	16
How is metal formed?			153	
Does metal have grain structure?	18	138	154	
How may metals be identified?	18	150	12	
How should metal be bent?	27	25	32	5
How should hooks and eyes be made?	27	25	36	
How is metal twisted?	31	27	34	
How are the fullers and swages used?	32	132	27	
B. Finish the gate hook using the correct tools to draw out, make square shoulders, make an eye, make a hook, and twist.				
Unit 3				
A. How to Forge Tool Steel.				
What is tool steel?	16	136	152	10
What ingredient makes tool steel hard?				
To what temperature should tool steel be heated to forge?	34	52	105	11
What happens if tool steel is not at the correct temperature when it is worked?	34	52	107	
How can you tell if it is at the correct temperature?	34	52	106	
B. Select stock for cold chisel. Draw the stock out to the correct shape.				
Unit 4				
A. Heat Treatment of Metals.				
What is annealing and how is it done?	34	53	101	
What is hardening and how is it done?	34	54	101	10
What is tempering and how is it done?	35	55	102	10
What is used to heat treat metals?	34	53	101	12
Should the metal be heated all the way through?				
What happens if the metal is not heated properly?				
How is the correct temperature recognized?	34	56	103	12
On a cold chisel, is the entire piece hardened?				
B. Harden and temper cold chisel.				
Unit 5				
A. Case-hardening.				
What is case-hardening?	35	59	169	7

Outline of Units for Forging and Heat Treating	1	2	3	4
What is used to case-harden?	35	59	171	7
Why is metal case-hardened?				
What temperature is used to case-harden?	35	59	171	8

B. Select stock for a scriber.
Cut and shape the stock and case-harden the point.
Students may select the remaining projects.

UNIT ASSIGNMENTS FOR SHEET METAL

In the following outline, "A" indicates the informational material which is to be taught and learned as a part of this unit, and "B" indicates the manipulative work to be performed by the students in each unit of instruction.

The columns are arranged to match the recommended textbook and references. Column No. 1 is the recommended textbook and the others are reference books. The books are referred to in columns with headings as follows:

Column No. 1 - General Shop Metalwork, by A. W. Dragoo and Howard O. Reed.

Column No. 2 - Modern Metalwork, by Everett R. Glazener.

Column No. 3 - Hand Processes (Sheet Metal Series), by Delmar Publishers.

Column No. 4 - Machine Processes (Sheet Metal Series), by Delmar Publishers.

Outline of Units for Sheet Metal	1	2	3	4
Unit 1				
A. Layout and Cutting Tools.				
What does sheet metal refer to?	35	61	3	
What tools are used to layout on sheet metal?	24	61	21	
Identify and know uses of the following: try square, framing square, circumference rule, hook rule, bench rule, dividers, center punch, scriber, and file.		61		
What is a metal thickness guage?		62		

Outline of Units for Sheet Metal	1	2	3	4
Identify and know how to use the following cutting tools: straight blade snips, double-cutting shears, hack saw, cold chisel, and hollow punch.	25	63	26	
What does the word guage mean in sheet metal?	37	62	3	
B. Layout and cut metal for small tool tray.	15			
Unit 2				
A. How to Form Sheet Metal by Hand.				
How are the following forming processes done? bending, folding, creasing, and general shaping.	26	65	38	
Is there more than one kind of stake?	27	65	34	
What is a bench plate?		65	33	
What is a hand folder?		65		
Identify and know how to use the following: tinners hammer, mallet, pliers, ball pein hammer, setting down hammer, and riveting hammer.	28	67	39	
B. Using forming tools, shape tool tray.				
Unit 3				
A. How to Prepare Edges and Joints by Hand.				
What type of edges may be made by hand?	28	65	46	
What type of joints may be made by hand?	32		46	
What is a hand groover?	33	68	72	
What is a rivet set?		70	108	
How is the hollow punch used?		64	90	
How should the solid punch be used?			89	
B. Prepare joints on tool tray for fastening.				
Unit 4				
A. How to Prepare and Use Soldering Copper.				
What are the different types of soldering coppers?	30	71	56	
What are the different sizes of soldering coppers?	30	71	57	
Why are there different sizes?	30	71	64	
What is solder?	30	71	64	
What is sal ammoniac?	31	72	58	
What is rosin?			58	
What does tinning the iron mean? How is it done?	30	71	61	
Why is it necessary to tin the soldering copper?	30	72	59	

Outline of Units for Sheet Metal	1	2	3	4
Is there more than one kind of solder?	30	71	64	
What are soldering fluxes?	31		64	
What is the purpose of solder?	31	72	67	
How should the following be soldered: lap seam, grooved seam, riveted seam, and solder a bottom.	31	72	67	
B. Solder joints on tool tray where necessary.				
Unit 5				
A. How to Rivet Sheet Metal.				
Where may rivets be used?	32		106	
What are the common sizes of rivets?			107	
How may the holes for rivets be made?	32		103	
How are rivets fastened?	33		108	
What metals are rivets made from?			108	
How are rivets spaced?			109	
B. Use rivets on tool tray where necessary.				
Unit 6				
A. How to Cut and Form Sheet Metal with Machines.				
What is a sheet metal squaring shear?	34	63		33
How is the squaring shear used?	34	63		33
What is a bar folder and how is it used?	34	65		1
What is a sheet metal break and how is it used?	34			13
What is a roll forming machine and how is it used?	35	66		21
What are the other sheet metal machines and how are they used?		66		38
What are the safety precautions for these machines?	9	32		
B. Make a funnel using sheet metal machines.				
Unit 7				
A. How Sheet Metal is Made and Surface Treated.				
What is an ingot?	35	8		
What is a bloom?	35			
What is a rolling mill?	36			
What does hot rolled mean?	36			
What does cold rolled mean?	36			
What does galvanizing mean?	36			
What is black iron?				
What is the purpose of galvanizing?	37			
What does galvannealing mean?	37			
What is tin plate?				

Outline of Units for Sheet Metal	1	2	3	4
B. Design and make project of students own choice. Suggested projects: waste basket, baking pan, round scoop, or fruit jar filler.				

UNIT ASSIGNMENTS FOR BENCH METAL

In the following outline, "A" indicates the informational material which is to be taught and learned as a part of this unit, and "B" indicates the manipulative work to be performed by the students in each unit of instruction.

The columns are arranged to match the recommended textbook and references. Column No. 1 is the recommended textbook and the others are reference books. The books are referred to in columns with headings as follows:

Column No. 1 - General Shop Metalwork, by A. W. Dragoo and Howard O. Reed.

Column No. 2 - Modern Metalwork, by Everett R. Glazener.

Column No. 3 - Metalwork Technology and Practice, by Oswald A. Ludwig.

Outline of Units for Bench Metal	1	2	3
Unit 1			
A. Layout and Cutting Tools.			
What are layout tools and how are they used?	71	35	37
What type of measuring is done with a micrometer?		35	61
How are dividers and calipers used?		37	39
What is a combination square?			
What is a centering head?	72	36	43
How should a hack saw be used?	63	39	73
How should a cold chisel be used?	74	33	83
What are the different kinds of files and how should they be used?	64	45	89
B. Make screwdriver or scriber.	56		
Unit 2			
A. How to Drill Holes.			
What are the different types of bits?	66	40	163
What is a hand drill and how is it used?		41	173

Outline of Units for Bench Metal	1	2	3
What is a breast drill and how is it used?		42	
How should the center of a hole to be drilled be marked?		42	186
What is purple layout dye?			49
B. Make a small hammer.	59		
Unit 3			
A. How to use the Tap and Die Set.			
What is the tap used for?	68	47	209
What are dies used for?	68	47	205
What are the different types of threads?	68	48	199
What is cutting oil used for?			
What are the uses of the different types of threads?			
B. Drill hole for hammer handle. Tap threads for handle if a metal handle is to be used.			
Unit 4			
A. How to Smooth and Polish Metal.			
Why should metal surfaces be polished?	69	54	103
What are the methods of smoothing and polishing?	70	55	104
What are abrasives?	76	53	103
Name some natural abrasives.	76	53	103
Name some artificial abrasives.	76	53	103
How are abrasives sold?			105
What are the different grades of abrasives?	76	53	105
Can polishing and buffing be done by machine?	70	53	
B. Smooth and polish hammer.			
Unit 5			
A. Finishing Metals.			
How is a clear or colored lacquer finish applied?		57	
Is enamel sometimes used to finish metal?		57	
How are antique or burnt oil finishes obtained?		57	
What is spot finishing?		58	
B. Apply finish to projects if necessary. Make other projects of the students choice.			
Unit 6			
A. How to use Power Tools.			
How to use and safety precautions will be			

Outline of Units for Bench Metal	1	2	3
taught on the following: grinder, buffer, portable drill, drill press, and metal cutting band saw.	67	40	
B. Use tools properly and in a safe manner at all times.			
Unit 7			
A. How Iron Ore is Changed into Metal.			
Where is iron ore obtained?	77	3	109
What is a blast furnace?	78	5	110
What is the blast furnace used for?	78	5	110
How is pig iron changed into steel?			
What are the open-hearth furnace, electric furnace, and the bessemer converter used for?	81	6,7	115
What are the three main ingredients of metal?		2	
What are some of the by-products of the iron and steel industries?			

CHAPTER V

SUMMARY AND RECOMMENDATIONS

In this report the study of the history of industrial arts reveals how this field of education had its beginning, how it grew and developed, and why it has been accepted as part of general education, especially in the junior high school.

The general shop is well adapted to the junior high school. It enables a student to discover his abilities and aptitudes through manipulation of a wide range of materials, tools, and the processes that go with them. Studies show that the present trend is toward the general shop type of industrial arts program.

Summary. The purpose of this report was to develop a course of study suitable for a general shop class on the ninth grade level. The subjects outlined are the ones that are taught most frequently in the better schools of the United States. The subjects are general mechanical drawing, general woodwork, general electricity, and general metalwork. Each area to be taught has been divided into units of instruction in the sequence the author believes most logical.

This course of study was made to be taught in units, because of the shop arrangement in the author's present school. It is the belief of the author that this course of study may be adapted to meet the need for any junior high school general shop program.

Recommendations. It is recommended by the author that this program

should be put into effect in the Satanta High School, and that handicrafts should be added to this curriculum for the ninth grade general shop students. It is also recommended that this course of study be used as an aid in making information and instruction for the subjects included in this report.

BIBLIOGRAPHY

1. American Vocational Association. A Guide to Improving Instruction in Industrial Arts. Washington, D. C.: American Vocational Association, 1953, 120 pages.

2. Anderson, Lewis Flint. History of Manual and Industrial Education. New York: D. Appleton and Company, 1926, 256 pages.

3. Bennett, Charles A. History of Manual and Industrial Education to 1870. Peoria, Illinois: The Manual Arts Press, 1926, 461 pages.

4. Bennett, Charles A. History of Manual and Industrial Education 1870 to 1917. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1937, 566 pages.

5. Berg, Edward, and Emil F. Kronquist. Mechanical Drawing Problems. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1946, 188 pages.

6. Cox, Phillip. The Junior High School and Its Curriculum. Dallas, Texas: Charles Scribner and Sons, 1929, 416 pages.

7. Cramlet, Ross C. Woodwork Visualized. Milwaukee, Wisconsin: The Bruce Publishing Co., 1953, 158 pages.

8. Douglass, J. H., and R. H. Roberts. Units in Hand Woodworking. Wichita, Kansas: The McCormick-Mathers Publishing Co., 1955, 160 pages.

9. Delmar Publishers, Inc. Hand Processes (Sheet Metal Series). Albany, New York: Delmar Publishers, Inc., 1946, 146 pages.

10. Delmar Publishers, Inc. Machine Processes (Sheet Metal Series). Albany, New York: Delmar Publishers, Inc., 1946, 86 pages.

11. Delmar Publishers, Inc. Heat Treatment of Metals (Machine Shop Series). Albany, New York: Delmar Publishers, Inc., 1951, 51 pages.

12. Dragoo, A. W., and Howard O. Reed. General Shop Metalwork. Bloomington, Illinois: McKnight Publishers, 1947, 102 pages.

13. Ericson, Emanuel E. Teaching the Industrial Arts. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1943, 222 pages.

14. Feirer, John L., and Ralph O. Williams. Basic Electricity. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1943, 222 pages.

15. French, Thomas E., and Carl L. Svensen. Mechanical Drawing. New York, New York: McGraw-Hill Book Company, Inc., 1957, 568 pages.

16. Friese, John F. Course Making in Industrial Education. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1946, 297 pages.

17. Friese, John F. Exploring the Manual Arts. New York, New York: The Century Company, 1926, 412 pages.

18. Glazener, Everett R. Modern Metalwork. Austin, Texas: The Steck Company, 1954, 156 pages.

19. Hale, E. M., H. McGinnis, and C. L. Hill. Introduction to Applied Drawing. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1952, 79 pages.

20. Harcourt, Robert H. Elementary Forge Practice. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1938, 182 pages.

21. Hunt, Dewitt, and John Bruce Tate. Hand Woodworking. Oklahoma City, Oklahoma: Harlow Publishing Corporation, 1956, 418 pages.

22. Jennings, R. G. Gas and A. C. Arc Welding and Cutting. Bloomington, Illinois: McKnight and McKnight Publishers, 1946, 92 pages.

23. Johnson, William H., and Louis V. Newkirk. The Electrical Crafts. New York, New York: The Macmillan Co., 1943, 146 pages.

24. Jones, E. W. Fundamentals of Applied Electricity. Milwaukee, Wisconsin: The Bruce Publishing Co., 1943, 341 pages.

25. Jones, E. W. General Electricity. Bloomington, Illinois: McKnight and McKnight Publishing Co., 1950, 89 pages.

26. Kansas State Department of Education. Kansas Tentative Guide to Teaching Industrial Arts. Topeka, Kansas: Printed by State Printer, 1950, 95 pages.

27. Lehmann, Herbert G. Shop Projects in Electricity. New York, New York: American Book Co., 1934, 190 pages.

28. Linde Air Products Company. The Oxy-Acetylene Handbook. New York, New York: Linde Air Products Company, 1947, 587 pages.

29. Ludwig, Oswald A. Metalwork Technology and Practice. Bloomington, Illinois: McKnight and McKnight Publishing Co., 1947, 397 pages.

30. Newkirk, Louis V. Organizing and Teaching the General Shop. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1947, 200 pages.

31. Selvidge, R. W., and J. M. Allton. Blacksmithing. Peoria, Illinois: The Manual Arts Press, 1925, 156 pages.

32. Silvius, G. Harold, and Estell H. Curry. Teaching Multiple Activities in Industrial Education. Bloomington, Illinois: McKnight and McKnight Publishing Co., 1956, 484 pages.

33. Smith, Robert E. Forging and Welding. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1956, 160 pages.

34. Stieri, Emanuele. Basic Welding Principles. New York, New York: Prentice-Hall, Inc., 1953, 220 pages.

35. Vernon, Ralph J. Modern Woodwork. Austin, Texas: The Steck Company Publishers, 1954, 140 pages.

36. Wilber, Gordon O. Industrial Arts in General Education. Scranton, Pennsylvania: International Textbook Co., 1948, 362 pages.

37. Wright, Forest B. Electricity in the Home and on the Farm. Milwaukee, Wisconsin: The Bruce Publishing Co., 1950, 380 pages.

VITA

Walter Travis Green, Jr.

Candidate for the Degree of

Master of Science

Report: A COURSE OF STUDY FOR NINTH GRADE UNIT GENERAL SHOP

Major Field: Industrial Arts Education

Biographical:

Personal data: Born in Coalgate, Oklahoma, October 28, 1925, the second child of two boys and two girls born to Walter Travis and Christena Mae Green; united in marriage to Doris June Dailey, September 2, 1948; have two children.

Education: Attended grade and high school in Tupelo, Oklahoma; graduated from high school in 1943; received Bachelor of Science degree from East Central State College, with a major in Industrial Arts, in July, 1949; attended summer school at Colorado A. and M. College in 1955; completed the requirements for the Master of Science degree at Oklahoma State University, August, 1959.

Professional experiences: Entered the United States Navy, October, 1943; spent twenty one weeks in signal school and seven months each on three ships, one in the Atlantic, one in Alaska, and the other in the Pacific; discharged in June, 1946; coached basketball and taught industrial arts for three years at Coolidge, Kansas; teacher of industrial arts at Satanta, Kansas the past six years.

Educational organizations: Member of the Kansas State Teachers Association, National Education Association (life member), Haskell County Teachers Association, and Iota Lambda Sigma Fraternity.

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Author: Walter Travis Green, Jr.

Report Adviser: John B. Tate

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